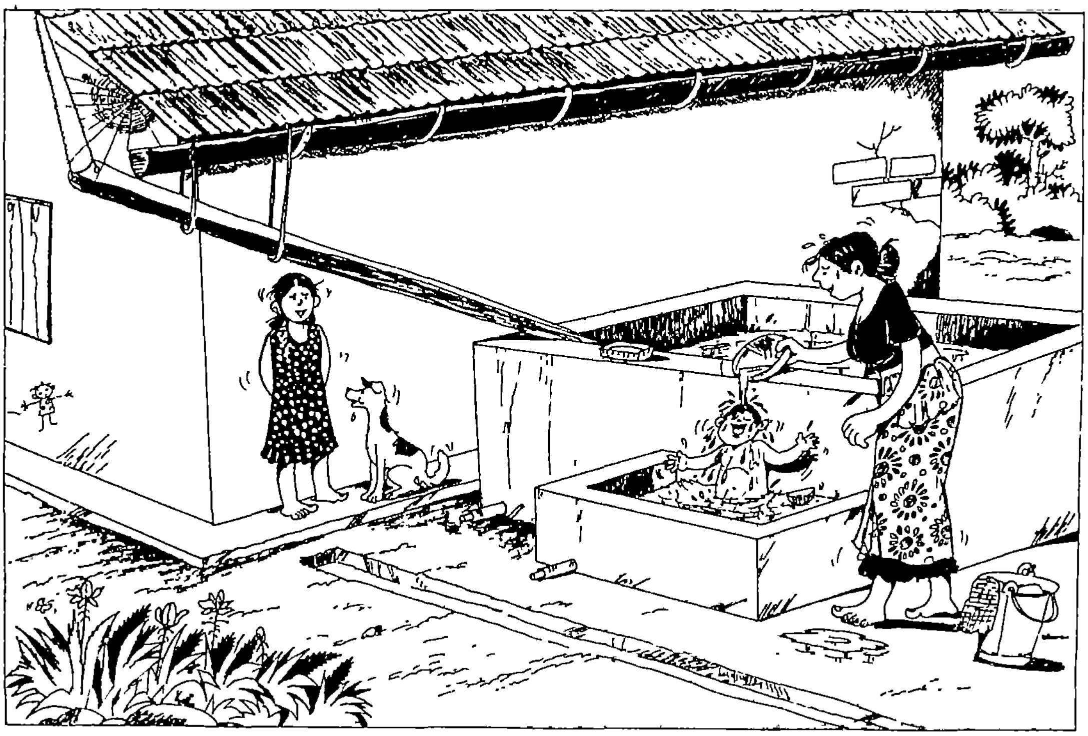
CWSSP

ACTION RESEARCH STUDY ON RAIN WATER HARVESTING



Project Report 2

Community Water Supply & Sanitation Project
Ministry of Housing, Construction & Public Utilities

CWSSP

- The Community Water Supply and Sanitation Project is an initiative of the Government of Sri Lanka with the support of the World Bank.
- The CWSS Programme Unit located within the Ministry of Housing, Construction & Public Utilities coordinates the project. The Regional Directorates in Badulla, Matara and Ratnapura, support Partner Organizations and Community Based Organizations in implementing their projects.
- CWSSP supports improvements in water supply and sanitation for approximately 650,000 rural people in 2,500 villages and 17 small towns in Badulla, Matara, Ratnapura and Monaragala Districts.
- Some 1600 schools in these districts will be eligible for support to improve personal hygiene through school water supply and sanitation, and hygiene education.
- CWSSP works with over 80 partner organizations (NGOs, co-operatives, government and quasi-government bodies) to support, motivate, organize and train communities to implement and manage their own water supply and sanitation schemes.

ADDRESS

Director
Community Water Supply & Sanitation Project
Ministry of Housing, Construction & Public Utilities
P.O. Box 30,
Battaramulla, SRI LANKA

Tel: (01) 872 141/872 142
Fax: (01) 872 143

CWSSP

ACTION RESEARCH STUDY ON RAIN WATER HARVESTING

Co-ordinated by K.D. (Deva) Hapugoda

August 1, 1995

Project Report 2

Community Water Supply & Sanitation Project
Ministry of Housing, Construction & Public Utilities

Table of Contents

PAGE

Annexes

1A. Terms of Reference

1. List of Main Document Consulted

2. Monthly Rain Fall Data of
   - 10 Regions in Badulla
   - 11 Regions in Ratnapura
   - 5 Regions in Matara

3. $5M^3$ Ferro-Cement Tank Drawing

4. Table with quantities and costs of $5M^3$ Ferro-Cement Tank

5. $5M^3$ Brick Dome Tank Drawing

6. Table with Quantities and Cost of $5M^3$ Brick Dome Tank.

7. Map Showing Location of relevant Meteorological stations at Badulla, Ratnapura and Matara Districts.

8. Rain Region Graphs

A	-	Badulla (City)	}	
B	-	Haputale	}	Badulla District
C	-	Kolonne	]	
D	-	Ratnapura (City)	]	Ratnapura District
E	-	Ambilipitiya	]	
F	-	Kekenadora	}	
G	-	AninKanda	}	Matara District

9. Storage to Catchment Graphs

R	-	Badulla (City)	}	
Q	-	Haputale	}	Badulla District
T	-	Ratnapura (City)	]	
O	-	Ambilipitiya	]	Ratnapura District
S	-	Kekenadora	}	
P	-	AninKanda	}	Matara District

10. Dry Season Supply to Catchment Graphs

X	-	Badulla (City)	}	
W	-	Haputale	}	Badulla District
Z	-	Ratnapura (City)	]	
U	-	Ambilipitiya	]	Ratnapura District
N	-	Kolonne	]	
Y	-	Kekenadora	}	
V	-	AninKanda	}	Matara District

11. 1.1 M^3 Cement Jar Drawing

12. Article on Asbestos Roofing and Safety.

13. Table with Quantities and Cost of 1.1M^3 Cement Jar.

14. Material and Cost Break Down of 5, 8 and 10M^3 Brick Dome Tank.

15. Projected Source Coverage Maps

Abbreviations

CBO	Community Based Organization
CRO	Community Relations Officer
CRO/T	Community Relations/Technical Officer
CWSSP	Community Water Supply & Sanitation Project
DD/T	Deputy Director/Technical
G.I.	Galvanized Iron
ITDG	International Technology Development Group
LPCD	Liters per capita per day
M^3	Cubic Meter
NERD	National Engineering Research and Development Centre
PO	Partner Organization
PVC	Poly Vinyl Chlorine
Qty	Quantity
R.C.	Run off coefficient
R.F.	Rain Fall
Rs	Sri Lanka Rupees (IRS = 0.02 US$ in June 95)
TO	Technical Officer
TSC	Technical Support Cell
UV	Ultra Violet

1. Abstract

Rain water harvesting is becoming an important option for underserved households and communities in Sri Lanka. Many areas in Sri Lanka offer a good potential for the introduction of rainwater harvesting, however as many people do not appreciate the potential of rainwater harvesting for domestic and drinking water purpose this technology is undervalued.

A policy for the Community Water Supply and Sanitation Project is formulated to enhance the application of rain water harvesting methods.

In rain water harvesting reliability of the supply depends on the size of the catchment area - often the roof -, the volume of the storage tank and the management of the daily consumption, all in relation to the local rainfall pattern. The study attempts to develop a suitable technical and economical solution to the storage of drinking water, and as a result proposes brick dome and ferrocement as the two most economical options.

Quality of rain water in storage is addressed on the basis of a literature study. Maps are provided indicating areas of high suitability for rain water harvesting.

Recommendations are given in respect of further trials and field level monitoring. Promotion and awareness raising for greater appreciation of rain water harvesting is advocated.

2. Preface

This report has been drafted in the framework of the World Bank financed Community Water Supply & Sanitation Project, executed by the Ministry of Housing, Construction & Public Utilities, Sri Lanka.

The need to assess the feasibility of rainwater harvesting as an water supply option specially for low income households located at places where no other viable option is available, has always existed. It is an appropriate time to do this study as a number of water supply schemes under CWSSP with no traditional options, continue to increase.

Given the time frame of just three months for the preparation of this report including trial construction at places upto 200 km away from the Head Office and the limited office facilities, some issues may not be dealt with in sufficient depth. Future studies may be able to correct any such deficiencies.

Numerous persons were involved with the study and their friendly response and cooperation significantly contributed to the formulation of this report. They include the TSC Manager Mr. Han Heijnen and the staff of CWSSP at Head Office, Regional Offices in Matara, Badulla and Ratnapura and the NERD Centre, Ja-Ela.

The co-operation of UNICEF, ITDG, SARVODAYA, the Faculty of Engineering Peradeniya, Residents of Rahaspokuna, Mr. Pigera of Bandarawela, Residents of Iriyagama and the Principal of Paradise School Ratnapura need special mention. The consultant is deeply indebted to all of them.

A special thank you to Ms. Samanthika de Silva for computer analyzing the data and typing the report.

3. Executive Summary

Introduction

An Action Research Study on Rain Water Harvesting was commissioned in January 1995 by CWSSP as part of its Research and Documentation Program.

Rainwater Harvesting appears to be the only option remaining for a number of water supply schemes, under CWSSP with no traditional options. This applies to all three districts where CWSSP is working : Matara, Badulla & Ratnapura.

The objective of the study was to design and construct low cost rain water harvesting storage tanks and to gather existing experience in Sri Lanka on rainwater harvesting, in order to investigate the possibility to conduct Pilot Projects to develop recommendations and guidelines for the in-corporation of the rain water harvesting option in the CWSSP.

The study comprised of four main steps :

1. Design and construction of trial tanks.
2. Visits to existing rainwater harvesting places in Sri Lanka.
3. Field visits to selected pilot project villages.
4. The collection and analysis of rainfall data.

Status of Rain Water Harvesting in Sri Lanka

Presently there is no planned rainwater harvesting program in Sri Lanka.

Local investigation reveals :

- that **rainwater harvesting** for domestic consumption is currently in **practice** in Sri Lanka.

- that a section of potential consumers are looking for **appropriate technology** to harvest and store rain water.

- that a section of potential consumers are **not sure** about rainwater harvesting. They are concerned about the quality and reliability of rain water.

Rain Water Harvesting as an Option

Technical potential for rain water harvesting exists every where in the island where a suitable catchment is available.

Economic feasibility varies from place to place. It is a reasonable option where,

- Water bills are high

- Traditional technical options are not economically feasible.

- Operation and maintenance of traditional methods are a major concern.

In the CWSSP rainwater harvesting is specially relevant in some 30% of the total projected project coverage where tube wells and pump systems are, envisaged, or in areas high up in the hills where there are no springs.

Various Technical Options Tested

- CWSSP criteria on rainwater collecting tanks system requires that a five cubic meter tank be built to cost below Rs. 5,400/- excluding unskilled labour.

Three types of storage tanks were studied:

Type	Capacity
Brick Dome	$5M^3$
Ferro-Cement	$5M^3$
Cement Jar	$1M^3$

These were designed and constructed. Construction indicates that :

- The brick dome tank can be constructed to meet this criteria.

- The ferro cement tank constructed, using the cost lowering method, was successful in bringing the standard cost of a $5m^3$ ferro cement tank down by a impressive 50%. It is anticipated that with a few more trials the cost could be brought down further to meet CWSSP criteria, by reducing skill labour time.

COMPARISON OF DIFFERENT TANKS

Type of Tank	Total Cost/ M^3 (1995) Rs.	Advantages	Disadvantages	Rural Level Construction
Brick Dome	'1318	- Can be built to any capacity from 2 - $10M^3$ - Can easily be maintained & repaired at rural level. - Dome roof prevents contamination - Water wasted is minimum due to extraction of water by pump	- Tank is under ground level - Need a pump to extract water - Difficult to empty for cleaning. - Risk of falling in by children, animals, etc.	- With a short training rural masons can built the tanks with locally available material.
Ferro-Cement (Pumpkin Shape)	1468	- Can be built upto $5M^3$ capacity. - Easy to maintain at rural level. - Water is well protected against outside contamination. - Convenient to take water from a gravity fed tap or siphon pipe - Safe for children and animals	- Difficult to built larger than $5M^3$ - The full tank is visible - Water might get wasted from the tap.	- With the use of a simple low cost mould possible to build at rural level with available materials.
Cement Jar	1874	- Easy to maintain & repair at rural level. - Water is well protected against outside contamination. - Safe for children & animals.	- Difficult to built larger than $2M^3$ capacity. - Need number of jars for a house. - Takes too much ground space to keep.	- Possible to build at rural level, with available material.

Pilot Project

Three places from the three districts were identified to do pilot projects. They are :

Dematawelhinna - Badulla District

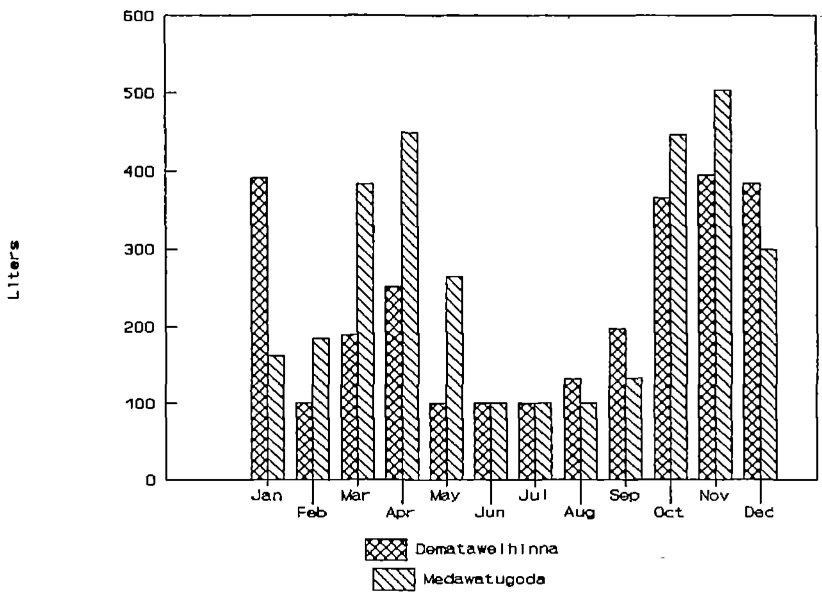
Medawatugoda Upper Sec.

Omalpe - Ratnapura District

Dorsar Kanda - Matara District

- At Dematawelhinna and Madawatugoda rainwater harvesting is technically and economically feasible to improve the present status of water supply. However supply per day will be less than 20LPCD from smaller catchment roofs during the dry spell in a ten year dry year. Graphs X and N depicts these scenarios. Bar graphs 3-1 & 3-2 gives the daily supply scenarios, possible from a well managed system consisting of a $60M^2$ (R.C.-0.8) catchment & $5M^3$ storage tank for Dematawelhinna & Madawatugoda respectively in a normal year.

Bar Graph 3.1 & 3.2



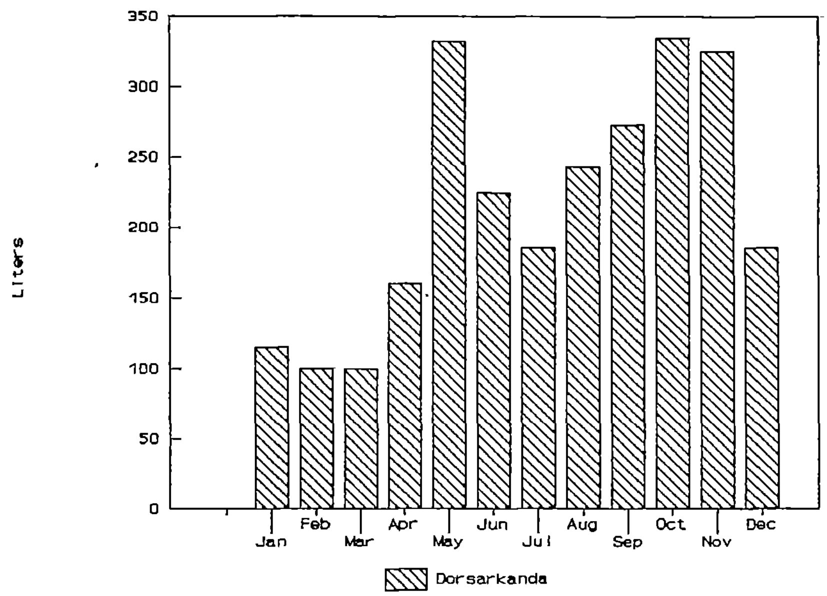
- At Dorsarkanda available roofs are mostly covered with thatch and are not suitable for rainwater harvesting. To do rainwater harvesting here suitable catchment must be constructed.

Most householders have taken house-building loans recently and have started to build better houses with permanent roofs, suitable as catchments.

Once suitable catchment is available rainwater harvesting becomes technically and economically feasible to improve the present status of water supply Graph Y gives the dry season supply to the catchment area scenario in a ten year dry year.

Bar graph 3-3 gives the daily supply scenario, possible from a well managed system consisting of a $60M^2$ catchment & $5M^3$ storage tank for Dorsarkanda in a normal year.

Bar Graph 3 3



Conclusion and Recommendations

1. There is adequate social acceptance of rainwater harvesting as a source of water in areas, where there is no adequate or sustainable fresh-water source within reasonable distance. However a vast majority of the potential beneficiaries do not understand the full benefits of rainwater harvesting.

   It is recommended to conduct an awareness campaign under the CWSSP targeted to potential consumers.

2. The study recommends the design and construction of the three pilot project already identified at Badulla, Ratnapura and Matara. By monitoring these projects after construction, to evaluate the technical economic and social aspects experience can be gained which in turn can be used to train the TO of Partner Organization in design and construction of rainwater harvesting systems.

3. The study recommends continued construction of ferro-cement tanks and Cement Jars with suggested improvements to bring down the cost to fall within the CWSSP cost criteria. These can be done at Regional Level.

4. From literature referred, the study concludes that the rainwater collected off

G.I. Sheet
Clay Tile &
Asbestos

made catchment is suitable for drinking and other domestic purposes. However, the first flush of water after the dry season should be discarded. To avoid any environmental problems, tank should be made mosquito proof.

4. Introduction

The time has come where serious consideration should be given to rainwater harvesting. In the dry zone as well as in the wet zones of Sri Lanka many areas that are potentially suitable for rainwater harvesting remain undeveloped. Rural poor inhabitants of these areas continue to use highly polluted water or suffer from lack of any water, for most basic needs, resulting in high incidence of water related diseases.

At the recommendation of the National Steering Committee, an Action Study on Rain Water Harvesting in Sri Lánka was started by the CWSSP at the end of Jan' 95. It is an appropriate time to do this study as the number of water-supply schemes under CWSSP with no traditional options, continues to increase.

The study involved an investigation phase, focused on obtaining and studying past and current published literature on the subject both local and foreign, and visits to sites where rainwater harvesting is currently practiced in Sri Lanka. Investigations were followed by a note for discussion, giving the preliminary options on rainwater harvesting by the Consultant.

Technical personnel of the CWSSP contributed at the discussion. As a result CWSSP accepted as a policy to :

1. promote **rainwater as a domestic supply** where other acceptable sources are not feasible due to technical, maintenance or economic reasons.
2. to ensure that rainwater would prove an acceptable alternative, CWSSP adopted the strategy to improve the existing situation to a reasonable level. i.e. to supply a minimum of **20 lpcd during the dry season.**
3. develop affordable **Rainwater** storage tanks

These strategic considerations and the objectives as stated in the Terms of Reference for the consultant guided the study. (See Annex 1A)

4.1 Purpose

The action research aimed to

1. design and construct a 5 cubic meter storage tank system to cost less than Rs. 5400/- excluding unskilled labour cost.
2. make appropriate recommendations for the incorporation of rainwater harvesting option in the CWSSP.
3. prepare training material so as to transfer skills to CWSSP technical staff.

4.2 Study Area

The study area covers the CWSSP Project area which comprises the Districts of Badulla, Ratnapura and Matara. However, the recommendations could be adapted to any part of Sri Lanka.

4.3 Methodology

The research study comprised of the following steps.

4.3.1 Desk studies

- Preparation of a work plan for the study
- A review of published literature on the subject covering local and foreign sources.
- An analysis of rainfall data.
- Design of tank including preparation of drawings and bill of quantities.
- Study of literature on rain water quality.

4.3.2 Collection of data

- Collection of data on rainfall from the Meteorological Department Colombo.

4.3.3 Field Visit

- Survey the existing rainwater harvesting experiences.
- Assess the level of interest/demand for rainwater harvesting from potential consumers within CWSSP area.

4.3.4 Construction

- Construction of a $5M^3$ Brick dome tank at Badulla
- Construction of a $5M^3$ Ferrocement trial tank at Ratnapura
- Construction of a $1M^3$ Cement Jar at NERD Centre Ja-Ela.

5. Status of Rain Water Harvesting in Sri Lanka

In Sri Lanka one can trace the evidence of rainwater harvesting back to the fifth century.

For instance, the network of storage reservoirs, swimming pools artificial streams and baffling fountains of the 5th Century rock fort of Sigiriya relied totally on rainwater harvesting. Agriculture also relied mainly on irrigation through cleverly designed, surface storage tanks (wewas).

In recent years many of this rain water collection skills have become obsolete. People now often rely on reticulated, central systems for drinking water supply and irrigation. So, presently Sri Lanka cannot claim a well planned rainwater harvesting program.

Local Investigations reveal however that

- rainwater harvesting for domestic consumption is currently in practice in Sri Lanka.
- a section of potential consumers are looking for appropriate technology to harvest and store rain water.
- a section of potential consumers are not sure about rainwater harvesting.

Details of a Few Selected Visits

5.1 Iriyagama

The residents of Iriyagama situated close to the Kandy Road at Peradeniya used mainly rain water before the town water supply system was put into operation. One house with a roof area of about 200 sq. meters has three 7000 liter tanks, made of masonry. This system built about sixty years ago is still usable. The residents had adequate water for all their domestic uses when the system was in use. The Bible School at Iriyagama too used rain water as the only source while running a 35 student hostel. Hosteliers were not allowed to bath with this water.

At present the town relies almost totally on the town's pipe water supply as their main source of water. This is unfortunate. Rainwater harvesting systems if re-used can be a useful additional source of water. However, as long as the town supply continue to supply government subsidized cheap water the interest of the resident to re-use the rainwater harvesting systems will be low.

5.2 Bandarawela

Mr. Pigera of Bandarawela, a retired police officer, built an a underground cistern to store rainwater in 1982. This rectangular cistern is 3 meter deep and holds about 18000 liters. The catchment roof, is approximately 180 M^2. The tank is made by simply plastering the sides of the pit with cement mortar, and all the work was done by the unskilled members of the family. This cistern has served up to four families in the past. This is the best water supply solution for people in the hills, says Mr. Pigera who got the idea from a friend in South India. In dry parts of South India where it rains only a few months per year harvesting rainwater has a long history, according to Mr. Pigera.

Mr. Pigera & the water system. (Hapugoda)

5.3 Galle

At the peak of the Buona Vista Hill, Galle a rainwater harvesting system is under construction. On completion rain water from part of the very large roof will fill into a 18000 liters. re-inforced concrete covered tank. The over flow from this tank is directed to a 90,000 liters open tank, through underground locally fabricated 30 cm diameter concrete pipes. The estimated cost for this system is about five hundred thousand rupees.

The Peak of Buona Vista Hill, has long suffered from lack of water. The rain water harvesting system design was proposed after an effort to supply water with tube wells and other means failed, said Mr. Lakshman Welikala, the Civil Engineer responsible for this design. The design was presented at the Tokyo International Rainwater Utilization conference in 1994.

5.4 Kundasale

Low income families at Ahaspokuna Village in Kundasale, have on their own built 1400 - 1800 liter tanks out of home burnt mud bricks. Out of the seven houses visited six of them had some form of permanent roofs. The gutters were standard pvc gutters. They have improvised a cheap polythene pipe to lead the water from the gutter into the tank. The roof area in most houses was over 40 m^2, and some tanks were said, never to go dry. A women in one of the houses was keen to add that they are very careful with water, as they pay up to Rs. 350 per 5000 liter bowser. At one house, a low level second tank built adjoining the main tank, collected some of the waste water for bathing, washing, etc. This is depicted in the front cover graphic. This water is re-used in the water-seal toilets. A recent aid project helped the inhabitants to build these toilets. The village households have collected and used rainwater for the last five years. Most tanks leak after about five years, however these can be repaired easily by replastering the inside.

None of the tanks had covers resulting in mosquito nuisance. One owner had some fish in the water, said to prevent mosquito breeding. The general view is that rain water is acceptable as a water source. However the cost of building tanks to store it is too costly. One family said they were willing to spend up to Rs. 10000/- in installments to build storage tanks, if they can store enough water for their domestic use.

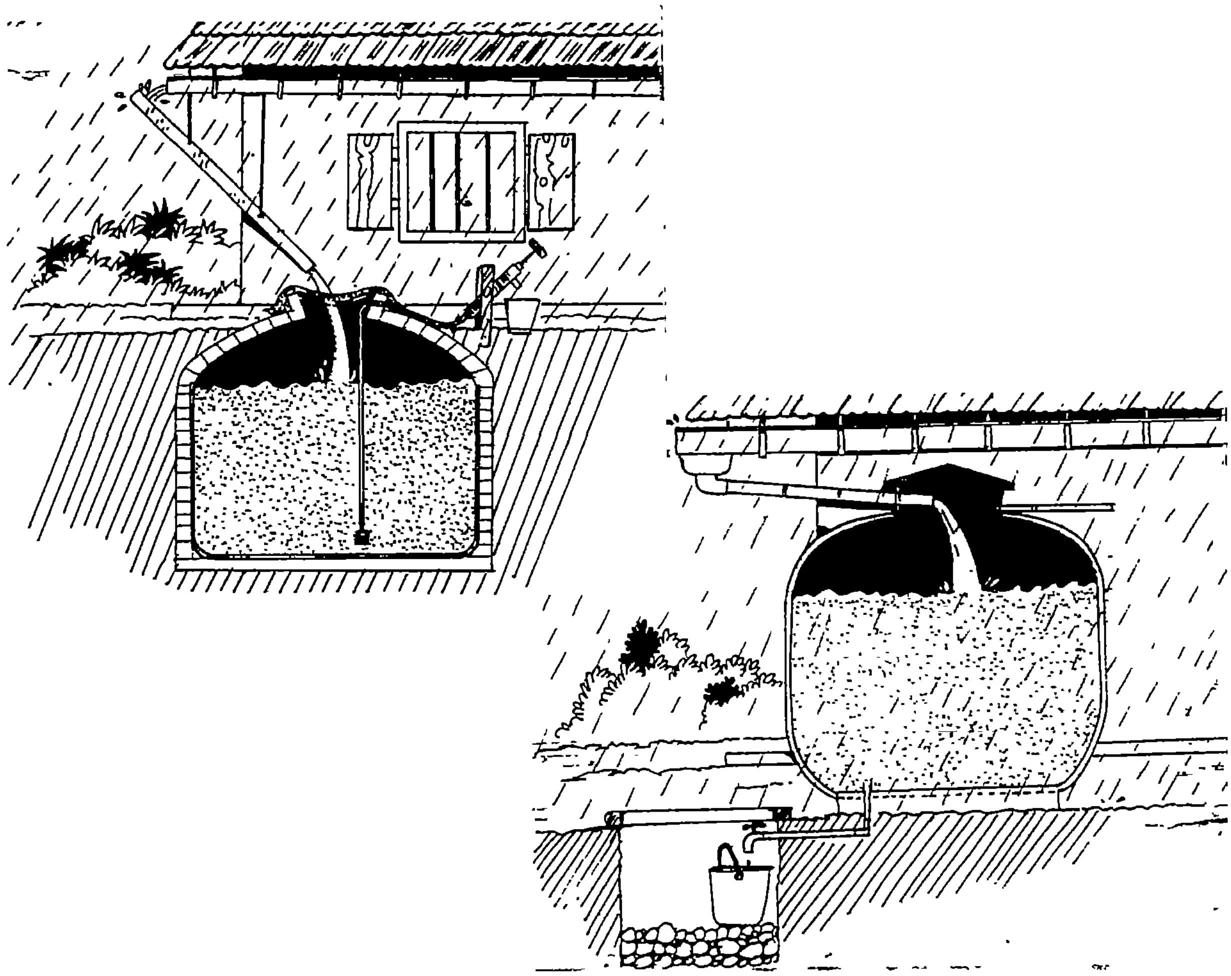
Typical System at Kundasale (Hapugoda)

5.5 Peradeniya

The residence of the Dean of the Faculty of Engineering, University of Peradeniya has an 2.40 meter high 30 cubic meter ferro-cement tank to store rainwater from an approximately 200 square meter area of his house roof. The water is pumped into a two cubic meter overhead tank and used for all domestic purposes including washing clothes by machine, Eight adults live here. An elaborate two-pump system to pump water from a well, located about one hundred meters lower in elevation, backs up the rainwater harvesting system. However this is rarely used. The tank costs about Rs. 10000 in 1992. The Professor is very pleased and proud of the system.

(Hapugoda)

6. Rain Water Harvesting as an Option.



6.1. Advantages and Disadvantages of Rain-Water Harvesting Systems.

Advantages and disadvantages of rainwater harvesting vary depending mainly on the rainfall pattern, catchment area, storage capacity and user demand, of a situation. General advantages and disadvantages are given below.

Advantages

- the quality of rainwater can be kept high with simple precautions.
- systems can be independent
- local materials and skills can be used for the construction of the systems.
- maintenance can be done by the user.
- water is available at the dwelling, this saves time in collecting water.

- during rainy periods a highlevel of domestic service can be expected as there is adequate water collected.

disadvantages

- High initial capital cost.
- available water is limited by rainfall and catchment area.
- water has a flat taste due to lack of minerals.
- lack of minerals in the water may cause nutrition deficiencies.
- the user must learn to ration the use of water during the dry season.

6.2. Feasibility

At the Project Development Phase, once there is doubt that traditional water-supply systems are not feasible due, to technical, economic or social reasons, consideration of the feasibility of rainwater harvesting can be initiated.

In the CWSSP the choice of technology must suite remote rural communities. Construction must be possible by locally available materials and skills. In a number of hilly areas available water supply options are tube wells or high head pump systems. Both can be poor choices. To construct tube wells external expensive technical inputs are needed. Some times lack of proper roads make it very difficult for rigs to get to the right place. Pump systems need fuel or electricity on a continuous basis. Their maintenance need funds and skilled personal.

In the existing in pump schemes under CWSSP, it is seen that paying for water on a regular basis is difficult for the beneficiaries who in many cases do not have a regular income.

Communal pump pipe schemes and tube well systems create social problems due to their communal nature. In most villages there are political, social and economic differences that trickle down into the management of communal water systems. Water right issues, such as the owner of the land where the springs are, located may protest, here too rainwater harvesting can be the choice to prevent further delays.

6.2.1 Rain fall

Sri Lanka is divided into two major zones, wet and dry. The dry zone occupies the majority of the land area. (65% of total land area). The dry zone gets the rain fall from North-East monsoon from November through April and the wet zone gets the rain from May through October mainly. (see figure 1).

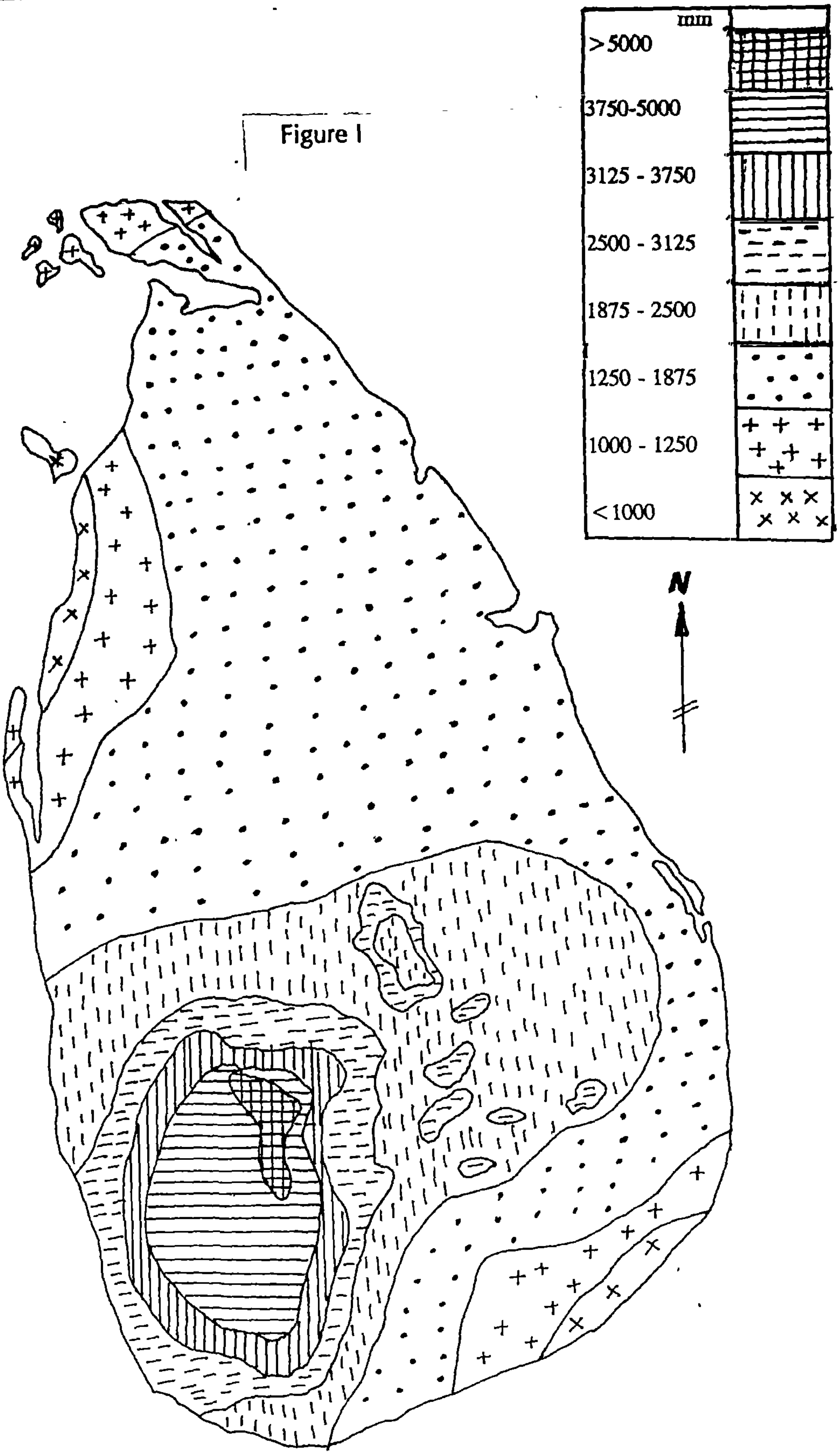
Reliable rainfall data is required when determining the supply from the system. Rainfall data for about the last 10 year period is preferable. This information can be obtained from the Colombo Meteorological Office.

If rain-fall data for a particular area is not available by identifying the area in the 1" contour maps at the Meteorological Office, monthly rainfall data can be obtained from the climatically closest station to this area.

For design purposes it is important to obtain monthly rainfall data. The Met: office sells one year monthly rain fall data at Rs. 15/- (1995). A computer print out on daily rain fall data too is available for sale.

A monthly rainfall data for selected stations relevant to the study is given in **Annex 2**. Figure I gives mean annual rainfall for the entire country.

Figure I



Mean Annual Rainfall (mm)

6.2.2 Water Demand

In a household water is used for drinking, cooking, cleaning, and washing. In rural areas under the CWSSP each person may use between 45 to 120 liters per day, if there is no restriction.

The supply from a rainwater harvesting system takes place in a variable manner depending on the rainfall pattern of a place. In the wet season in a normal year (about 6 months of the year) it can supply upto six times the dry season supply. In this way where a dry season demand is 20 liters per person per day, during half the year the demand can go up to 120 liters per person per day.

The next step involves estimating the total annual demand and comparing it with the supply possible from the relevant rainwater catchment area. If the supply exceeds the demand rainwater harvesting is technically feasible.

Table 6 - 1 sites examples with different rainfall average and roof catchment areas.

Table 6.1

Annual Average Rainfall mm	Roof Area M^2	Run off Coefficient	Annual Average Supply M^3	Annual Minimum Demand M^3	Feasibility
1300	40	0.8	41.6	36.5	Feasible
1300	20	0.8	20.8	36.5	Demand too high
1750	20	0.8	28	36.5	Demand too high
1750	30	0.8	42	36.5	Feasible
3500	14	0.8	39.2	36.5	Feasible

If the supply is less than demand, then a possible solution includes increasing the catchment area, or reducing the demand for rainwater by limiting it uses to say, drinking and cooking.

6.2.3 Water Supply

Graphs U,V,W,X,Y,Z (Annex 10) give possible driest (in a ten year period) season supplies in liters per day from a 5 m^3 storage for catchment areas upto 200 sqr. mtrs. for selected six meteorological station regions in Badulla, Matara and Ratnapura districts.

Table 6.2 is prepared using the above graphs. The catchment area is selected as $60M^2$.

Table 6 - 2

District	Roof Area M^2	Storage M^3	Dry season supply in liters from one roof per day.	
			In a area with high average annual/rainfall	In a area with low average annual rainfall
Matara	60	5	150 (Aninkanda)	65 (Kekenadora)
Ratnapura	60	5	125 (Ratnapura)	48 (Ambilipitiya)
Badulla	60	5	77 (Haputale)	62 (Badulla)

Minimum water-supply volumes are for the driest months of the driest year, in a ten year period. Water-supply can go up to six times these amounts during the remaining months depending on how wet it is.

Table 6 - 3 gives the possible daily supplies, in different months, from a well managed system with a $60M^2$ catchment and $5M^3$ tank, at Ambilipitiya in the Ratnapura district, in a normal year.

In all other regions in the three districts, it is possible to get a better level of service than at Ambilipitiya from a well managed rain water harvesting system as rainfall at Ambilipitiya is among the lowest in the three districts.

Table 6 - 3

Ambilipitiya in a Normal Year [System $60M^2$ catchment $5M^3$ Storage]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly mean R.F.	75.9	66.9	120	153	112	44	55	41	71.8	201	243	160
Monthly Supply M^3 [Catchment $60M^2$ R.C. 0.8]	3.6	3.2	5.8	7.3	5.4	2.1	2.6	2	3.4	9.7	11.7	7.7
Taken from the months supply M^3	3	3	5.8	7.3	3	2.1	2.6	2	3	9.7	11.7	7.7
Taken from other monthly supply M^3	0	0	0	0	-2.3	+.9	+.4	+1	0	0	0	0
Possible Supply in a day in Liters	100	100	190	240	100	100	100	100	100	315	384	250

Conclusion: In a normal year, if the tank is half full at the end of May, this catchment can supply 100 liters per day throughout the dry season months upto September. This is a very reasonable level of service for a area as dry as Ambilipitiya.

6.3. Economics

Initial per capita capital cost of a rainwater harvesting system is high, in relation to other types of water supply systems.

A typical rainwater harvesting systems consist of

1. Suitable roof catchment
2. Gutter & down pipe system
3. A storage tank of adequate size.
4. Device to extract water from the tank.

Normally, the catchment will be an existing roof and gutters & down pipes. These are considered part of the building.

The major cost being in the construction of tanks, the economic analysis given below refer to the cost of tank construction.

6.3.1 Cost Scenario

Graphs O,P,Q,R,S,T (Annex - 9) give the required tank storage volumes for roof areas upto 200 square meters in 6 selected Meteorological Station regions in the three district of Badulla, Ratnapura and Matara.

Graphs O,P,Q,R,S,T takes into account monthly rainfall variation of a ten year period. Tank storage volume is the requirement for the ten year dry year.

Graphs A,B,D,E,F,G (Annex - 8) prepared by mass curve analysis (numerical method) were used to prepare the graphs O,P,Q,R,S,T.

Table 6.4

District	Roof Area M^2	Minimum Supply from a roof per day lit (M^3/YR)	Storage required in Cubic Meters	
			Station with high Avg Annual R.F.	Station with Low Avg. Annual Rainfall
Matara	60	100 (36.5)	(Aninkanda) 0.6	(Kekenadora) 9.5
Ratnapura	60	100 (36.5)	(Ratnapura) 2.5	(Ambilipitiya) 17.5
Badulla	60	100 (36.5)	(Haputale) 6.75	(Badulla) 12.5

Runoff coefficient = 0.8

If five persons live in a house with a suitable roof catchment area of $60M^2$ and each person requires supply of 20 lit per day, the annual required supply is 36.5 cubic meters.

Where the roof area is taken as $60M^2$ Table 6.4 gives required storage values within each district.

eg. At Matara district required volume is approximately from 0.6 to 11 cubic meters depending on the rainfall of the area. At Rs. 1.25 per lit for constructing a storage tanks, costs per house of $60M^2$ catchment roof varies between 750 to Rs. 13,750.

Comment: Storage values given in Table 6.4 are for the 10 year driest year. In a normal year the level of service improves considerably, as can be seen from Table 6.3.

Table 6.5

Tank	Capacity M^3	Total Cost	Pump	Cost per Lit Storage Rs.
Brick Dome	5	5592	450	1.21
Brick Dome	8	8129	450	1.08
Brick Dome	10	9175	450	0.97
Ferro-Cement	5	7166	NIL	1.43
Jar	1.1		NIL	ref. annex 13

Total cost exclude transport cost.

Annex 14 gives material and cost breakdown of the brick dome tanks.

Table 6.5 gives cost per liter of storage for four types of tanks. A brick dome tank is built below ground. Therefore the cost of, extraction pump is included.

Table 6.6

Total Tank Cost (Example)

DISTRICT	Roof Area M^2	Possible min Supply per day from a roof (house) Liters in a ten year dry year	Total Cost per Tank System	
			Area with high Avg. Rain Fall Rs.	Area with Low Avg. Rain Fall Rs.
Matara	60	100	750	11,875
Ratnapura	60	100	3125	21,875
Badulla	60	100	8438	15,625

Table 6.7

CWSSP Contribution as 80% of Total Cost

DISTRICT	Roof Area M^2	Possible min Supply per day from a roof (house) Liters in a ten year dry year	CWSSP Cost per Tank System	
			Area with high Avg. Rain Fall Rs.	Area with Low Avg. Rain Fall Rs.
Matara	60	100	600	9,500
Ratnapura	60	100	2500	17,500
Badulla	60	100	6750	12,500

Tables 6 - 6 & 6 - 7 gives general trend of the costs of rainwater harvesting in the relevant three districts, where the minimum supply for a house per day is 100 liters in a ten year dry year.

To bring the CWSSP contribution down to Rs. 5390/-, options are,

1. to increase the catchment area.
2. to lower to minimum service level, for the ten year dry year.
3. to select a relevant low cost tank option.

Various scenarios, to be considered in Badulla are as follows.

Table 6 - 8 gives the cost scenario when minimum supply per day in a ten year dry year from a roof is 50 liters.

Table 6.8

Catchment area M^2	40	60	80
Annual Supply (R.C - 0.8) M^3	56	84	112
Annual Demand M^3	18.3	18.3	18.3
Demand as % of Supply	33	22	16
Required Storage as % of Supply. (From Rain Region graph A Annex 8)	9	4	1.5
Required Storage M^3	5	3.4	1.7
Total Cost of Storage Rs.	6250	4250	2125
CWSSP Cost Rs.	5000	3400	1700

Table 6 - 9 gives the cost scenario when minimum supply per day in a ten year dry year from a roof is 75 liters.

Table 6.9

Catchment area M^2	40	60	80	100
Annual Supply (R.C = 0.8) M^3	56	84	112	140
Annual Demand M^3	27.4	27.4	27.4	27.4
Demand as % of Supply	49	33	25	20
Required Storage as % of Supply. (From Rain Region graph A Annex 8)	18	9	5	2.5
Required Storage M^3	10	7.6	5.6	3.5
Total Cost of Storage Rs.	12,500	9,500	7,000	4,375
CWSSP Cost Rs.	10,000	7,600	5,600	3,500

Note: 1. In a normal year minimum supply per day is more than double.
2. Six months of the year, when it is wet supply per day from a roof can go up six times the supply volume, of the dry months, in the same system.

Possible daily supply in liters from a well managed Rain Water Harvesting System in a normal year in the Badulla Rain Region, consisting of different size catchments and a $5M^3$ storage tank, is given in Table 6 - 10.

Table 6 - 10

Catchment Area M^2	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
20	70	70	70	70	70	70	70	70	70	70	70	70
30a	100	100	100	100	100	100	80	65	110	184	200	125
40	252	100	100	100	100	100	100	100	148	250	260	250
60	383	110	187	252	100	100	100	131	228	365	409	377

Note: a With a $5.5M^3$ Tank possible to manage a minimum supply of 100 LPD.

6.4. Social

Once it has been tentatively established that it is technically and economically feasible to construct a rain water harvesting system, the next step involves social and community assessment. This stage is critical to the success of the scheme.

Consideration must be given to traditional practices within the community. The role of women and children is carrying water, existing catchment possibilities, palatability of rain water, communal vs individual systems, and maintenance expenditure management.

At the end the community members should willingly choose the option of rainwater harvesting.

6.5. Design

The design stage of the project involves in sizing the storage tank. Two acceptable methods are discussed below.

6.5.1 Dry season demand versus supply method

To determine the required tank volume multiply the days of the longest dry period by the amount of water required per day.

e.g at Badulla.

To supply 100 lit per day per house to accommodate a 50 day dry period, the required storage volume is:

$$100 \times 50 \quad - \quad 5000\ M^3$$

This method gives only a rough estimate of the storage required. It does not take into account the variation in the annual rainfall pattern.

Table 6 - 11 gives water supply scenario from a $5M^3$ tank.

FIXED - Storage Capacity 5000 Liters

Table 6 - 11

Length of Drought Days	Family of 6 available Water per Person per Day	Family of 5 Available Water per Person per Day
14	60	70
21	40	48
28	30	36
35	24	29
42	20	24
49	17	20
56	15	18
63	13	16
70	12	14
77	11	13
84	10	12
91	9	11

Note : The possible service level in 70 to 90 day dry spell is considered adequate for most basic needs such as drinking and cooking.

6.5.2 Mass curve analysis method

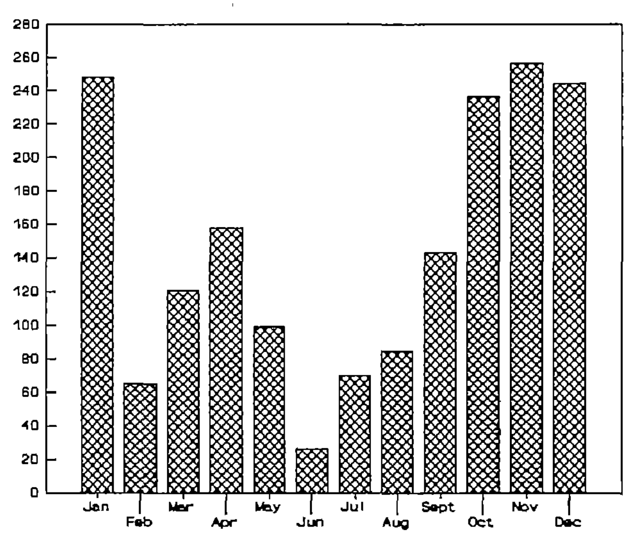
A more accurate method of sizing a tank, involves an analysis of monthly rainfall data using the mass curve technique. Best is to use approximately the latest 10 years of data. As an example, the data for the Badulla area is analysed below.

Badulla Monthly Rainfall data (mm) is in **Table 6 - 12.**

BADULLA RAINFALL DATA in mm

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
1985	171.2	76.1	185.4	75.6	82.2	16.9	52.0	133.6	90.8	233.3	188.9	245.1	1551.10
1986	721.5	136.8	281.0	250.1	120.4	2.0	71.3	98.0	65.8	376.2	131.4	207.8	2462.30
1987	206.5	42.7	85.7	218.7	171.6	3.6	10.2	62.9	175.0	273.8	165.2	88.4	1504.30
1988	48.4	59.0	198.7	249.0	35.6	30.0	51.9	246.1	136.8	147.1	350.9	241.5	1795.00
1989	201.0	14.9	80.2	114.1	51.3	39.0	216.7	76.5	249.6	295.7	267.6	106.4	1713.00
1990	386.0	118.8	156.0	149.0	101.3	8.4	105.3	43.0	172.5	179.1	151.7	332.3	1903.40
1991	347.9	39.1	101.1	219.0	90.3	48.0	25.4	31.0	147.4	155.9	153.1	300.8	1659.00
1992	85.3	0.0	0.0	46.6	85.2	0.3	48.0	32.6	63.2	112.1	584.1	245.0	1302.40
1993	63.9	36.4	76.6	97.7	236.3	86.6	101.7	85.2	134.2	270.0	241.1	329.8	1759.50
1994	247.6	129.6	42.3	159.1	17.2	26.5	17.2	37.2	197.4	320.0	328.4	343.5	1866.00
Average	247.9	65.3	120.7	157.9	99.1	26.1	70.0	84.6	143.3	236.3	256.2	244.1	1751.6
Standard Deviation	190.6	45.9	79.4	70.0	61.7	25.4	57.7	62.3	56.0	81.1	131.1	85.3	292.6

Rain Fall Analysis - Badulla



6.5.2.1 **Design** (example Badulla)

1. Roof size $60M^2$
   Run off coefficient 0.8

2. Average yearly supply = Area x runoff coeff. x average annual rainfall

   = 60 X 0.8 X 1.75

   Average annual rainfall = 1750 mm (1985 to 1994)

3. Table of Mass Curve Analysis

4. Decide monthly demand (supply) = 1500 liters

5. From the mass curve analysis **(Table 6 - 13)** the storage requirement is determined as = 464548.8 - 461548.8 = 3000 liters

   (Total amount stored in the 85th Month minus 87th Month)

Comment: In the above case it is possible to give an extra level of service with a 5000 liter storage tank, which can be constructed within CWSSP criteria in Badulla.

Table 6 – 13

RAINWATER HARVEST STUDY

RAINFALL MASS CURVE ANALYSIS – MONTHLY (Numerical Method)

BADULLA 1985 TO 1994 ROOF AREA = 60 M^2

RUN OFF COEFFICIENT = 0.8

Month	Monthy Rainfall	Monthly Supply Liters	Cumulative Supply Liters	Monthly Demand Liters	Amount Stored Liters	Total Amount Stored Liters	Required Tank Volumn Liters	
1	0.0	0.0	0.0	0	0.0	0.0		48
2	0.0	0.0	0.0	0	0.0	0.0		48
3	0.0	0.0	0.0	0	0.0	0.0		48
4	75.6	3628.8	3628.8	1500	2128.8	2128.8		48
5	82.2	3945.6	7574.4	1500	2445.6	4574.4		48
6	16.9	811.2	8385.6	1500	−688.8	3885.6		48
7	52.0	2496.0	10881.6	1500	996.0	4881.6		48
8	133.6	6412.8	17294.4	1500	4912.8	9794.4		48
9	90.8	4358.4	21652.8	1500	2858.4	12652.8		48
10	233.3	11198.4	32851.2	1500	9698.4	22351.2		48
11	188.9	9067.2	41918.4	1500	7567.2	29918.4		48
12	245.1	11764.8	53683.2	1500	10264.8	40183.2		48
13	721.5	34632.0	88315.2	1500	33132.0	73315.2		48
14	136.8	6566.4	94881.6	1500	5066.4	78381.6		48
15	281.0	13488.0	108369.6	1500	11988.0	90369.6		48
16	250.1	12004.8	120374.4	1500	10504.8	100874.4		48
17	120.4	5779.2	126153.6	1500	4279.2	105153.6		48
18	2.0	96.0	126249.6	1500	−1404.0	103749.6		48
19	71.3	3422.4	129672.0	1500	1922.4	105672.0		48
20	98.0	4704.0	134376.0	1500	3204.0	108876.0		48
21	65.8	3158.4	137534.4	1500	1658.4	110534.4		48

Month	Monthy Rainfall	Monthly Supply Liters	Cumulative Supply Liters	Monthly Demand Liters	Amount Stored Liters	Total Amount Stored Liters	Required Tank Volumn Liters	
22	376.2	18057.6	155592.0	1500	16557.6	127092.0		48
23	131.4	6307.2	161899.2	1500	4807.2	131899.2		48
24	207.8	9974.4	171873.6	1500	8474.4	140373.6		48
25	206.5	9912.0	181785.6	1500	8412.0	148785.6		48
26	42.7	2049.6	183835.2	1500	549.6	149335.2		48
27	85.7	4113.6	187948.8	1500	2613.6	151948.8		48
28	218.7	10497.6	198446.4	1500	8997.6	160946.4		48
29	171.6	8236.8	206683.2	1500	6736.8	167683.2		48
30	3.6	172.8	206856.0	1500	−1327.2	166356.0		48
31	10.2	489.6	207345.6	1500	−1010.4	165345.6		48
32	62.9	3019.2	210364.8	1500	1519.2	166864.8		48
33	175.0	8400.0	218764.8	1500	6900.0	173764.8		48
34	273.8	13142.4	231907.2	1500	11642.4	185407.2		48
35	165.2	7929.6	239836.8	1500	6429.6	191836.8		48
36	88.4	4243.2	244080.0	1500	2743.2	194580.0		48
37	48.4	2323.2	246403.2	1500	823.2	195403.2		48
38	59.0	2832.0	249235.2	1500	1332.0	196735.2		48
39	198.7	9537.6	258772.8	1500	8037.6	204772.8		48
40	249.0	11952.0	270724.8	1500	10452.0	215224.8		48
41	35.6	1708.8	272433.6	1500	208.8	215433.6		48
42	30.0	1440.0	273873.6	1500	−60.0	215373.6		48
43	51.9	2491.2	276364.8	1500	991.2	216364.8		48
44	246.1	11812.8	288177.6	1500	10312.8	226677.6		48
45	136.8	6566.4	294744.0	1500	5066.4	231744.0		48
46	147.1	7060.8	301804.8	1500	5560.8	237304.8		48
47	350.9	16843.2	318648.0	1500	15343.2	252648.0		48
48	241.5	11592.0	330240.0	1500	10092.0	262740.0		48

Month	Monthy Rainfall	Monthly Supply Liters	Cumulative Supply Liters	Monthly Demand Liters	Amount Stored Liters	Total Amount Stored Liters	*Required* Tank Volumn Liters	
49	201.0	9648.0	339888.0	1500	8148.0	270888.0		48
50	14.9	715.2	340603.2	1500	−784.8	270103.2		48
51	80.2	3849.6	344452.8	1500	2349.6	272452.8		48
52	114.1	5476.8	349929.6	1500	3976.8	276429.6		48
53	51.3	2462.4	352392.0	1500	962.4	277392.0		48
54	39.0	1872.0	354264.0	1500	372.0	277764.0		48
55	216.7	10401.6	364665.6	1500	8901.6	286665.6		48
56	76.5	3672.0	368337.6	1500	2172.0	288837.6		48
57	249.5	11976.0	380313.6	1500	10476.0	299313.6		48
58	295.7	14193.6	394507.2	1500	12693.6	312007.2		48
59	267.6	12844.8	407352.0	1500	11344.8	323352.0		48
60	106.4	5107.2	412459.2	1500	3607.2	326959.2		48
61	386.0	18528.0	430987.2	1500	17028.0	343987.2		48
62	118.8	5702.4	436689.6	1500	4202.4	348189.6		48
63	156.0	7488.0	444177.6	1500	5988.0	354177.6		48
64	149.0	7152.0	451329.6	1500	5652.0	359829.6		48
65	101.3	4862.4	456192.0	1500	3362.4	363192.0		48
66	8.4	403.2	456595.2	1500	−1096.8	362095.2		48
67	105.3	5054.4	461649.6	1500	3554.4	365649.6		48
4	43.0	2064.0	463713.6	1500	564.0	366213.6		48
69	172.5	8280.0	471993.6	1500	6780.0	372993.6		48
70	179.1	8596.8	480590.4	1500	7096.8	380090.4		48
71	151.7	7281.6	487872.0	1500	5781.6	385872.0		48
72	332.3	15950.4	503822.4	1500	14450.4	400322.4		48
73	347.9	16699.2	520521.6	1500	15199.2	415521.6		48
74	39.1	1876.8	522398.4	1500	376.8	415898.4		48
75	101.1	4852.8	527251.2	1500	3352.8	419251.2		48

Month	Monthy Rainfall	Monthly Supply Liters	Cumulative Supply Liters	Monthly Demand Liters	Amount Stored Liters	Total Amount Stored Liters	Required Tank Volumn Liters	
76	219	10512.0	537763.2	1500	9012.0	428263.2		48
77	90.3	4334.4	542097.6	1500	2834.4	431097.6		48
78	48.0	2304.0	544401.6	1500	804.0	431901.6		48
79	25.4	1219.2	545620.8	1500	−280.8	431620.8		48
80	31.0	1488.0	547108.8	1500	−12.0	431608.8		48
81	147.4	7075.2	554184.0	1500	5575.2	437184.0		48
82	155.9	7483.2	561667.2	1500	5983.2	443167.2		48
83	153.1	7348.8	569016.0	1500	5848.8	449016.0		48
84	300.8	14438.4	583454.4	1500	12938.4	461954.4		48
85	85.3	4094.4	587548.8	1500	2594.4	464548.8		48
86	0.0	0.0	587548.8	1500	−1500.0	463048.8		48
87	0.0	0.0	587548.8	1500	−1500.0	461548.8		48
88	46.6	2236.8	589785.6	1500	736.8	462285.6		48
89	85.2	4089.6	593875.2	1500	2589.6	464875.2		48
90	0.3	14.4	593889.6	1500	−1485.6	463389.6		48
91	48.0	2304.0	596193.6	1500	804.0	464193.6		48
92	32.6	1564.8	597758.4	1500	64.8	464258.4		48
93	63.2	3033.6	600792.0	1500	1533.6	465792.0		48
94	112.1	5380.8	606172.8	1500	3880.8	469672.8		48
95	584.1	28036.8	634209.6	1500	26536.8	496209.6		48
96	245.0	11760.0	645969.6	1500	10260.0	506469.6		48
97	63.9	3067.2	649036.8	1500	1567.2	508036.8		48
98	36.4	1747.2	650784.0	1500	247.2	508284.0		48
99	76.6	3676.8	654460.8	1500	2176.8	510460.8		48
100	97.7	4689.6	659150.4	1500	3189.6	513650.4		48
101	236.3	11342.4	670492.8	1500	9842.4	523492.8		48
102	86.6	4156.8	674649.6	1500	2656.8	526149.6		48

Month	Monthy Rainfall	Monthly Supply Liters	Cumulative Supply Liters	Monthly Demand Liters	Amount Stored Liters	Total Amount Stored Liters	Required Tank Volumn Liters	
103	101.7	4881.6	679531.2	1500	3381.6	529531.2		48
104	85.2	4089.6	683620.8	1500	2589.6	532120.8		48
105	134.2	6441.6	690062.4	1500	4941.6	537062.4		48
106	270.0	12960.0	703022.4	1500	11460.0	548522.4		48
107	241.1	11572.8	714595.2	1500	10072.8	558595.2		48
108	329.8	15830.4	730425.6	1500	14330.4	572925.6		48
109	247.6	11884.8	742310.4	1500	10384.8	583310.4		48
110	129.6	6220.8	748531.2	1500	4720.8	588031.2		48
111	42.3	2030.4	750561.6	1500	530.4	588561.6		48
112	159.1	7636.8	758198.4	1500	6136.8	594698.4		48
113	17.2	825.6	759024.0	1500	−674.4	594024.0		48
114	26.5	1272.0	760296.0	1500	−228.0	593796.0		48
115	17.2	825.6	761121.6	1500	−674.4	593121.6		48
116	37.2	1785.6	762907.2	1500	285.6	593407.2		48
117	197.4	9475.2	772382.4	1500	7975.2	601382.4		48
118	320.0	15360.0	787742.4	1500	13860.0	615242.4		48
119	328.4	15763.2	803505.6	1500	14263.2	629505.6		48
120	343.5	16488.0	819993.6	1500	14988.0	644493.6		48

Though accurate it is too complicated a method to determine the storage capacity when a project involves close to a hundred houses of different roof catchment sizes.

Here it is useful to prepare graphs, applicable to any roof sizes and demand related to a set of rainfall data, relevant to an area or region.

There graphs are named as Rain Region Graphs in this report. Details of these Rain Region graphs are given in the section 6.5.2.2.

6.5.2.2. Rain Region Graph

For the Badulla region rainfall data, the rain region graph is given in graph A of Annex 8.

Rain Region Graphs for

Haputale	] Badulla District
Ratnapura	}
Ambilipitiya	} Ratnapura District
Kolonna	}
Kekenadora	]
Aninkanda	] Matara District

are given in Annex 8. These represent high & low average rainfall regions in the three districts.

This is a useful graph though it was derived from a particular roof. It works for all demands for any roof area and with any run off co-efficient. This graph can be used in the field to analyse individual systems located in one area. The graph is prepared by repeating mass curve analysis for a set of data using different demands. These graphs can be plotted easily by regional technical staff.

Assumptions used in the above analysis.

- Demand is the same for every month.
- Demand is constant from year to year.
- Rainfall pattern in the future will be similar to pattern of rainfall data used.
- Evaporation from tanks is included in the run off co-efficient.

6.6. Construction

Construction of a Rainwater Harvesting system include the catchment, the gutter system, storage and a water extraction device.

6.6.1 Roof catchment

The roof should be made of suitable materials such as galvanized iron (G.I.) sheet. Thatched roofs are not suitable as decaying vegetative materials would add taste and colour to the water. However this water can be used for livestock irrigation and to flush toilet. There should be no trees over shadowing the roof as falling leaves also would act similarly. If GI roofs are painted the paint should be non toxic. Generally there is a fear of using asbestos roofs as rainwater catchment. Some authorities maintain that this fear is not justified as the fibre causes cancer only when inhaled **(Annex 12).** Tiled roofs have the drawback, that they are difficult to clean, and are susceptible to algae growth. The best option seem to be GI sheets painted with non toxic paint.

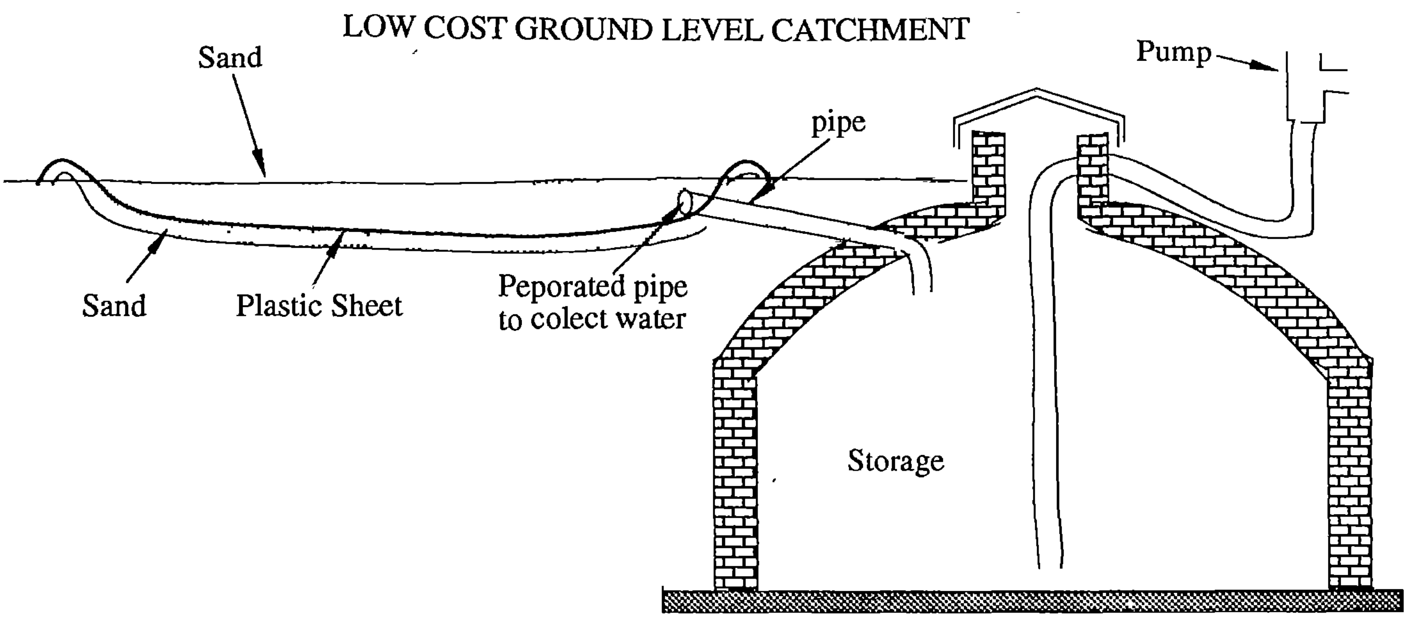
Most roofs in rural Sri Lanka are made of or fast becoming made of GI sheet or tiles.

6.6.2 Surface catchment

Where there is no suitable roof catchment rainwater can be harvested by construction of an impervious surface on the ground itself.

Chicken wire re-inforced concrete floor costs about Rs. 250/m^2

A cheaper catchment surface can be made by laying a piece of plastic sheeting in a shallow excavated and levelled area as given in the drawing. The estimated cost to be around Rs. 50/m^2 for a 60/m^2 area.



6.6.3 Gutter System

Effective guttering is an important part of the roof catchment systems. GI and UPVC can be used for gutters and down pipes. Sizing will depend on the roof area.

A facility to catch the first flush or bypass for flushing the roof is essential. For small systems this can be done by simply fixing a small length of flexible hose at the end of the down pipe. When the roof is being flushed the flexible hoses should be taken out of the storage tank inlet, and directed to a drain. Once the roof is clean this could be inserted back into the storage tank.

Just before the rainy season the roof is usually cleaned by sweeping off the impurities collected on it such as dust, leaves, bird dropping etc. The first rainfall is then used to flush the roof by keeping the bypass open.

Table 6 - 14

Standard PVC Gutters and Down Pipes for a 60m^2 roof.

(length of gutters - 15 meters)

Item	Unit	Qty	Unit Cost	Cost
Gutters	meters	15	87	1305
Clips	No	25	13	325
Center Running Head	No	02	80	160
Down Pipe	meters	7.5	60	450
TOTAL				2240

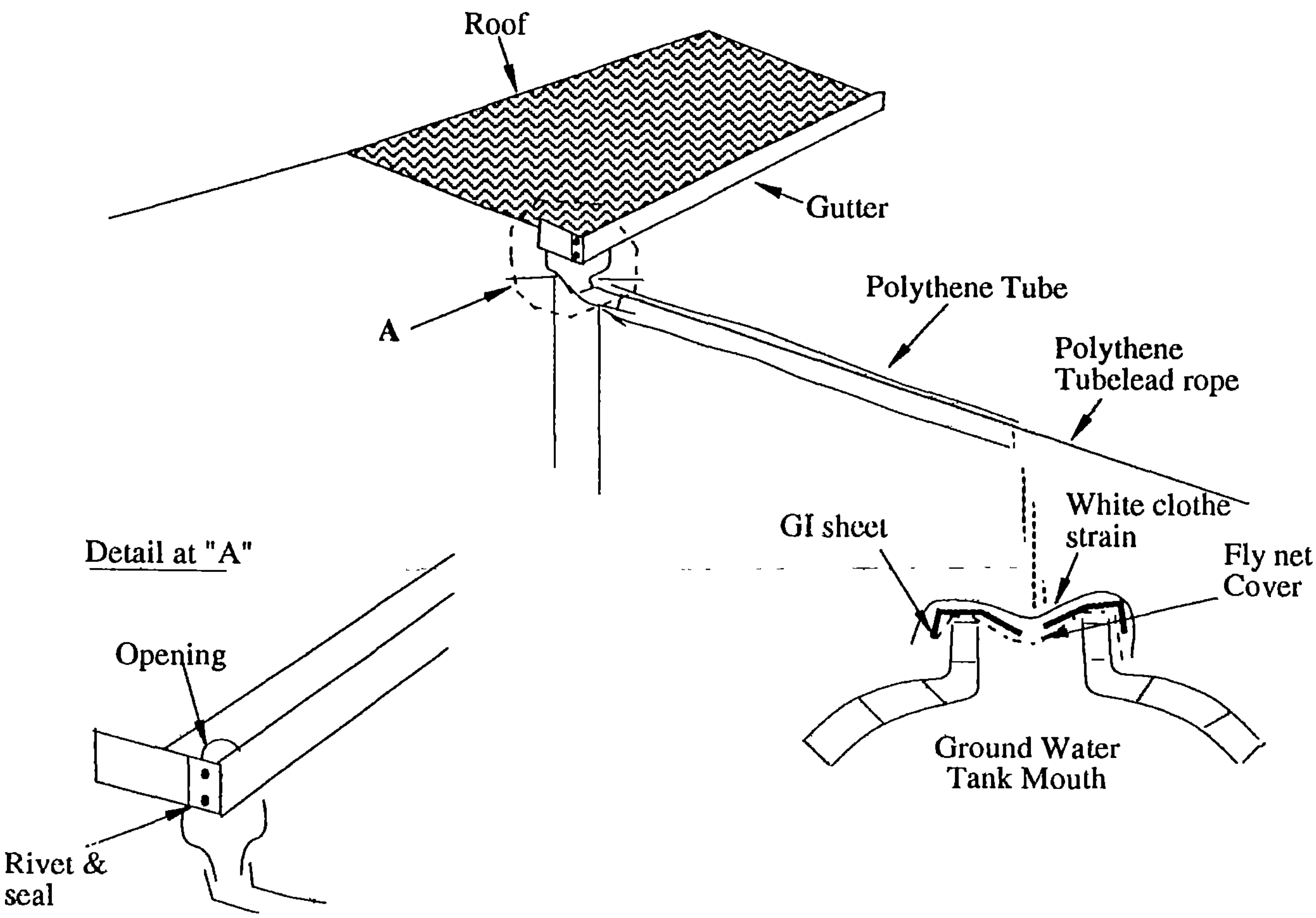
Cost (May 95) Rs.

Table 6 - 15

Low cost GI sheet gutters and polythene tube down pipe for a 60m^2 roof.
(Length of gutters - 15 meters)

Item	Unit	Qty	Unit Cost	Cost
GI sheet	M^2	6	100	600
Nylon Rope	M	12	7	84
Polythene Tube	M	6	6.50	39
Other				100
TOTAL				823

Cost (May 95) Rs.



6.6.4 The Storage Tank

A satisfactory storage tank is the most important part of a Rainwater Harvesting System. Its construction must be simple to manage at rural level, and result in a durable tank.

Three trial tanks were constructed to test various tank options. Details are given in **chapter 7.**

Table 6 - 16

Comparison of Different Tanks

Type of Tank	Total Cost M^3 (1995)	Can be Built above Ground	Resistance to UV Light	Minor Repairs at Rural Level	Remarks
Fibre Glass	5500	Yes	Poor	Difficult	
HDPE	5500	Yes	Good	Difficult	
Ferrocement	1468	Yes	Good	Easy	Cost can be brought down
Brick dome	1318	No	Good	Easy	Can be built above ground with re-enforcement.
Jar	1874	Yes	Good	Easy	Cost can be brought down

6.6.5 Water Extraction Device

When storage tanks are build above ground water can be extracted by fixing a tap at the bottom of the tank or by siphoning the water with a tube with a tap attached at the point of collection.

When storage is underground a low-cost home-made PVC pump can be used to extract the water.

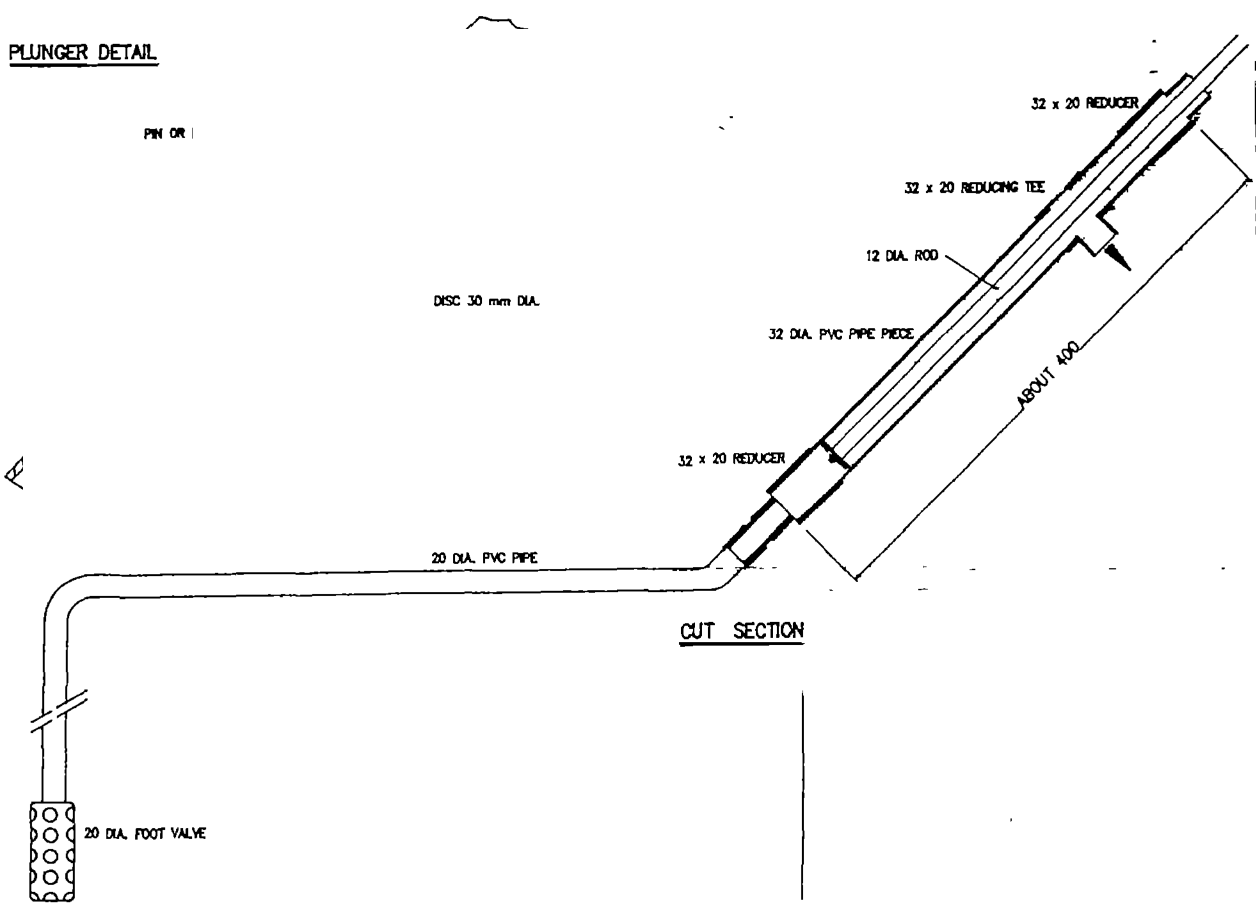
Table 6 - 17 gives the material and cost breakdown.

Table 6 - 17

Rain Water Harvesting
Low Head Home Made PVC Hand Pump

Item	Unit	Qty	Unit Cost	Cost
3/4" Foot Valve	No	01	150	150
3/4" Valve Socket	No	01	10	10
3/4" Bend	No	02	10	20
1 1/4x3/4 Reducing Socket	No	01	22	22
1 1/4" Pipe	Mtr	0.5	65.6	32.8
3/4" Pipe	Mtr	4	30	120
Plunger	No.	1	30	30
TOTAL				424.8
		Say		450/-

Costs (May 95) Rs.



7. Technical Options Tested

Three types of storage containers were constructed as trials. The objective being to build tanks with $5M^3$ storage capacity at a cost below Rs. 5400/-, excluding unskilled labour.

7.1 Ferro-Cement Tank

The ferro-cement tank (built above ground) is based on an a idea by Neil Herath - Rural Water Supply Engineer (CWSSP). It is a pumpkin shaped $5M^3$ ferro cement tank was successfully constructed by R.M.N.D. Illukumbura Senior Technical officer Ratnapura CWSSP.

A skeleton mould, made out of shaped 1" 'L'irons, is fixed around a circular foundation with horizontal rings made of 6mm mild steel bars at different heights to stabilise and to give the pumpkin shape. Two layers of 1/2" chicken-mesh are used as re-inforcement.

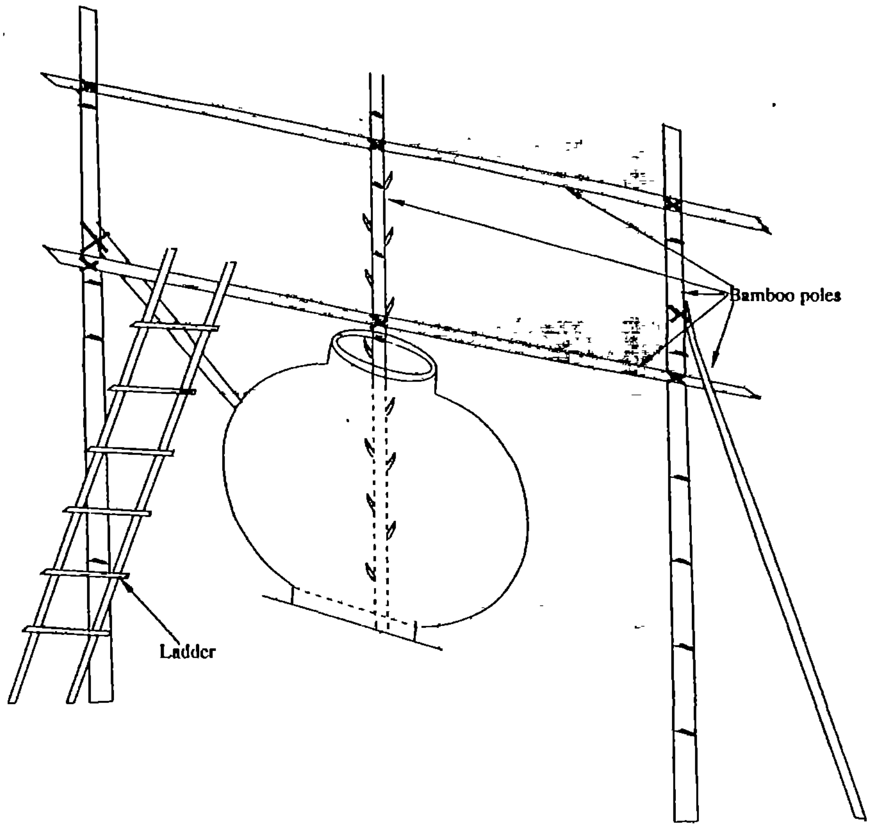
Material and cost break-down is given in **Annex - 4.**

Tank drawing is given in **Annex - 3.**

Actual material plus skilled labour plus mould cost of the tank is Rs. 5441. Under normal circumstances the cost of the ferro-cement pumpkin shaped tank is above the project criteria.

However by over-coming various constraints and delays that occurred during the construction phase, it should be possible to bring down the cost to meet financial project criteria. The construction method had many novel features, and with experience, the construction time will be reduced saving on skill and labour costs.

Construction Phase scaffolding arrangement is given below :



Illukumbura suggests

- To reduce the time of skilled labour and cement waste.

  1. The skeleton mould to have at least 8 verticals and 6mmΦ re-bar (removable) horizontal rings, every 10 cm vertically.

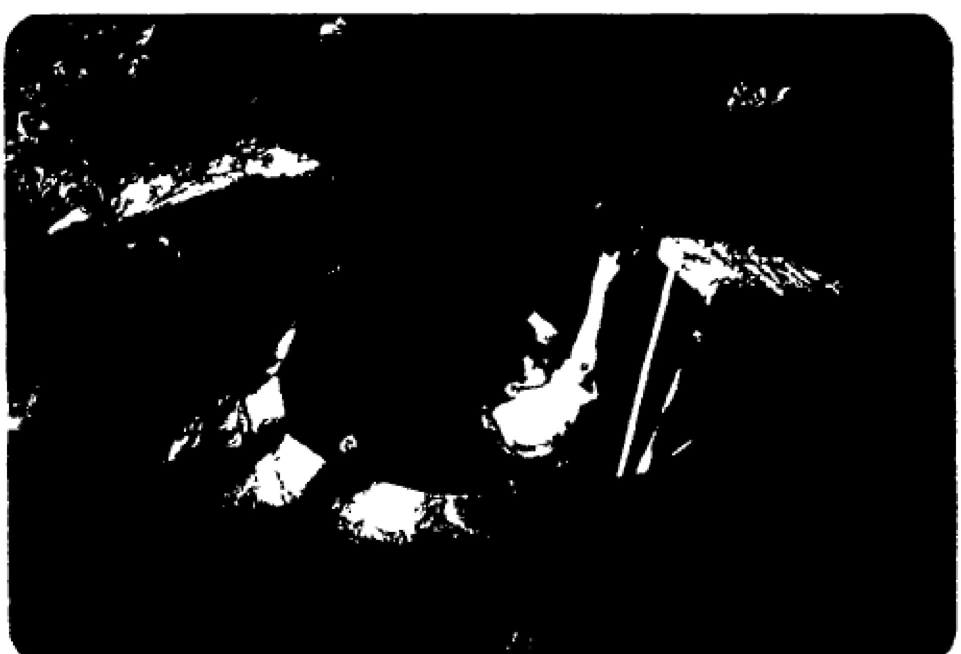
  2. To plaster the exterior of the walls first and to remove the mould from inside the tank to do the inside plaster, and complete the tank.

This trial tank was built at Paradise School premises in Kuruwita Ratnapura. The co-operation and help of the school principal Mrs P.I. Wimalasiri must be mentioned here with gratitude.

7.2 Brick-dome tank (built under ground)

The brick masonry tank was built at a potential rainwater harvesting site at Badulla. With actual material plus skilled labour the cost of the tank is Rs. 4298. In addition the transport of materials cost Rs. 1000/-. Under normal circumstances the brick rainwater storage tank will be acceptable within the project criteria and will be affordable to the householder in terms of labour and cash.

The roof of the tank is made of 1/4 brick thick in the shape of a dome without the use of a mould. The tank can be completed by a crew of one skilled worker and three helpers in three days, excluding excavation.



An engineer and a skilled worker from the NERD Centre Ja-Ela, conducted a training course in the construction of the tank, for the technical staff and village masons involved in the project in the Badulla District. The tank is currently being inco-operated into a rainwater harvesting system.

The trial tank construction at Badulla, included the following input from the Regional Office.

- Selection of a site at a project village.
- Supply & transport of materials to site.
- Provision of transport for trainees and trainers, from the Regional Office to the site for 3 days.

The Regional Director and District Engineer gave their fullest support in arranging these inputs. Special mention must be made of young resource engineer Wijaya Widyaratne and CRO Sunil Ratnasiri for their positive attitude, which enabled the work to get organized with short notice, to be completed on time.

Material and cost break-down in **Annex 6.**

Tank drawing in **Annex - 5.**

7.3. Cement Jars

Cement Jars of 1 to 2 M^3 capacity are popular rainwater storage containers used in Thailand. Investigations reveal that these Jars are not made in Sri Lanka. Available data on cement jars were collected.

Trial Jar of one above $1M^3$ capacity was constructed at National Engineering Research and Development Centre Ja-Ela.

One layer of 1/2" chicken mesh fixed on to a skeleton made of 6mm re-bar placed 9" apart both ways (horizontally and vertically) and plastered with 1:3 cement sand mortar to a 1" thick wall. The inside is made water-proof by painting with cement slurry.

Cover is made separately with 1/2: "chicken mesh" re-inforced cement mortar and fixed on to the lower section, which has the shape of a bucket.

Drawing is given in **Annex - 11.**

Cost break down is given in **Annex 13.**

7.4 Clay pot or Jars

Clay pot of upto 200 liter capacity are made at Molagoda on the Kandy, Colombo Road.

Market price of a 200 liter Clay Jar or Pot is Rs. 1500/-. Cost per liter Rs. 7.50.

Conclusion - Cost per liter is too high compared to the cost of all other types of storage tanks.

8. Pilot Project

Three villages in the three districts, where standard options, are not feasible due to technical economic and social reasons, were identified and visited.
They are:

8.1. Madawatugoda Upper Section, in Omalpe Ratnapura District.

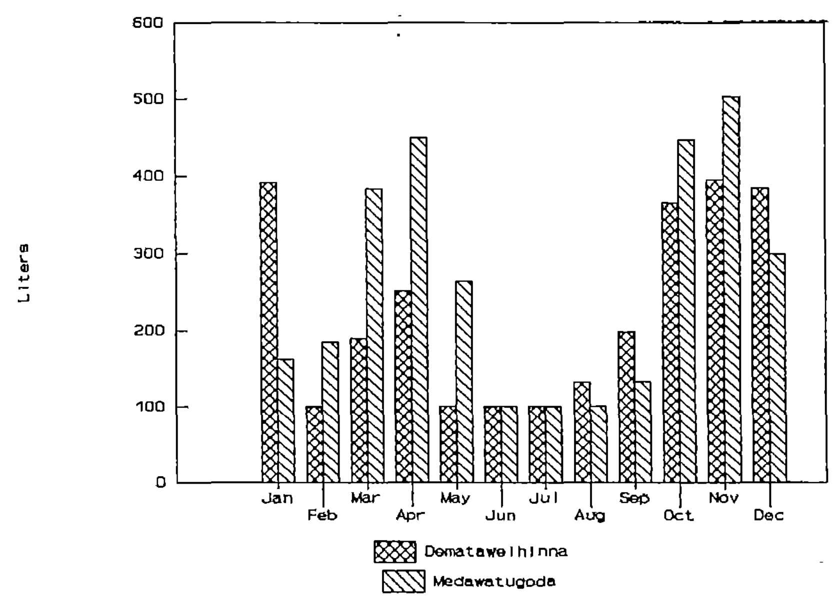
Here about 40 tile-roofed small households live on the slope of a high hill. Few springs are available below house levels, but they are used to irrigate the paddy lands below, and the farmers do not allow them to be used for piped domestic supply.

Two visits were made to Madawatugoda during the period of study. The climatically closest meteorological station to Madawatugoda is at Kollone, with an average annual rainfall of 1.7 meters. (1955-1965).

Available tile & GI sheet roofs can be used as catchment areas. Roof areas are generally above $40M^2$.

Graph N gives minimum dry season supplies from varying roof-catchment in a day in a ten year dry year. Required storage is given as $5M^3$ which could be constructed within project criteria. As catchment roof areas differ from house to house with a $5M^3$ storage tank the service level too changes. However the dry season service level will be a substantial improvement from the present status of water-supply of the majority of the households.

Bar Graph 3.1 & 3.2



Here rainwater harvesting is technically and economically feasible to improve the present status in water supply. Bar graph above gives the supply possible from typical system in a normal year. System include $60m^2$ catchment & $5m^3$ tank.

The option can be put forward to the beneficiaries, and if they choose it as the preferable option, the design work can start.

8.2. Dematawelhinna Village in the Badulla District.

Dematawelhinna village is situated about 6 miles from the Regional Office, Badulla on top of the slope of a hill, 205 families live here. Houses are built of mud bricks. Most houses have GI corrugated-sheet roofs. Roof areas vary between 30 to 100 m^2. In the dry season women collect water in pots from the water holes located at the bottom of the hill.

Rainwater harvesting is a new concept to the village. Presently about 10 to 20 pots of water is required per day per house. When explained the building of tanks big enough to store the number of pots of rain water required per day-times the number of dry period days, it is easily understood by the householders.

With the advice of the DD/T the first brick-dome trial tank was constructed at a household in this village. Since then the understanding & enthusiasm on rainwater harvesting has increased according to Resource Engineer Mr. Widyaratne. Number of householders have made requests for rainwater storage tanks.

Other options, such as gravity pipe systems, dug wells are not feasible at Dematawelhinna, according to CRO and villages.

A pump-water scheme is possible. For this water must be bought from the Water Board and pumped up a nearly 100m and stored for distribution. The Regional Office estimate is Rs. 140/- month per house maintenance. This is not affordable to the villagers, according to the Chairman of the CBO for running cost and most villagers have no regular income.

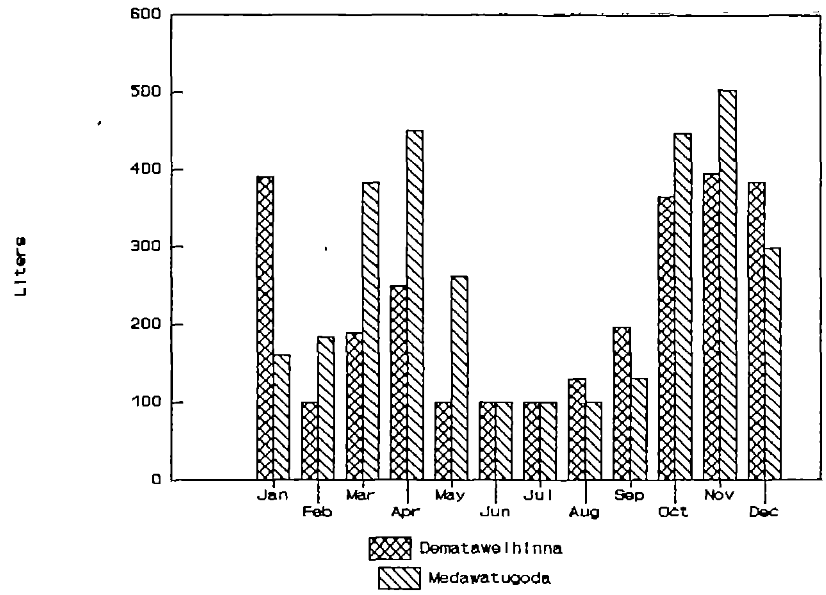
At a meeting held at the village presided by Regional Director CWSSP Badulla, an awareness presentation on rainwater harvesting was conducted. Since over one hundred applications requesting rainwater harvesting systems were received by the CWSSP Regional Office Badulla. Design and Construction of this project is expected to begin in August '95.

The climatically closest meteorological station to Dematawelhinna is at Badulla, with an average annual rainfall of 1.75 meters (85-94). Graph X (Annex - 10) a gives possible dry season supply in liters from a roof catchment in a day from a $5M^3$ storage tank system in a ten year dry year.

Available roofs are mostly GI and vary in area. These can be used as roof-catchment.

With a $5M^3$ tank which can be constructed within CWSSP criteria, it is possible to improve the present water-supply status to different levels depending on the size of the catchment roofs. Supply from a typical system in a normal year is depicted in the bar graph below.

Bar Graph 3.1 & 3.2



Therefore rainwater harvesting is technically and economically feasible to improve the present status of water supply.

8.3. Dorsar Kanda Village Matara

A visit was made to the village with CRO/T and the Community Facilitator.

The village is situated on a hill about 6 Km from the Matara Regional Office. Half of the families live close to the bottom of the hill where shallow wells are possible.

The highest point is about 40 m above ground-water level. A few houses have permanent roofing made of tiles. Most houses have thatched roofs.

Most householders have taken house building loans recently and have started to build better houses with permanent roofs. Electricity is available at the bottom of the hill. A dirt road is available upto the top of the hill.

A few members of the CBO were contacted including the President, and the priest of the village. It is their aspiration to get both water and electricity to their houses, which they see available at low-income houses close by.

However, they are not ready to pay more than their counterpart in the town for pipe water. This issue needs more investigation and analysis.

The original design included a pump pipe scheme.

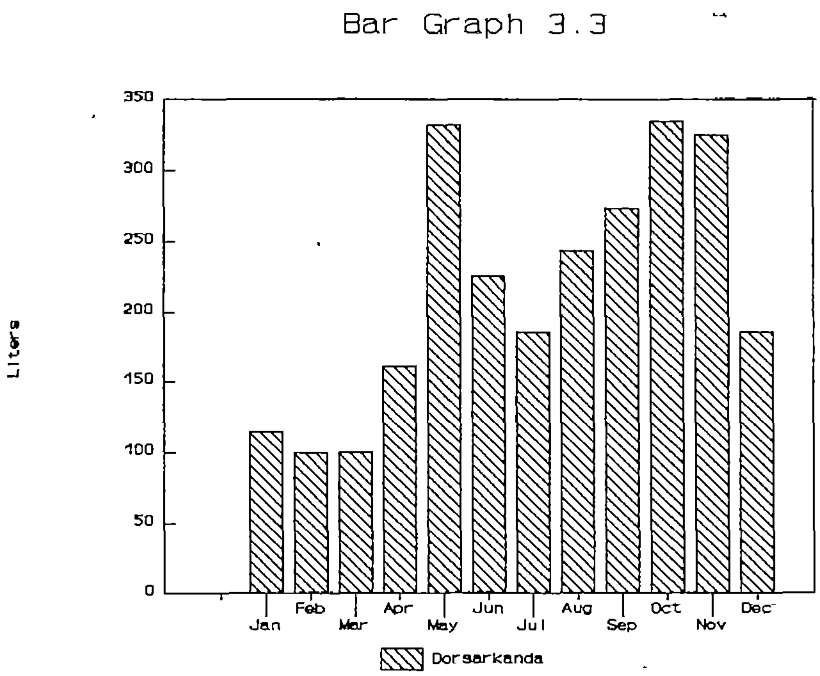
The current rainwater-harvesting practice is only to collect small quantities of water from tree trunks.

Climatically closest meteorological station to Dorsarkanda village is at Kekenadora, with an average annual rainfall of 1.23 meters. (80-89). Graph Y gives possible dry season supply in liters from roofs of varying sizes in a day, using a 5 M^3 storage tank system in a ten year dry year.

Available roofs are mostly thatch and are not suitable for rainwater harvesting. To do rainwater harvesting, first a suitable catchment must be constructed.

Once suitable catchment is available, rainwater harvesting becomes technically and economically feasible to improve the present status of water supply.

Supply from a typical system in a normal year is depicted in the bar graph below. System consists of 60m^2 catchment & 5m^3 tank.



9. Conclusion and Recommendation

9.1. Technical

The rainwater Harvesting Action research concludes that rainwater harvesting is technically feasible in the three districts of Badulla, Ratnapura and Matara.

Rainfall is adequate and most buildings have suitable roof-catchment.

The research recommends the design and construction of the three pilot projects already identified, at Badulla, Ratnapura and Matara. Monitor these projects after construction and review the technical, economic and social aspects and the policy on rainwater-harvesting accordingly.

9.2. Economic

The study concludes that it is possible to build a 5000 liter storage tank with brick (underground) or ferro-cement (over ground) to cost less than Rs. 5400 excluding unskilled labour. However, the level of service from a $5M^3$ storage tank will vary according to the rainfall pattern of the location and the size of the catchment area used.

The research recommends the continued construction of ferro-cement type trial tanks in order to bring the cost down further and improve the design.

9.3. Social

A vast majority of potential beneficiaries specially the lower income groups do not understand the full benefit of rainwater-harvesting. Reliability of rain as a source and the quality of rainwater are their main concerns.

It is recommended to conduct an awareness campaign under the CWSSP, targeted to potential consumers on rainwater harvesting.

The potential beneficiaries include houses located at higher elevation and away from the existing sources, where specially women have to walk long distances to fetch water.

9.4. Design

The study recommends the preparation and use of Rain Region Graphs to design the size of tanks, for a set of rainfall data. The required tank sizes can be determined for different catchment areas and demands, by the use of 'Rain Region' graphs. Rain Region graphs should be prepared at Head Office or Regional Office levels of CWSSP with available monthly rainfall data for each région where the rainfall pattern is similar.

Higher storage is expensive to build. The alternative is to reduce the demand in a ten year dry year. For drinking and cooking 6 lit per capita per day can be considered as standard. Where roof-catchment is limited, the next option is to build low-cost ground level catchment with underground storage tank.

9.5. Construction

The construction of Pilot Projects should be supervised direct from the Regional Offices with maximum community involvement.

Training on low-cost tank construction should be given to relevant masons and supervisors prior to actual construction. These training costs must be budgeted for in addition to the pilot projects.

With relevant experience gained from the pilot project the next step should be to train Technical Officers of the Partner Organizations in designing and the construction of the rainwater-harvesting systems.

9.6. Quality

The quality of rainwater depends on how clean the atmosphere is. The cleanliness of the material of the catchment surface, gutters and down pipes, the storage tank and the water extraction device, determines the quality more significantly.

The atmosphere is considered to be clean in the rural and small town areas where the CWSSP is being implemented.

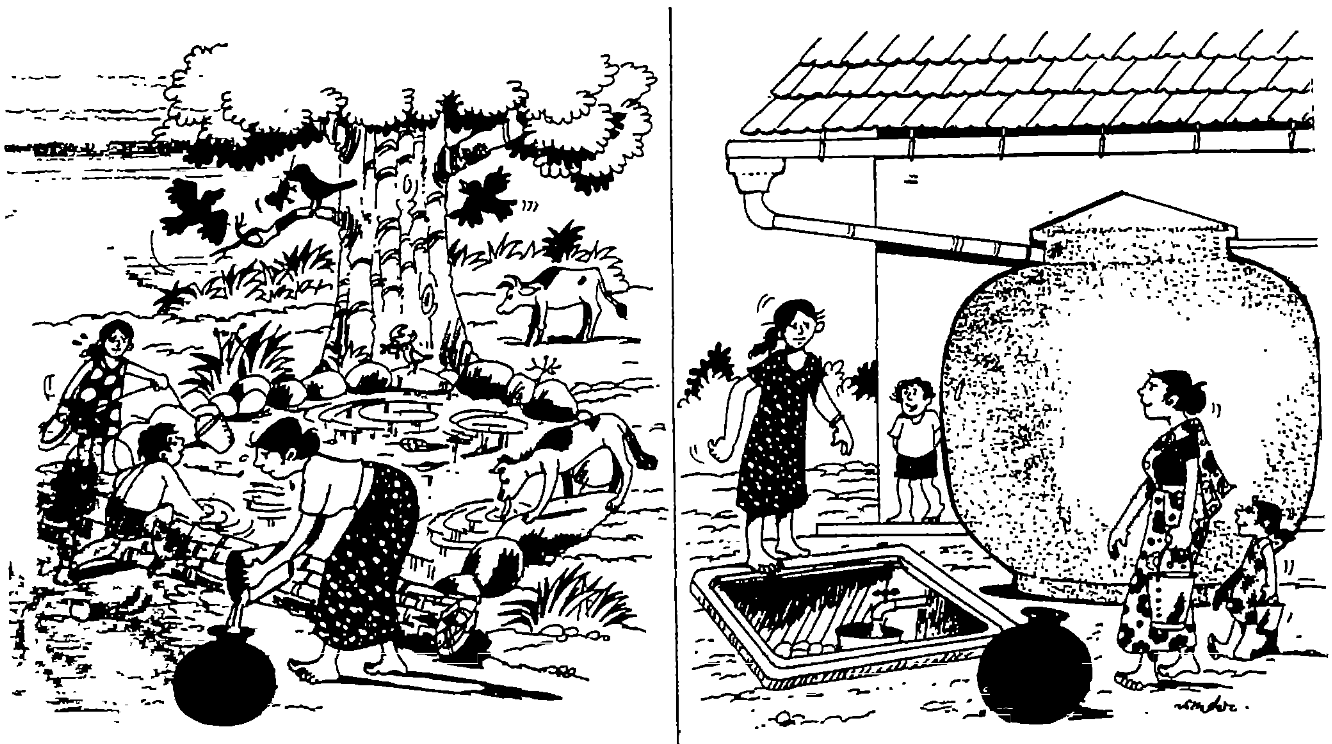
The best surface for a catchment is the G.I. or Aluminium sheet roofs, Tiles, asbestos and plastic are only satisfactory.

The gutters and down pipes made of GI or PVC or polythene are considered satisfactory.

Storage tanks should be covered and made mosquito proof. Where there is any chance of pollution, the pot method of chlorination can be used to keep the water clean.

Water should be extracted from the tank by means of a pump or siphon pipe or gravity tap and not by bucket to prevent human contamination.

Rain water harvesting has the distinct advantage of being a separate system for each household. This prevents any outside contamination of the tanks.



Annex 1 A

RAINWATER HARVESTING - ACTION RESEARCH

Task No.

1. **Design** a functional water storage system capable of holding 5,000 litres and costing not more than Rs.5,400 (excluding unskilled labour costs).

2. **Construct** sufficient number of prototypes of the above to ensure that after appropriate artisan training they can be constructed without major difficulty in a village situation using typically available local labour and materials.

3. Conduct a brief **survey** of the experience to date with rainwater harvesting in Sri Lanka and record any significant lessons of either technical or social significance.

4. Visit and investigate the two villages (Badulla & Matara) where options other than rainwater do not appear to be available. **Assess** the level of interest/demand of the villagers and, if favourable, seek their agreement to participate in a pilot project.

5. With the assistance of CWSPU District staff, **conduct a pilot project** in the two villages in a manner such as will generate maximum community involvement and contribution.

6. Review likely demand and physical potential for ground-level rainwater harvesting and, if appropriate, **make recommendations** for further development.

7. Based on the pilot experience and other relevant Sri Lankan experience, **make appropriate recommendations** for the incorporation of rainwater harvesting options in the CWSSP

8. **Prepare summary training material** so as to transfer necessary skills to CWSPU technical staff.

TIME ALLOCATED

A. TECHNICAL

B COMMUNITY

REMUNERATION RATE

CWSPU standard rates to be paid.

Main Reports and Publications Consulted

1. World Bank executed UNDP Project INT/82/002 Information & Training for Low-cost Water Supply & Sanitation. Rainwater roof catchment systems Washington. World Bank. 1986. 50p. ISBN-08213-0799-1

2. Rajapakse R.K.C. Sri Lanka's contribution towards Rainwater Catchment Technology. Sri Lanka. 1983 21p

3. Cowater International, Inc. Rural Water Supply District Development Plans, Matara District Sri Lanka. 1991 108p. ref. p. 26,29,35,39,42

4. Cowater International Inc. Rural Water Supply District Development Plan Ratnapura District Sri Lanka. 1991. 107p. ref. p. 25,29,34,39,41

5. Cowater International Inc. Rural Water Supply District Development Plan Badulla District Sri Lanka. 113p. ref. p. 30,36,42,44

6. Dharmabalan P. High Water Bill Can Rain Water Supplement Part or Whole of it. National Water Supply & Drainage Board, Sri Lanka. 1989. 5p.

7. Tarawa Water Supply Project. Report on Ferro Cement Tanks. Sydney. Australian Construction Services. 1988. 10p.

8. AFPRO. Evaluation Study Report on Rainwater Harvesting Structures in Kanya Kumari District, Tamil Nadu, New Delhi. AFPRO. 1993. 44p. PIN 110058.

9. Wijetunga S.K. & Wijegoonewardene S.J.P. Assessment of the Application of Appropriate Technologies in the Improvement of Rural Water Supply in Sri Lanka. Colombo. ITDG. 1992. 66p.

10. Lee Micheal D. & Visscher Jan Teun, Water Harvesting. A Guide for planners & Project Managers Technical Paper Series No. 30. Hague. IRC. 1992. 96p.

11. Michealides G. Allybobus M & Young P.J. Optimised Design and Water Quality Study of Roof Top Rainwater Catchment, Maututius. Wat. Supply Vol. 4, Seychelles p. 117-122, 1986 Pergamon Journals Ltd. U.K.

12. Gunting. Sapari & Ghazali. Variation in Rainwater quality from Roof Catchments. Malaysia. Wat Res. Vol 23 No. 6 pp 761 - 765 1989, Pergaman. U.K.

13. Michealides. Investigation into the quality of roof harvested Rainwater for Domestic use in Developing Countries. Dundee University U.K. 10p.

14. Good. Roof Runoff as a Diffuse Source of Metals and Aquatic Toxicity in Storm Water Wat. Sci Tech. Vol 28 No. 3 - 5 pp 317-321 1993. IAWQ U.K.

15. GOULD A. Review of the Development, Current Status & Future Potential of Rainwater Catchment Systems for Household Supply in Africa. Rainwater catchment Systems. 10p.

Annex 2

RAINFALL ANALYSIS

STATION : UPPER OHIYA ESTATE

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	274.8	414.7	77.2	424.6	112.2	17.7	218.1	29.7	76.2	333.5	601.2	99.3	2679.2
1961	256.5	240.2	184.4	277.8	220.2	32.5	38.1	54.1	88.3	279.6	291.0	244.8	2207.5
1962	153.1	96.2	221.7	297.4	228.0	55.6	75.1	116.5	104.1	381.5	321.5	279.4	2330.1
1963	349.5	253.2	356.8	447.2	204.7	56.1	50.0	22.3	137.1	434.0	508.0	287.0	3105.9
1964	209.8	200.9	202.4	494.0	148.5	77.9	125.7	100.8	152.9	148.5	55.6	162.5	2079.5
1965	79.5	101.6	286.5	753.3	218.6	5.5	5.5	136.1	68.5	369.5	305.3	298.7	2628.6
1966	182.3	57.4	265.6	403.6	48.0	31.2	20.3	64.0	213.8	261.1	433.3	212.0	2192.6
1967	233.6	177.0	221.4	153.1	85.0	34.7	5.0	101.6	21.0	268.9	449.3	151.3	1901.9
1968	149.6	46.2	254.7	216.9	130.5	50.8	38.6	26.6	31.2	523.4	346.9	340.1	2155.5
1969	266.1	102.6	17.2	310.3	17.7	27.4	65.7	241.0	83.8	593.3	276.6	474.7	2475.4
1970	186.6	268.4	313.9	449.0	176.7	46.4	33.7	31.2	94.9	246.8	62.2	345.9	2255.7
1971	320.5	174.4	168.4	402.3	40.1	60.7	101.8	170.4	284.9	183.6	181.8	446.0	2534.9
1972	98.8	0.0	140.7	249.4	220.9	42.6	57.4	19.0	164.8	463.2	728.9	180.3	2366.0
1973	48.0	117.6	136.1	264.9	116.3	67.0	113.5	62.9	50.8	408.1	327.4	594.3	2306.9
1974	81.2	200.9	74.6	303.0	220.9	15.2	48.2	50.8	182.8	133.8	381.0	264.1	1956.5
1975	194.5	109.2	144.7	436.8	215.9	45.7	66.0	121.9	160.0	50.8	495.3	205.7	2246.5
1976	299.4	69.3	221.9	426.2	218.6	139.4	29.2	152.1	75.6	281.1	729.4	371.6	3013.8
1977	8.8	215.6	232.1	631.1	378.2	43.6	126.4	104.3	173.9	654.0	633.9	279.9	3381.8
1978	77.9	189.9	286.0	236.4	281.4	23.6	153.6	69.8	111.5	432.3	319.5	378.4	2560.3
1979	50.8	188.9	46.2	361.7	106.4	39.1	63.2	40.3	339.5	412.4	623.0	180.8	2442.3
1980	36.0	84.0	146.0	410.2	292.1	60.9	8.8	71.8	133.8	303.5	497.0	261.1	2305.2
1981	175.1	36.3	183.9	183.2	196.9	42.7	207.8	69.4	159.9	256.8	316.8	113.9	1942.7
1982	26.5	177.5	313.8	194.1	318.0	93.4	12.9	82.6	85.5	267.7	426.8	274.3	2273.1
1983	58.8	20.4	82.6	48.7	201.3	24.8	45.0	480.0	63.6	308.8	390.7	723.2	2447.9
1984	393.2	570.8	581.9	593.0	209.2	70.8	116.7	152.1	273.4	303.8	439.1	276.1	3980.1
1985	162.2	286.7	351.4	321.3	199.0	179.9	57.8	91.1	64.8	171.9	407.5	433.6	2727.2
1986	798.0	441.2	299.3	830.6	292.7	29.6	32.6	91.1	86.8	241.5	142.0	112.3	3397.7
1987	157.9	46.8	366.0	346.3	287.8	43.9	4.3	67.4	515.9	1599.1	690.6	138.6	4264.6
1988	77.1	387.4	211.9	722.1	103.0	27.5	49.3	216.6	120.3	66.1	321.0	396.0	2698.9
1989	195.8	49.0	116.9	299.5	351.0	100.2	160.7	163.5	341.1	188.9	403.5	149.4	2519.5
AVERAGE	186.7	177.5	216.9	379.3	194.7	52.9	71.1	106.7	148.7	352.3	403.5	289.2	2579.3
STAND.DEV.	151.4	134.8	115.0	174.3	89.1	36.1	57.3	88.6	106.9	270.1	173.1	142.5	554.3
MAXIMUM	798.0	570.8	581.9	830.6	378.2	179.9	218.1	480.0	515.9	1599.1	729.4	723.2	4264.6
MINIMUM	8.8	0.0	17.2	48.7	17.7	5.5	4.3	19.0	21.0	50.8	55.6	99.3	1901.9

YEAR	TOTAL	RANK	PROBABILITY
1967	1901.9	1	0.03226
1981	1942.7	2	0.06452
1974	1956.5	3	0.09677
1964	2079.5	4	0.12903
1968	2155.5	5	0.16129
1966	2192.6	6	0.19355
1961	2207.5	7	0.22581
1975	2246.5	8	0.25806
1970	2255.7	9	0.29032
1982	2273.1	10	0.32258
1980	2305.2	11	0.35484
1973	2306.9	12	0.38710
1962	2330.1	13	0.41935
1972	2366.0	14	0.45161
1979	2442.3	15	0.48387
1983	2447.9	16	0.51613
1969	2475.4	17	0.54839
1989	2519.5	18	0.58065
1971	2534.9	19	0.61290
1978	2560.3	20	0.64516
1965	2628.6	21	0.67742
1960	2679.2	22	0.70968
1988	2698.9	23	0.74194
1985	2727.2	24	0.77419
1976	3013.8	25	0.80645
1963	3105.9	26	0.83871
1977	3381.8	27	0.87097
1986	3397.7	28	0.90323
1984	3980.1	29	0.93548
1987	4264.6	30	0.96774

10 Year Moving Average

Year	Avg.
60 - 69	2375.6
61 - 70	2333.3
62 - 71	2366.0
63 - 72	2369.6
64 - 73	2289.7
65 - 74	2277.4
66 - 75	2239.2
67 - 76	2321.3
68 - 77	2469.3
69 - 78	2509.8
70 - 79	2506.5
71 - 80	2511.4
72 - 81	2452.2
73 - 82	2442.9
74 - 83	2457.0
75 - 84	2659.4
76 - 85	2707.4
77 - 86	2745.8
78 - 87	2834.1
79 - 88	2848.0
80 - 89	2855.7

RAINFALL ANALYSIS

STATION : WELIMADA GROUP

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	180.8	331.9	15.4	237.4	56.6	23.8	139.9	32.2	42.1	204.7	277.3	45.9	1588.0
1961	176.5	133.8	140.9	184.9	87.3	5.8	21.3	17.7	107.9	186.1	193.5	180.0	1435.7
1962	135.1	35.3	82.6	87.6	163.5	8.1	5.3	77.2	29.2	139.7	96.5	146.5	1006.6
1963	172.9	97.5	115.8	131.3	89.6	66.5	53.3	57.4	82.2	131.5	151.6	139.4	1289.0
1964	98.0	180.0	126.7	35.3	70.1	41.9	137.4	19.8	40.1	99.3	100.5	134.3	1083.4
1965	52.0	139.9	48.5	326.1	147.5	6.8	26.6	143.5	48.2	145.7	200.9	202.6	1488.3
1966	106.1	20.8	120.1	232.6	61.4	34.7	22.6	165.3	166.6	188.4	137.6	113.0	1369.2
1967	131.0	140.4	93.7	156.2	46.7	67.3	36.0	28.4	87.1	260.0	341.1	140.9	1498.8
1968	64.0	1.5	80.2	76.4	30.7	34.5	5.3	45.2	93.9	214.6	152.9	202.6	1001.8
1969	163.0	23.8	101.0	211.0	116.8	5.5	31.4	133.0	100.8	192.5	71.6	374.6	1525.0
1970	107.6	216.6	115.5	145.7	51.0	12.9	8.3	63.2	78.4	110.7	256.5	329.4	1495.8
1971	136.3	85.5	49.5	166.8	29.2	7.6	41.4	128.2	139.1	141.4	116.3	320.0	1359.3
1972	83.3	0.0	66.5	263.1	92.2	30.7	50.0	12.4	101.6	405.3	232.9	205.9	1543.9
1973	14.9	24.3	56.3	108.2	61.2	21.3	48.0	30.4	78.9	181.6	150.3	317.7	1093.1
1974	0.0	61.7	46.7	132.8	167.6	23.8	70.1	55.8	110.7	33.0	106.9	307.8	1116.9
1975	128.2	34.0	186.6	179.5	92.2	42.6	98.5	63.0	166.6	51.8	109.2	239.5	1381.7
1976	159.7	10.6	41.9	198.3	24.3	86.1	41.9	60.7	75.4	60.1	201.9	140.9	1101.8
1977	2.5	32.7	96.7	186.6	109.2	0.0	59.9	89.1	106.1	258.5	206.5	132.0	1279.8
1978	57.6	13.2	88.3	23.8	152.1	0.0	22.6	18.7	49.5	282.9	194.5	182.3	1085.5
1979	56.6	50.0	6.0	122.6	61.4	47.2	26.1	59.1	148.8	348.4	307.3	140.2	1371.7
1980	27.4	0.0	80.5	199.8	172.4	1.2	0.0	11.4	100.8	177.8	161.2	98.8	1031.3
1981	62.7	33.5	76.7	67.9	56.4	17.5	26.7	30.7	70.4	144.3	248.7	106.9	941.8
1982	3.0	0.0	130.8	81.8	127.3	18.0	3.0	19.8	99.8	129.8	243.3	206.1	1062.7
1983	43.2	14.0	23.1	15.7	95.8	37.1	36.3	16.5	33.8	176.6	139.0	330.2	961.3
1984	160.5	210.8	128.3	284.7	98.8	0.0	103.6	74.7	150.9	81.3	184.9	87.4	1565.9
1985	64.3	59.7	123.2	37.6	116.0	28.2	3.6	80.3	60.7	112.8	115.1	161.0	962.5
1986	501.4	77.2	90.2	134.1	134.3	31.0	82.8	27.4	47.0	205.5	78.5	94.7	1504.1
1987	90.9	17.0	71.4	176.0	111.2	26.7	4.8	85.6	94.0	276.0	138.2	88.1	1179.9
1988	20.6	87.4	87.9	252.5	46.0	20.8	114.6	101.6	90.7	31.7	45.2	142.2	1041.2
1989	123.7	10.4	16.8	32.5	105.9	52.6	129.5	10.9	108.2	146.3	145.0	48.3	930.1
AVERAGE	104.1	71.5	83.6	149.6	92.5	26.7	48.4	58.2	89.3	170.6	170.2	178.6 MM	1243.2
STAND.DEV.	92.3	78.6	41.3	81.2	42.1	21.5	41.8	41.8	37.7	86.2	70.6	88.2 MM	219.7
MAXIMUM	501.4	331.9	186.6	326.1	172.4	86.1	139.9	165.3	166.6	405.3	341.1	374.6 MM	1588.0
MINIMUM	0.0	0.0	6.0	15.7	24.3	0.0	0.0	10.9	29.2	31.7	45.2	45.9 MM	930.1

TOTAL	YEAR	TOTAL	RANK	PROBABILITY
1588.0	1989	930.1	1	0.03226
1435.7	1981	941.8	2	0.06452
1006.6	1983	961.3	3	0.09677
1289.0	1985	962.5	4	0.12903
1083.4	1968	1001.8	5	0.16129
1488.3	1962	1006.6	6	0.19355
1369.2	1980	1031.3	7	0.22581
1498.8	1988	1041.2	8	0.25806
1001.8	1982	1062.7	9	0.29032
1525.0	1964	1083.4	10	0.32258
1495.8	1978	1085.5	11	0.35484
1359.3	1973	1093.1	12	0.38710
1543.9	1976	1101.8	13	0.41935
1093.1	1974	1116.9	14	0.45161
1116.9	1987	1179.9	15	0.48387
1381.7	1977	1279.8	16	0.51613
1101.8	1963	1289.0	17	0.54839
1279.8	1971	1359.3	18	0.58065
1085.5	1966	1369.2	19	0.61290
1371.7	1979	1371.7	20	0.64516
1031.3	1975	1381.7	21	0.67742
941.8	1961	1435.7	22	0.70968
1062.7	1965	1488.3	23	0.74194
961.3	1970	1495.8	24	0.77419
1565.9	1967	1498.8	25	0.80645
962.5	1986	1504.1	26	0.83871
1504.1	1969	1525.0	27	0.87097
1179.9	1972	1543.9	28	0.90323
1041.2	1984	1565.9	29	0.93548
930.1	1960	1588.0	30	0.96774

10 Year Moving Average

Year	Avg.
60 - 69	1328.6
61 - 70	1319.4
62 - 71	1311.7
63 - 72	1365.5
64 - 73	1345.9
65 - 74	1349.2
66 - 75	1338.6
67 - 76	1311.8
68 - 77	1289.9
69 - 78	1298.3
70 - 79	1283.0
71 - 80	1236.5
72 - 81	1194.8
73 - 82	1146.6
74 - 83	1133.5
75 - 84	1178.4
76 - 85	1136.4
77 - 86	1176.7
78 - 87	1166.7
79 - 88	1162.2
80 - 89	1118.1

RAINFALL ANALYSIS

STATION NAME: KIRKLEES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	465.5	619.2	35.8	297.6	124.9	9.1	158.7	35.8	73.6	290.5	325.6	212.8	2649.1
1961	343.4	349.5	161.5	261.3	217.1	59.1	46.4	61.2	93.9	170.6	414.5	387.6	2566.1
1962	342.1	136.3	116.0	197.1	96.7	49.7	9.6	194.0	10.1	250.4	208.2	421.3	2031.5
1963	559.5	277.3	110.9	251.2	230.1	26.4	100.3	64.5	213.6	264.6	376.6	862.6	3137.6
1964	399.2	309.3	149.0	142.4	38.6	37.0	196.3	33.0	107.4	176.5	206.7	337.0	2132.4
1965	212.3	282.9	115.8	358.6	355.0	20.0	12.9	200.4	105.4	233.6	452.1	369.5	2718.5
1966	370.0	163.3	253.2	198.6	47.2	27.1	39.3	198.3	165.8	320.8	293.1	366.5	2449.2
1967	440.4	334.0	226.5	261.8	49.7	124.9	40.8	67.8	60.7	309.8	655.8	373.1	2945.3
1968	392.6	17.0	199.3	183.6	54.1	25.6	11.9	7.3	124.9	233.4	334.0	369.0	1952.7
1969	412.2	127.7	28.4	394.2	113.2	9.6	18.5	117.0	129.7	277.8	118.3	743.9	2490.5
1970	405.3	326.3	206.7	261.1	140.9	13.7	35.0	89.1	59.6	114.0	532.3	733.8	2917.8
1971	571.5	22.6	89.6	237.4	57.9	19.0	34.5	284.2	175.3	212.5	442.9	702.3	2849.7
1972	319.7	7.3	97.5	227.8	137.4	141.2	65.2	15.2	182.8	633.7	556.2	517.3	2901.3
1973	128.5	131.8	109.4	176.5	102.8	25.4	147.5	40.6	58.6	247.3	311.1	709.4	2188.9
1974	9.6	158.4	160.5	259.3	79.2	54.6	84.7	45.7	132.8	45.4	187.9	782.5	1980.6
1975	326.6	119.3	224.7	275.8	70.1	36.3	156.2	137.4	145.0	58.9	220.2	686.0	2456.5
1976	384.3	82.0	44.7	289.0	70.1	21.8	18.5	111.5	73.6	99.0	80.0	332.4	1606.9
1977	27.1	86.8	85.3	228.6	155.1	17.2	72.8	93.2	91.4	381.5	431.5	590.0	2260.5
1978	299.4	151.3	201.1	34.7	246.8	21.0	38.1	14.7	49.7	460.5	360.1	385.3	2262.7
1979	186.1	60.9	52.8	141.9	10.6	85.8	15.4	83.8	280.4	535.9	400.8	458.7	2313.1
1980	148.0	8.8	93.4	173.7	135.1	4.0	176.0	195.8	83.5	206.2	272.5	117.6	1614.6
1981	108.5	21.8	114.0	16.1	127.0	31.0	259.5	65.3	142.0	243.6	340.5	268.1	1737.4
1982	12.0	30.3	145.9	139.9	20.5	24.3	46.5	18.2	71.4	406.1	343.0	450.5	1708.6
1983	231.1	36.6	4.6	24.5	193.0	10.5	45.7	118.5	56.9	314.9	365.2	676.0	2077.5
1984	365.3	356.3	243.4	208.4	88.2	5.0	22.3	53.9	82.9	101.5	327.4	276.9	2130.5
1985	172.4	156.4	166.9	109.7	128.8	21.4	44.5	130.1	137.2	221.4	246.7	346.7	1882.2
1986	1193.4	192.0	181.4	357.6	163.7	4.0	76.5	36.5	89.9	315.6	228.9	372.6	3212.0
1987	369.4	93.7	108.9	207.6	190.1	10.5	5.8	120.6	86.7	482.8	330.7	171.9	2186.7
1988	144.0	81.9	276.5	344.3	159.7	49.4	53.5	177.4	106.2	114.7	439.8	501.9	2449.3
1989	339.8	12.1	50.2	83.9	133.0	47.3	237.2	91.6	178.8	280.7	337.9	292.3	2084.8
AVERAGE	322.6	158.4	135.1	211.5	124.6	34.4	75.0	96.8	112.3	266.8	338.3	453.9	2329.6
STAND.DEV.	218.9	140.2	71.1	95.5	73.9	32.2	69.6	67.7	55.5	136.4	123.1	182.3	436.2
MAXIMUM	1193.4	619.2	276.5	394.2	355.0	141.2	259.5	284.2	280.4	633.7	655.8	782.5	3212.0
MINIMUM	9.6	7.3	4.6	16.1	10.6	4.0	5.8	7.3	10.1	45.4	80.0	117.6	1606.9

YEAR	TOTAL	RANK	PROBABILITY
1976	1606.9	1	0.03226
1980	1614.6	2	0.06452
1982	1708.6	3	0.09677
1981	1737.4	4	0.12903
1985	1882.2	5	0.16129
1968	1952.7	6	0.19355
1974	1980.6	7	0.22581
1962	2031.5	8	0.25806
1983	2077.5	9	0.29032
1989	2084.8	10	0.32258
1984	2130.5	11	0.35484
1964	2132.4	12	0.38710
1987	2186.7	13	0.41935
1973	2188.9	14	0.45161
1977	2260.5	15	0.48387
1978	2262.7	16	0.51613
1979	2313.1	17	0.54839
1966	2443.2	18	0.58065
1988	2449.3	19	0.61290
1975	2456.5	20	0.64516
1969	2490.5	21	0.67742
1961	2566.1	22	0.70968
1960	2649.1	23	0.74194
1965	2718.5	24	0.77419
1971	2849.7	25	0.80645
1972	2901.3	26	0.83871
1970	2917.8	27	0.87097
1967	2945.3	28	0.90323
1963	3137.6	29	0.93548
1986	3212.0	30	0.96774

10 YEAR MOVING AVERAGE

60 – 69	2506.7
61 – 70	2533.6
62 – 71	2561.9
63 – 72	2648.9
64 – 73	2554.0
65 – 74	2538.9
66 – 75	2512.7
67 – 76	2429.0
68 – 77	2360.5
69 – 78	2391.5
70 – 79	2373.8
71 – 80	2243.5
72 – 81	2132.3
73 – 82	2013.0
74 – 83	2001.8
75 – 84	2016.8
76 – 85	1959.4
77 – 86	2119.9
78 – 87	2112.5
79 – 88	2131.2
80 – 89	2108.4

RAINFALL ANALYSIS

STATION NAME: HORABORAWEWA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	568.9	843.0	22.6	259.3	143.7	0.0	151.3	25.4	13.7	247.3	362.4	173.4	2811.0
1961	511.3	195.0	144.2	343.1	54.6	6.3	14.2	5.3	52.5	197.8	603.7	560.8	2688.8
1962	384.8	174.2	177.8	244.3	174.4	4.3	10.9	339.0	46.4	163.3	275.3	339.0	2333.7
1963	455.4	319.7	113.5	158.7	61.2	0.0	42.4	2.2	184.4	238.5	494.7	641.3	2712.0
1964	509.2	419.3	159.0	70.3	79.2	3.8	112.7	104.3	37.3	110.2	185.1	411.4	2201.8
1965	208.5	813.8	103.3	231.3	65.0	10.1	1.5	229.9	0.0	305.8	454.9	412.2	2536.3
1966	358.1	96.5	265.2	81.0	44.1	12.1	3.3	84.0	111.5	323.5	356.8	307.5	2033.6
1967	275.5	299.2	130.0	54.6	11.1	49.7	2.7	4.0	54.6	251.4	749.0	378.9	2260.7
1968	287.5	18.0	290.3	88.1	8.6	6.0	10.9	62.0	26.6	222.5	200.1	342.6	1563.2
1969	262.7	189.2	35.8	253.2	43.9	13.2	4.5	182.1	120.6	365.5	119.3	704.5	2294.5
1970	354.5	532.1	105.1	143.0	85.0	4.3	2.5	21.0	64.2	40.1	288.2	290.8	1930.8
1971	357.6	231.5	115.6	152.6	71.4	13.2	46.3	62.0	63.3	207.7	339.6	401.2	2061.8
1972	263.1	231.5	72.6	152.6	71.4	16.5	38.1	62.0	63.3	207.7	427.7	507.4	2113.8
1973	134.1	448.8	75.1	69.0	38.6	58.4	59.9	10.6	95.2	183.3	530.3	621.5	2324.8
1974	3.0	199.4	37.8	176.5	109.4	6.0	38.6	26.9	46.2	52.3	85.8	522.2	1244.1
1975	225.0	161.0	135.1	104.6	130.0	11.9	147.5	49.5	116.0	67.0	194.8	316.9	1659.3
1976	326.8	53.3	57.6	117.0	39.8	54.6	56.3	75.4	30.4	78.4	310.3	224.5	1424.4
1977	60.4	66.2	181.6	67.3	84.0	4.0	107.9	29.7	172.9	255.7	280.6	290.5	1600.8
1978	130.3	79.7	72.3	101.8	43.6	0.0	22.0	5.0	13.9	237.2	189.2	565.1	1460.1
1979	162.8	82.2	118.1	65.5	9.3	18.5	22.3	0.0	70.3	308.6	384.0	319.2	1560.8
1980	53.3	0.0	53.3	285.2	44.1	0.0	0.0	13.9	4.3	253.4	336.5	89.6	1133.6
1981	135.1	231.5	107.2	76.5	127.2	0.0	119.6	2.5	17.8	171.2	339.6	317.0	1645.2
1982	22.6	0.0	95.0	214.6	101.6	10.8	48.5	28.4	49.7	288.3	302.8	489.8	1652.1
AVERAGE	263.1	231.5	115.6	152.6	71.4	13.2	46.3	62.0	63.3	207.7	339.6	401.2	1967.3
STAND.DEV.	158.0	201.5	64.6	81.8	42.8	16.8	47.3	81.9	48.7	87.7	152.4	151.3	474.9
MAXIMUM	568.9	843.0	290.3	343.1	174.4	58.4	151.3	339.0	184.4	365.5	749.0	704.5	2811.0
MINIMUM	3.0	0.0	22.6	54.6	8.6	0.0	0.0	0.0	0.0	40.1	85.8	89.6	1133.6

YEAR	TOTAL	RANK	PROBABILITY
1980	1133.6	1	0.04167
1974	1244.1	2	0.08333
1976	1424.4	3	0.12500
1978	1460.1	4	0.16667
1979	1560.8	5	0.20833
1968	1563.2	6	0.25000
1977	1600.8	7	0.29167
1981	1645.2	8	0.33333
1982	1652.1	9	0.37500
1975	1659.3	10	0.41667
1970	1930.8	11	0.45833
1966	2033.6	12	0.50000
1971	2061.8	13	0.54167
1972	2113.8	14	0.58333
1964	2201.8	15	0.62500
1967	2260.7	16	0.66667
1969	2294.5	17	0.70833
1973	2324.8	18	0.75000
1962	2333.7	19	0.79167
1965	2536.3	20	0.83333
1961	2688.8	21	0.87500
1963	2712.0	22	0.91667
1960	2811.0	23	0.95833

10 YEAR MOVING AVERAGE

60 - 69	2343.6
61 - 70	2255.5
62 - 71	2192.8
63 - 72	2170.8
64 - 73	2132.1
65 - 74	2036.4
66 - 75	1948.7
67 - 76	1887.7
68 - 77	1821.7
69 - 78	1811.4
70 - 79	1738.1
71 - 80	1658.3
72 - 81	1616.7
73 - 82	1570.5

RAINFALL ANALYSIS

WEST - HAPUTALE

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1961	251.5	162.6	246.1	299.5	278.8	33.0	52.1	56.0	46.8	405.1	328.2	159.1	2318.8
1962	91.9	70.2	268.8	445.4	215.1	52.4	44.9	97.4	82.2	335.3	332.6	287.0	2323.2
1963	255.2	174.6	351.1	632.2	354.5	90.1	37.9	22.0	230.8	491.6	539.5	281.4	3460.9
1964	118.5	148.5	344.3	468.4	65.3	26.2	97.2	94.7	107.7	101.7	70.5	67.2	1710.2
1965	19.4	104.8	323.9	715.6	352.9	0.0	1.2	85.7	78.0	325.6	360.0	295.8	2662.9
1966	133.6	41.2	268.2	462.2	22.1	28.4	1.2	83.4	206.0	311.5	811.0	256.6	2325.4
1967	151.4	116.0	177.7	205.5	39.9	45.5	11.8	105.5	47.8	397.7	377.9	172.4	1843.1
1968	168.2	24.1	186.1	365.4	108.9	77.7	54.6	22.6	40.9	501.6	187.4	194.5	1932.0
1969	126.1	262.2	171.9	372.5	187.4	30.1	12.7	169.6	71.5	565.9	195.3	464.1	2629.3
1970	135.1	274.6	400.9	538.7	148.6	47.0	26.4	37.8	75.7	203.4	436.4	285.9	2610.5
1971	230.4	276.3	199.9	408.5	18.3	39.3	77.5	117.1	282.9	215.4	135.8	314.6	2316.0
1972	58.6	0.0	257.0	382.6	198.1	36.8	141.9	20.2	155.7	595.9	588.7	176.3	2611.8
1973	13.9	65.5	154.1	312.9	74.3	31.8	15.7	26.1	61.8	296.8	230.9	295.1	1578.9
1974	0.0	103.0	81.6	244.1	182.3	50.3	78.3	36.8	316.1	492.2	419.7	324.4	2328.8
1980	2.7	15.2	224.9	288.9	272.2	12.2	10.6	28.1	197.5	301.2	335.1	240.3	1878.9
1981	137.9	15.2	224.9	147.7	149.0	51.9	118.8	52.8	129.5	215.2	428.3	85.4	1755.6
1982	34.1	18.0	229.1	182.9	478.3	136.8	31.3	104.2	65.8	320.0	519.2	152.5	2272.2
1983	10.4	39.1	80.7	139.3	216.8	17.4	70.7	104.2	65.3	270.1	310.2	152.5	1476.7
1986	10.4	36.4	155.7	549.3	347.5	26.4	29.1	102.9	73.0	478.0	134.5	159.4	2102.6
1987	170.4	54.0	262.5	333.1	273.8	8.0	9.0	54.7	264.0	735.0	274.0	295.2	2733.7
1988	30.5	240.0	270.0	558.0	124.5	31.0	69.0	110.5	164.5	29.5	450.0	149.0	2226.5
1989	102.5	51.0	81.0	250.5	272.0	55.0	212.0	103.5	176.0	264.0	198.0	119.5	1883.0
AVERAGE	102.4	104.2	225.5	377.4	196.8	42.2	54.7	74.4	133.6	356.9	334.6	224.0	2226.7
STD.DEV.	80.2	88.9	84.9	153.7	118.3	29.1	50.9	39.6	82.5	162.9	141.2	92.5	448.7
MAXIMUM	255.2	276.3	400.9	715.6	478.3	136.8	212.0	169.6	316.1	735.0	588.7	464.1	3460.9
MINIMUM	0.0	0.0	80.7	139.3	18.3	0.0	1.2	20.2	40.9	29.5	70.5	67.2	1476.7

YEAR	TOTAL	RANK	PROBABILITY
1983	1476.7	1	0.04348
1973	1578.9	2	0.08696
1964	1710.2	3	0.13043
1981	1755.6	4	0.17391
1967	1843.1	5	0.21739
1980	1878.9	6	0.26087
1989	1883.0	7	0.30435
1968	1932.0	8	0.34783
1986	2102.6	9	0.39130
1988	2226.5	10	0.43478
1982	2272.2	11	0.47826
1971	2316.0	12	0.52174
1961	2318.8	13	0.56522
1962	2323.2	14	0.60870
1966	2325.4	15	0.65217
1974	2328.8	16	0.69565
1970	2610.5	17	0.73913
1972	2611.8	18	0.78261
1969	2629.3	19	0.82609
1965	2662.9	20	0.86957
1987	2733.7	21	0.91304
1963	3460.9	22	0.95652

10 YEAR MOVING AVERAGE

YEAR	AVG
61 - 70	2382.2
62 - 71	2382.0
63 - 72	2410.8
64 - 73	2222.6
65 - 74	2284.5
66 - 80	2206.1
67 - 81	2149.2
68 - 82	2191.5
69 - 83	2146.0
70 - 86	2093.3
71 - 87	2105.6
72 - 88	2096.7
73 - 89	2023.8

RAINFALL ANALYSIS

STATION : DIYATALAWA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTA	L
1960	211.4	265.7	28.4	227.3	162.4	67.1	150.3	13.0	35.7	210.8	344.4	44.8	1754.	3
1961	135.9	167.5	156.9	167.3	203.8	11.9	26.8	19.1	111.5	253.3	191.5	190.4	1635.	9
1962	117.8	78.7	164.9	173.2	157.2	72.7	53.3	103.2	107.1	291.6	169.7	167.0	1656.	4
1963	181.2	115.0	83.4	159.7	80.6	31.3	55.6	28.0	161.8	303.8	277.2	258.5	1741.	1
1964	144.1	131.3	116.4	118.5	82.2	29.0	154.8	54.4	112.1	228.9	176.6	104.7	1453.	0
1965	46.8	99.8	50.0	270.8	106.4	3.9	50.2	170.2	59.0	292.8	279.6	207.0	1636.	5
1966	100.4	12.6	149.3	163.8	23.8	23.6	3.1	199.2	211.3	240.2	177.1	157.8	1462.	2
1967	128.2	142.7	52.0	128.9	96.6	31.3	56.4	45.4	48.6	250.5	269.1	113.8	1368.	5
1968	54.6	14.3	118.5	57.6	89.1	101.2	15.5	80.1	35.0	283.9	248.2	167.0	1265.	0
1969	174.4	54.1	74.0	219.4	80.2	1.8	18.7	183.3	71.9	292.8	160.7	395.3	1731.	6
1970	116.0	279.7	174.0	342.7	142.9	23.3	14.1	19.7	81.7	165.6	466.9	322.9	2154.	5
1971	148.4	149.0	138.6	201.9	29.3	21.5	28.1	184.4	203.9	306.5	172.7	270.2	1854.	5
1972	58.4	33.0	69.9	124.1	175.0	53.4	62.0	8.7	117.1	383.4	269.3	186.8	1543.	1
1973	18.1	15.5	127.8	95.3	65.8	53.1	36.6	56.4	98.8	320.5	173.0	297.6	1364.	5
1974	8.1	155.2	89.8	201.1	153.9	48.1	91.1	37.4	134.5	86.6	188.6	235.7	1428.	1
1975	142.5	35.5	191.6	214.2	154.1	34.6	98.8	116.5	248.0	90.0	211.5	243.4	1780.	7
1976	203.5	25.0	62.3	198.2	9.0	162.2	10.5	64.3	40.3	130.4	301.6	219.1	1426.	4
1977	2.4	81.5	82.7	141.9	150.7	38.0	98.3	69.6	230.4	520.0	272.2	155.2	1843.	9
1978	74.9	123.2	141.6	118.1	152.6	2.3	63.0	4.9	74.1	258.4	241.7	207.6	1462.	4
1978	74.9	123.2	141.6	118.1	152.6	2.3	63.0	4.9	74.1	404.6	178.1	173.4	1510.	8
1979	27.6	115.6	24.1	172.9	70.2	91.2	21.8	12.4	258.4	404.6	388.2	86.5	1673.	5
1980	23.2	0.0	58.3	254.8	62.9	1.3	0.1	22.0	122.2	303.8	305.6	129.4	1283.	6
1981	43.9	50.0	73.5	156.1	95.3	21.2	243.9	64.4	124.1	181.3	200.1	101.2	1362.	0
1982	3.5	2.7	202.8	121.8	214.3	42.4	29.6	55.1	104.6	270.3	226.3	161.2	1434.	6
1983	18.3	37.1	14.9	63.7	176.0	14.7	37.9	59.3	18.4	290.3	237.2	271.1	1238.	9
1984	227.7	236.0	219.4	239.1	112.5	21.7	116.7	172.7	165.7	114.6	216.6	134.3	1977.	0
1985	88.7	80.3	128.7	73.2	72.4	31.0	112.5	151.9	95.2	126.1	146.4	254.0	1365.	4
AVERAGE	95.4	97.2	108.7	167.5	113.8	38.6	63.4	74.1	116.5	259.5	240.4	194.7	1570.	7
STD.DEV.	67.4	76.5	55.4	65.7	53.7	35.0	54.9	61.9	65.6	100.5	73.8	77.7	225.	8
MAXIMUM	227.7	279.7	219.4	342.7	214.3	162.2	243.9	199.2	258.4	520.0	466.9	395.3	2154.	5
MINIMUM	2.4	0.0	14.9	87.6	9.0	1.3	0.1	4.9	18.4	86.6	146.4	44.8	1238.	9

YEAR	TOTAL	RANK	PROBABILITY
1983	1238.9	1	0.03571
1968	1265.0	2	0.07143
1980	1283.6	3	0.10714
1981	1362.0	4	0.14286
1973	1364.5	5	0.17857
1985	1365.4	6	0.21429
1967	1368.5	7	0.25000
1976	1426.4	8	0.28571
1974	1428.1	9	0.32143
1982	1434.6	10	0.35714
1964	1453.0	11	0.39286
1966	1462.2	12	0.42857
1978	1462.4	13	0.46429
1978	1510.8	14	0.50000
1972	1543.1	15	0.53571
1961	1635.9	16	0.57143
1965	1636.5	17	0.60714
1962	1656.4	18	0.64286
1979	1673.5	19	0.67857
1969	1731.6	20	0.71429
1963	1741.1	21	0.75000
1960	1754.3	22	0.78571
1975	1780.7	23	0.82143
1977	1843.9	24	0.85714
1971	1854.5	25	0.89286
1984	1977.0	26	0.92857
1970	2154.5	27	0.96429

10 YEAR MOVING AVERAGE	
60 - 69	157[illegible].5
61 - 70	161[illegible].5
62 - 71	1631.3
63 - 72	1621.0
64 - 73	1581.3
65 - 74	150[illegible].9
66 - 75	159[illegible].3
67 - 76	1591.7
68 - 77	163[illegible].2
69 - 78	165[illegible].0
70 - 78	163[illegible].9
71 - 79	158[illegible].8
72 - 80	1531.7
73 - 81	1511.6
74 - 82	152[illegible].6
75 - 83	1501.7
76 - 84	1521.3
77 - 85	151[illegible].2

RAINFALL ANALYSIS

STATION : CANAVARELLA GROUP

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1971	164.4	288.8	83.4	469.4	70.4	8.7	129.0	263.4	261.2	244.1	243.4	487.2	2714.2
1972	85.1	29.8	67.1	257.9	114.9	131.9	139.4	33.8	195.9	720.4	306.6	325.2	2449.0
1973	53.4	66.6	189.5	298.2	15.6	47.3	139.9	149.7	156.8	385.9	259.1	520.2	2326.2
1974	10.7	262.9	40.2	351.3	149.7	66.9	105.0	27.7	311.5	213.2	196.9	378.0	2114.0
1975	173.0	85.4	263.7	391.7	36.6	21.4	201.0	327.7	204.8	159.6	311.2	303.8	2538.9
1976	310.9	28.0	234.0	544.9	77.8	134.9	65.6	186.0	89.7	160.1	510.1	332.3	2674.3
1977	7.2	70.4	98.9	353.4	315.3	99.6	177.1	110.3	340.7	504.0	517.4	186.2	2780.5
1978	30.0	98.3	265.2	227.1	207.3	25.4	131.1	28.8	103.2	416.4	341.7	474.5	2348.0
1979	53.9	58.5	47.0	384.6	30.7	79.0	59.1	62.0	335.3	656.1	887.3	270.3	2977.8
1980	40.4	0.0	69.1	634.5	407.4	19.6	81.8	31.5	260.9	258.9	571.0	138.0	2542.1
1981	70.1	111.5	131.3	478.8	176.8	60.2	249.8	109.0	238.0	402.8	522.5	306.8	2851.6
1982	0.0	0.0	216.7	238.0	306.8	47.8	15.5	8.8	114.4	545.4	378.9	212.5	2085.8
1983	36.7	50.5	1.0	51.0	149.6	46.1	29.2	107.6	182.5	299.0	253.1	377.3	1568.6
1984	287.5	331.3	300.0	273.6	220.6	11.4	213.8	48.5	255.9	210.7	335.2	102.4	2590.9
1985	131.2	141.9	221.8	256.8	39.5	29.2	64.0	99.0	170.5	330.9	192.4	252.6	1979.8
AVERAGE	97.0	108.3	148.6	347.4	174.6	55.3	118.3	106.3	214.8	367.2	388.5	311.2	2437.2
STAND.DEV.	94.7	101.0	94.0	140.3	104.4	39.3	61.2	89.4	78.0	169.3	179.0	119.7	363.2
MAXIMUM	310.9	331.3	300.0	634.5	407.4	134.9	249.8	327.7	340.7	720.4	887.3	520.2	2977.8
MINIMUM	0.0	0.0	1.0	51.0	15.6	8.7	15.5	8.8	89.7	159.6	192.4	102.4	1568.6

YEAR	TOTAL	RANK	PROBABILITY
1983	1568.6	1	0.06250
1985	1979.8	2	0.12500
1982	2085.8	3	0.18750
1974	2114.0	4	0.25000
1973	2326.2	5	0.31250
1978	2348.0	6	0.37500
1972	2449.0	7	0.43750
1975	2538.9	8	0.50000
1980	2542.1	9	0.56250
1984	2590.9	10	0.62500
1976	2674.3	11	0.68750
1971	2714.2	12	0.75000
1977	2780.5	13	0.81250
1981	2851.6	14	0.87500
1979	2977.8	15	0.93750

10 Year Moving Avg

Year	Avg.
71 - 81	2546.7
72 - 82	2560.4
73 - 83	2524.1
74 - 84	2449.9
75 - 85	2497.6

RAINFALL ANALYSIS

STATION : BIBILE DISPENSARY

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1972	110.2	79.4	92.8	101.9	12.5	29.3	29.8	8.2	97.8	294.2	261.9	428.3	1546.9
1973	42.0	90.3	142.3	14.3	32.1	38.1	77.5	27.2	58.5	183.9	344.5	560.1	1570.8
1974	0.0	91.2	70.7	223.8	187.5	10.2	66.1	9.2	83.6	56.9	178.1	427.3	1404.6
1975	117.6	105.4	147.8	126.2	50.3	0.0	132.8	141.2	129.8	98.6	168.1	354.6	1582.4
1976	311.1	32.6	66.9	207.6	0.0	24.4	37.6	138.2	88.2	85.4	234.2	322.6	1588.8
1977	18.7	95.3	106.2	70.2	90.7	0.0	52.1	22.4	90.2	361.2	228.6	467.2	1623.8
1978	73.7	135.9	82.9	63.0	130.1	0.0	34.3	0.0	22.7	237.0	225.1	404.2	1389.9
1979	16.6	30.5	58.5	0.0	0.0	1.6	68.9	31.8	140.5	351.3	400.1	230.9	1410.7
1980	10.6	0.0	6.4	147.1	113.3	0.0	0.0	82.6	37.4	191.6	231.4	217.2	1077.6
1985	211.9	191.5	153.1	64.7	0.0	39.6	53.9	100.8	57.7	140.8	128.5	406.8	1549.1
AVERAGE	110.2	79.4	92.8	101.9	61.7	14.3	55.3	56.2	80.6	200.1	240.1	381.9	1474.4
STAND.DEV.	17.8	51.8	43.8	71.2	62.3	15.9	33.6	51.9	35.6	103.4	76.8	99.3	155.1
MAXIMUM	311.1	191.5	153.1	223.8	187.5	39.6	132.8	141.2	140.5	361.2	400.1	560.1	1623.8
MINIMUM	0.0	0.0	6.4	0.0	0.0	0.0	0.0	0.0	22.7	56.9	128.5	217.2	1077.6

YEAR	TOTAL	RANK	PROBABILITY
1980	1077.6	1	0.09091
1978	1381.9	2	0.18182
1974.	1404.6	3	0.27273
1979	1410.7	4	0.36364
1972	1546.3	5	0.45455
1985	1549.1	6	0.54545
1973	1570.8	7	0.63636
1975	1582.4	8	0.72727
1976	1588.8	9	0.81818
1977	1621.8	10	0.90909

RAINFALL ANALYSIS

STATION NAME: BANDARAWELA-IRRIGATION

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	261.4	241.9	53.9	234.2	104.4	51.1	182.9	16.6	30.5	287.1	445.1	91.5	2000.6
1961	161.6	154.5	169.2	210.4	241.3	64.6	41.4	17.3	99.4	193.9	169.7	115.6	1638.9
1962	145.6	68.9	147.6	96.1	204.0	51.1	36.9	72.1	40.7	190.0	178.6	163.1	1391.7
1963	234.5	107.2	59.2	126.0	78.3	59.7	51.1	77.3	127.3	234.0	293.2	34.1	1481.9
1964	8.7	3.4	3.1	18.3	24.4	9.4	30.5	41.5	90.5	241.1	182.2	91.2	744.3
1965	39.9	113.6	47.8	290.1	139.5	2.6	91.0	140.0	78.8	329.2	302.6	230.7	1805.8
1966	114.1	6.7	85.9	137.2	42.5	17.8	0.6	183.7	99.4	226.6	232.0	130.6	1277.1
1967	148.6	156.0	52.6	159.8	77.5	116.4	17.3	99.6	33.8	222.8	273.9	132.1	1490.4
1968	66.6	10.5	138.2	84.6	152.4	24.9	13.3	98.3	67.9	270.6	159.8	181.9	1269.0
1969	186.2	74.0	41.2	175.1	89.9	5.6	9.2	204.8	49.1	286.0	127.0	470.2	1719.1
1970	114.6	217.5	167.2	266.7	156.5	42.0	21.6	39.9	140.3	88.2	410.8	285.3	1949.6
1971	152.2	61.0	31.8	128.8	23.9	12.5	39.2	132.4	132.4	349.8	127.3	335.3	1526.6
1972	30.0	38.1	39.4	147.6	115.1	122.5	39.2	8.4	156.5	410.3	304.3	171.8	1583.2
1973	29.0	11.0	102.2	110.3	60.0	36.4	70.2	51.9	129.8	340.4	223.1	389.2	1553.5
1974	25.4	123.2	80.1	172.8	162.6	83.4	52.6	19.1	166.7	97.8	138.7	241.3	1383.7
1975	190.5	31.8	212.4	161.3	108.0	31.5	49.6	91.5	238.8	68.9	204.0	286.3	1674.6
1976	198.2	16.6	110.3	332.3	5.1	95.0	0.0	101.6	107.0	193.6	276.4	232.2	1668.3
1977	1.3	61.0	83.9	144.8	152.4	40.7	95.3	47.3	136.4	451.7	254.3	108.5	1577.6
1978	55.2	118.4	182.9	106.7	141.0	3.9	65.8	0.8	77.6	238.0	183.4	237.0	1410.6
1979	31.8	54.7	17.8	135.9	63.3	59.7	8.9	14.0	189.0	299.3	393.0	153.0	1420.4
1980	31.3	0.0	29.5	292.9	65.8	10.5	0.0	0.0	154.2	318.5	285.5	118.2	1303.4
1981	45.2	41.4	60.2	118.1	164.6	46.5	185.9	16.5	151.6	139.2	220.5	117.4	1307.1
1982	0.0	91.4	208.5	63.8	140.7	27.2	16.5	14.7	71.1	358.9	292.4	111.3	1396.5
1983	17.0	31.5	8.6	104.9	66.5	20.1	60.5	58.9	17.5	248.4	187.7	302.3	1123.9
1984	259.0	214.1	210.8	230.4	138.2	14.5	156.2	122.9	117.8	190.0	211.8	119.1	1984.8
1985	117.5	95.0	165.1	88.9	65.3	10.7	35.3	135.4	83.1	153.2	213.1	222.0	1384.6
1986	368.3	141.0	176.5	142.7	121.7	34.3	51.8	41.2	147.8	254.3	89.6	112.5	1681.7
1987	90.6	9.9	99.9	8.1	106.4	2.8	0.0	35.0	215.6	351.1	230.4	127.0	1216.8
1988	24.4	88.7	110.7	338.6	69.6	30.0	151.9	146.3	117.8	63.0	330.2	114.5	1585.7
1989	99.6	11.4	48.5	81.8	116.6	23.1	197.1	7.3	145.5	318.3	156.7	61.0	1266.9
AVERAGE	108.3	79.8	96.2	157.0	106.6	38.4	59.1	67.9	114.5	247.1	236.5	182.9	1493.9
STAND.DEV.	91.6	66.9	64.6	83.3	53.5	31.8	57.8	56.4	53.7	96.8	84.6	99.6	261.6
MAXIMUM	368.3	241.9	212.4	338.6	241.3	122.5	197.1	204.8	238.8	451.7	445.1	470.2	2000.6
MINIMUM	0.0	0.0	3.1	8.1	5.1	2.6	0.0	0.0	17.5	63.0	89.6	34.1	744.3

YEAR	TOTAL	RANK	PROBABILITY
1964	744.3	1	0.03226
1983	1123.9	2	0.06452
1987	1216.8	3	0.09677
1989	1266.9	4	0.12903
1968	1269.0	5	0.16129
1966	1277.1	6	0.19355
1980	1303.4	7	0.22581
1981	1307.1	8	0.25806
1974	1383.7	9	0.29032
1985	1384.6	10	0.32258
1962	1391.7	11	0.35484
1982	1396.5	12	0.38710
1978	1410.6	13	0.41935
1979	1420.4	14	0.45161
1963	1481.9	15	0.48387
1967	1490.4	16	0.51613
1971	1526.6	17	0.54839
1973	1553.5	18	0.58065
1977	1577.6	19	0.61290
1972	1583.2	20	0.64516
1988	1585.7	21	0.67742
1961	1638.9	22	0.70968
1976	1668.3	23	0.74194
1975	1674.6	24	0.77419
1986	1681.7	25	0.80645
1969	1719.1	26	0.83871
1965	1805.8	27	0.87097
1970	1949.6	28	0.90323
1984	1984.8	29	0.93548
1960	2000.6	30	0.96774

10 YEAR MOVING AVERAGE

Year	Avg.
60 - 69	1481.9
61 - 70	1476.8
62 - 71	1465.6
63 - 72	1484.7
64 - 73	1491.9
65 - 74	1555.8
66 - 75	1542.7
67 - 76	1581.8
68 - 77	1590.5
69 - 78	1604.7
70 - 79	1574.8
71 - 80	1510.2
72 - 81	1488.2
73 - 82	1469.6
74 - 83	1426.6
75 - 84	1486.7
76 - 85	1457.7
77 - 86	1459.1
78 - 87	1423.0
79 - 88	1440.5
80 - 89	1425.1

RAINFALL ANALYSIS

STATION : BADULLA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	355.7	450.0	18.5	256.4	192.3	8.9	75.7	16.2	34.5	384.8	256.9	81.7	2131.6
1961	216.2	188.0	235.0	190.7	103.6	29.5	41.7	64.2	95.8	199.7	332.4	303.8	2009.6
1962	201.9	44.8	154.3	149.8	172.8	59.9	14.7	197.6	1.2	156.4	153.0	220.5	1528.9
1963	292.1	151.9	39.7	245.1	129.3	50.2	24.2	94.5	197.6	174.1	334.9	316.3	2049.9
1964	219.4	302.5	98.1	214.7	34.7	36.6	143.1	60.6	48.6	146.5	100.4	186.6	1591.8
1965	86.7	175.6	160.8	406.6	196.1	7.4	57.9	270.9	70.3	283.2	421.3	384.1	2528.9
1966	166.5	54.6	144.5	226.1	65.8	31.7	17.6	125.1	116.0	229.9	364.4	255.2	1797.4
1967	170.5	199.3	96.9	115.8	92.1	178.9	97.8	30.1	60.9	243.1	372.7	183.3	1841.4
1968	106.9	4.7	92.3	94.4	53.5	41.0	13.3	28.1	106.4	236.8	213.9	183.8	1175.1
1969	213.2	77.1	107.5	312.6	77.5	8.9	41.6	170.7	43.1	205.6	70.4	537.0	1865.2
1970	193.2	286.4	118.4	331.8	51.6	3.5	63.2	79.2	84.1	95.5	492.6	336.0	2135.5
1971	212.9	183.7	65.7	338.6	38.8	4.6	37.4	217.0	155.2	158.6	212.2	369.5	1994.2
1972	120.4	0.2	37.7	163.0	100.8	53.1	74.5	20.7	204.4	546.6	255.3	379.1	1955.8
1973	30.7	32.4	104.6	103.2	83.1	22.6	219.7	52.1	95.8	181.1	231.0	468.7	1625.0
1974	3.1	101.0	64.1	248.7	163.5	60.1	31.6	30.6	172.8	74.8	110.1	481.0	1541.4
1975	170.5	92.4	141.9	215.3	22.4	22.5	154.6	137.8	224.7	91.1	231.5	289.8	1794.5
1976	242.1	13.8	66.4	264.0	70.5	23.4	67.1	141.2	40.0	123.9	325.3	176.3	1554.0
1977	7.8	57.0	109.6	175.7	110.2	17.3	107.2	99.7	164.7	330.1	198.8	311.4	1689.5
1978	82.3	98.9	144.6	28.0	336.6	2.2	36.7	17.7	66.6	277.4	219.3	267.4	1547.7
1979	67.0	25.9	51.3	210.4	65.5	37.2	70.9	78.6	291.9	386.8	474.1	179.7	1938.3
1980	59.2	0.1	92.9	336.5	104.6	0.3	7.4	28.9	111.7	180.4	243.2	161.3	1328.5
1981	74.8	110.0	70.2	175.2	102.3	11.5	187.9	28.1	148.4	226.8	242.6	186.8	1564.6
1982	7.7	0.0	140.4	202.6	139.4	24.4	28.2	23.9	200.5	344.8	225.0	361.8	1698.7
1983	65.8	39.8	43.5	76.2	53.0	31.3	61.8	57.7	49.6	299.3	227.8	442.4	1448.2
1984	216.9	311.1	212.4	214.5	135.2	8.7	137.9	13.9	136.5	227.1	194.9	116.1	1925.2
1985	171.2	76.1	168.4	75.6	82.2	16.9	52.0	133.6	90.8	233.3	188.9	245.1	1551.1
1986	721.5	136.8	281.0	250.1	120.4	2.0	71.3	98.0	65.8	376.2	131.4	207.8	2462.3
1987	206.5	42.7	85.7	218.7	171.6	3.6	10.2	62.9	175.0	273.8	165.2	88.4	1504.3
1988	48.4	59.0	198.7	249.0	35.6	30.0	51.9	246.1	136.8	147.1	350.9	241.5	1795.0
1989	201.0	14.9	80.2	114.1	51.3	39.0	222.5	76.5	249.6	295.7	267.6	106.4	1718.8
AVERAGE	163.4	111.0	114.7	206.8	105.2	28.9	74.1	90.1	121.3	237.7	253.6	269.0	1775.7
STD.DEV.	136.2	108.6	61.5	87.2	64.1	32.9	59.1	70.4	69.9	102.4	102.7	118.7	298.9
MAXIMUM	721.5	450.0	281.0	406.6	336.6	178.9	222.5	270.9	291.9	546.6	492.6	537.0	2528.9
MINIMUM	3.1	0.0	18.5	28.0	22.4	0.3	7.4	13.9	1.2	74.8	70.4	81.7	1175.1

YEAR	TOTAL	RANK	PROBABILITY	10 YEAR MOVING AVERAGE YEAR	AVG.
1968	1175.1	1	0.03226	60 - 69	1850.1
1980	1328.5	2	0.06452	61 - 70	1850.5
1983	1448.2	3	0.09677	62 - 71	1849.8
1987	1504.3	4	0.12903	63 - 72	1892.7
1962	1528.9	5	0.16129	64 - 73	1850.2
1974	1541.4	6	0.19355	65 - 74	1845.2
1978	1547.7	7	0.22581	66 - 75	1772.6
1985	1551.1	8	0.25806	67 - 76	1748.2
1976	1554.0	9	0.29032	68 - 77	1733.0
1981	1564.6	10	0.32258	69 - 78	1770.3
1964	1591.8	11	0.35484	70 - 79	1777.7
1973	1625.0	12	0.38710	71 - 80	1696.8
1977	1689.5	13	0.41935	72 - 81	1653.8
1982	1698.7	14	0.45161	73 - 82	1628.1
1989	1718.8	15	0.48387	74 - 83	1610.4
1975	1794.5	16	0.51613	75 - 84	1648.8
1988	1795.0	17	0.54839	76 - 85	1624.5
1966	1797.4	18	0.58065	77 - 86	1715.3
1967	1841.4	19	0.61290	78 - 87	1696.8
1969	1865.2	20	0.64516	79 - 88	1721.5
1984	1925.2	21	0.67742	80 - 89	1699.5
1979	1938.3	22	0.70968		
1972	1955.8	23	0.74194		
1971	1994.2	24	0.77419		
1961	2009.6	25	0.80645		
1963	2049.9	26	0.83871		
1960	2131.6	27	0.87097		
1970	2135.5	28	0.90323		

RAINFALL ANALYSIS

STATION : UGGALKALTOTA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1938	7.6	250.4	418.3	379.2	0.5	2.0	20.0	1.7	19.5	86.3	209.5	109.2	1804.2
1939	5.0	0.0	152.4	355.6	101.6	7.3	10.1	7.3	41.4	241.8	434.0	357.8	1714.3
1940	0.0	89.1	129.5	233.9	326.3	25.4	1.0	0.0	27.9	425.5	452.9	199.4	1910.9
1941	108.7	3.5	273.5	177.0	389.8	16.7	2.5	0.0	49.7	426.9	305.0	247.9	2001.2
1942	139.7	45.4	310.3	381.2	232.6	93.2	24.8	26.1	46.4	123.9	154.9	164.3	1682.8
1943	121.6	85.3	426.2	177.2	321.8	24.8	1.5	8.8	6.8	223.0	287.5	242.3	1926.8
1944	146.0	237.9	208.7	341.6	179.3	36.0	0.0	0.0	45.2	437.1	352.8	429.5	2414.1
1945	4.0	68.5	166.6	226.5	16.5	56.3	27.9	6.3	0.0	263.1	685.5	194.3	1714.5
1946	96.2	6.6	150.1	551.6	79.7	0.0	0.0	18.7	90.1	210.3	276.5	202.4	1681.2
1947	133.3	7.6	519.6	164.3	254.2	51.5	57.1	229.6	13.4	153.6	242.5	174.4	2001.1
1948	260.3	36.3	203.2	403.0	90.9	10.9	6.8	59.1	0.0	315.7	399.0	260.0	2045.2
1949	114.3	103.1	3.5	502.9	6.6	12.4	47.4	5.5	0.0	150.1	402.0	296.1	1643.9
1950	28.4	112.7	98.5	143.0	33.0	0.0	11.1	42.6	16.0	142.4	327.1	165.8	1120.6
1951	265.2	126.7	159.5	379.4	248.6	37.3	12.9	0.0	280.4	94.7	461.7	71.8	2128.2
1952	160.0	72.1	264.6	642.3	412.4	0.0	18.2	0.0	66.8	69.3	254.7	132.0	2092.4
1953	72.6	101.0	243.3	243.5	4.8	43.4	70.6	24.1	61.2	299.4	303.0	233.4	1700.3
1954	272.0	133.8	251.0	297.1	45.9	0.0	6.0	20.5	0.0	279.4	226.3	343.9	1875.9
1955	141.4	170.1	209.8	368.8	43.9	8.3	3.0	19.3	171.1	71.8	381.5	49.7	1718.7
1956	72.1	0.0	282.9	143.5	12.1	96.5	14.7	0.5	8.8	139.7	445.8	132.8	1349.4
1957	29.2	75.4	223.0	367.2	199.3	33.2	18.2	12.7	5.3	356.6	605.7	437.8	2363.6
1958	83.8	33.7	405.1	316.2	132.8	5.0	10.6	9.1	68.5	192.2	444.7	133.3	1835.0
1959	39.3	253.7	71.3	270.5	257.8	112.5	20.5	6.6	25.1	275.5	451.1	162.8	1946.7
1960	267.2	248.9	63.7	269.7	12.7	5.3	154.6	0.0	58.9	293.8	314.7	182.3	1871.8
1961	177.0	130.3	265.6	288.5	146.0	29.9	32.0	20.0	14.2	260.3	283.7	108.5	1756.0
1962	123.9	94.4	238.5	312.4	165.3	11.4	2.5	52.3	39.3	164.5	481.5	197.3	1883.3
1963	357.1	70.3	143.5	526.5	391.9	24.8	10.1	9.3	23.6	253.7	587.7	197.6	2596.1
1964	57.1	99.5	179.8	250.9	73.6	12.7	73.4	17.2	68.5	174.2	59.9	57.6	1124.4
1965	1.7	0.0	114.0	76.2	0.0	0.0	0.0	15.2	13.9	39.1	241.3	239.5	740.9
1966	104.6	12.7	69.5	157.7	39.3	0.0	0.0	0.0	61.7	357.8	299.7	121.4	1224.4
1967	92.9	47.7	0.0	0.0	75.1	8.1	1.5	0.0	0.0	0.0	0.0	72.6	297.9
AVERAGE	115.7	90.6	210.9	298.2	143.1	23.5	22.0	20.4	44.1	217.4	345.7	197.3	1728.9
STAND.DEV.	90.8	76.3	122.7	140.5	129.0	27.0	31.7	41.7	56.5	115.3	147.2	98.5	468.4
MAXIMUM	357.1	253.7	519.6	642.3	412.4	112.5	154.6	229.6	280.4	437.1	685.5	437.8	2596.1
MINIMUM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.7	297.9

YEAR	TOTAL	RANK	PROBABILITY
1967	297.9	1	0.03226
1965	740.9	2	0.06452
1950	1120.6	3	0.09677
1964	1124.4	4	0.12903
1966	1224.4	5	0.16129
1956	1349.4	6	0.19355
1938	1504.2	7	0.22581
1949	1643.9	8	0.25806
1946	1681.2	9	0.29032
1942	1682.8	10	0.32258
1953	1700.3	11	0.35484
1939	1714.3	12	0.38710
1945	1714.5	13	0.41935
1955	1718.7	14	0.45161
1961	1756.0	15	0.48387
1958	1835.0	16	0.51613
1960	1871.8	17	0.54839
1954	1875.9	18	0.58065
1962	1883.3	19	0.61290
1940	1910.9	20	0.64516
1943	1926.8	21	0.67742
1959	1946.7	22	0.70968
1947	2001.1	23	0.74194
1941	2001.2	24	0.77419
1948	2045.2	25	0.80645
1952	2092.4	26	0.83871
1951	2128.2	27	0.87097
1957	2363.6	28	0.90323
1944	2414.1	29	0.93548
1963	2596.1	30	0.96774

10 Year Moving Average

Year	Avg.
38 - 47	1855.1
39 - 48	1909.2
40 - 49	1902.2
41 - 50	1823.1
42 - 51	1835.8
43 - 52	1876.8
44 - 53	1854.2
45 - 54	1800.3
46 - 55	1800.8
47 - 56	1767.6
48 - 57	1803.8
49 - 58	1782.8
50 - 59	1813.1
51 - 60	1888.2
52 - 61	1851.0
53 - 62	1830.1
54 - 63	1919.7
55 - 64	1844.5
56 - 65	1746.7
57 - 66	1734.2
58 - 67	1527.7

RAINFALL ANALYSIS

STATION : RATNAPURA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	158.4	321.5	123.4	332.5	325.0	411.4	400.0	146.6	125.9	300.4	191.5	72.9	3209.5
1961	104.2	74.8	170.2	334.2	474.0	257.9	391.1	515.5	470.5	405.3	379.9	160.8	3738.4
1962	138.5	79.6	197.1	191.7	742.5	339.6	166.1	263.7	401.3	425.9	397.6	177.6	3521.2
1963	208.4	147.2	272.3	451.7	394.8	428.5	420.5	423.0	602.2	521.8	410.1	181.6	4462.1
1964	84.9	178.9	286.2	444.5	690.3	276.8	641.2	229.5	443.2	432.9	282.5	155.9	4146.8
1965	72.4	93.0	183.4	386.2	662.6	243.0	101.9	548.3	413.8	434.2	321.1	340.2	3800.1
1966	80.4	70.9	221.9	273.6	159.8	230.6	151.9	302.5	759.3	469.4	296.1	153.1	3169.5
1967	104.5	56.0	247.6	254.9	296.9	458.0	399.3	261.6	280.0	656.7	553.7	355.5	3924.7
1968	190.8	137.4	187.0	157.4	424.1	843.0	419.1	168.9	425.6	374.0	234.1	355.5	3916.9
1969	58.0	168.2	126.5	269.3	984.1	360.9	91.9	298.3	286.0	158.6	192.1	236.8	3530.7
1970	101.2	147.7	284.9	344.3	263.2	373.0	369.0	416.2	253.2	188.6	379.2	98.7	3519.2
1971	192.7	96.5	189.2	429.8	398.1	376.3	341.0	466.8	634.4	353.5	442.6	227.4	4150.3
1972	124.5	60.9	172.7	325.0	641.9	325.9	247.2	234.7	596.6	550.5	332.9	153.4	3766.2
1973	56.9	61.9	310.7	342.8	279.7	527.3	220.2	240.5	152.9	322.1	229.5	254.1	2998.6
1974	1.2	107.2	120.1	569.6	464.9	481.6	617.0	243.7	726.9	242.4	65.5	283.1	3923.2
1975	76.6	271.2	224.9	460.0	653.2	535.5	183.2	366.8	324.5	684.1	668.5	217.3	4665.8
1976	54.3	159.5	221.1	429.5	384.3	163.6	302.2	245.3	155.1	361.0	523.8	366.8	3366.5
1977	19.1	128.3	229.3	404.8	676.7	473.5	110.9	183.7	200.0	530.7	338.8	360.9	3656.7
1978	164.7	90.2	127.9	264.3	845.2	296.7	257.2	194.4	389.5	427.5	429.4	255.5	3742.5
1979	103.9	166.0	163.7	333.5	285.6	434.8	294.4	106.5	662.5	493.3	279.1	167.1	3490.4
1980	42.7	27.7	214.9	379.2	400.5	333.9	327.3	273.2	220.5	293.6	507.6	249.5	3270.6
1981	99.4	145.9	174.1	280.1	292.5	347.8	325.8	141.1	424.4	299.6	379.8	187.5	3098.0
1982	55.5	24.4	316.1	455.4	545.3	892.5	307.2	267.2	237.5	628.2	638.8	129.4	4499.5
1983	93.1	78.8	150.1	128.0	495.1	387.6	276.1	284.4	456.5	146.0	344.6	534.8	3355.1
1984	274.7	388.6	356.7	529.2	564.0	329.0	515.9	48.2	312.1	255.4	343.7	264.5	4182.0
1985	214.2	174.1	273.7	133.2	504.2	746.2	249.8	183.4	252.9	646.1	251.7	346.4	3975.9
1986	159.6	319.0	131.3	358.7	287.5	201.8	121.3	270.3	700.2	435.0	277.8	284.5	3547.0
1987	138.7	11.2	157.9	239.2	302.7	233.1	18.8	660.4	322.0	475.3	381.4	72.6	3013.3
1988	94.7	298.6	228.2	262.2	412.7	652.4	331.7	557.6	694.3	224.5	378.8	139.3	4285.0
1989	47.5	7.8	123.3	257.1	405.9	632.2	610.9	282.7	448.5	500.4	320.0	97.4	3733.7
AVERAGE	110.6	136.5	206.3	334.1	475.2	419.5	307.0	294.2	422.4	427.9	359.1	229.3	3722.0
STD.DEV.	62.1	96.1	63.9	108.8	189.0	179.8	155.1	140.7	175.6	131.5	128.1	104.9	439.0
MAXIMUM	274.7	388.6	356.7	569.6	984.1	892.5	641.2	660.4	759.3	684.1	668.5	534.8	4665.8
MINIMUM	1.2	7.8	120.1	128.0	159.8	163.6	18.8	48.2	152.9	146.0	65.5	72.6	2998.6

YEAR	TOTAL	RANK	PROBABILITY
1973	2998.6	1	0.03226
1981	3098.0	2	0.06452
1966	3169.5	3	0.09677
1960	3209.5	4	0.12903
1980	3270.6	5	0.16129
1983	3355.1	6	0.19355
1976	3366.5	7	0.22581
1979	3490.4	8	0.25806
1970	3519.2	9	0.29032
1962	3521.2	10	0.32258
1969	3530.7	11	0.35484
1977	3656.7	12	0.38710
1961	3738.4	13	0.41935
1978	3742.5	14	0.45161
1972	3766.2	15	0.48387
1965	3800.1	16	0.51613
1968	3916.9	17	0.54839
1974	3923.2	18	0.58065
1967	3924.7	19	0.61290
1985	3975.9	20	0.64516
1964	4146.8	21	0.67742
1971	4150.3	22	0.70968
1984	4182.0	23	0.74194
1963	4462.1	24	0.77419
1982	4499.5	25	0.80645
1975	4665.8	26	0.83871
1986	3547.0	27	0.87097
1987	3013.3	28	0.90323
1988	4285.0	29	0.93548
1989	3733.7	30	0.96774

10 YEAR MOVING AVERAGE	AVG
60 – 69	3742.0
61 – 70	3773.0
62 – 71	3814.2
63 – 72	3838.7
64 – 73	3692.3
65 – 74	3669.9
66 – 75	3756.5
67 – 76	3776.2
68 – 77	3749.4
69 – 78	3732.0
70 – 79	3727.9
71 – 80	3703.1
72 – 81	3597.9
73 – 82	3671.2
74 – 83	3706.8
75 – 84	3732.7
76 – 85	3663.7
77 – 86	3681.8
78 – 87	3617.4
79 – 88	3671.7
80 – 89	3696.0

RAINFALL ANALYSIS

STATION : PELMADULLA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	296.9	267.7	159.2	317.2	304.2	242.5	238.7	86.3	319.0	209.8	113.0	92.4	2646.9
1961	117.6	168.6	165.3	150.1	467.3	239.2	319.7	419.1	389.6	423.1	247.9	240.5	3348.0
1962	123.9	134.8	175.7	329.9	735.0	283.2	163.3	105.1	363.7	360.1	330.7	171.1	3276.5
1963	230.6	189.9	427.2	275.8	276.8	324.1	278.8	399.0	342.3	308.8	441.4	237.9	3732.6
1964	130.4	170.6	273.5	258.5	360.9	312.1	464.3	173.2	445.2	251.7	366.5	160.2	3375.1
1965	8.8	62.9	300.9	256.7	595.1	231.1	60.4	355.6	350.5	368.0	319.7	314.7	3224.4
1966	112.2	132.3	238.2	454.6	76.2	194.8	108.7	208.5	704.0	300.9	205.2	151.6	2887.2
1967	104.3	106.4	219.2	242.5	275.0	298.7	228.6	221.9	127.0	631.1	452.8	122.1	3029.6
1968	345.2	97.7	144.5	166.3	323.5	384.5	363.4	113.7	301.7	422.4	141.9	272.7	3077.5
1969	80.5	72.8	186.4	330.7	909.8	246.6	37.0	260.8	199.6	381.0	241.3	330.2	3276.7
1970	215.9	195.5	241.3	317.5	114.3	203.2	292.1	132.0	165.1	469.9	355.6	177.8	2880.2
1971	196.8	210.8	266.7	320.0	254.0	368.3	304.8	431.8	812.8	381.0	457.2	99.3	4103.5
1972	45.9	8.6	235.9	382.5	642.8	127.7	270.0	170.4	532.1	417.5	313.1	135.3	3281.8
1973	41.4	135.6	445.7	568.1	152.1	324.6	104.6	316.9	183.1	378.7	340.6	361.6	3353.0
1974	0.0	93.4	225.0	506.9	391.6	439.3	461.2	246.3	437.1	126.4	32.0	553.2	3572.4
1975	127.5	78.2	267.7	129.2	488.6	540.0	124.7	306.8	291.5	644.1	667.2	231.6	3897.1
1976	85.5	53.0	149.0	366.7	355.3	94.4	238.7	215.6	89.4	372.8	333.5	314.4	2668.3
1977	8.6	39.6	123.6	274.8	402.8	372.1	50.0	254.5	122.6	418.3	509.5	413.2	2989.6
1978	147.8	294.8	228.6	241.5	922.5	279.9	266.7	327.1	425.9	412.2	742.9	143.0	4432.9
1979	46.2	69.8	169.4	456.1	332.4	351.0	328.9	21.3	401.5	358.6	363.4	109.7	3008.3
1980	0.0	185.2	260.9	235.5	182.6	212.0	35.6	121.7	184.9	161.9	468.1	189.7	2238.1
1981	133.8	191.0	178.3	152.2	214.6	326.6	119.6	146.8	237.2	91.7	346.2	93.1	2231.1
1982	63.0	99.6	242.8	242.8	454.7	61.3	613.9	185.9	176.3	529.8	751.6	54.1	3475.8
1983	5.3	104.4	170.7	104.7	308.9	395.2	170.2	104.6	332.0	51.6	143.5	42.4	1933.5
1984	292.1	130.8	398.0	284.5	417.1	431.5	461.8	16.3	493.5	348.0	372.1	214.6	3860.3
1985	206.3	166.9	193.3	207.5	450.8	522.7	190.8	106.4	122.4	336.8	510.0	375.7	3389.6
1986	110.8	126.6	230.2	284.6	398.7	308.2	241.7	215.4	326.0	312.8	366.7	214.6	3136.3
1987	0.0	0.0	27.9	321.8	130.0	308.2	8.9	282.8	159.5	572.4	420.1	214.6	2446.2
1988	3.4	209.5	425.7	296.2	649.5	327.9	178.8	337.3	510.5	84.3	281.9	191.8	3496.8
1989	35.6	0.0	134.6	63.5	374.7	434.8	526.5	178.0	234.6	470.4	366.7	214.6	3034.0
AVERAGE	110.8	126.6	230.2	284.6	398.7	308.2	241.7	215.4	326.0	353.2	366.7	214.6	3176.8
STAND.DEV.	95.0	72.8	93.7	113.1	208.9	113.2	152.2	110.2	169.5	147.2	163.7	112.6	545.9
MAXIMUM	345.2	294.8	445.7	568.1	922.5	540.0	613.9	431.8	812.8	644.1	751.6	553.2	4432.9
MINIMUM	0.0	0.0	27.9	63.5	76.2	61.3	8.9	16.3	89.4	51.6	32.0	42.4	1933.5

YEAR	TOTAL	RANK	PROBABILITY
1983	1933.5	1	0.03226
1981	2231.1	2	0.06452
1980	2238.1	3	0.09677
1987	2446.2	4	0.12903
1960	2646.9	5	0.16129
1976	2668.3	6	0.19355
1970	2880.2	7	0.22581
1966	2887.2	8	0.25806
1977	2989.6	9	0.29032
1979	3008.3	10	0.32258
1967	3029.6	11	0.35484
1989	3034.0	12	0.38710
1968	3077.5	13	0.41935
1986	3136.3	14	0.45161
1965	3224.4	15	0.48387
1962	3276.5	16	0.51613
1969	3276.7	17	0.54839
1972	3281.8	18	0.58065
1961	3348.0	19	0.61290
1973	3353.0	20	0.64516
1964	3375.1	21	0.67742
1985	3389.6	22	0.70968
1982	3475.8	23	0.74194
1988	3496.8	24	0.77419
1974	3572.4	25	0.80645
1963	3732.6	26	0.83871
1984	3860.3	27	0.87097
1975	3897.1	28	0.90323
1971	4103.5	29	0.93548
1978	4132.9	30	0.96774

10 Year Moving Average

Year	Avg.
60 - 69	3187.5
61 - 70	3210.8
62 - 71	3286.3
63 - 72	3286.9
64 - 73	3248.9
65 - 74	3268.6
66 - 75	3335.9
67 - 76	3314.0
68 - 77	3310.0
69 - 78	3445.6
70 - 79	3418.7
71 - 80	3354.5
72 - 81	3167.3
73 - 82	3186.7
74 - 83	3044.7
75 - 84	3073.5
76 - 85	3022.8
77 - 86	3069.6
78 - 87	3015.2
79 - 88	2921.6
80 - 89	2924.2

RAINFALL ANALYSIS

STATION : MAHAWALATENNA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	277.8	267.9	360.4	399.2	80.2	8.3	168.4	18.5	39.1	302.5	131.3	173.2	2226.8
1961	266.1	68.3	275.5	432.3	149.3	60.7	94.2	75.1	40.3	220.4	294.6	203.7	2180.5
1962	76.7	99.0	265.4	362.2	280.9	31.7	69.8	14.4	129.0	308.3	291.8	157.2	2086.4
1963	274.3	124.7	288.7	462.5	309.4	138.1	62.9	13.7	75.6	381.7	786.8	501.3	3419.7
1964	78.4	115.0	378.9	310.6	90.9	105.9	122.9	14.4	142.7	144.7	59.9	72.8	1637.1
1965	5.5	245.1	207.2	293.6	290.3	57.4	12.7	73.9	90.4	190.2	422.6	280.9	2169.8
1966	165.1	62.7	205.2	394.4	1.7	42.4	38.8	20.3	219.2	446.5	229.3	176.2	2001.8
1967	117.0	127.2	231.9	326.8	147.5	77.7	34.5	64.0	15.7	369.5	467.3	144.2	2123.3
1968	129.7	10.9	159.5	175.2	117.8	76.7	91.6	2.2	75.1	542.5	278.3	234.6	1894.1
1969	32.5	148.8	180.8	185.9	464.5	72.8	3.3	66.5	49.2	462.2	196.5	442.4	2305.4
1970	135.6	168.1	315.2	330.4	160.0	21.8	33.5	7.1	29.7	148.0	388.8	178.8	1917.0
1971	219.4	114.0	349.5	329.7	58.6	143.5	70.8	78.9	242.5	233.1	382.7	157.2	2379.9
1972	46.4	20.5	442.9	144.7	215.6	7.3	72.3	12.9	127.7	319.2	322.3	92.7	1824.5
1973	71.1	0.5	302.8	338.3	118.1	66.2	22.3	35.0	5.3	411.9	270.0	311.6	1953.1
1974	0.0	253.2	131.0	359.9	97.2	75.6	120.9	44.1	98.0	116.1	128.4	419.6	1842.0
1975	92.2	263.6	114.3	240.5	232.4	275.5	31.4	20.3	93.2	61.4	457.2	154.1	2036.1
1976	21.8	68.8	2.2	263.6	77.9	7.1	0.7	52.8	38.3	255.2	218.9	107.4	1114.7
1977	167.6	329.9	265.1	352.8	192.2	59.1	34.2	0.0	36.3	534.1	336.2	3.0	2310.5
1978	65.2	152.1	365.7	269.4	383.5	28.7	69.5	99.3	89.4	335.7	530.3	259.8	2640.6
1979	21.8	11.6	183.6	253.2	245.6	73.1	80.0	37.5	142.4	466.5	289.3	272.5	2077.1
1980	2.0	33.5	130.8	195.3	156.2	55.3	36.5	73.1	28.1	347.7	561.0	26.9	1646.4
1981	8.6	125.2	167.9	132.8	186.5	118.4	39.9	70.4	135.6	53.3	371.3	24.9	1404.8
1982	56.4	0.0	212.8	209.3	320.5	191.8	41.2	4.3	82.9	386.8	450.9	190.9	2147.8
1983	102.9	117.0	243.3	265.6	179.4	84.9	10.7	34.0	70.2	369.3	232.2	203.3	1932.8
1984	270.8	152.8	404.2	397.2	60.5	83.0	92.1	6.9	154.4	123.3	457.9	243.3	2446.4
1985	133.6	197.8	379.8	119.9	321.9	351.2	5.4	41.5	82.9	283.2	319.5	190.9	2427.6
1986	102.9	117.0	243.3	265.6	197.4	84.9	54.0	41.8	87.0	219.5	109.6	211.1	1753.8
1987	72.9	20.8	105.7	332.6	28.9	36.1	12.5	65.0	33.7	190.3	448.9	174.9	1522.3
1988	42.6	82.9	354.3	348.6	183.3	100.0	78.7	123.6	13.3	159.8	35.0	72.8	1594.9
1989	29.4	12.4	27.1	36.2	82.0	11.8	13.3	34.8	20.1	112.3	118.1	43.8	541.9
AVERAGE	102.9	117.0	243.2	265.6	180.0	84.9	54.0	41.5	82.9	283.2	319.5	190.9	1985.6
STAND.DEV.	84.8	88.1	109.2	99.0	108.0	74.8	39.8	31.1	57.9	135.3	162.3	117.5	495.5
MAXIMUM	277.8	329.9	442.9	462.5	464.5	351.2	168.4	123.6	242.5	542.5	786.8	501.3	3419.7
MINIMUM	0.0	0.0	2.2	36.2	1.7	7.1	0.7	0.0	5.3	53.3	35.0	3.0	541.9

YEAR	TOTAL	RANK	PROBABILITY
1989	541.9	1	0.03226
1976	1114.7	2	0.06452
1981	1404.8	3	0.09677
1987	1522.3	4	0.12903
1988	1594.9	5	0.16129
1964	1637.1	6	0.19355
1980	1646.4	7	0.22581
1986	1753.8	8	0.25806
1972	1824.5	9	0.29032
1974	1842.0	10	0.32258
1968	1894.1	11	0.35484
1970	1917.0	12	0.38710
1983	1932.8	13	0.41935
1973	1953.1	14	0.45161
1966	2001.8	15	0.48387
1975	2036.1	16	0.51613
1979	2077.1	17	0.54839
1962	2086.4	18	0.58065
1967	2123.3	19	0.61290
1982	2147.8	20	0.64516
1965	2169.8	21	0.67742
1961	2180.5	22	0.70968
1960	2226.8	23	0.74194
1969	2305.4	24	0.77419
1977	2310.5	25	0.80645
1971	2379.9	26	0.83871
1985	2427.6	27	0.87097
1984	2446.4	28	0.90323
1978	2640.6	29	0.93548
1963	3419.7	30	0.96774

10 Year Moving Average

Year	Avg.
60 - 69	2204.5
61 - 70	2173.5
62 - 71	2193.5
63 - 72	2167.3
64 - 73	2020.6
65 - 74	2041.1
66 - 75	2027.7
67 - 76	1939.0
68 - 77	1957.7
69 - 78	2033.2
70 - 79	2010.4
71 - 80	1983.3
72 - 81	1885.8
73 - 82	1918.1
74 - 83	1916.1
75 - 84	1976.5
76 - 85	2015.7
77 - 86	2079.6
78 - 87	2000.8
79 - 88	1895.4
80 - 89	1741.9

RAINFALL ANALYSIS

STATION NAME: HAPUGASTENNA ESTATE

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	226.5	315.9	137.9	278.6	478.5	419.6	492.7	224.7	733.5	342.9	256.5	130.5	4037.8
1961	138.6	106.9	285.4	334.0	713.4	319.7	439.1	810.7	501.3	564.1	482.6	352.5	5048.3
1962	206.7	169.4	298.7	306.3	813.5	280.9	306.0	346.9	415.0	632.9	440.9	272.5	4491.7
1963	264.9	248.4	284.2	441.7	543.8	548.1	495.5	525.7	625.0	568.9	458.7	221.9	5226.8
1964	135.1	205.2	418.0	290.5	855.7	429.7	702.0	306.0	654.0	408.4	456.9	158.4	5019.9
1965	88.3	134.8	419.6	378.4	934.2	467.6	121.6	770.6	544.3	473.4	502.1	354.0	5188.9
1966	102.3	147.3	327.9	654.0	275.5	261.6	193.5	315.2	951.9	375.1	380.2	166.1	4150.6
1967	121.9	118.3	213.3	270.7	245.8	465.8	296.9	419.9	310.8	817.3	496.0	255.7	4032.4
1968	300.2	140.2	156.4	259.0	493.0	1013.9	570.2	334.7	507.7	364.9	390.6	418.5	4949.3
1969	73.6	95.5	215.9	312.4	1132.0	600.2	119.3	331.4	338.8	536.1	244.8	370.8	4370.8
1970	246.8	206.5	374.9	418.3	276.6	530.6	456.1	391.9	444.2	661.6	284.4	181.6	4473.5
1971	132.0	224.7	233.1	598.8	652.7	545.5	470.4	576.5	1191.7	391.1	462.0	226.0	5701.5
1972	102.8	35.5	131.5	261.1	815.3	367.7	539.4	472.1	937.5	784.0	530.8	129.2	5106.9
1973	96.5	148.0	226.8	318.5	292.6	613.4	411.4	348.7	156.4	428.4	391.1	447.2	3879.0
1974	0.0	291.3	205.2	417.0	566.6	667.7	917.4	382.2	889.5	365.7	239.7	367.5	5309.8
1975	32.2	201.4	353.5	818.6	866.9	912.6	273.3	758.9	496.3	1040.8	772.4	332.9	6559.8
1976	92.7	80.0	178.8	619.7	337.0	219.2	458.2	372.8	202.6	479.0	540.2	404.1	3984.3
1977	43.1	180.0	298.1	470.6	754.6	519.6	148.8	253.7	343.4	674.6	520.9	346.2	4553.6
1978	165.3	372.1	236.4	310.6	830.3	291.8	424.6	504.2	747.7	306.8	661.9	168.6	5100.3
1979	90.6	198.3	203.2	264.1	734.0	501.3	398.7	118.8	913.3	577.0	626.8	223.5	4849.6
1980	53.6	54.9	138.2	386.6	417.6	412.5	476.0	519.5	276.6	329.7	428.2	330.7	3824.1
1981	158.0	118.1	238.2	347.2	412.0	557.0	504.7	227.8	601.0	273.8	541.5	156.5	4135.8
1982	34.0	37.9	330.4	395.7	751.8	1210.6	497.3	298.7	272.5	653.8	693.9	100.6	5277.2
1983	56.4	103.1	87.9	57.4	423.1	450.1	332.5	484.4	530.9	214.9	296.2	459.2	3496.1
1984	349.9	196.1	403.6	685.5	775.5	512.2	717.1	82.5	541.3	405.6	388.9	165.4	5223.6
1985	306.8	149.6	438.7	195.3	628.8	1159.1	392.7	285.0	396.0	636.3	276.9	407.7	5272.9
1986	133.9	294.4	129.0	430.0	362.0	313.4	265.9	436.1	715.8	586.0	286.8	333.2	4286.5
1987	150.1	18.2	165.8	486.3	503.3	359.1	7.9	638.1	410.5	605.0	594.6	149.6	4168.5
1988	125.2	498.3	415.5	478.0	745.0	690.4	545.8	835.1	816.1	174.0	293.1	183.9	5800.4
1989	95.5	6.9	178.8	389.1	977.9	887.5	814.1	515.9	728.5	744.7	650.5	137.7	6129.1
AVERAGE	137.5	170.0	257.5	385.7	623.0	550.9	426.3	432.3	573.1	513.9	453.0	265.1	4788.3
STAND.DEV.	86.2	107.0	100.3	136.8	232.6	251.5	200.9	190.5	246.9	191.1	142.2	108.9	719.4
MAXIMUM	349.9	498.3	438.7	685.5	1132.0	1210.6	917.4	835.1	1191.7	1040.8	772.4	459.2	6559.8
MINIMUM	0.0	[illegible]	87.9	57.4	245.8	219.2	7.9	82.5	156.4	174.0	239.7	100.6	3496.1

YEAR	TOTAL	RANK	PROBABILITY
1983	3496.1	1	0.03226
1980	3824.1	2	0.06452
1973	3879.0	3	0.09677
1976	3984.3	4	0.12903
1967	4032.4	5	0.16129
1960	4037.8	6	0.19355
1981	4135.8	7	0.22581
1966	4150.6	8	0.25806
1987	4168.5	9	0.29032
1986	4286.5	10	0.32258
1969	4370.8	11	0.35484
1970	4473.5	12	0.38710
1962	4491.7	13	0.41935
1977	4553.6	14	0.45161
1979	4849.6	15	0.48387
1968	4949.3	16	0.51613
1964	5019.9	17	0.54839
1961	5048.3	18	0.58065
1978	5100.3	19	0.61290
1972	5106.9	20	0.64516
1965	5188.9	21	0.67742
1984	5223.6	22	0.70968
1963	5226.8	23	0.74194
1985	5272.9	24	0.77419
1982	5277.2	25	0.80645
1974	5309.8	26	0.83871
1971	5701.5	27	0.87097
1988	5800.4	28	0.90323
1989	6129.1	29	0.93548
1975	6559.8	30	0.96774

10 YEAR MOVING AVERAGE

60 - 69	4651.7
61 - 70	4695.2
62 - 71	4760.5
63 - 72	4822.1
64 - 73	4687.3
65 - 74	4716.3
66 - 75	4853.4
67 - 76	4836.7
68 - 77	4888.9
69 - 78	4904.0
70 - 79	4951.8
71 - 80	4886.9
72 - 81	4730.3
73 - 82	4747.4
74 - 83	4709.1
75 - 84	4700.4
76 - 85	4571.8
77 - 86	4602.0
78 - 87	4563.5
79 - 88	4633.5
80 - 89	4761.4

RAINFALL ANALYSIS

STATION NAME: HAMBEGAMUWA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	231.9	139.7	96.0	199.1	18.2	0.0	162.8	11.6	110.4	325.6	278.6	93.9	1667.8
1961	378.9	141.4	173.9	238.2	67.8	25.1	42.1	29.4	49.0	271.5	237.7	82.8	1737.8
1962	87.6	30.7	79.5	225.2	106.9	7.3	9.3	13.2	13.9	85.5	290.0	195.0	1144.1
1963	131.0	80.0	88.1	235.9	152.9	19.8	35.8	7.6	28.4	408.1	393.7	93.9	1675.2
1964	131.0	112.2	135.3	177.8	62.9	23.6	136.9	7.1	62.9	132.5	73.6	32.5	1088.3
1965	0.0	159.5	168.9	285.2	125.7	7.3	22.0	82.0	41.4	235.9	345.4	154.9	1628.2
1966	53.3	20.3	379.2	481.3	25.4	50.8	5.0	12.7	162.5	292.1	93.9	144.7	1721.2
1968	45.9	82.6	155.9	230.9	72.5	18.7	34.9	29.1	66.0	208.1	251.6	144.1	1340.4
1969	9.3	50.0	162.5	431.0	208.0	28.1	0.0	220.7	39.6	309.6	205.9	317.7	1982.4
1970	92.7	218.6	153.9	477.0	16.5	0.0	25.6	0.0	108.2	146.8	637.7	263.9	2140.9
1971	103.1	261.8	135.1	193.0	0.0	0.0	0.0	73.1	81.5	192.5	281.4	180.3	1501.8
1972	0.0	0.0	203.2	370.8	147.3	0.0	0.0	0.0	38.1	278.3	158.2	64.7	1260.6
1973	15.2	6.3	168.6	97.0	43.9	44.7	39.3	26.9	203.9	319.2	273.8	271.7	1510.5
1974	4.3	87.1	135.3	210.3	34.0	2.0	12.7	13.7	24.8	25.1	334.7	39.6	923.6
1975	17.7	15.7	169.1	321.0	132.0	65.2	117.0	7.1	95.5	12.7	348.4	138.9	1440.3
1976	22.3	0.0	95.2	135.8	0.0	0.0	0.0	0.0	7.6	231.1	373.8	221.9	1087.7
1977	0.0	147.0	71.1	255.7	107.6	8.8	27.9	13.2	36.8	432.8	385.8	51.0	1537.7
1985	64.4	70.2	390.2	53.6	119.3	64.8	4.1	24.0	115.0	212.8	137.1	489.2	1744.7
1986	129.0	108.3	240.6	116.9	37.1	15.2	0.0	21.9	3.1	88.3	47.5	2.5	810.4
1987	16.2	0.0	46.2	110.3	11.1	0.0	0.0	23.1	83.9	268.0	87.2	109.6	755.6
1988	9.4	86.6	121.4	169.4	40.6	17.8	14.0	24.6	44.5	79.8	266.4	67.1	941.6
1989	18.8	0.0	61.2	64.5	66.0	12.7	77.9	0.0	34.3	22.1	33.0	9.4	399.9
AVERAGE	71.0	82.6	155.9	230.9	72.5	18.7	34.9	29.1	66.0	208.1	251.6	144.1	1365.5
STAND.DEV.	89.3	72.1	86.2	120.2	55.9	20.1	46.0	46.6	49.5	118.6	139.5	113.3	422.3
MAXIMUM	378.9	261.8	390.2	481.3	208.0	65.2	162.8	220.7	203.9	432.8	637.7	489.2	2140.9
MINIMUM	0.0	0.0	46.2	53.6	0.0	0.0	0.0	0.0	3.1	12.7	33.0	2.5	399.9

YEAR	TOTAL	RANK	PROBABILITY
1989	399.9	1	0.04348
1987	755.6	2	0.08696
1986	810.4	3	0.13043
1974	923.6	4	0.17391
1988	941.6	5	0.21739
1976	1087.7	6	0.26087
1964	1088.3	7	0.30435
1962	1144.1	8	0.34783
1972	1260.6	9	0.39130
1968	1340.4	10	0.43478
1975	1440.3	11	0.47826
1971	1501.8	12	0.52174
1973	1510.5	13	0.56522
1977	1537.7	14	0.60870
1965	1628.2	15	0.65217
1960	1667.8	16	0.69565
1963	1675.2	17	0.73913
1966	1721.2	18	0.78261
1961	1737.8	19	0.82609
1985	1744.7	20	0.86957
1969	1982.4	21	0.91304
1970	2140.9	22	0.95652

10 YEAR MOVING AVERAGE

60 - 70	1612.6
61 - 71	1596.0
62 - 72	1548.3
63 - 73	1584.9
64 - 74	1509.8
65 - 75	1545.0
66 - 76	1490.9
68 - 77	1472.6
69 - 85	1513.0
70 - 86	1395.8
71 - 87	1257.3
72 - 88	1201.3
73 - 89	1115.2

RAINFALL ANALYSIS

STATION : LAUDERDALE GROUP

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	149.5	344.1	164.3	319.2	295.9	193.8	323.5	65.5	726.6	326.3	294.8	74.1	3577.6
1961	258.3	76.9	155.7	330.2	498.0	263.9	192.2	356.6	237.9	429.2	596.3	399.2	3794.4
1962	303.5	161.0	302.5	711.4	712.9	266.4	602.2	341.3	615.1	449.3	602.4	625.8	5693.8
1963	247.9	163.8	221.2	570.9	523.2	514.8	750.0	559.3	563.3	612.1	457.7	548.6	5732.8
1964	270.0	169.1	371.0	338.0	576.5	579.6	726.6	462.5	340.8	153.1	206.7	179.3	4373.2
1965	5.0	4.5	128.2	355.0	587.2	159.7	70.6	247.1	451.3	335.0	411.9	409.4	3164.9
1966	40.1	4.5	815.3	232.4	56.3	158.7	92.9	3.8	669.5	522.2	185.4	284.2	2765.3
1967	215.6	113.0	232.9	298.1	204.2	351.2	159.7	248.6	227.3	814.0	392.1	295.4	3552.1
1968	160.5	49.5	69.5	79.7	127.2	557.5	570.5	135.1	348.8	139.7	131.8	148.8	2518.6
1969	43.4	101.0	292.8	309.1	1265.1	372.8	86.8	294.8	274.3	562.6	335.0	763.5	4701.2
1970	208.7	138.9	419.8	282.4	277.6	246.1	223.0	220.2	201.4	374.1	484.6	195.3	3272.1
1971	264.1	192.0	147.0	398.5	288.7	355.3	279.9	312.6	850.6	193.8	813.3	453.8	4549.6
1972	134.1	69.8	121.1	240.5	837.9	177.5	278.3	260.0	613.9	530.8	834.2	99.8	3997.9
1973	62.7	191.5	576.0	262.8	107.9	339.3	140.9	303.0	114.8	544.3	232.6	381.5	3257.3
1974	11.4	90.4	41.9	263.1	331.7	433.5	430.7	250.9	474.9	214.8	276.3	166.6	2986.2
1975	93.7	159.7	215.3	412.4	431.8	605.5	141.4	304.8	295.4	475.4	423.9	422.4	3981.7
1976	122.4	45.7	252.9	269.7	227.0	67.8	113.7	182.8	56.1	302.7	386.0	427.9	2454.7
1977	6.8	141.7	217.1	343.4	439.6	224.0	251.9	255.1	212.5	330.7	874.8	264.9	3262.5
1978	83.0	245.1	240.7	246.3	707.6	181.8	224.5	411.7	368.3	291.5	723.1	194.8	3918.4
1979	35.8	103.4	55.1	334.0	389.0	284.0	273.2	116.1	489.7	386.1	468.1	350.3	3284.8
1980	36.1	8.9	105.2	252.0	132.6	268.2	219.0	291.0	89.9	229.9	140.0	200.8	1973.6
1981	93.2	159.8	87.6	387.5	406.1	371.2	89.7	317.3	119.7	182.5	371.3	155.3	2741.2
1982	0.0	80.1	236.2	547.4	643.2	851.8	315.4	192.0	62.9	383.6	624.0	87.4	4024.0
1983	117.6	119.1	88.9	41.8	293.3	144.8	122.2	188.6	302.0	124.3	251.8	366.7	2161.1
1984	412.9	140.9	254.7	504.9	257.5	347.3	245.4	0.0	246.1	337.8	529.7	134.4	3411.6
1985	214.9	226.4	311.4	199.4	557.1	771.2	107.8	72.0	107.9	619.7	344.3	319.4	3851.5
1986	129.7	188.8	198.6	463.5	115.4	120.0	100.9	335.3	505.6	264.5	213.4	149.0	2774.7
1987	129.5	0.0	175.0	252.6	175.0	221.7	0.0	413.8	198.6	481.5	192.7	172.1	2412.5
1988	78.7	101.5	221.4	330.2	310.5	281.7	173.0	255.1	348.8	378.6	403.5	294.5	3177.5
AVERAGE	145.8	123.8	221.4	330.2	406.1	334.9	251.9	255.1	348.8	378.6	403.5	295.4	3495.4
STAND.DEV.	117.7	77.5	126.3	135,3	258.7	187.7	189.5	127.4	209.0	162.6	177.0	164.6	908.9
MAXIMUM	449.5	344.1	576.0	711.4	1265.1	851.8	750.0	559.3	850.6	814.0	813.3	763.5	5732.8
MINIMUM	0.0	0.0	41.9	41.8	56.3	67.8	0.0	0.0	56.1	124.3	131.8	74.1	1973.6

YEAR	TOTAL	RANK	PROBABILITY
1980	1973.6	1	0.03333
1983	2161.1	2	0.06667
1987	2412.5	3	0.10000
1976	2454.7	4	0.13333
1968	2518.6	5	0.16667
1981	2741.2	6	0.20000
1966	2765.3	7	0.23333
1986	2774.7	8	0.26667
1974	2986.2	9	0.30000
1965	3164.9	10	0.33333
1988	3177.5	11	0.36667
1973	3257.3	12	0.40000
1977	3262.5	13	0.43333
1970	3272.1	14	0.46667
1979	3284.8	15	0.50000
1984	3411.6	16	0.53333
1967	3552.1	17	0.56667
1960	3577.6	18	0.60000
1961	3794.4	19	0.63333
1985	3851.5	20	0.66667
1978	3918.4	21	0.70000
1975	3981.7	22	0.73333
1972	3997.9	23	0.76667
1982	4024.0	24	0.80000
1964	4373.2	25	0.83333
1971	4549.6	26	0.86667
1969	4701.2	27	0.90000
1962	5693.8	28	0.93333
1963	5732.8	29	0.96667

10 Year Moving Average Year	Avg.
60 - 69	3987.4
61 - 70	3956.8
62 - 71	4032.4
63 - 72	3862.8
64 - 73	3615.2
65 - 74	3476.5
66 - 75	3558.2
67 - 76	3527.1
68 - 77	3498.2
69 - 78	3638.2
70 - 79	3496.5
71 - 80	3366.7
72 - 81	3185.8
73 - 82	3188.4
74 - 83	3078.8
75 - 84	3121.4
76 - 85	3108.3
77 - 86	3140.3
78 - 87	3055.3
79 - 88	2981.2

RAINFALL ANALYSIS

STATION NAME: GODAKAWELA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	194.8	192.7	203.9	229.8	135.6	90.4	238.5	35.8	179.3	320.5	160.5	88.6	2070.4
1961	217.6	156.2	115.8	125.2	143.7	72.3	125.2	172.9	102.8	226.0	409.4	165.1	2032.2
1962	169.1	121.9	160.7	220.7	334.2	34.0	134.1	73.6	124.4	167.3	240.5	193.5	1974.0
1963	230.6	147.5	148.0	350.7	233.6	135.6	112.5	112.2	168.6	223.5	353.8	231.6	2448.2
1964	29.4	116.5	285.2	205.4	131.8	100.8	159.0	74.6	209.8	116.3	115.0	184.9	1728.7
1965	32.0	150.8	142.7	355.6	204.4	59.6	40.1	134.8	158.4	256.5	320.0	213.8	2068.7
1966	88.9	28.7	382.2	219.9	29.2	57.9	96.2	60.9	298.1	352.5	146.0	177.8	1938.3
1967	74.1	111.2	92.7	218.4	113.0	196.0	136.6	122.1	61.7	512.5	378.2	89.1	2105.6
1968	228.0	8.6	247.3	168.4	141.9	238.2	213.8	57.9	168.4	257.8	101.3	141.4	1973.0
1969	16.5	73.4	137.9	196.5	406.4	108.4	61.9	166.1	86.1	367.7	234.4	630.1	2485.4
1970	118.1	78.7	310.6	204.4	165.1	134.1	122.6	86.1	61.7	217.9	367.0	252.4	2118.7
1971	181.6	223.0	451.3	302.7	96.7	156.2	116.0	121.1	329.6	272.2	378.7	252.2	2881.3
1972	22.3	15.2	163.3	102.3	299.7	53.3	151.6	81.5	239.7	363.2	482.6	127.0	2101.7
1973	33.7	6.6	439.1	261.6	51.8	123.4	37.3	182.3	14.9	233.9	242.5	203.4	1830.5
1974	1.7	16.0	64.0	329.4	90.4	119.6	219.7	185.9	261.1	61.9	138.9	121.1	1609.7
1975	9.1	57.1	144.7	107.9	412.4	241.0	123.1	310.6	221.7	350.0	483.3	144.5	2605.4
1976	18.2	3.5	312.1	301.4	103.6	25.6	62.4	64.2	0.0	146.8	299.9	429.5	1767.2
1977	7.6	129.7	434.0	222.7	198.1	190.2	44.9	38.3	40.1	350.2	327.1	225.8	2208.7
1978	126.7	128.2	166.8	193.5	361.6	95.5	95.5	96.2	159.7	223.5	330.4	38.1	2015.7
1979	129.5	34.2	12.1	92.7	176.2	234.9	170.6	55.3	287.7	205.4	457.2	180.3	2036.1
1980	3.8	12.7	50.8	279.4	101.6	76.2	105.4	76.2	127.0	152.4	482.6	132.0	1600.1
1981	92.5	84.0	329.2	216.2	172.7	127.9	113.5	100.1	143.2	248.0	429.8	31.0	2088.2
1982	29.0	62.5	239.8	341.3	275.9	315.6	134.6	20.5	59.0	187.9	433.2	79.5	2178.8
1983	16.8	57.1	37.6	83.1	91.7	55.9	90.7	85.6	176.1	142.9	220.8	355.5	1413.8
1984	269.2	131.5	207.0	301.3	187.2	155.5	150.9	16.0	153.5	105.2	393.8	117.1	2188.2
1985	83.6	170.5	277.9	107.9	290.8	343.1	65.4	57.3	120.9	367.7	337.3	211.7	2434.1
1986	119.5	107.9	169.3	299.8	15.3	102.7	47.6	184.6	219.2	221.7	176.1	51.1	1694.8
1987	177.7	23.8	58.7	183.5	86.6	63.2	0.0	166.0	115.0	257.0	247.2	111.4	1490.1
1988	115.1	155.5	252.2	300.2	128.9	132.4	76.5	92.9	197.6	24.4	461.5	216.3	2153.5
1989	31.0	0.0	105.7	179.5	174.5	126.0	271.6	91.9	98.7	260.3	185.4	26.2	1550.8
AVERAGE	95.6	86.8	204.8	223.4	178.5	132.2	117.3	103.5	152.8	239.8	311.1	180.7	2026.4
STAND.DEV.	79.9	62.8	120.7	79.7	104.2	77.8	61.8	60.9	81.7	102.6	118.0	121.7	332.2
MAXIMUM	269.2	223.0	451.3	355.6	412.4	343.1	271.6	310.6	329.6	512.5	483.3	630.1	2881.3
MINIMUM	1.7	0.0	12.1	83.1	15.3	25.6	0.0	16.0	0.0	24.4	101.3	26.2	1413.8

YEAR	TOTAL	RANK	PROBABILITY
1983	1413.8	1	0.03226
1987	1490.1	2	0.06452
1989	1550.8	3	0.09677
1980	1600.1	4	0.12903
1974	1609.7	5	0.16129
1986	1694.8	6	0.19355
1964	1728.7	7	0.22581
1976	1767.2	8	0.25806
1973	1830.5	9	0.29032
1966	1938.3	10	0.32258
1968	1973.0	11	0.35484
1962	1974.0	12	0.38710
1978	2015.7	13	0.41935
1961	2032.2	14	0.45161
1979	2036.1	15	0.48387
1965	2068.7	16	0.51613
1960	2070.4	17	0.54839
1981	2088.2	18	0.58065
1972	2101.7	19	0.61290
1967	2105.6	20	0.64516
1970	2118.7	21	0.67742
1988	2153.5	22	0.70968
1982	2178.8	23	0.74194
1984	2188.2	24	0.77419
1977	2208.7	25	0.80645
1985	2434.1	26	0.83871
1963	2448.2	27	0.87097
1969	2485.4	28	0.90323
1975	2605.4	29	0.93548
1971	2881.3	30	0.96774

10 YEAR MOVING AVERAGE	
60 - 69	2082.5
61 - 70	2087.3
62 - 71	2172.2
63 - 72	2185.0
64 - 73	2123.2
65 - 74	2111.3
66 - 75	2165.0
67 - 76	2147.9
68 - 77	2158.2
69 - 78	2162.4
70 - 79	2117.5
71 - 80	2065.6
72 - 81	1986.3
73 - 82	1994.0
74 - 83	1952.4
75 - 84	2010.2
76 - 85	1993.1
77 - 86	1985.9
78 - 87	1914.0
79 - 88	1927.8
80 - 89	1879.2

RAINFALL ANALYSIS

STATION : EMBILIPITIYA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	114.9	110.8	33.8	305.2	61.4	14.7	161.6	3.2	94.3	284.8	215.0	90.9	1490.6
1961	202.7	184.7	150.5	47.0	96.1	38.6	85.8	58.8	56.3	201.1	226.3	128.9	1506.8
1962	216.3	34.5	94.9	167.9	140.1	21.3	28.5	20.4	113.2	103.5	375.9	160.3	1476.8
1963	116.8	66.6	59.7	92.1	141.8	46.4	48.1	22.3	68.3	395.4	317.5	96.0	1471.0
1964	116.8	96.4	141.8	151.6	85.5	32.2	92.6	43.8	78.2	93.4	66.6	78.2	1097.1
1965	0.0	143.8	96.6	114.1	178.1	11.6	68.5	68.5	103.0	280.0	324.4	184.0	1572.6
1966	68.5	77.4	216.0	287.7	2.5	9.1	13.1	20.0	216.9	291.5	90.7	143.1	1436.5
1967	68.5	44.4	49.3	221.6	112.2	31.8	87.3	43.4	51.4	369.5	198.6	26.2	1334.2
1968	321.4	0.0	115.7	69.0	105.0	74.4	66.2	7.5	36.0	5.7	324.4	66.4	1191.7
1969	2.7	5.5	197.9	224.5	170.0	33.3	0.7	222.8	102.2	367.3	202.5	598.7	2180.1
1970	167.4	84.7	69.9	176.2	75.3	11.3	32.8	22.7	16.1	42.1	293.7	198.6	1190.8
1973	38.3	60.1	155.8	142.4	82.4	34.6	31.9	35.5	23.2	305.2	144.4	279.6	1388.4
1974	0.0	81.7	83.6	90.3	92.5	39.2	52.4	40.0	109.8	73.5	104.9	105.8	873.7
1975	54.5	151.9	251.6	181.8	330.6	108.0	66.2	30.5	56.8	47.4	289.9	208.8	1778.0
1976	24.8	3.0	36.7	242.2	85.7	5.4	17.1	30.2	23.3	211.2	341.6	94.8	1116.0
1977	0.5	43.7	169.7	93.9	131.1	12.3	9.5	63.9	38.1	266.7	291.0	127.2	1247.6
1978	34.1	46.2	115.7	79.0	212.1	8.9	13.2	25.0	78.3	106.9	136.2	93.7	949.3
1979	2.0	107.2	2.3	202.3	129.5	31.8	19.8	3.3	94.4	88.6	318.2	290.5	1289.9
1980	0.8	2.0	42.8	210.9	56.7	16.3	25.6	1.0	53.6	118.3	555.8	290.5	1374.3
1982	5.1	45.5	127.1	117.1	201.8	112.5	47.2	48.8	12.7	277.8	439.1	106.3	1541.0
1983	0.0	0.0	22.6	43.5	52.0	6.1	6.1	29.2	13.2	87.3	132.5	265.4	657.9
1984	64.3	155.2	183.8	114.2	52.3	24.4	391.1	8.5	13.2	331.7	291.3	129.5	1759.5
1985	84.7	54.8	253.6	44.2	154.0	145.6	4.7	18.4	135.0	264.6	223.9	178.9	1562.4
1986	143.2	97.4	128.7	137.5	49.0	18.6	6.7	55.1	99.2	165.0	57.0	43.9	1001.3
1987	66.6	1.1	187.4	238.2	28.8	11.3	0.0	111.5	101.1	265.2	57.0	54.5	1122.7
1988	57.7	40.8	149.5	177.7	82.5	13.6	50.2	37.7	79.9	187.3	314.8	123.1	1364.8
AVERAGE	75.9	66.9	120.7	152.8	111.9	44.4	54.9	41.2	71.8	201.2	243.6	160.1	1345.3
STD.DEV	79.7	51.9	68.7	72.8	67.5	38.4	76.6	43.5	45.9	112.5	121.5	114.8	308.6
MAXIMUM	321.4	184.7	253.6	305.2	330.6	145.6	391.1	222.8	216.9	395.4	555.8	598.7	2180.1
MINIMUM	0.0	0.0	2.3	43.5	2.5	5.4	0.0	1.0	12.7	5.7	57.0	26.2	657.9

YEAR	TOTAL	RANK	PROBABILITY
1983	657.9	1	0.03704
1974	873.7	2	0.07407
1978	949.3	3	0.11111
1986	1001.3	4	0.14815
1964	1097.1	5	0.18519
1976	1116.0	6	0.22222
1987	1122.7	7	0.25926
1970	1190.8	8	0.29630
1968	1191.7	9	0.33333
1977	1247.6	10	0.37037
1979	1289.9	11	0.40741
1967	1334.2	12	0.44444
1988	1364.8	13	0.48148
1980	1374.3	14	0.51852
1973	1388.4	15	0.55556
1966	1436.5	16	0.59259
1963	1471.0	17	0.62963
1962	1476.8	18	0.66667
1960	1490.6	19	0.70370
1961	1506.8	20	0.74074
1982	1541.0	21	0.77778
1985	1562.4	22	0.81481
1965	1572.6	23	0.85185
1984	1759.5	24	0.88889
1975	1778.0	25	0.92593
1969	2180.1	26	0.96296

10 YEAR MOVING AVERAGE	AVG
60 - 69	1476.5
61 - 70	1446.6
62 - 73	1434.2
63 - 74	1373.9
64 - 75	1404.6
65 - 76	1406.5
66 - 77	1374.0
67 - 78	1325.3
68 - 79	1320.9
69 - 80	1339.1
70 - 82	1274.4
73 - 83	1221.1
74 - 84	1258.7
75 - 85	1327.6
76 - 86	1249.9
77 - 87	1250.6
78 - 88	1262.3

RAINFALL ANALYSIS

STATION NAME: EHELIYAGODA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	146.9	324.2	120.4	474.5	340.4	356.2	603.3	137.5	411.8	421.7	435.4	116.1	3808.4
1961	143.6	144.6	361.7	522.3	699.1	385.9	364.8	573.1	470.7	337.4	446.1	322.6	4771.9
1962	99.4	45.8	234.7	470.7	675.7	307.9	277.2	293.9	365.6	622.1	546.9	82.6	4024.5
1963	149.9	363.3	157.7	556.8	510.5	468.2	654.4	433.4	749.1	682.5	570.0	277.7	5573.5
1964	49.8	113.8	177.6	333.6	745.8	350.3	864.9	290.6	448.9	572.3	344.2	161.6	4453.4
1965	93.5	171.8	364.0	367.1	757.7	229.4	189.8	690.9	587.6	827.3	243.6	344.0	4866.7
1966	162.1	34.8	315.0	615.2	174.8	247.2	220.0	204.5	762.8	695.0	358.1	401.6	4188.1
1967	90.2	94.8	357.7	216.2	322.1	872.0	329.5	316.0	306.9	791.3	299.3	226.6	4224.6
1968	94.5	108.5	482.6	490.3	300.5	735.1	432.4	225.9	587.3	355.9	306.4	146.6	4266.0
1969	69.6	297.0	74.5	508.6	1123.0	325.7	68.6	291.4	276.9	513.9	327.5	463.9	4360.6
1970	127.6	186.5	386.9	627.2	427.8	447.3	419.4	234.5	365.9	672.6	205.0	296.2	4386.9
1971	192.3	153.0	129.3	573.8	625.1	481.1	293.9	505.5	666.8	302.8	213.4	232.7	4449.7
1972	20.1	23.4	77.7	380.5	630.0	537.8	213.7	166.9	640.6	776.5	539.0	131.3	4139.5
1973	23.4	320.6	385.6	329.7	387.4	492.8	321.1	238.3	185.7	428.8	304.3	376.3	3796.0
1974	0.0	172.3	234.7	570.5	459.8	466.4	585.3	220.8	727.0	223.3	83.6	218.7	3962.4
1975	91.4	161.6	309.7	434.9	816.4	497.6	363.3	312.2	592.4	524.6	947.5	131.1	5182.7
1976	35.6	17.3	216.5	478.8	221.8	197.2	303.6	461.8	154.0	519.5	505.0	281.5	3392.6
1977	15.5	204.0	426.3	512.9	746.0	546.7	93.0	270.3	234.7	612.8	374.7	138.7	4375.6
1978	167.7	279.7	160.8	349.0	931.2	187.5	251.3	210.4	368.3	543.9	638.1	262.7	4350.6
1979	60.2	418.1	252.5	353.6	368.9	468.9	325.9	106.7	801.2	586.5	585.8	319.1	4647.4
1980	1.3	3.1	193.6	445.6	479.9	293.4	294.2	342.9	344.0	414.3	599.2	238.6	3650.1
1981	145.0	143.5	267.7	321.8	399.5	379.1	235.5	210.6	606.8	493.8	507.2	242.2	3952.7
1982	29.7	0.0	214.6	545.1	727.5	686.6	338.8	241.2	225.5	654.3	632.5	211.3	4507.1
1983	17.3	18.8	25.3	83.8	194.3	320.5	216.4	356.7	738.1	319.3	340.8	706.5	3337.8
1984	355.3	270.4	391.0	811.8	774.9	389.5	593.1	36.1	257.4	276.3	621.8	34.9	4812.5
1985	332.6	319.3	292.4	163.5	652.4	743.2	152.2	257.4	335.6	704.1	305.6	470.9	4729.2
1986	162.5	194.3	251.0	496.3	319.6	168.5	75.4	239.5	630.2	546.7	304.3	222.4	3610.7
1987	154.8	17.8	21.2	202.5	442.6	232.7	15.0	672.0	304.8	724.4	365.6	199.0	3352.4
1988	56.7	196.2	315.2	416.1	367.6	491.3	472.3	585.1	564.7	129.7	416.8	80.5	4092.2
1989	27.7	15.2	127.3	212.9	313.9	741.8	596.5	215.6	420.3	463.5	266.4	146.2	3547.3
AVERAGE	103.9	160.5	244.2	428.9	531.2	434.9	338.8	311.4	470.7	534.0	421.1	250.3	4229.8
STAND.DEV.	85.5	119.1	119.7	153.8	230.6	179.1	192.3	157.9	189.9	178.9	172.6	138.1	529.3
MAXIMUM	355.3	418.1	482.6	811.8	1123.0	872.0	864.9	690.9	801.2	827.3	947.5	706.5	5573.5
MINIMUM	0.0	0.0	21.2	83.8	174.8	168.5	15.0	36.1	154.0	129.7	83.6	34.9	3337.8

YEAR	TOTAL	RANK	PROBABILITY
1983	3337.8	1	0.03226
1987	3352.4	2	0.06452
1976	3392.6	3	0.09677
1989	3547.3	4	0.12903
1986	3610.7	5	0.16129
1980	3650.1	6	0.19355
1973	3796.0	7	0.22581
1960	3808.4	8	0.25806
1981	3952.7	9	0.29032
1974	3962.4	10	0.32258
1962	4024.5	11	0.35484
1988	4092.2	12	0.38710
1972	4139.5	13	0.41935
1966	4188.1	14	0.45161
1967	4224.6	15	0.48387
1968	4266.0	16	0.51613
1978	4350.6	17	0.54839
1969	4360.6	18	0.58065
1977	4375.6	19	0.61290
1970	4386.9	20	0.64516
1971	4449.7	21	0.67742
1964	4453.4	22	0.70968
1982	4507.1	23	0.74194
1979	4647.4	24	0.77419
1985	4729.2	25	0.80645
1961	4771.9	26	0.83871
1984	4812.5	27	0.87097
1965	4866.7	28	0.90323
1975	5182.7	29	0.93548
1963	5573.5	30	0.96774

10 YEAR MOVING AVERAGE

60 - 69	4461.8
61 - 70	4511.6
62 - 71	4479.4
63 - 72	4490.9
64 - 73	4313.2
65 - 74	4264.1
66 - 75	4295.7
67 - 76	4216.1
68 - 77	4231.2
69 - 78	4239.7
70 - 79	4268.3
71 - 80	4194.7
72 - 81	4145.0
73 - 82	4181.7
74 - 83	4135.9
75 - 84	4220.9
76 - 85	4175.6
77 - 86	4197.4
78 - 87	4095.0
79 - 88	4069.2
80 - 89	3959.2

RAINFALL ANALYSIS

STATION : BALANGODA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	192.0	347.4	272.8	283.9	112.2	44.3	194.8	22.0	187.4	150.1	143.8	151.7	2102.4
1961	176.1	100.8	194.2	281.1	262.1	177.5	40.6	138.4	17.5	329.7	593.7	201.6	2513.3
1962	149.3	152.3	174.5	330.9	320.4	63.8	203.6	100.1	186.1	100.1	239.5	183.6	2211.2
1963	327.2	152.3	207.9	458.9	121.7	245.7	139.4	60.9	93.6	218.1	537.8	332.5	2891.0
1964	149.3	124.0	223.2	195.2	129.4	113.2	180.7	48.0	143.9	134.8	132.4	206.3	1781.4
1965	23.6	100.2	170.5	410.1	332.7	64.0	19.2	125.2	122.0	235.2	396.2	307.6	2305.5
1966	194.3	90.2	168.4	434.7	13.9	45.2	36.0	38.4	308.5	380.9	276.7	232.2	2223.4
1967	167.1	142.2	207.9	458.9	121.7	173.4	36.1	60.2	20.0	461.4	606.3	161.8	2617.0
1968	2.4	0.0	134.0	164.4	88.9	247.1	202.8	-	-	-	-	-	839.6
1969	-	-	-	-	-	-	-	113.8	-	-	-	-	113.8
1970	-	-	-	-	-	-	-	-	48.0	187.6	357.0	239.1	831.7
1971	361.5	169.3	223.2	367.7	154.5	181.0	77.9	294.8	441.1	290.8	-	-	2580.8
1972	-	-	-	-	-	-	-	-	-	-	507.0	166.5	673.5
1973	54.6	29.1	287.9	165.0	64.0	141.7	30.1	120.3	30.2	365.4	290.7	367.1	1941.1
1974	0.0	236.0	241.5	397.9	104.4	164.5	175.8	151.7	211.6	53.9	253.8	411.9	2403.0
1975	72.1	187.3	367.5	503.6	200.2	483.2	40.8	179.9	140.7	122.9	499.1	197.9	3001.2
1976	37.8	55.8	167.5	273.4	173.3	7.6	26.0	81.0	22.7	-	-	-	845.1
1977	-	-	-	-	-	-	-	-	-	374.7	377.0	263.1	1014.8
1978	29.8	55.8	23.0	92.0	350.0	7.6	50.0	162.0	170.0	248.0	386.0	77.0	1651.2
1979	167.2	60.0	18.2	269.5	473.0	95.4	153.9	27.7	404.5	617.5	490.2	232.0	3007.1
1980	10.0	33.5	85.7	333.3	151.6	73.1	80.0	71.8	113.5	140.6	523.0	183.5	1791.6
1981	103.0	74.6	102.1	159.9	473.0	165.1	7.6	-	-	-	-	-	1085.3
1982	-	-	-	-	-	-	-	93.0	0.0	529.0	701.0	120.3	1440.3
1983	20.0	57.5	18.0	200.9	341.3	33.1	30.5	55.0	83.4	258.2	281.8	282.5	1662.0
1984	292.8	184.3	701.5	403.7	82.0	142.3	124.0	43.0	177.0	196.3	488.4	206.9	3042.2
1985	85.9	123.1	291.7	244.7	424.8	511.0	31.1	21.4	107.1	513.3	362.0	365.4	3081.5
1986	135.2	55.0	172.0	662.8	18.1	93.9	58.5	141.1	217.6	168.1	123.5	178.1	2021.9
1987	105.1	55.5	175.6	135.1	312.8	106.1	0.0	129.8	185.0	272.2	410.0	220.9	2109.1
1988	67.0	160.8	436.4	458.5	127.4	144.6	210.1	66.5	222.5	208.3	252.7	255.8	2611.6
AVERAGE	121.8	115.3	211.0	320.3	206.4	147.6	89.6	97.8	152.2	273.2	384.6	231.1	2351.7
STD.DEV.	99.3	76.5	142.5	136.8	136.4	125.2	71.4	61.5	112.3	144.0	153.3	79.5	793.4
MAXIMUM	361.5	347.4	701.5	662.8	473.0	511.0	210.1	294.8	441.1	617.5	701.0	411.9	3081.5
MINIMUM	0.0	0.0	16.2	92.0	13.9	7.6	0.0	21.4	0.0	53.9	123.5	77.0	113.8

RAINFALL ANALYSIS

STATION : THIHAGODA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	108.7	149.8	67.3	136.6	174.7	123.6	173.4	111.5	140.2	120.9	171.1	68.8	1546.6
1961	59.6	60.7	94.2	105.1	401.3	117.8	201.9	423.4	416.5	518.6	152.4	78.2	2709.7
1962	99.5	0.0	64.7	103.6	389.6	150.8	152.4	187.1	122.4	133.0	240.7	351.5	1995.3
1963	137.1	85.3	41.9	126.4	232.1	175.1	211.8	381.7	510.5	405.3	245.3	122.4	2674.9
1964	33.0	108.2	30.7	54.3	249.1	189.9	298.9	66.5	173.9	264.4	210.8	24.1	1703.8
1965	20.3	62.9	12.9	144.7	258.8	50.8	37.5	171.1	356.8	368.8	138.6	270.0	1893.2
1966	29.9	36.0	3.3	262.3	43.1	56.3	59.6	147.8	316.9	204.4	185.6	116.3	1461.5
1967	68.3	30.4	10.1	25.4	167.6	141.4	101.8	117.6	166.6	437.3	187.9	54.6	1589.0
1968	226.8	0.0	72.1	43.1	60.4	265.9	127.5	42.9	28.9	27.9	35.8	20.5	951.8
1969	30.4	28.4	0.0	18.0	248.1	32.0	9.9	257.8	23.3	209.8	212.3	500.6	1570.6
1970	12.9	5.0	125.7	12.4	157.4	6.6	55.8	169.6	14.7	147.0	141.4	84.5	933.0
1971	81.7	25.9	20.3	41.1	93.9	65.0	155.4	25.9	88.9	186.9	161.0	145.0	1091.0
1972	223.2	31.4	124.7	89.9	289.8	149.3	90.9	90.6	342.1	235.2	342.1	40.8	2050.0
1973	44.1	100.8	277.1	86.3	254.7	393.4	336.5	35.5	206.1	382.7	124.4	367.2	2608.8
1974	0.0	19.3	21.0	267.2	319.2	126.7	154.6	238.2	418.3	111.2	54.6	148.8	1879.1
1975	45.4	80.5	96.5	256.0	338.8	309.6	75.6	153.1	156.9	361.9	281.1	106.6	2262.0
1976	27.6	12.1	128.2	129.2	175.7	57.4	102.8	131.5	22.0	395.0	588.2	324.3	2094.0
1977	12.4	40.8	168.6	66.2	250.9	125.2	62.4	175.0	185.9	352.0	279.6	148.3	1867.3
1978	101.0	15.4	285.7	132.0	540.7	115.3	95.5	292.6	148.5	108.7	464.5	56.6	2356.5
1979	20.0	170.4	67.5	133.3	260.3	201.6	264.1	58.1	493.7	80.5	397.2	198.1	2344.8
1980	7.1	56.1	9.9	268.9	118.1	106.6	94.0	70.6	106.1	283.4	435.6	185.9	1822.3
1981	40.4	55.4	33.0	171.2	343.2	59.7	49.8	162.8	237.2	33.0	150.6	131.8	1468.1
1982	65.0	0.0	83.6	222.0	182.9	506.2	276.4	29.2	134.4	585.0	516.9	137.9	2739.5
1983	0.0	0.0	20.8	67.3	88.6	178.3	134.9	166.9	310.1	40.6	175.8	157.5	1340.8
1984	240.8	169.4	69.1	246.9	372.4	288.5	189.5	0.0	88.9	103.6	236.7	56.4	2062.2
1985	37.3	65.8	129.3	135.6	360.9	432.8	77.2	314.7	121.4	389.2	247.9	148.9	2461.0
1986	110.2	80.8	126.2	117.1	178.3	33.5	15.7	42.9	217.7	233.7	220.7	125.7	1502.5
1987	53.3	51.1	43.7	138.4	104.1	128.5	6.3	429.5	197.3	393.9	305.1	79.8	1931.0
1988	42.3	46.5	107.2	113.3	167.8	338.1	300.5	351.6	252.0	22.1	180.3	60.4	1982.1
1989	46.7	0.9	1.9	77.3	141.2	248.2	326.6	242.6	185.7	255.8	414.7	37.1	1978.7
AVERAGE	67.5	53.0	77.9	126.4	232.1	175.1	146.6	169.6	206.1	246.4	250.0	145.0	1895.7
STAND.DEV.	64.1	47.7	71.3	75.3	114.1	122.8	98.8	119.9	138.9	151.8	130.2	112.0	487.8
MAXIMUM	240.8	170.4	285.7	268.9	540.7	506.2	336.5	429.5	510.5	585.0	588.2	500.6	2739.5
MINIMUM	0.0	0.0	0.0	12.4	43.1	6.6	6.3	0.0	14.7	22.1	35.8	20.5	933.0

YEAR	TOTAL	RANK	PROBABILITY
1970	933.0	1	0.03226
1968	951.8	2	0.06452
1971	1091.0	3	0.09677
1983	1340.8	4	0.12903
1966	1461.5	5	0.16129
1981	1468.1	6	0.19355
1986	1502.5	7	0.22581
1960	1546.6	8	0.25806
1969	1570.6	9	0.29032
1967	1589.0	10	0.32258
1964	1703.8	11	0.35484
1980	1822.3	12	0.38710
1977	1867.3	13	0.41935
1974	1879.1	14	0.45161
1965	1893.2	15	0.48387
1987	1931.0	16	0.51613
1989	1978.7	17	0.54839
1988	1982.1	18	0.58065
1962	1995.3	19	0.61290
1972	2050.0	20	0.64516
1984	2062.2	21	0.67742
1976	2094.0	22	0.70968
1975	2262.0	23	0.74194
1979	2344.8	24	0.77419
1978	2356.5	25	0.80645
1985	2461.0	26	0.83871
1973	2608.8	27	0.87097
1963	2674.9	28	0.90323
1961	2709.7	29	0.93548
1982	2739.5	30	0.96774

10 Year Moving Average

Year	Avg.
60 - 69	1809.6
61 - 70	1748.3
62 - 71	1586.4
63 - 72	1591.9
64 - 73	1585.3
65 - 74	1602.8
66 - 75	1639.7
67 - 76	1702.9
68 - 77	1730.8
69 - 78	1871.2
70 - 79	1948.7
71 - 80	2037.6
72 - 81	2075.3
73 - 82	2144.2
74 - 83	2017.4
75 - 84	2035.8
76 - 85	2055.7
77 - 86	1996.5
78 - 87	2002.9
79 - 88	1965.4
80 - 89	1928.8

RAINFALL ANALYSIS

STATION : MAWARELLA ESTATE

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	289.8	210.3	147.8	271.7	286.2	136.9	315.9	113.0	260.0	232.1	233.6	51.3	2548.6
1961	199.6	110.7	218.4	143.2	367.5	169.9	268.4	371.6	425.1	338.5	345.9	270.2	3229.0
1962	121.1	73.6	178.5	219.9	367.2	166.6	119.3	212.0	290.5	216.6	405.1	407.4	2777.8
1963	231.6	160.2	179.5	451.3	315.9	6.8	279.4	332.4	543.5	557.7	355.0	179.8	3593.1
1964	140.2	158.7	146.3	281.4	374.3	197.3	331.4	147.5	280.4	96.2	230.1	295.6	2679.4
1965	15.2	103.8	190.5	165.8	451.8	209.5	67.3	257.3	471.4	419.3	556.7	358.3	3266.9
1966	166.3	73.1	236.9	396.2	74.4	121.1	93.2	197.3	660.4	637.7	250.4	318.2	3225.2
1967	289.3	59.6	151.3	210.3	189.4	398.8	386.0	199.8	192.5	615.6	530.3	169.9	3332.8
1968	545.8	45.9	266.4	90.1	181.8	386.5	424.1	99.3	196.3	194.5	100.3	250.9	2781.9
1969	27.1	91.1	137.6	118.8	668.5	212.5	48.0	306.3	164.3	324.1	494.0	840.9	3433.2
1970	169.1	143.2	256.0	261.6	224.5	281.4	175.0	185.4	163.3	466.8	381.7	216.9	2924.9
1971	281.4	227.8	323.5	458.9	230.1	267.4	226.0	172.7	455.4	383.7	341.1	205.9	3573.9
1972	115.5	4.8	258.5	232.4	616.2	100.5	107.4	185.6	536.4	577.5	403.8	160.7	3299.3
1973	27.4	151.3	353.3	291.0	201.1	462.2	151.8	160.2	160.5	564.1	303.7	556.7	3383.3
1974	0.0	168.9	157.2	337.0	297.1	247.6	300.9	190.5	417.8	123.1	254.7	249.6	2744.4
1975	119.1	258.3	337.5	420.8	426.2	512.0	78.4	190.5	167.6	496.0	600.7	470.9	4078.0
1976	150.1	96.7	229.6	387.6	295.4	114.5	205.2	157.9	10.9	387.6	572.0	273.0	2880.5
1977	7.6	123.4	305.0	291.5	421.6	230.1	176.0	208.5	158.2	524.5	428.2	372.8	3247.4
1978	233.1	138.6	342.9	175.5	647.1	132.0	159.5	230.6	190.5	259.3	521.2	102.1	3132.4
1979	70.8	166.2	56.6	457.2	255.2	200.9	209.5	45.4	489.7	353.8	456.1	237.2	2988.6
1980	22.0	55.8	47.2	378.2	298.1	202.6	103.6	138.4	100.3	334.0	567.1	174.2	2421.5
1981	87.9	169.4	136.6	223.8	288.3	197.0	68.6	84.3	260.8	210.4	491.4	145.7	2364.2
1982	72.9	90.2	301.8	352.7	406.3	615.0	181.3	173.2	200.8	513.3	665.0	190.0	3762.5
1983	145.2	14.3	145.8	19.0	112.2	196.9	116.7	234.8	412.3	115.7	358.1	669.8	2540.8
1984	472.3	203.3	292.8	326.8	380.3	318.7	214.0	3.1	187.9	251.8	479.1	117.6	3247.7
1985	215.3	130.9	242.1	257.7	325.7	760.0	187.2	198.8	223.6	591.3	250.4	323.8	3706.8
1986	169.5	132.0	246.1	437.0	128.5	139.2	117.4	208.7	469.1	308.0	198.7	210.3	2764.5
1987	187.9	33.2	309.2	229.3	231.0	133.4	2.3	452.5	235.0	634.7	275.8	169.3	2893.6
1988	171.4	149.8	271.0	342.6	350.9	238.7	203.4	337.3	369.9	187.4	506.0	167.7	3296.1
1989	49.2	39.9	202.7	75.4	238.7	356.4	297.8	266.3	57.3	187.6	363.6	39.5	2174.4
AVERAGE	159.8	119.2	222.3	276.8	321.7	255.1	187.2	202.0	291.7	370.1	397.3	273.2	3076.4
STAND.DEV.	125.7	62.4	80.2	118.1	142.0	158.0	101.6	92.5	158.6	167.4	135.6	173.0	442.5
MAXIMUM	545.8	258.3	353.3	458.9	668.5	760.0	424.1	452.5	660.4	637.7	665.0	840.9	4078.0
MINIMUM	0.0	4.8	47.2	19.0	74.4	6.8	2.3	3.1	10.9	96.2	100.3	39.5	2174.4

YEAR	TOTAL	RANK	PROBABILITY
1989	2174.4	1	0.03226
1981	2364.2	2	0.06452
1980	2421.5	3	0.09677
1983	2540.8	4	0.12903
1960	2548.6	5	0.16129
1964	2679.4	6	0.19355
1974	2744.4	7	0.22581
1986	2764.5	8	0.25806
1962	2777.8	9	0.29032
1968	2781.9	10	0.32258
1976	2880.5	11	0.35484
1987	2893.6	12	0.38710
1970	2924.9	13	0.41935
1979	2988.6	14	0.45161
1978	3132.4	15	0.48387
1966	3225.2	16	0.51613
1961	3229.0	17	0.54839
1977	3247.4	18	0.58065
1984	3247.7	19	0.61290
1965	3266.9	20	0.64516
1988	3296.1	21	0.67742
1972	3299.3	22	0.70968
1967	3332.8	23	0.74194
1973	3383.3	24	0.77419
1969	3433.2	25	0.80645
1971	3573.9	26	0.83871
1963	3593.1	27	0.87097
1985	3706.8	28	0.90323
1982	3762.5	29	0.93548
1975	4078.0	30	0.96774

10 Year Moving Average

Year	Avg.
60 - 69	3086.8
61 - 70	3124.4
62 - 71	3158.9
63 - 72	3211.1
64 - 73	3190.1
65 - 74	3196.6
66 - 75	3277.7
67 - 76	3243.2
68 - 77	3234.7
69 - 78	3269.7
70 - 79	3225.3
71 - 80	3174.9
72 - 81	3054.0
73 - 82	3100.3
74 - 83	3016.0
75 - 84	3066.4
76 - 85	3029.2
77 - 86	3017.6
78 - 87	2982.3
79 - 88	2998.6
80 - 89	2917.2

RAINFALL ANALYSIS

STATION NAME: KEKENADORA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	114.5	101.3	103.1	62.9	165.6	106.1	157.4	92.9	71.6	147.3	112.7	26.9	1262.3
1961	164.0	37.8	44.9	52.8	320.5	100.0	87.8	438.1	367.0	457.2	128.7	87.1	2285.9
1962	83.5	6.0	65.7	84.3	338.3	124.7	202.1	209.5	141.9	61.4	182.1	127.5	1627.0
1963	157.4	48.7	25.4	73.1	526.2	129.0	212.8	268.7	496.3	561.8	340.9	138.9	2979.2
1964	48.2	66.2	68.3	34.5	217.6	218.4	364.7	104.3	239.7	313.9	210.8	52.3	1938.9
1965	0.0	59.9	14.9	85.8	256.2	111.5	76.2	296.9	340.1	400.5	306.8	323.8	2272.6
1966	19.0	18.2	108.9	331.9	78.7	86.6	82.8	142.4	243.8	383.0	158.4	136.6	1790.3
1967	199.8	43.1	0.0	69.3	228.0	220.2	220.9	163.8	191.8	418.8	265.4	51.3	2072.4
1968	216.6	7.6	53.3	32.0	189.2	365.5	219.9	54.6	118.3	144.5	145.5	87.6	1632.6
1969	29.9	63.5	33.7	64.2	398.5	97.0	21.0	284.7	53.3	213.8	214.6	590.2	2064.4
1970	17.7	101.6	212.5	200.6	424.9	36.8	84.5	116.8	76.2	154.4	172.2	109.4	1707.6
1971	358.9	2.5	227.0	191.2	116.8	170.6	72.3	230.1	253.7	260.0	151.1	241.3	2275.5
1972	17.0	30.4	89.1	38.6	338.5	71.8	66.8	76.9	275.0	303.5	280.0	14.7	1582.3
1973	57.4	60.1	112.2	64.0	187.4	323.8	188.4	53.8	149.6	294.1	153.1	191.5	1835.4
1974	0.0	20.8	39.6	176.7	281.9	146.0	209.2	100.8	303.0	26.6	102.1	87.8	1494.5
1975	51.5	122.9	121.6	194.5	211.8	206.2	31.7	80.7	75.4	232.9	239.0	96.7	1664.9
1976	8.8	0.0	10.4	124.2	94.2	74.6	118.3	130.8	3.5	234.1	479.0	184.4	1462.3
1977	0.0	31.4	94.9	56.1	270.0	132.3	56.6	145.0	119.8	310.1	185.6	27.6	1429.4
1978	13.9	195.5	155.7	99.8	408.1	103.3	56.6	166.6	150.8	142.7	334.7	67.5	1895.2
1979	28.7	148.0	16.0	108.4	30.9	195.8	175.2	44.7	388.8	121.6	476.2	152.1	1886.4
1980	55.3	66.0	4.5	172.2	93.2	127.0	62.2	91.6	104.1	224.2	384.5	114.8	1499.6
1981	26.9	34.5	0.0	16.8	165.6	21.3	32.8	139.4	193.6	254.2	249.4	104.9	1239.4
1982	325.2	188.4	130.3	121.9	179.8	292.6	221.7	389.5	115.0	34.2	46.8	140.5	2185.9
1983	81.6	57.8	83.0	11.2	62.7	109.5	92.5	129.8	282.7	72.1	17.6	155.2	1155.7
1984	144.8	91.2	52.6	235.0	290.1	138.4	164.6	0.0	71.4	41.7	199.9	17.5	1447.2
1985	19.3	24.9	32.8	39.1	186.7	268.5	35.8	136.4	85.3	125.0	167.4	96.0	1217.2
1986	94.5	29.5	89.1	98.3	65.8	14.5	20.1	20.1	61.7	98.0	127.5	14.7	733.8
1987	47.0	.020	24.4	99.3	17.0	65.5	3.5	292.1	77.5	313.4	218.0	35.5	1193.2
1988	2.0	50.8	39.6	126.2	97.3	154.1	169.4	139.7	92.2	16.0	94.0	17.8	999.1
1989	64.8	25.4	17.8	26.2	95.5	90.9	45.0	79.5	55.4	52.8	99.6	12.7	665.6
AVERAGE	81.6	57.8	69.0	103.0	211.2	143.4	118.4	154.0	173.2	213.8	207.5	116.8	1649.9
STAND.DEV.	91.6	50.7	57.9	72.8	126.6	84.4	84.0	103.6	118.5	139.9	110.4	113.3	490.3
MAXIMUM	358.9	195.5	227.0	331.9	526.2	365.5	364.7	438.1	496.3	561.8	479.0	590.2	2979.2
MINIMUM	0.0	0.0	0.0	11.2	17.0	14.5	3.5	0.0	3.5	16.0	17.6	12.7	665.6

YEAR	TOTAL	RANK	PROBABILITY
1989	665.6	1	0.03226
1986	733.8	2	0.06452
1988	999.1	3	0.09677
1983	1155.7	4	0.12903
1987	1193.2	5	0.16129
1985	1217.2	6	0.19355
1981	1239.4	7	0.22581
1960	1262.3	8	0.25806
1977	1429.4	9	0.29032
1984	1447.2	10	0.32258
1976	1462.3	11	0.35484
1974	1494.5	12	0.38710
1980	1499.6	13	0.41935
1972	1582.3	14	0.45161
1962	1627.0	15	0.48387
1968	1632.6	16	0.51613
1975	1664.9	17	0.54839
1970	1707.6	18	0.58065
1966	1790.3	19	0.61290
1973	1835.4	20	0.64516
1979	1886.4	21	0.67742
1978	1895.2	22	0.70968
1964	1938.9	23	0.74194
1969	2064.4	24	0.77419
1967	2072.4	25	0.80645
1982	2185.9	26	0.83871
1965	2272.6	27	0.87097
1971	2275.5	28	0.90323
1961	2285.9	29	0.93548
1963	2979.2	30	0.96774

10 YEAR MOVING AVERAGE

60 - 69	1992.6
61 - 70	2037.1
62 - 71	2036.1
63 - 72	2031.6
64 - 73	1917.2
65 - 74	1872.8
66 - 75	1812.0
67 - 76	1779.2
68 - 77	1714.9
69 - 78	1741.2
70 - 79	1723.4
71 - 80	1702.6
72 - 81	1598.9
73 - 82	1659.3
74 - 83	1591.3
75 - 84	1586.6
76 - 85	1541.8
77 - 86	1469.0
78 - 87	1445.4
79 - 88	1355.8
80 - 89	1233.7

RAINFALL ANALYSIS

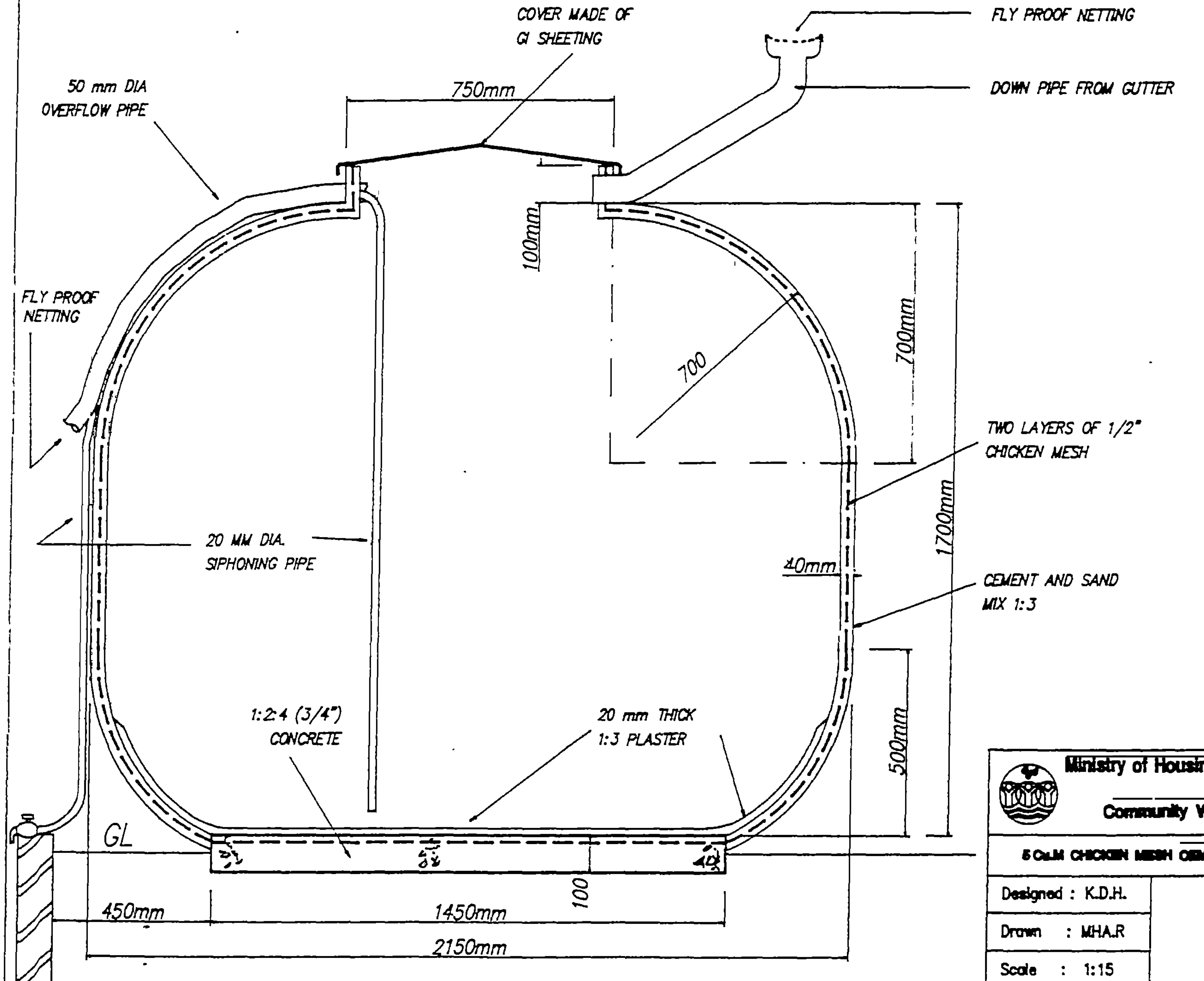
STATION : KAMBURUPITIYA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1960	114.9	110.8	33.8	305.2	61.4	14.7	161.6	3.2	94.3	284.8	215.0	90.9	1490.6
1961	202.7	184.7	150.5	47.0	96.1	68.6	85.8	58.8	56.3	201.1	226.3	128.9	1506.8
1962	216.3	34.5	94.9	167.9	140.1	21.3	28.5	20.4	113.2	103.5	375.9	160.3	1476.8
1963	116.8	66.6	59.7	92.1	141.8	46.4	48.1	22.3	68.3	395.4	317.5	96.0	1471.0
1964	216.3	96.4	141.8	151.6	85.5	52.2	92.6	43.8	78.2	93.4	66.6	78.2	1196.6
1965	0.0	143.8	141.8	114.1	178.1	11.6	68.5	68.5	103.0	280.0	324.4	184.0	1617.8
1966	68.5	77.4	216.0	287.7	2.5	9.1	13.1	20.0	216.9	291.5	90.7	143.1	1436.5
1967	68.5	44.4	49.3	221.6	112.2	61.8	87.3	43.4	51.4	369.5	324.4	26.2	1460.0
1968	321.4	0.0	115.7	69.0	105.0	74.4	66.2	7.5	36.0	5.7	198.6	66.4	1065.9
1969	2.7	5.5	197.9	224.5	170.0	93.3	0.7	222.8	102.2	367.3	202.5	598.7	2188.1
1970	167.4	84.7	89.9	176.2	75.3	11.3	32.8	22.7	16.1	42.1	293.7	198.6	1190.8
1973	38.3	60.1	155.8	142.4	82.4	84.6	31.9	35.5	23.2	305.2	144.4	279.6	1383.4
1974	0.0	81.7	83.6	90.3	92.5	39.2	52.4	40.0	109.8	73.5	104.9	105.8	873.7
1975	54.5	151.9	251.6	181.8	330.6	108.0	66.2	30.5	56.8	47.4	289.9	208.8	1778.0
1976	24.8	3.0	36.7	242.2	85.7	5.4	17.1	30.2	23.3	211.2	341.6	94.8	1116.0
1977	0.5	43.7	169.7	93.9	131.1	12.3	9.5	63.9	38.1	266.7	291.0	127.2	1247.6
1978	34.1	46.2	115.7	79.0	212.1	8.9	13.2	25.0	78.3	106.9	136.2	93.7	949.3
1979	2.0	107.2	2.3	202.3	129.5	31.8	19.8	3.3	94.4	88.6	318.2	290.5	1289.9
1980	0.8	2.0	42.8	210.9	56.7	16.3	25.6	1.0	53.6	118.3	555.8	290.5	1374.3
1982	5.1	45.5	127.1	117.1	201.8	112.5	47.2	48.8	12.7	277.8	439.1	106.3	1541.0
1983	0.0	0.0	22.6	43.5	52.0	6.1	6.1	29.2	13.2	87.3	132.5	265.4	657.9
1984	64.3	155.2	183.8	114.2	52.3	24.4	391.1	8.5	13.2	87.3	291.3	129.5	1515.1
1985	84.7	54.8	253.6	44.2	154.0	145.6	4.7	18.4	135.0	264.6	223.9	178.9	1562.4
1986	143.2	97.4	128.7	137.5	49.0	18.6	6.7	55.1	99.2	165.0	67.0	43.9	1001.3
1987	66.6	1.1	187.4	238.2	28.8	11.3	0.0	111.5	101.1	265.2	67.0	54.5	1122.7
1988	67.7	40.8	149.5	177.7	82.5	63.6	50.2	37.7	79.9	187.3	314.8	123.1	1364.8
AVERAG	79.7	66.9	122.4	152.8	111.9	44.4	54.9	41.2	71.8	191.8	243.6	160.1	1341.5
STD.DE	83.9	51.9	68.6	72.8	67.5	38.4	76.6	43.5	45.9	111.4	121.5	114.8	303.8
MAXIMU	321.4	184.7	253.6	305.2	330.6	145.6	391.1	222.8	216.9	395.4	555.8	598.7	2188.1
MINIMU	0.0	0.0	2.3	43.5	2.5	5.4	0.0	1.0	12.7	5.7	57.0	26.2	657.9

YEAR	TOTAL	RANK	PROBABILITY
1983	657.9	1	0.03704
1974	873.7	2	0.07407
1978	949.3	3	0.11111
1986	1001.3	4	0.14815
1968	1065.9	5	0.18519
1976	1116.0	6	0.22222
1987	1122.7	7	0.25926
1970	1190.8	8	0.29630
1964	1196.6	9	0.33333
1977	1247.6	10	0.37037
1979	1289.9	11	0.40741
1988	1364.8	12	0.44444
1980	1374.3	13	0.48148
1973	1383.4	14	0.51852
1966	1436.5	15	0.55556
1967	1460.0	16	0.59259
1963	1471.0	17	0.62963
1962	1476.8	18	0.66667
1960	1490.6	19	0.70370
1961	1506.8	20	0.74074
1984	1515.1	21	0.77778
1982	1541.0	22	0.81481
1985	1562.4	23	0.85185
1965	1617.8	24	0.88889
1975	1778.0	25	0.92593
1969	2188.1	26	0.96296

10 YEAR MOVING AVERAGE

	AVG.
60 - 69	1491.0
61 - 70	1461.0
62 - 73	1446.7
63 - 74	1380.4
64 - 75	1419.1
65 - 76	1411.0
66 - 77	1374.0
67 - 78	1325.3
68 - 79	1306.3
69 - 80	1331.1
70 - 82	1274.4
73 - 83	1221.1
74 - 84	1234.3
75 - 85	1301.2
76 - 86	1225.5
77 - 87	1226.2
78 - 88	1237.9



Ministry of Housing, Construction & Public Utilities Community Water Supply & Sanitation Project	
5 Cu.M CHICKEN MESH CEMENT TANK FOR RAIN WATER HARVESTING	
Designed : K.D.H.	
Drawn : MHA.R	
Scale : 1:15	
Date :	

Annex – 4

5M^3 RAIN WATER HARVESTING TANK – RATNAPURA DISTRICT
(FERRO–CEMENT TYPE)

MAY 95

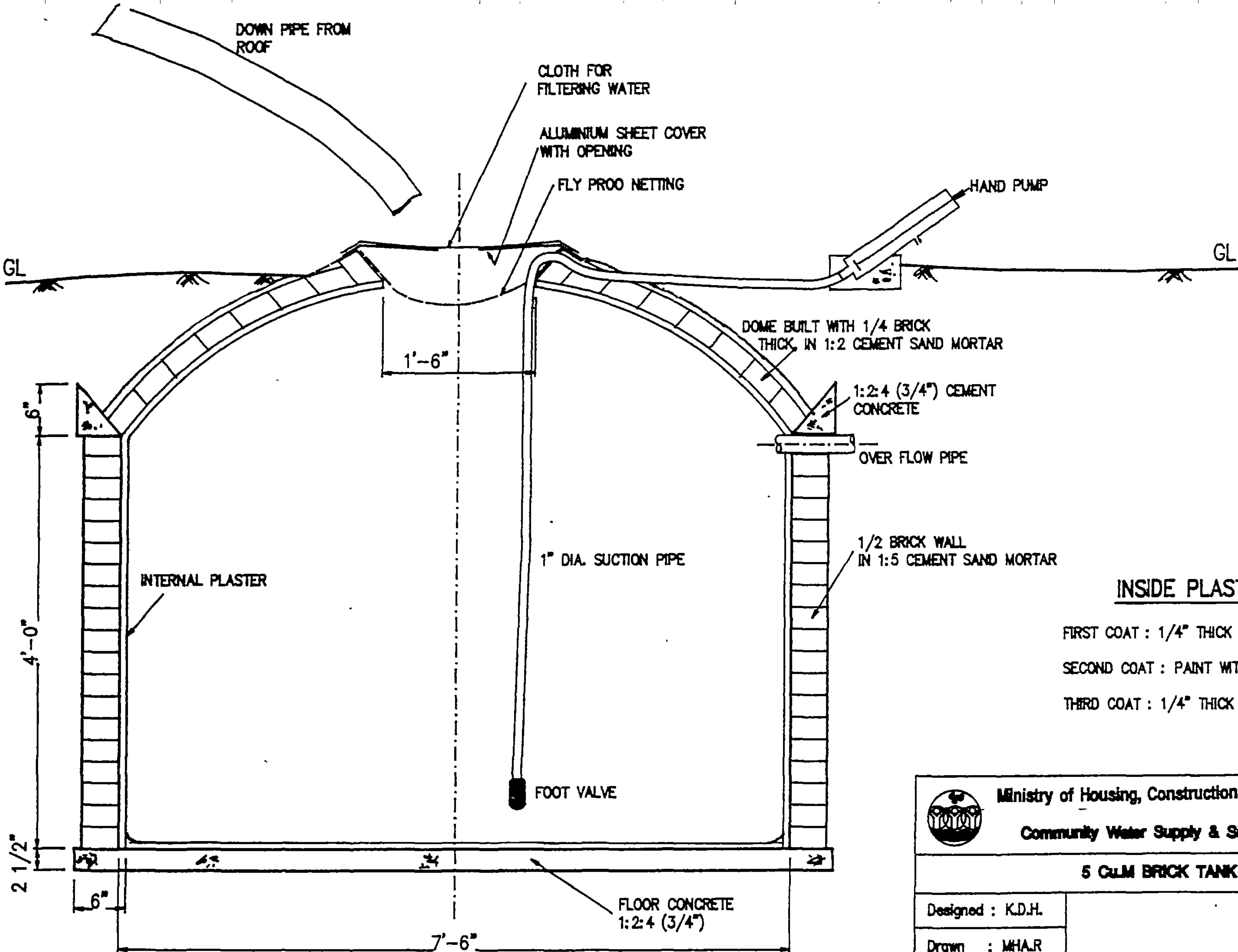
MAJOR COSTS (TRIAL CONSTRUCTION)

MATERIAL	UNIT	QTY	UNIT COST	COST	COST INTERNAL	COST EXTERNAL
CEMENT	Bag	8	265	2120		2120
SAND	ft^3	55	3.5	192.5		192.5
METAL	ft^3	6	18	108	54	54
1/2" CHICKEN MESH	ft^2	366	4	1464		1464
				3884		
MOULD				325		325
TRANSPORT				500	150	350
SKILLED LABOUR	HR	56	22	1232		1232
UNSKILLED LABOUR	HR	112	12.5	1400	1400	
				7341.5	1604	5737
					Contributions	
					22%	73%
					HH	CWSSP

Note:			Cost of a liter
	1. Material + Skill Labour + Mould	= 5441	1.09
	Material + Skill Labour + Mould + Transport	= 5941	1.19
	Material + Skill Labour + Mould + Transport + Unskill Labour	= 7342	1.47

2. The mould is used for the consrtuction of ten tanks. Total Cost of the mould is Rs. 3250/–.

sda/c/rwhr.wk3/23May95



INSIDE PLASTERING

FIRST COAT : 1/4" THICK IN 1:3 CEMENT, SAND

SECOND COAT : PAINT WITH NEAT CEMENT SLURRY

THIRD COAT : 1/4" THICK IN 1:2 CEMENT, SAND

Ministry of Housing, Construction & Public Utilities

Community Water Supply & Sanitation Project

5 CuM BRICK TANK

Designed : K.D.H.	
Drawn : MHA.R	
Scale : 1:15	
Date :	

Annex – 6

RAIN WATER HARVESTING TANK
Brick Dome Type
Badulla District

February 1995

Size	D = 6'4"
5 m3	Hwall = 5'
	Hdome = 1'6"

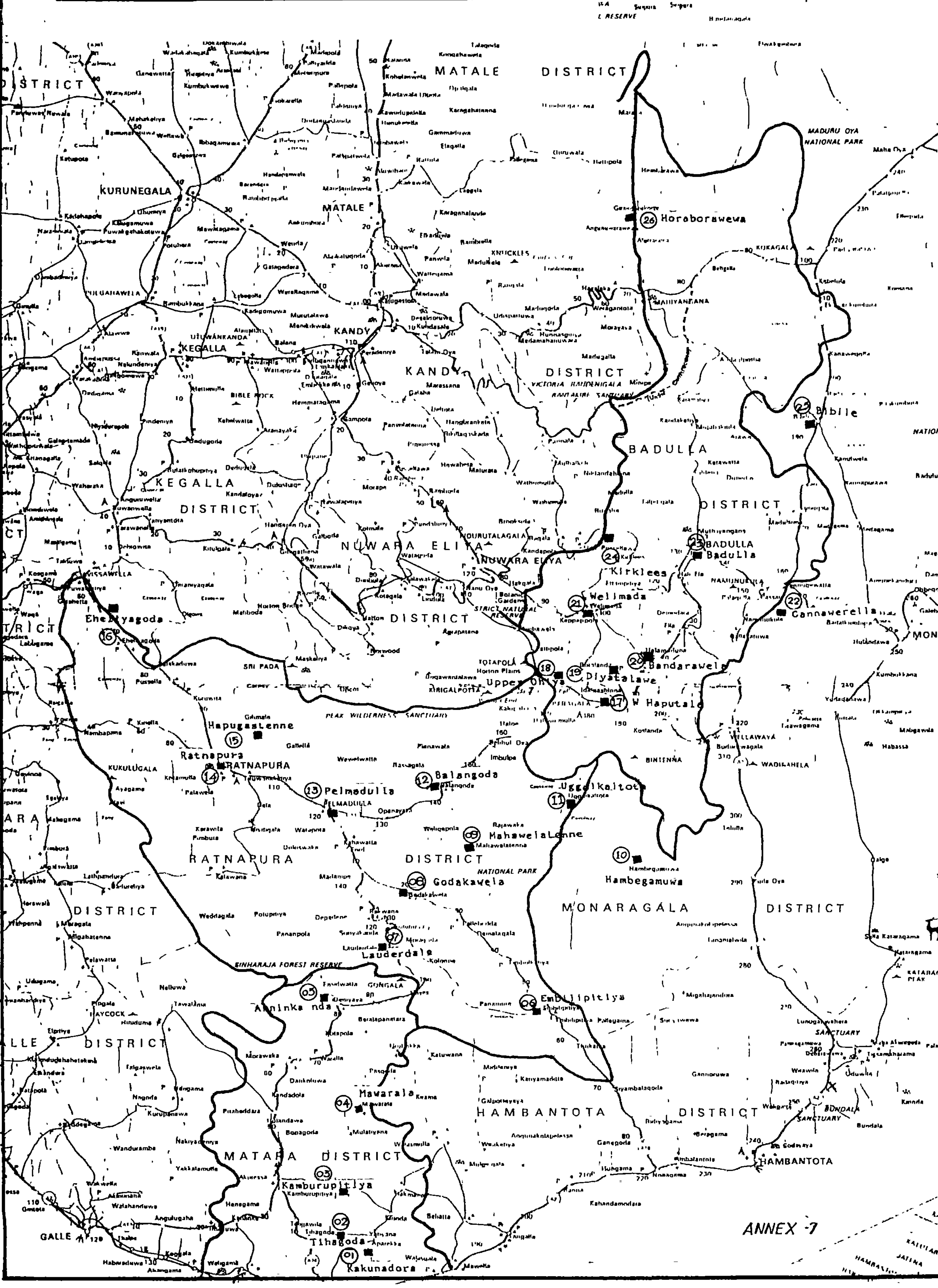
Material	Unit	Quantity	Unit Cost	Cost	Cost internal	Cost external
Cement	Bag	8.6	265	2279		2279
Sand	ft3	33	3.5	115.5		115.5
Metal (3/4")	ft3	9	18	162	81	81
Bricks (2")	nos.	750	1.5	1125		1125
				3681.5		
Transport				1000	300	700
Skilled labour	hour	28	22	616		616
Unskilled labour	hour	96	12.5	1200	1200	
					1581	4916.5
					Contributions	
					24%	76%
					HH	CWSSP

Conclusion

Under normal circumstances a brick rainwater storage tank will be acceptable within the project criteria and will be affordable to the householder in terms of labour and cash

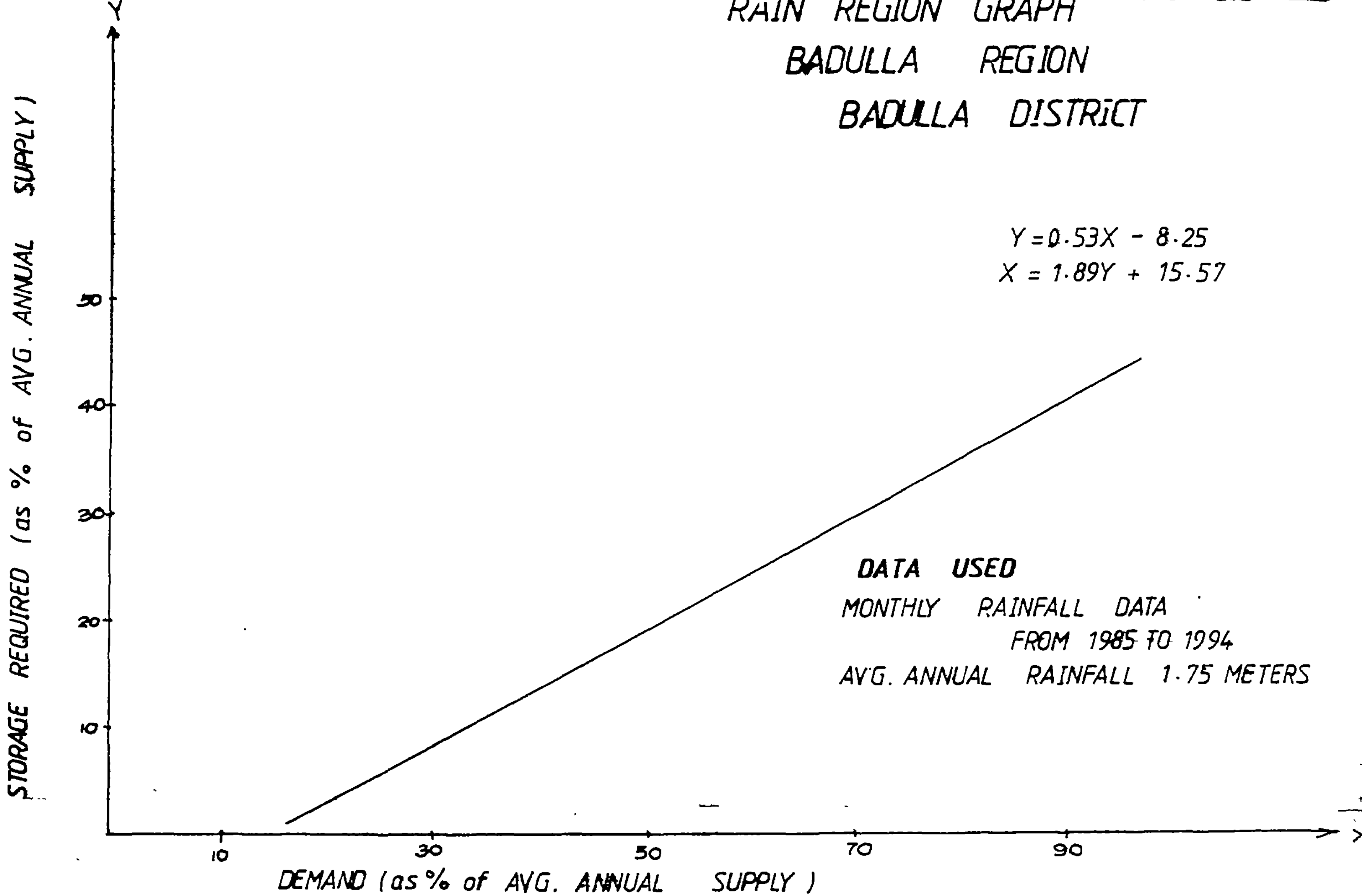
Material + skilled labour	Rs.	4297.5
Material + skilled labour + transport	Rs.	5297.5
Material + skilled labour + transport and unskilled labour	Rs.	6497.5

MAP SHOWING LOCATIONS OF RAINFALL STATIONS

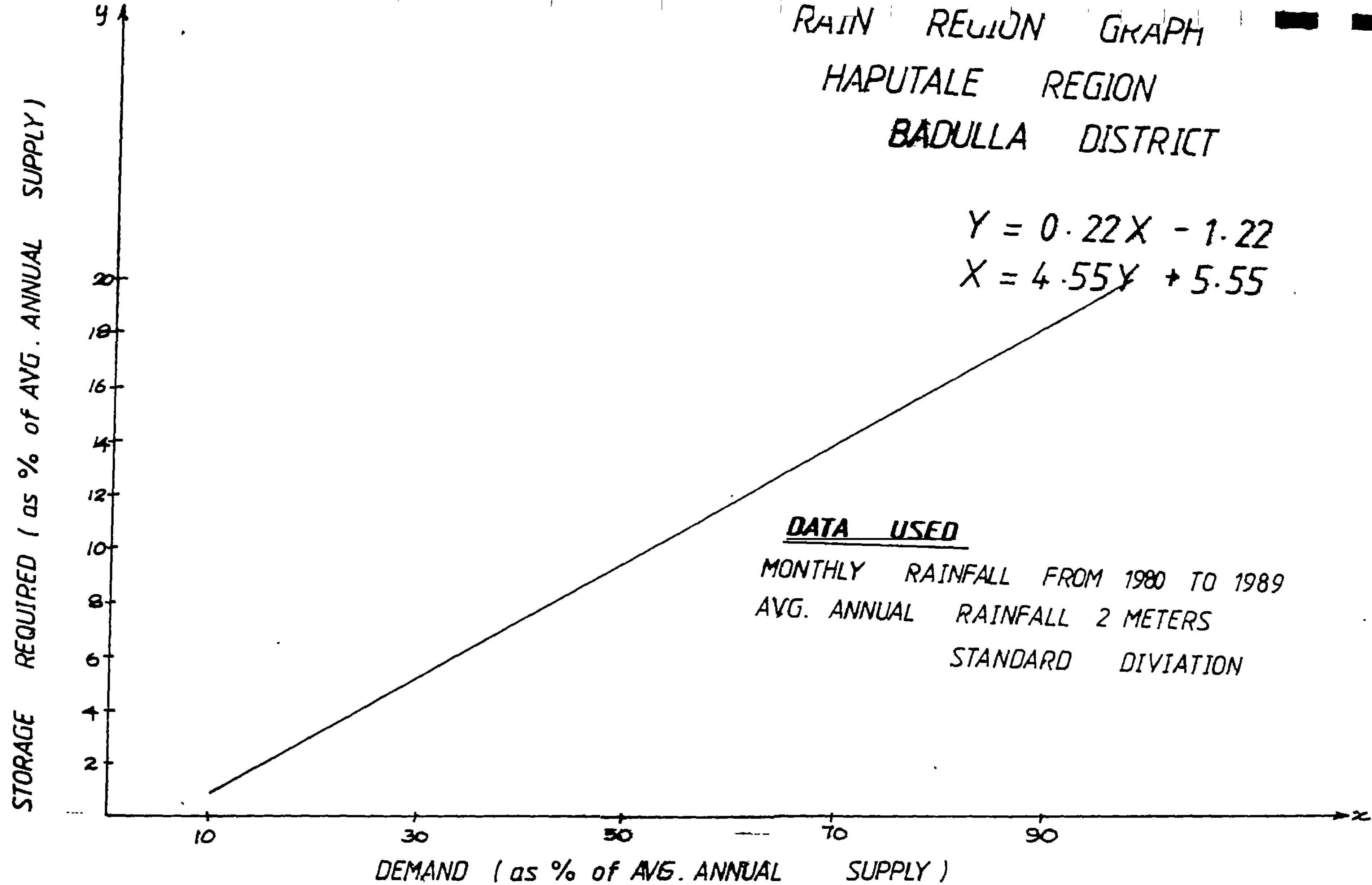


ANNEX -7

RAIN REGION GRAPH
BADULLA REGION
BADULLA DISTRICT

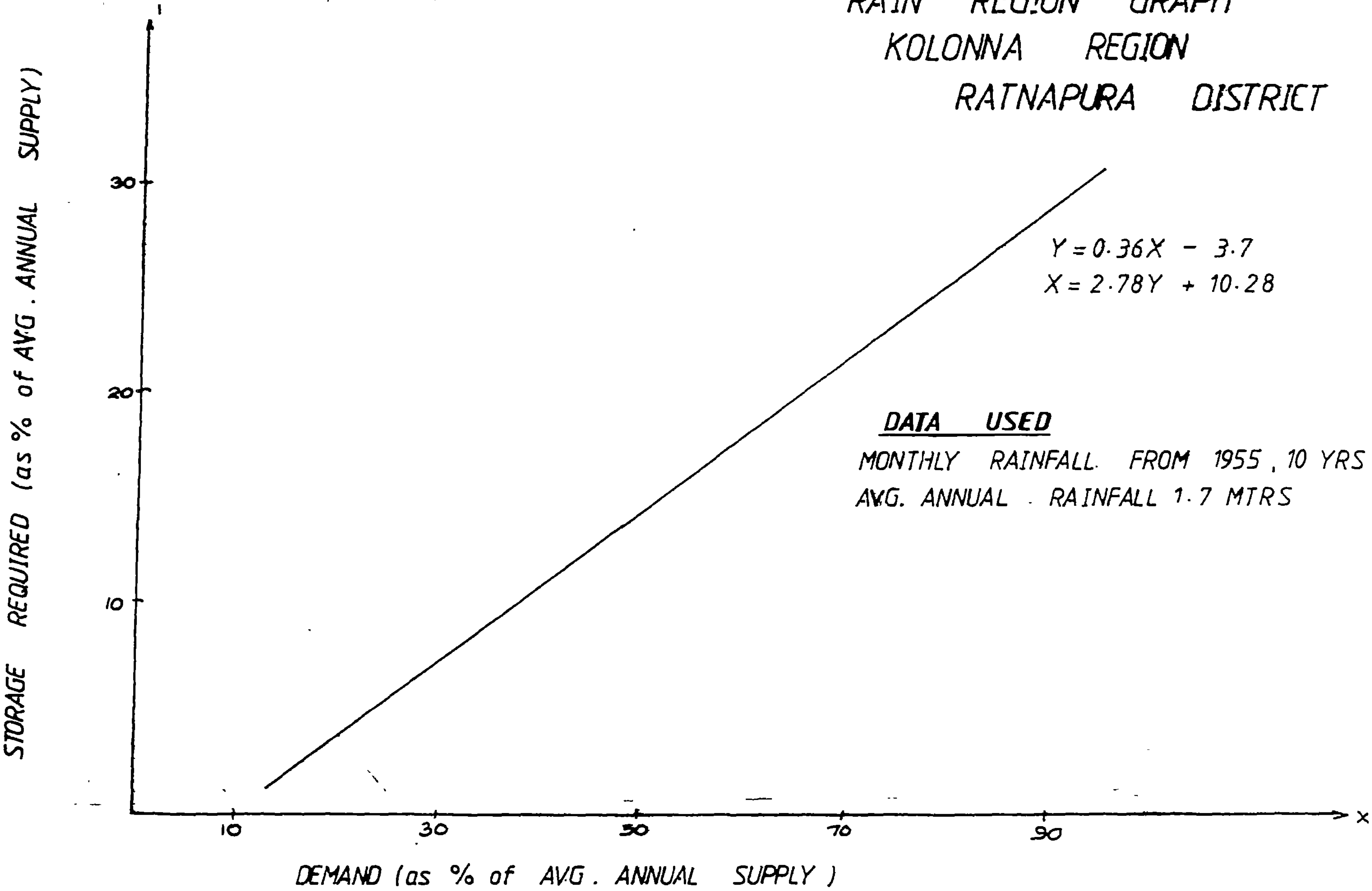


GRAPH - A
ANNEX - 8



GRAPH - B
ANNEX - 8

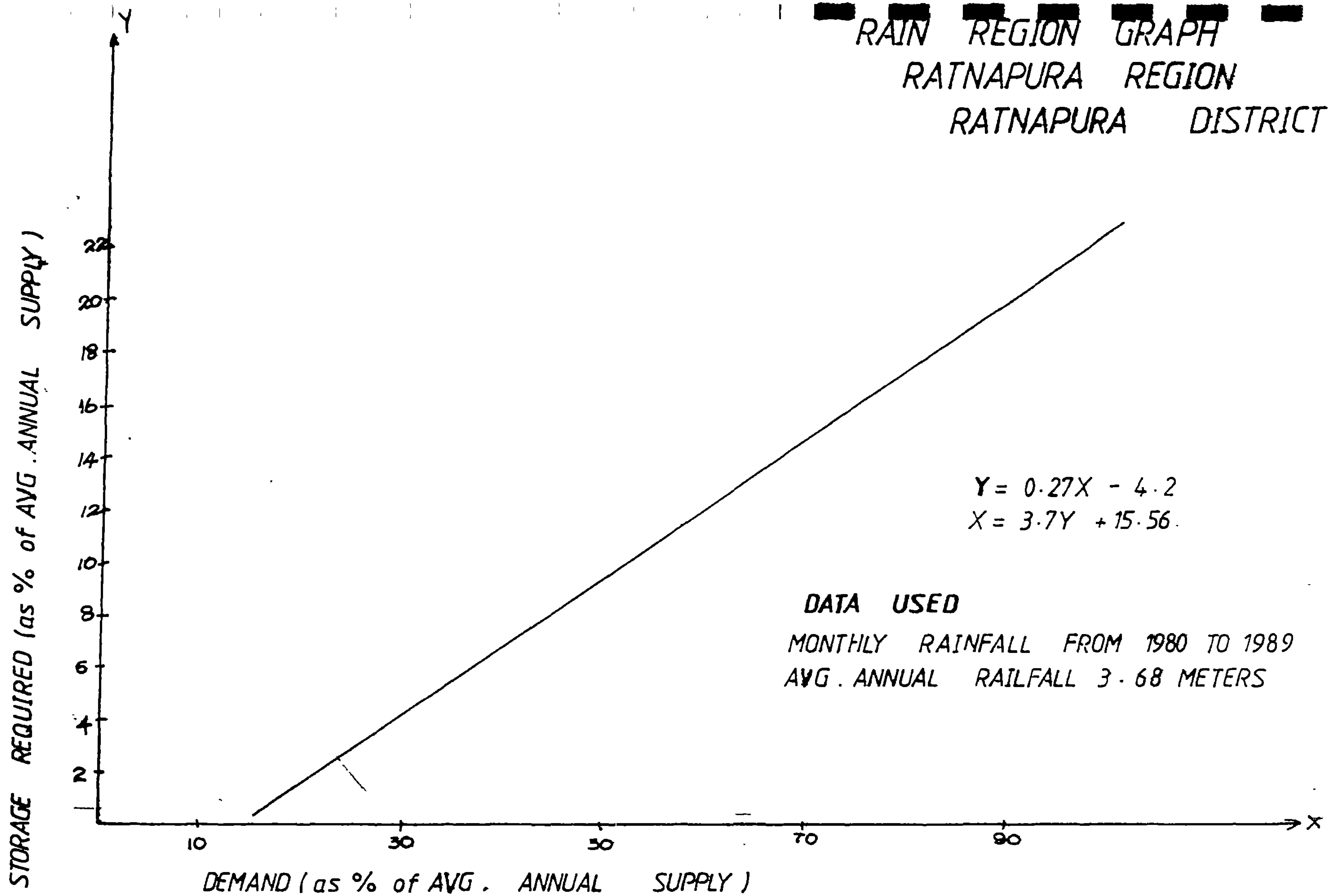
RAIN REGION GRAPH
KOLONNA REGION
RATNAPURA DISTRICT



GRAPH - C

ANNEX - 8

RAIN REGION GRAPH
RATNAPURA REGION
RATNAPURA DISTRICT

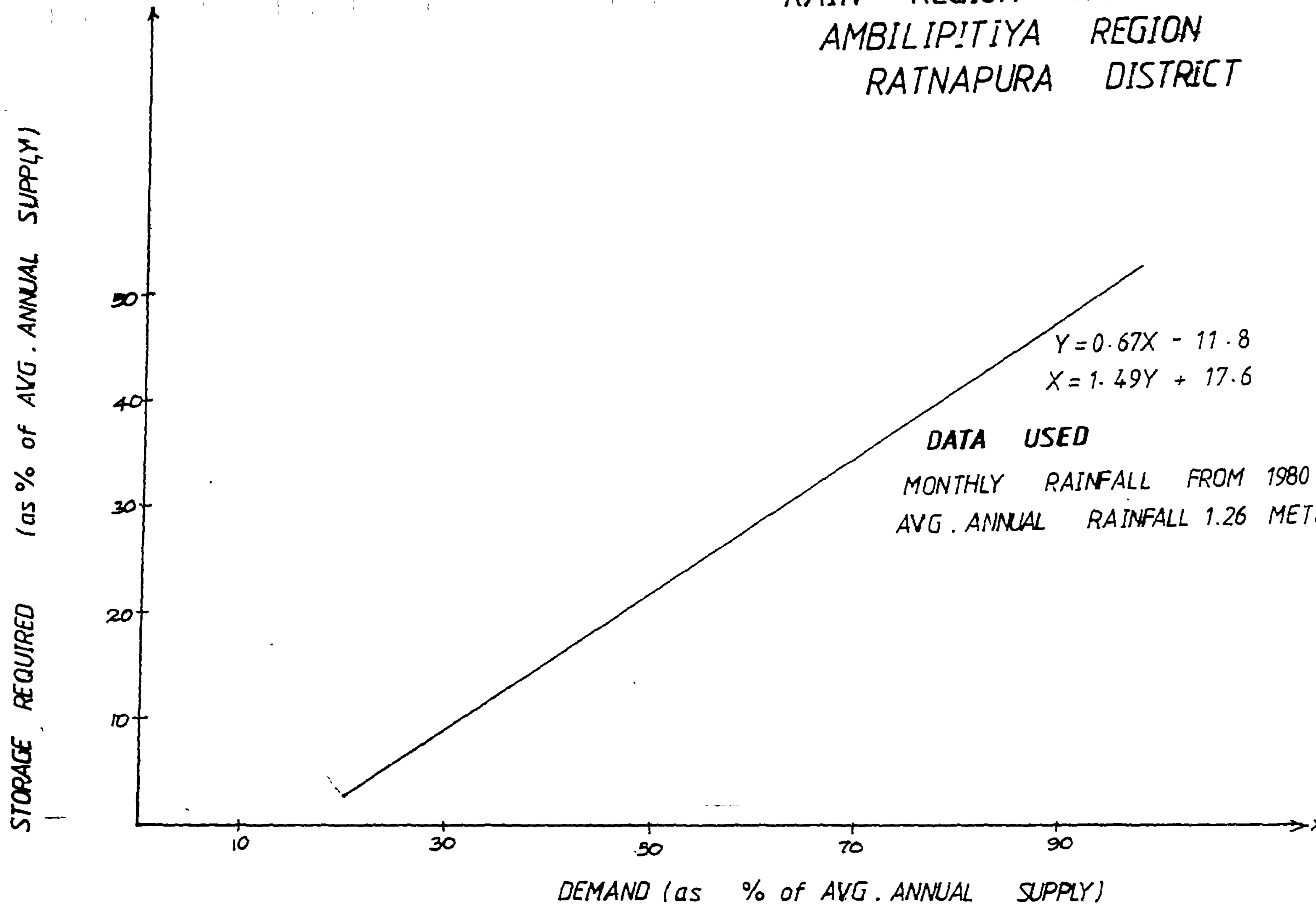


GRAPH - D
ANNEX - 8

REGION GRAPH

AMBILIPITIYA REGION

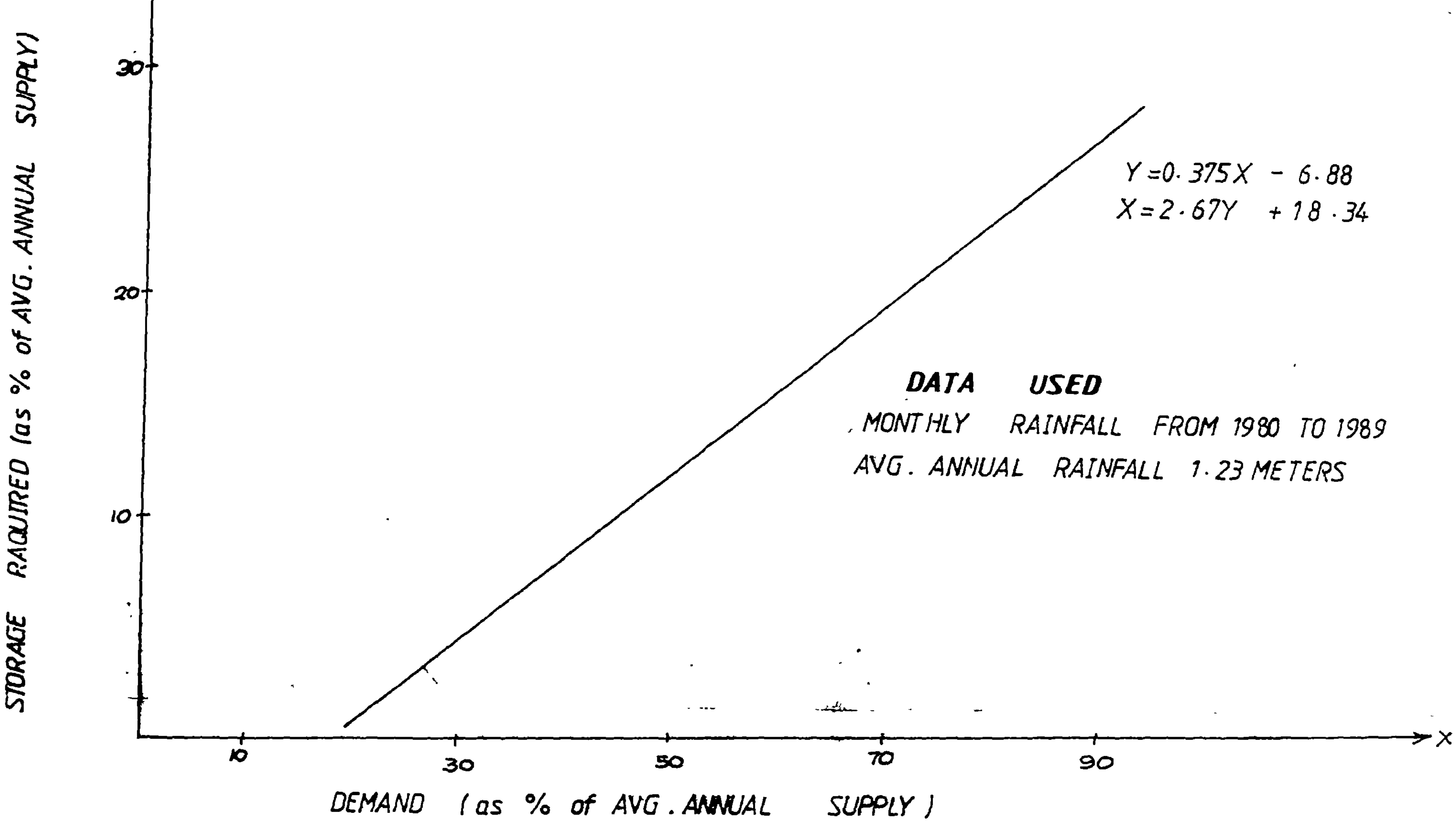
RATNAPURA DISTRICT



GRAPH - E

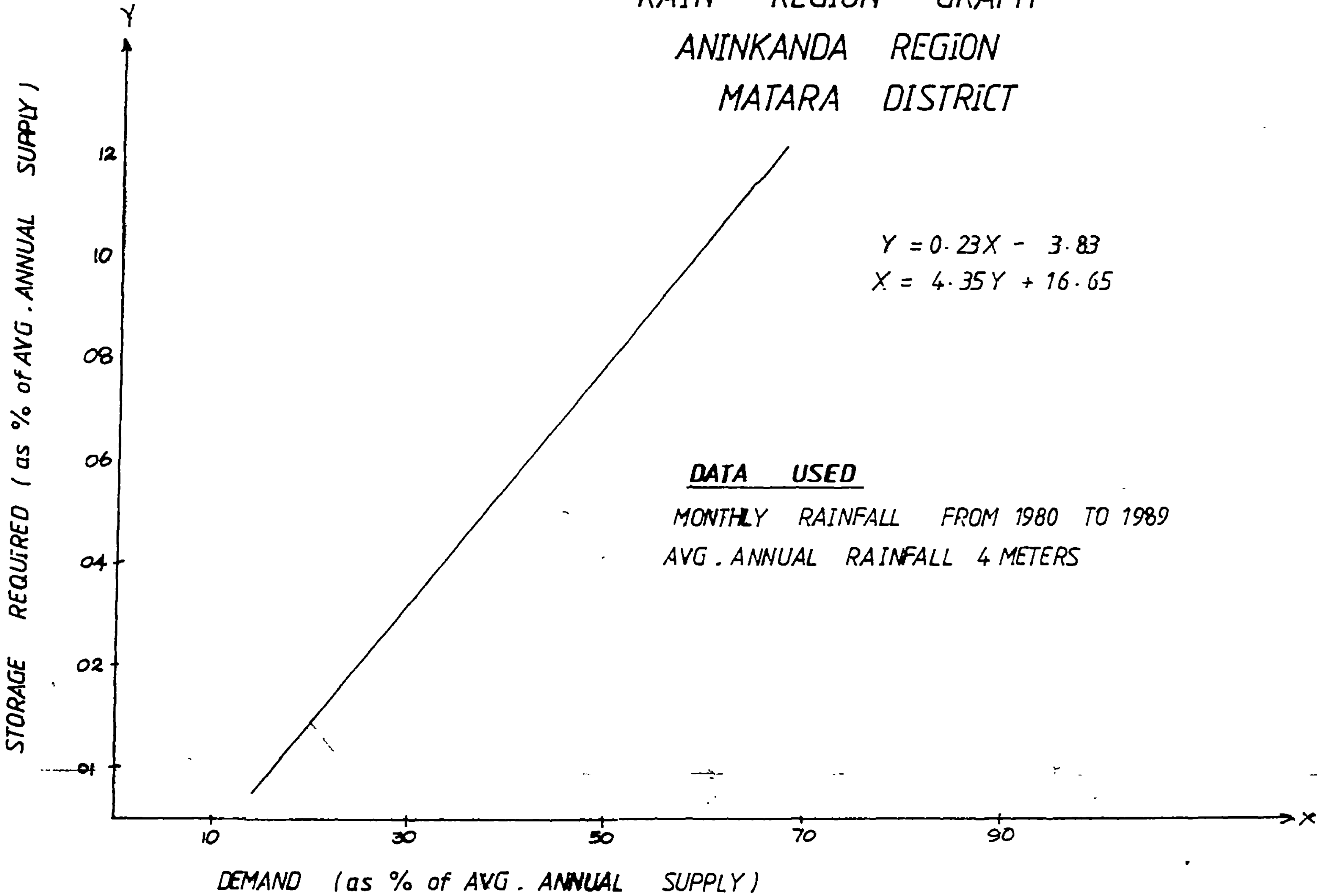
ANNEX - 8

RAIN REGION GRAPH
KEKENADORA REGION
MATARA DISTRICT



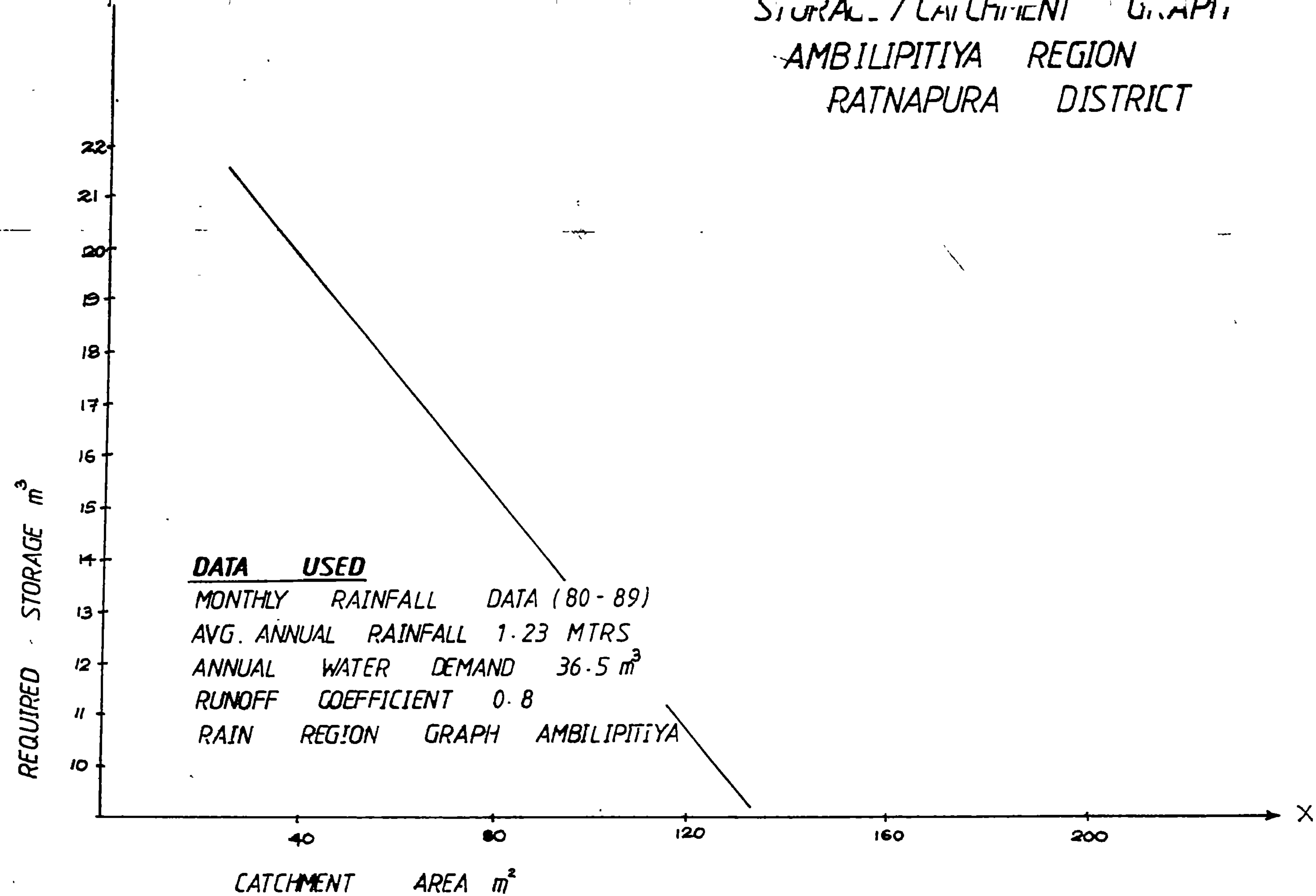
GRAPH - F
ANNEX - 8

RAIN REGION GRAPH
ANINKANDA REGION
MATARA DISTRICT



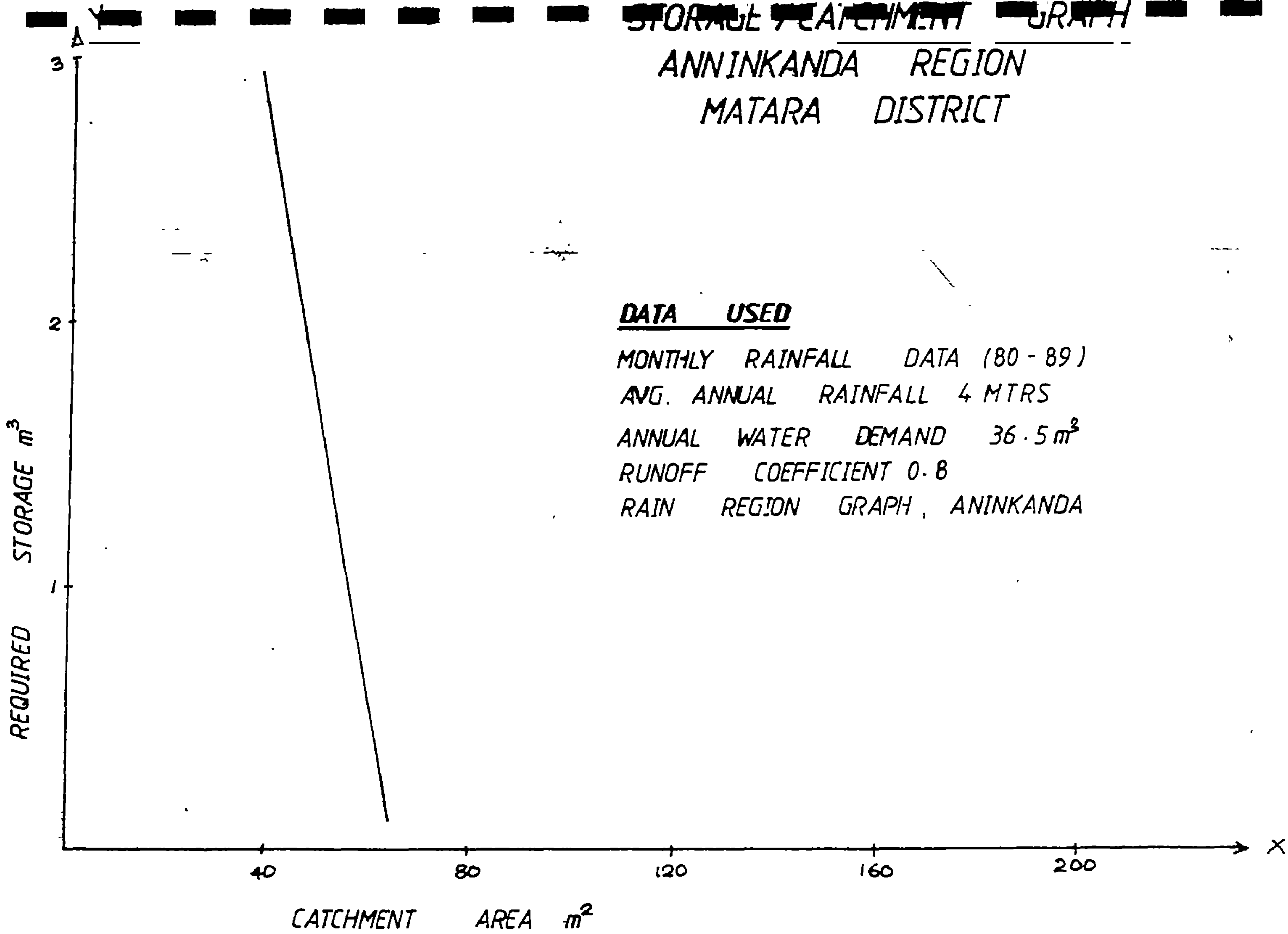
GRAPH - G
ANNEX - 8

STORAGE / CATCHMENT GRAPH
AMBILIPITIYA REGION
RATNAPURA DISTRICT



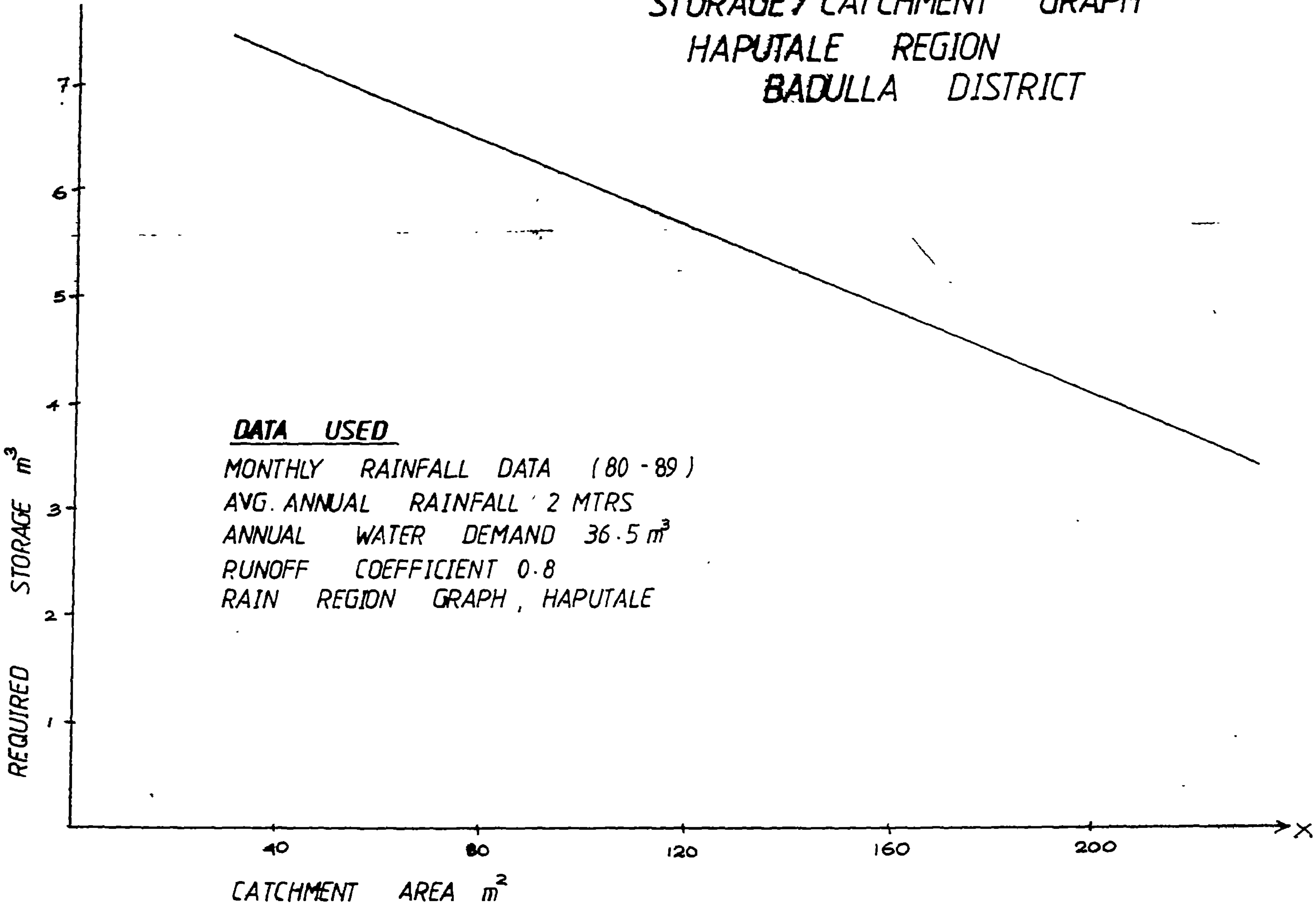
GRAPH - 0
ANNEX - 9

STORAGE / CATCHMENT GRAPH
ANNINKANDA REGION
MATARA DISTRICT



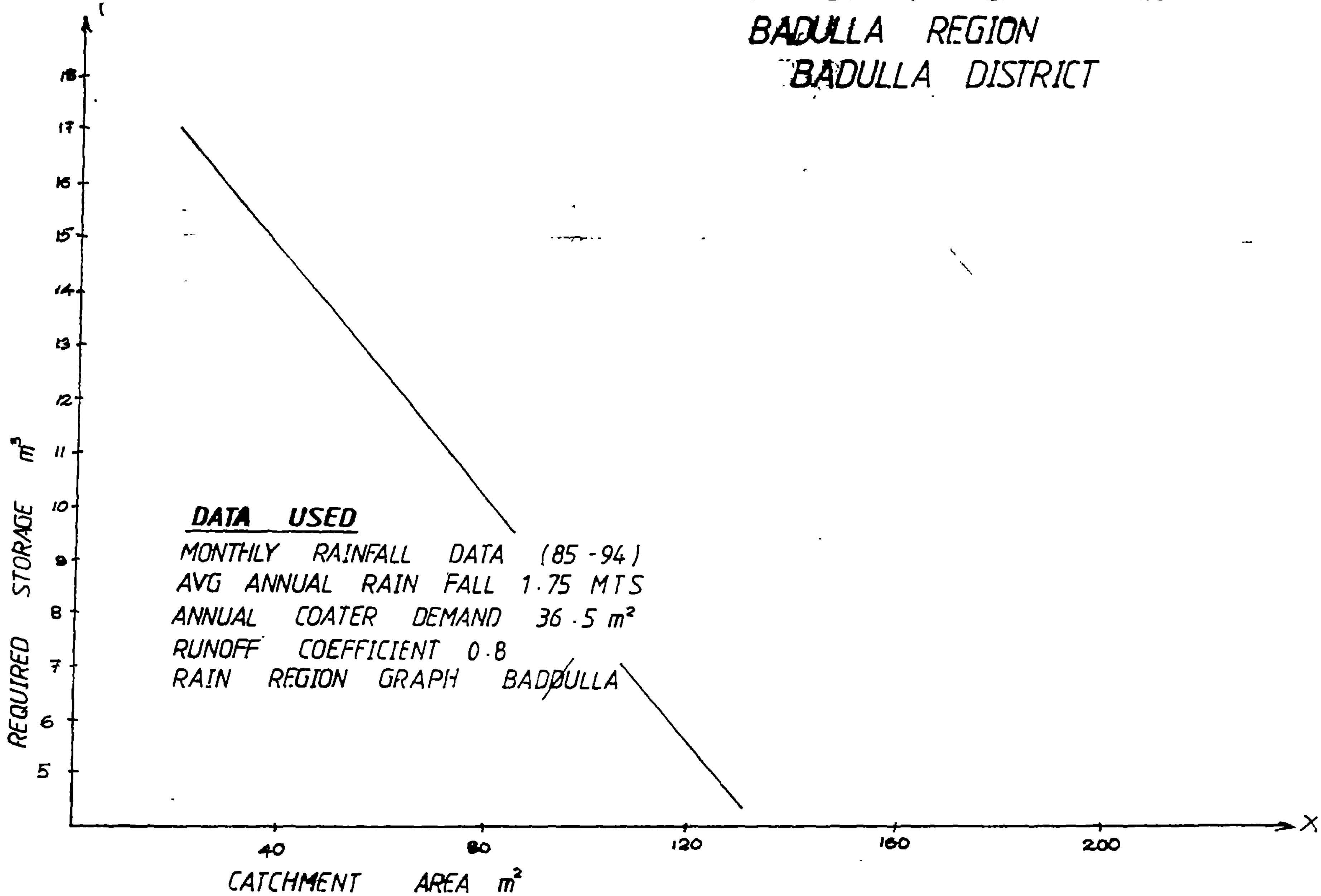
GRAPH - P
ANNEX - 9

STORAGE / CATCHMENT GRAPH
HAPUTALE REGION
BADULLA DISTRICT



GRAPH - Q
ANNEX - 9

BADULLA REGION
BADULLA DISTRICT



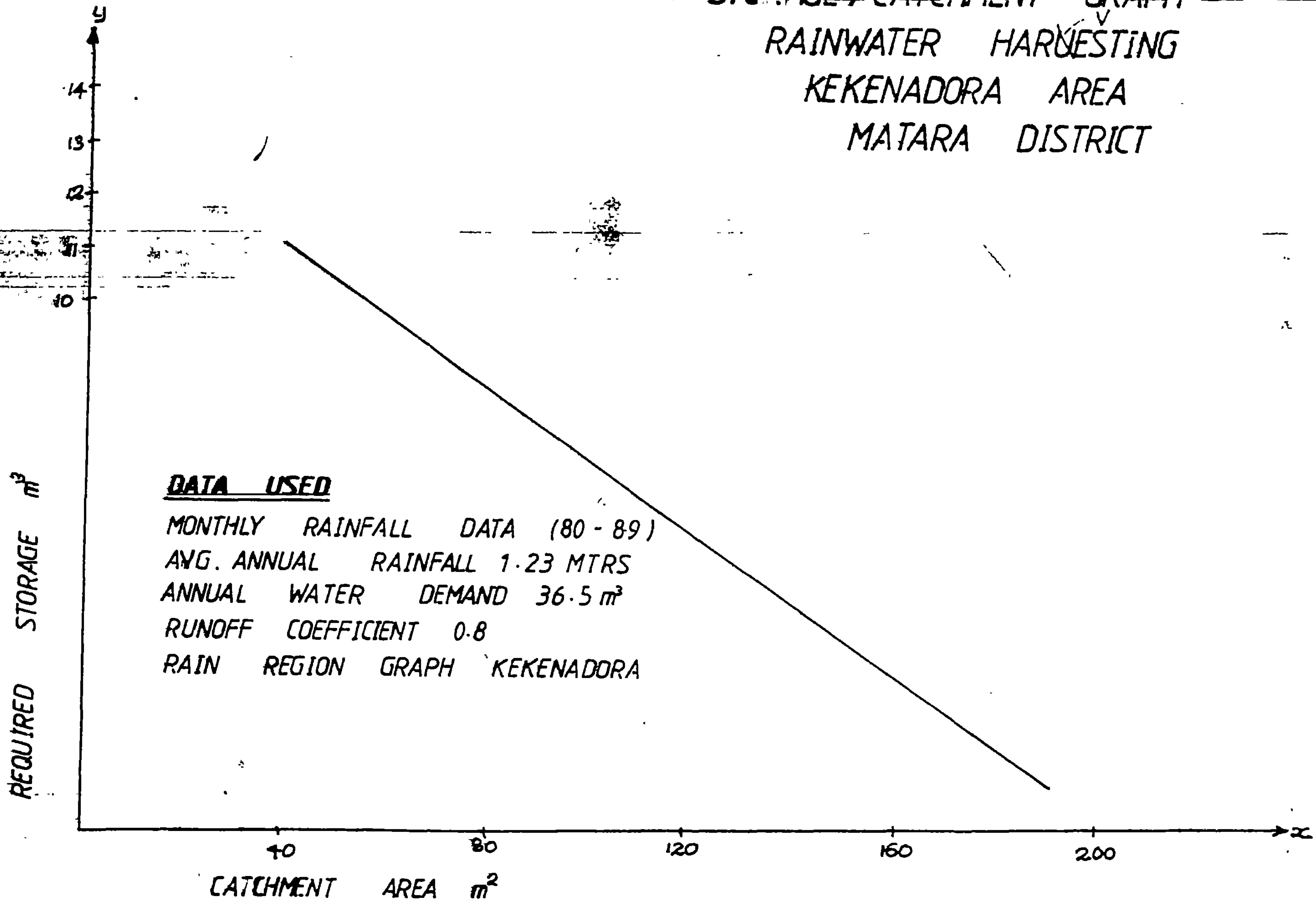
GRAPH - R
ANNEX - 9

[illegible] GRAPH

RAINWATER HARVESTING

KEKENADORA AREA

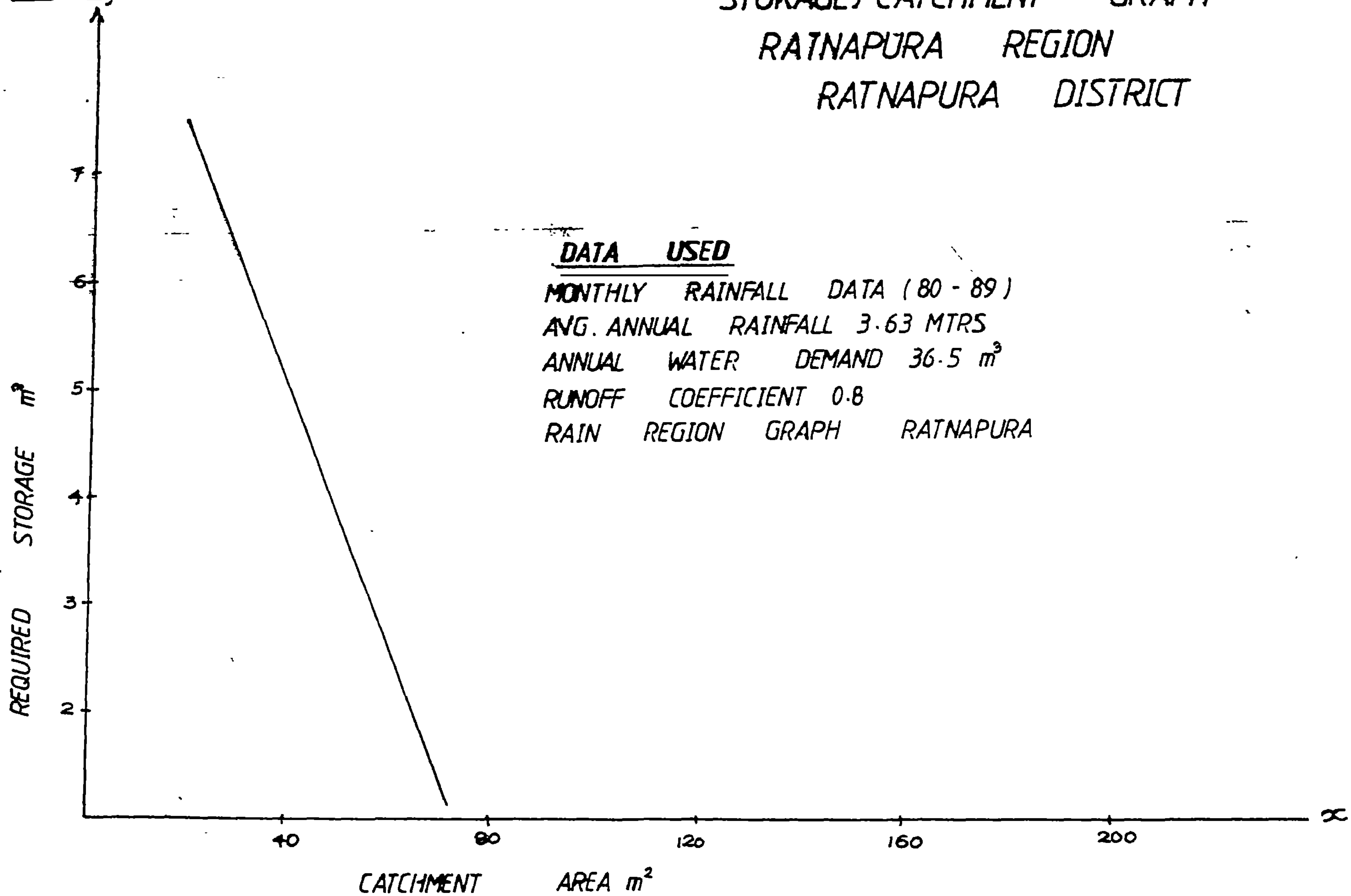
MATARA DISTRICT



GRAPH - 5

ANNEX - 9

STORAGE / CATCHMENT GRAPH
RATNAPURA REGION
RATNAPURA DISTRICT

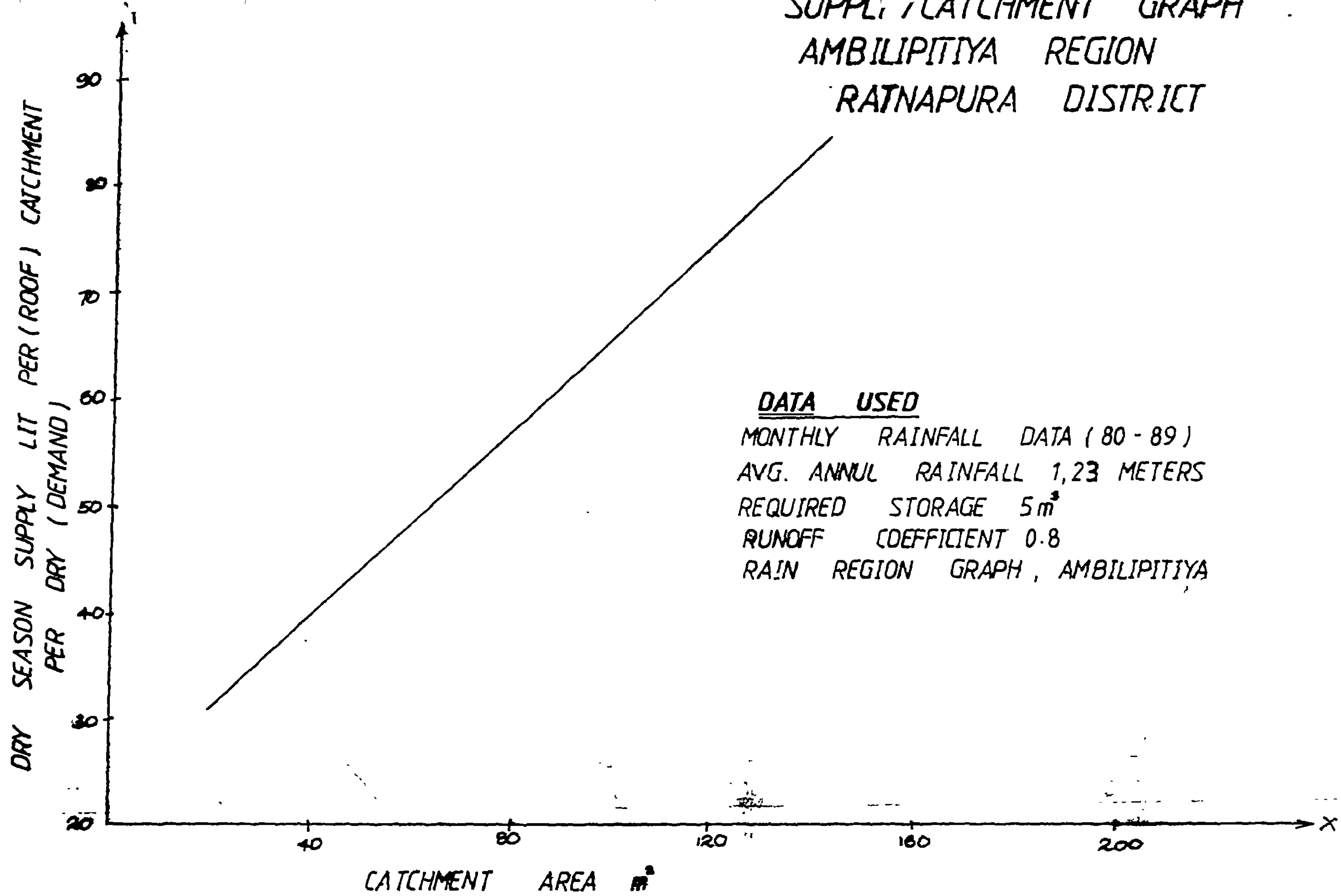


DATA USED

MONTHLY RAINFALL DATA (80 - 89)
AVG. ANNUAL RAINFALL 3.63 MTRS
ANNUAL WATER DEMAND 36.5 m^3
RUNOFF COEFFICIENT 0.8
RAIN REGION GRAPH RATNAPURA

GRAPH - T
ANNEX - 9

SUPPLY /CATCHMENT GRAPH
AMBILIPITIYA REGION
RATNAPURA DISTRICT



DATA USED

MONTHLY RAINFALL DATA (80 - 89)

AVG. ANNUL RAINFALL 1,23 METERS

REQUIRED STORAGE $5 m^3$

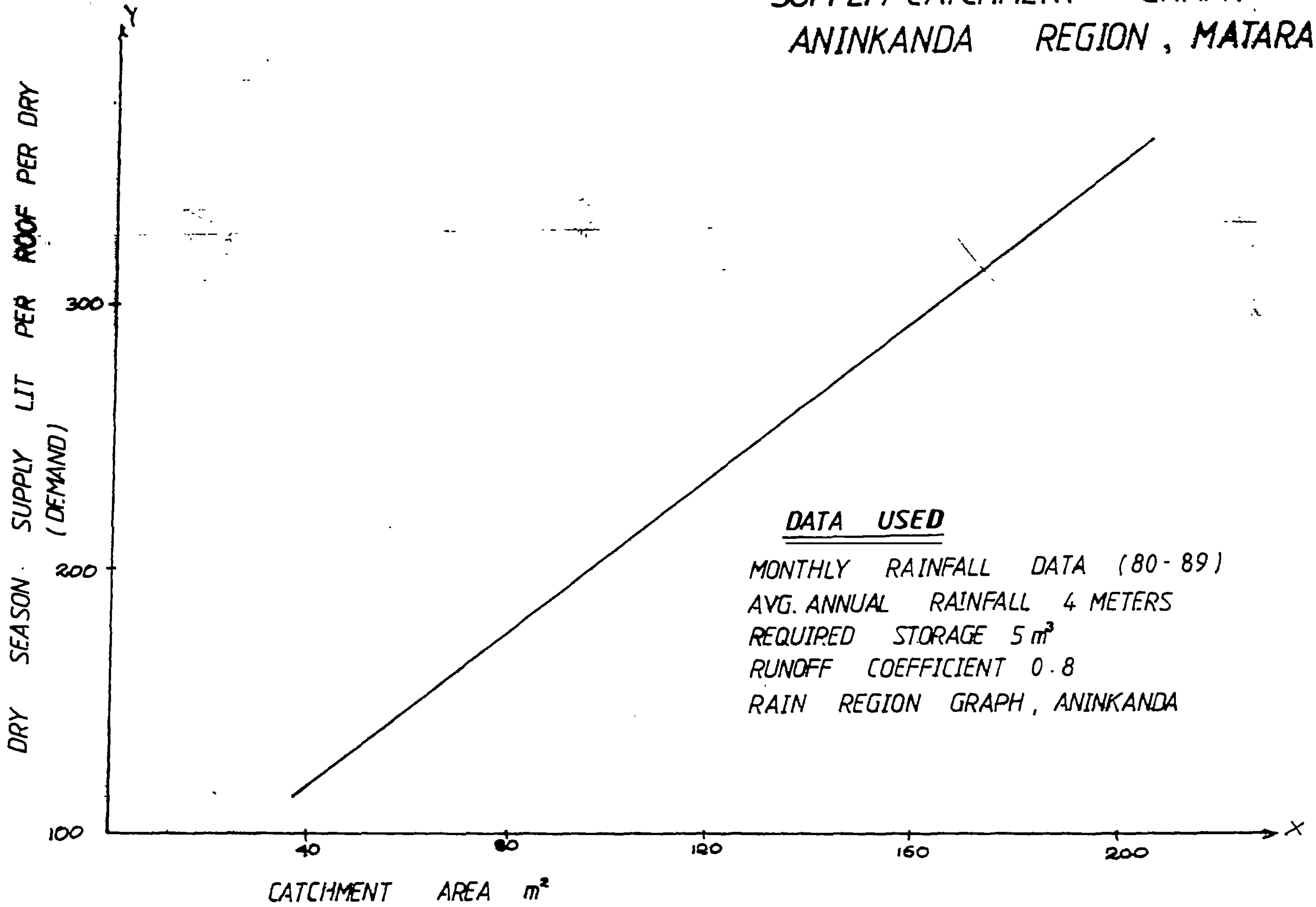
RUNOFF COEFFICIENT 0.8

RAIN REGION GRAPH, AMBILIPITIYA

GRAPH - U

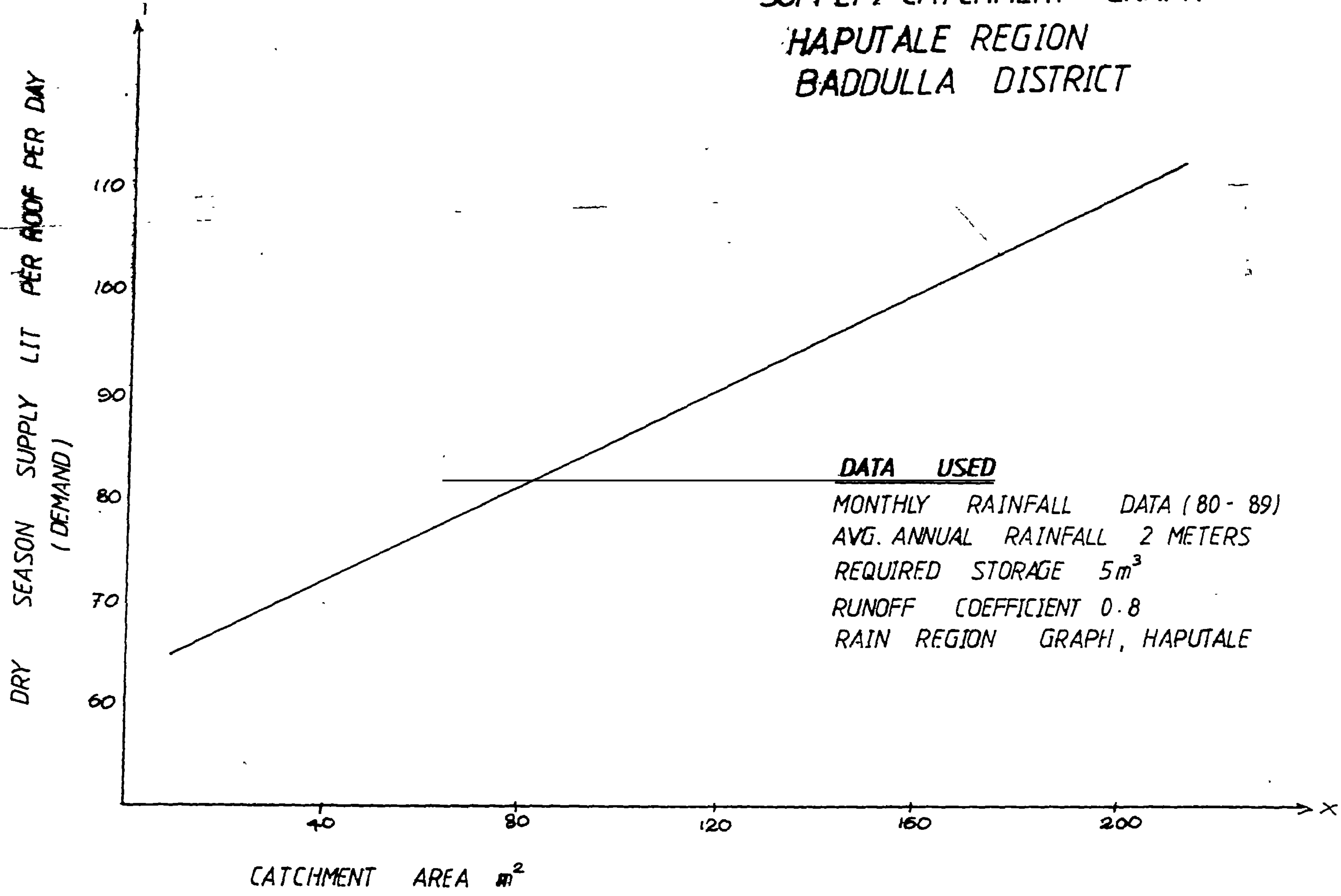
ANNEX - 10

SUPPLY, CATCHMENT GRAPH
ANINKANDA REGION, MATARA



GRAPH - V
ANNEX - 10

SUPPLY / CATCHMENT GRAPH
HAPUTALE REGION
BADDULLA DISTRICT



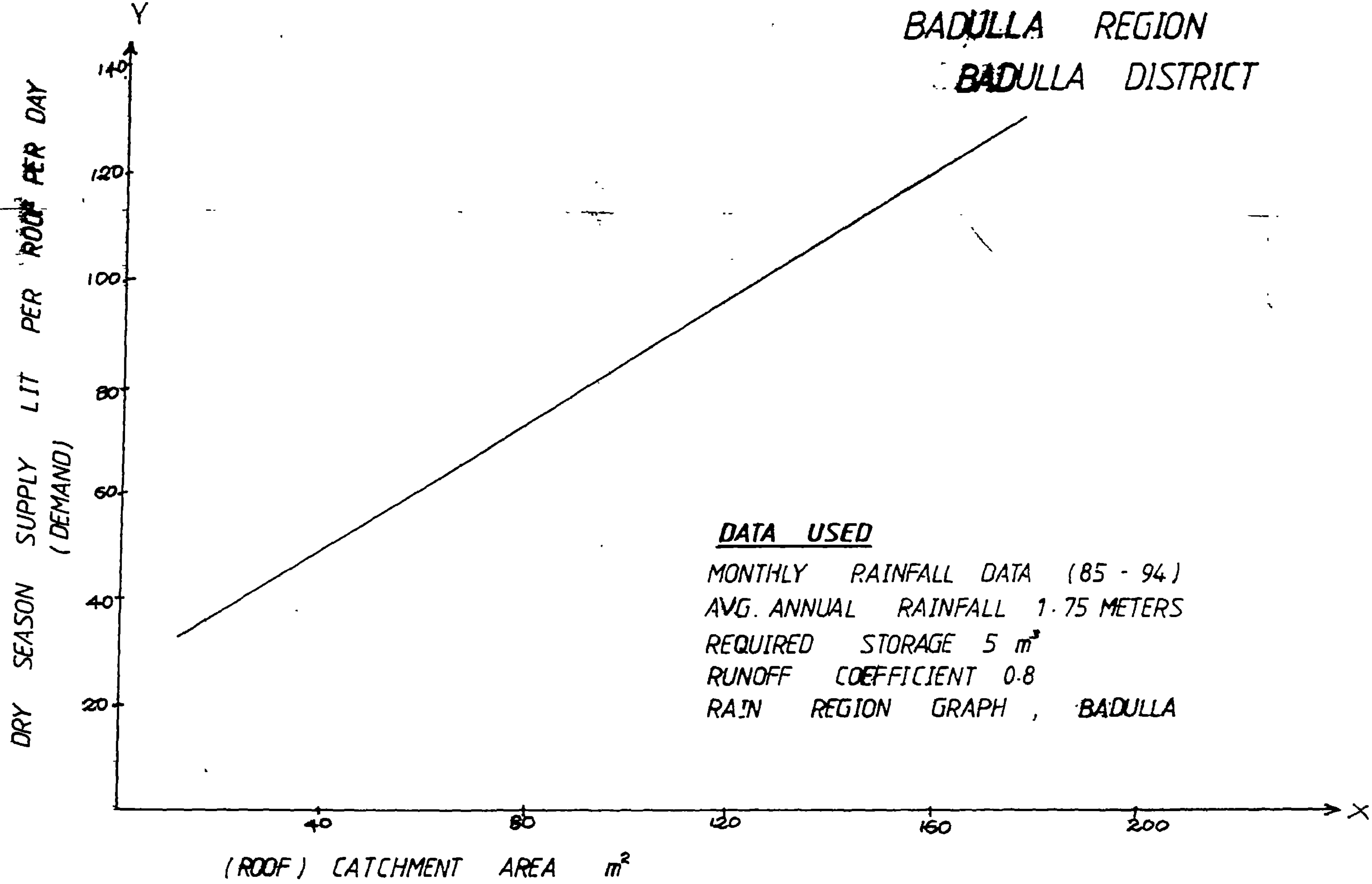
DATA USED

MONTHLY RAINFALL DATA (80 - 89)
AVG. ANNUAL RAINFALL 2 METERS
REQUIRED STORAGE 5 m^3
RUNOFF COEFFICIENT 0.8
RAIN REGION GRAPH, HAPUTALE

GRAPH - W
ANNEX - 10

BADULLA REGION

BADULLA DISTRICT

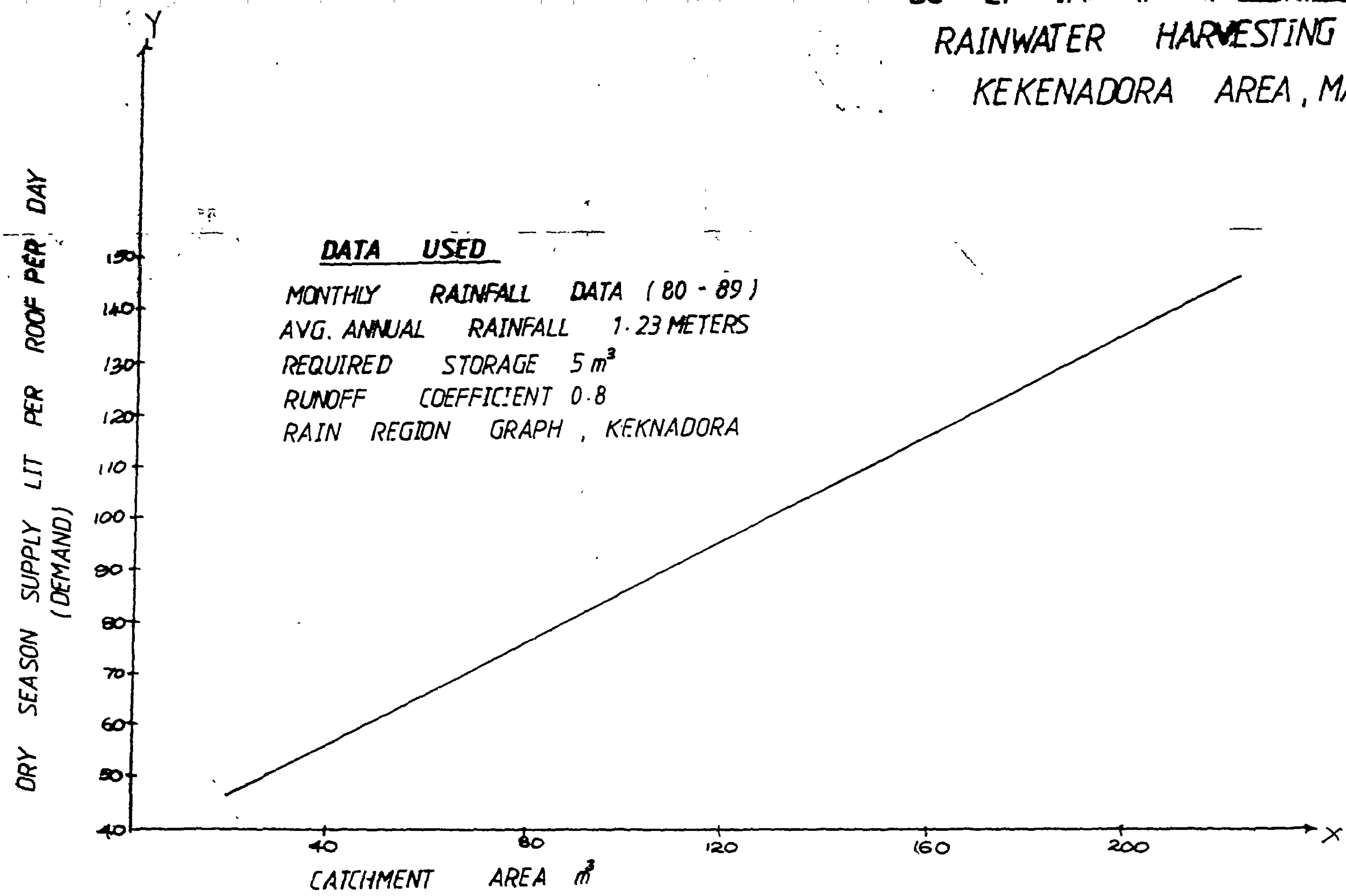


GRAPH - X

ANNEX - 10

RAINWATER HARVESTING

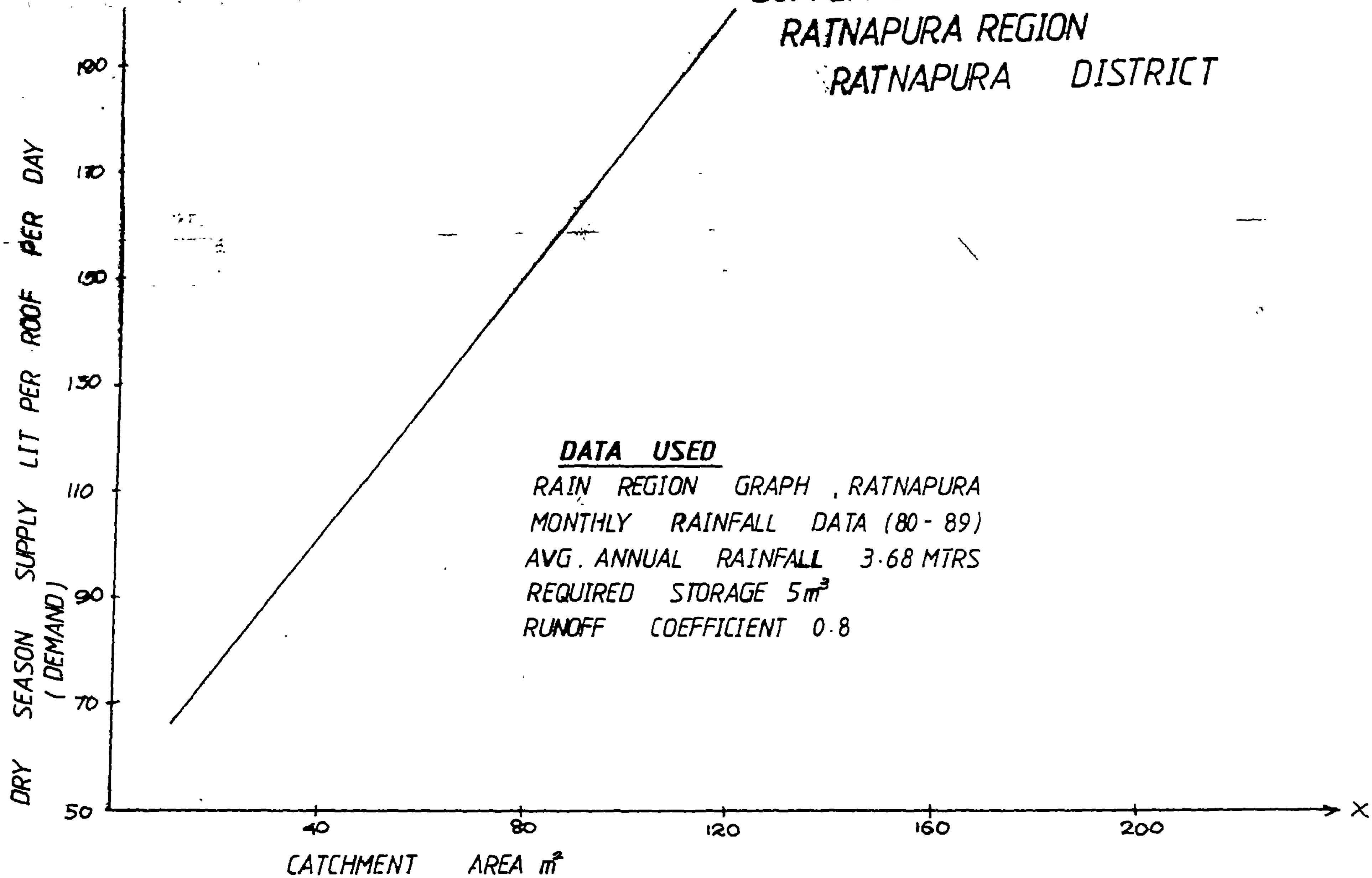
KEKENADORA AREA, MATAR



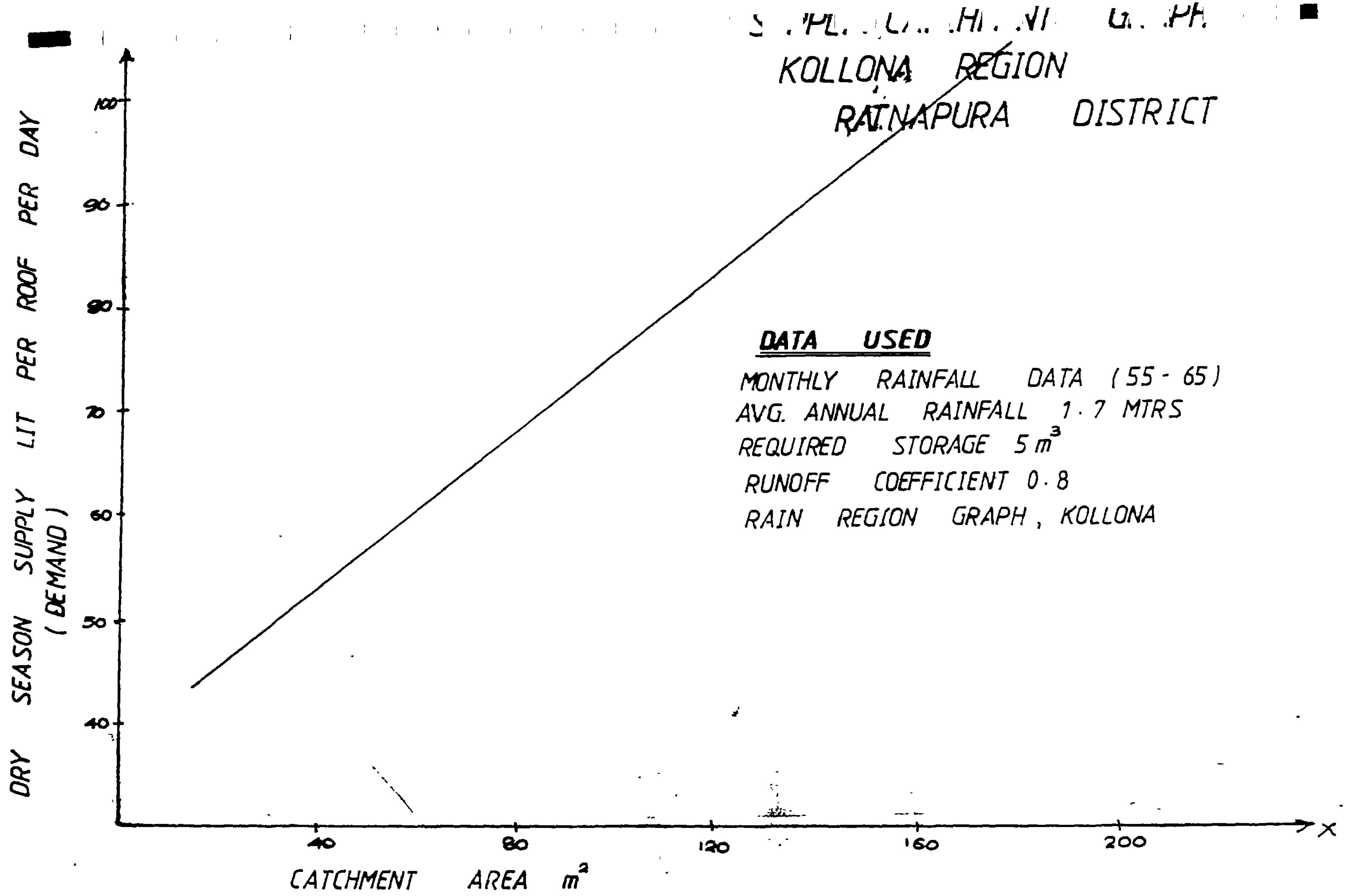
GRAPH - Y

ANNEX - 10

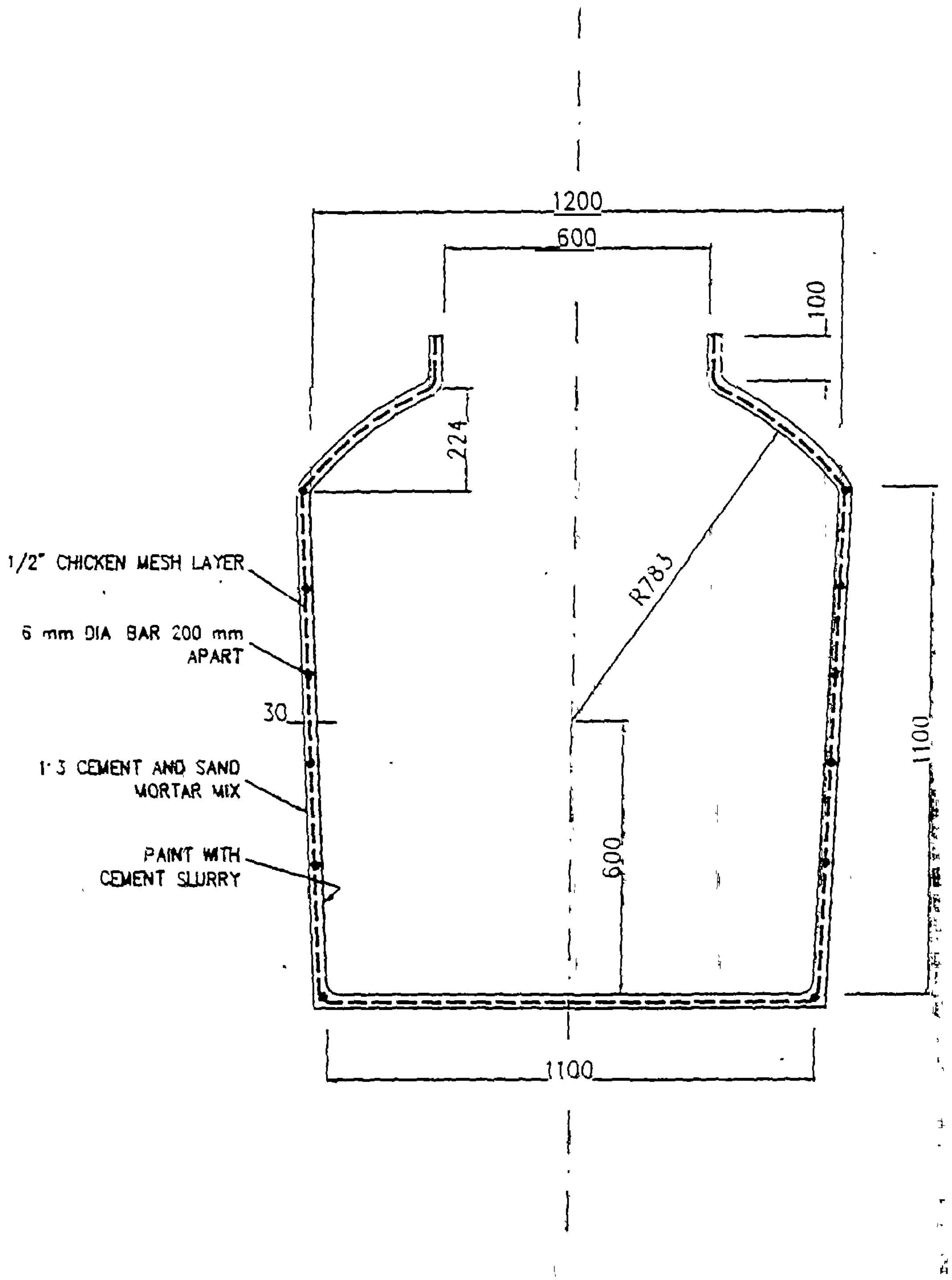
SUPPLY, CATCHMENT GRAPH
RATNAPURA REGION
RATNAPURA DISTRICT



GRAPH - Z
ANNEX - 10



GRAPH - N
ANNEX - 10



Ministry of Housing, Construction & Public Utilities	
Community Water Supply & Sanitation Project	
1.1 Cu.M CEMENT JAR	
Designed: K.D.H.	
Drawn: MHA R	
Scale: 1:15	
Date	

RHIC NETWORK PRIORITY: *Asbestos Roofing and Safety*

by Dan Campbell, RHIC Manager

RHIC periodically receives requests for information and advice on the potential negative health impacts on drinking water harvested from roofs made from asbestos/cement (A/C) sheeting. Such roofing sheets are common in many countries and offer important advantages such as ease of local manufacture, durability, and relatively low prices. Because of the very limited information available on health issues of rainwater harvesting from asbestos roofing, RHIC invites readers to share any information you may have on this important topic. RHIC would like to learn of any policies or experiences in water consumption from A/C roofs from the RHIC network.

Some experts advocate that materials containing asbestos should never be used as roofing material because asbestos fibers can be loosened if roofing sheets are cut or damaged, causing the potential for human ingestion. Asbestos research has centered on human hazards due to ingestion through the lungs by breathing, and clearly demonstrated that this is hazardous to human health, causing cancer, gastro-intestinal tract and pulmonary fibrosis. Research is much more limited on human ingestion of asbestos through the alimentary system by drinking or eating. In fact, RHIC staff have not identified any viable information or research on the health consequences of human consumption of rainwater that contains asbestos fibers.

Asbestos is a generic name for a group of six naturally occurring hydrated polysilicate minerals (amosite, chrysotile, tremolite, actinolite, anthophyllite, and crocidolite). Asbestos/cement pipe contains an average of 170g of asbestos per kg (80% chrysotile and 20% crocidolite). These minerals separate into microscopic fibers that are heat resistant, flexible, durable, and virtually indestructible in most uses. Asbestos fibers are very stable in the environment, do not evaporate into air or dissolve in water, and do not break down over time.

Due to these stable characteristics, asbestos fibers have been used in a wide range of products such as water and sewage pipes, roofing sheets, electrical insulators, and heating insulation. Asbestos is commonly found in most domestic water supplies. Typical asbestos concentrations in rivers and lakes are considered to be about 1 million fibers per liter.

• • • • •

Slow sand and gravel filters can remove up to 90% of asbestos fibers and other particulate matter and can be designed to serve small communities as well as individual families.

For information on filter design contact RHIC.

• • • • •

Asbestos levels also depend upon neighboring industrial sources. In Canada, the asbestos content of untreated water from the Ottawa River has been reported to be 9.5 million fibers per liter. Based on surveys in Canada, it was found that about 5 percent of the Canadian public consume water with asbestos concentration exceeding 10 million fibers per liter and about 0.6 percent consume water with concentrations exceeding 100 million fibers per liter. Levels range up to 2000 million fibers per liter in some asbestos mining communities.

According to the World Health Organization (WHO), 1984 guidelines on drinking water quality, the most effective method for removal involves chemical coagulation with iron salts and polyelectrolytes followed by filtration. Ordinary sand filtration removes about 90 percent of the individual asbestos fibers from water supplies.

One of the few studies available on rainwater quality from asbestos roofing was conducted in Thailand in 1989. This study showed that E. coli. levels were considerably higher in runoff from A/C roofs than from galvanized iron. Some research indicates this is because sunlight is more effective in killing bacteria on metal surfaces than on A/C surfaces.

In addition to the above research, the RHIC document collection includes records of one rainwater harvesting project that was influenced by the use of A/C roofing. In the late 1980's, the U.S. Agency for International Development in Honduras decided not to include rainwater catchments on rural schools because the Ministry of Education insisted on using locally manufactured A/C roofing for reasons of cost savings and job creation by using local products.

In the U.S., a great deal of research has been conducted by the Environmental Protection Agency (EPA) and other organizations on the health impacts of consuming water from asbestos-cement pipes. On July 12, 1989, under the US Toxic Substances Control Act (TSCA), the EPA banned most asbestos-containing products, including A/C pipe. A/C pipe, however, was included in the ban because of the risk posed by exposure to *airborne* asbestos during A/C pipe manufacture, transport and installation. The EPA concluded that consumption of drinking water transported by A/C pipelines *posed no significant health risk because of the pipe material* and that existing A/C pipelines did not need to be removed because of the ban.

The current EPA drinking water standard for asbestos, which became effective in July 1992, is set at 7 million fibers/liter for fibers longer than 10mm. The 1984 WHO guidelines do not contain a guideline for asbestos in water supplies. WHO directives state that:

continued on page 12

RHIC NETWORK NEWS

○ Dr. Al-Homoud is looking for information and experts on the design and construction of ponds and small desert dams which can be used for water harvesting in the desert. His address is: Dr. Azm S. Al-Homoud, Assistant Professor, Civil Engineering Dept., Jordan University of Science & Technology, PO Box 3030, Irbid, Jordan, Phone: 295111, FAX: 295123.

○ Mr. Nissen-Petersen has recently left Botswana for Namibia to work for 6 months on a UNICEF water tank and well program. He can be reached at: Erik Nissen-Petersen, ASAL Consultants Ltd., PO Box 867, Kitui, Kenya, Phone: 0141-22706 & 22123, FAX: 0141-22571 & 2-740524.

○ In South Africa, a local non-governmental organization known as SAWIC maintains a bibliographic database of nearly 200,000 references and is interested in receiving research and project reports from other organizations involved in rainwater harvesting. The Centre publishes 2 journals, entitled *WATER SA* and the *SA Water Bulletin*. which are available on request. For further information, contact: Angela Rethman, Project Manager, South African Water Information Centre (SAWIC), PO Box 395, Pretoria 0001, South Africa, Phone: (012) 841-2048, FAX: (012) 86-2869.

○ Brian Skinner is seeking information on wire-reinforced cement mortar tanks or jars that have been well-tried under field conditions. This includes plain wire or barbed wire reinforced containers as well as those using ferrocement. He also is seeking construction details of unreinforced mortar jars. Please contact him as soon as possible if you have information. Brian Skinner, WEDC, Loughborough University of Technology, Leicestershire, LE11 3TU, England, Phone: (44) 509-222392, FAX: (44) 509-211079.

○ Alan Fewkes is developing a microcomputer software program for sizing rainwater catchment systems and he is keenly interested in relevant information and contacts with others who may also be interested. Alan Fewkes, Faculty of Environmental Studies, Nottingham Polytechnic, Burton Street, Nottingham NG1 4BU, United Kingdom, Phone: (0602) 418418, FAX: (0602) 484266

○ Todd Boulanger seeks information on agencies that fund community workshops on rainwater catchments, water quality, and environmental monitoring. He is also interested in reports and data on the lead concentrations of different types of building materials. If you can assist, contact Todd at the following address: Todd Boulanger, Water Resources Research Center, University of Hawaii at Manoa, Holmes, Hall 283, 2540 Dole Street, Honolulu, Hawaii 96822, Phone: (808) 956-7381, FAX: (808) 956-6870

○ The International Association for Environmental Hydrology (IAEH) is new association created to encourage effective communication across all countries and between all disciplines that relate to water and the environment. It promotes links between the scientific community and practicing environmental hydrologists and water professionals. The Association publishes the *Journal of Environmental Hydrology* and the *Environmental Hydrology Report* which are both available at no cost to association members. Membership fees are $96 per year for non-students. For further information, contact: Roger Peebles, IAEH, PO Box 1088, Alexandria, Virginia 22313, USA, Phone: (703) 683-9768, FAX: (703) 683-6137.

Network Priority, continued from page 7

> *"the health hazards associated with occupational exposure to airborne asbestos are well documented. The harmful effects, however, of swallowed asbestos on human health have not been determined. Studies in progress should permit a more complete evaluation of any hazard resulting from the swallowing of asbestos, but available data are, at present, insufficient to determine whether a guideline value is needed. The hypothesis that ingested asbestos fibers cause cancer cannot be ruled out at the present time."*

With such uncertainty about the use of asbestos cement roofing materials and water pipes and the potential health risks, it is especially important that the results of diverse field experience and research become available for analysis. Please assist in this issue by sharing with RHIC your experiences and information on this topic. ○

WATER AND SANITATION FOR HEALTH PROJECT

For additional information about activities and reports highlighted in this issue, contact:

WASH Operations Center
1611 North Kent Street, Room 1001
Arlington, Virginia 22209 USA

Water and Sanitation for Health Project, Contract No. DPE 5973-Z-00-8081-00, Project No. 836-1249. Sponsored by the Office of Health, Bureau for Research and Development, U.S. Agency for International Development, Washington, DC 20523.

Cement Jar 1.1 M^3

Trial Tank build at NERD Centre
Ja-Ela. May 95

Description	Actuals used in the trial				Estimate Possible to do with		Householder Cost	CWSSP Cost
	Unit	Unit Cost	Qty	Cost	Qty	Cost		
Cement	Bag	265	4	1060	2.5	663		663
Sand	ft^3	4	10	40	10	40		40
1/2" Chicken Mesh	ft^2	4	80	320	80	320		320
6"m Rods	length	25	9	225	3	75		75
				1645				
Skill Labour	HR	22	24	528	8	176		176
Unskill Labour	HR	12.5	24	300	48	600	600	
				828				
Welding				200		NIL		
				2673		1874	600	1274
							HH	CWSSP
							32%	68%
Cost per Liter				2.43		1.87	.55	1.16

CONCLUSION: Cost is above CWSSP criteria, of 1.08 per liter maximum cost per liter can be brought down by building Jars of larger capacity (eg. 1.5 M^3) and more

5, 8 & 10M³ BRICK DOME TANKS
QUANTITIES AND COSTS (1995)

VOLUME	FLOOR	WALL	DOME	1:3 PLASTER 1:2 COAT I	NEAT CEMENT	COAT II	QTY	UNIT COST	COST	REMARK
	Area (ft^2)									
5M³ H 4' D 7'6"	53	99	54	260	210	210				
Cement Bag	2	1.5	1.6	1.6	0.4	1.5	8.6	265	2279	– Transport not
Brick No	–	560	190	–	–	–	750	1.5	1125	included
Sand ft³	5	10	5	7	–	6	33	3.5	116	– Dome volume not
Metal 3/4" ft³	6	–	–		3		9	18	162	taken
Mason HR	2	4	6	6	4	6	28	22	616	– Dome thickness
Labour HR	6	24	18	18	12	18	96	12.5	1200	2" brick
									5498	Cost Rs. 1.10/Lit
	Area (ft^2)									
8M³ H 4' D9'6"	81	124	85	375	286	286				
Cement Bag	3	2	2.5	2.3	0.5	2	12.3	265	3259	
Brick No	–	700	800 300	–	–	–	1000 300	1.5	1500 450	
Sand ft³	8	13	8	10	–	8.2	47.2	3.5	165	
Metal 3/4" ft³	9	–	–		4		13	18	234	– Dome thickness
Mason HR	3	5	9	9	5	8	39	22	858	4" Brick
Labour HR	9	30	28	26	16	24	133	12.5	1663	
									8129	Cost Rs. 1.02/Lit
	Area (ft^2)									
10M³ H 5' D9'6"	81	160	85	405	316	316				
Cement Bag	3	2.4	2.5	2.5	0.7	2.5	13.6	265	3604	– Dome thickness
Brick No	–	905	600	–	–	–	1505	1.5	2258	4" Brick
Sand ft³	8	16	8	11	–	10	53	3.5	186	
Metal 3/4" ft³	9	–		–	4		13	18	234	
Mason HR	3	6	9	9	6.5	10	44	22	968	
Labour HR	9	39	28	28	20	30	154	12.5	1925	
									9175	Cost Rs. 0.92/Lit

sds/c/bdt/23may95

APPENDIX I

RAINWATER HARVESTING SYSTEM COST ANALYSIS. SYSTEM CONSISTS OF 5M³ TANK & 60M² CATCHMENT

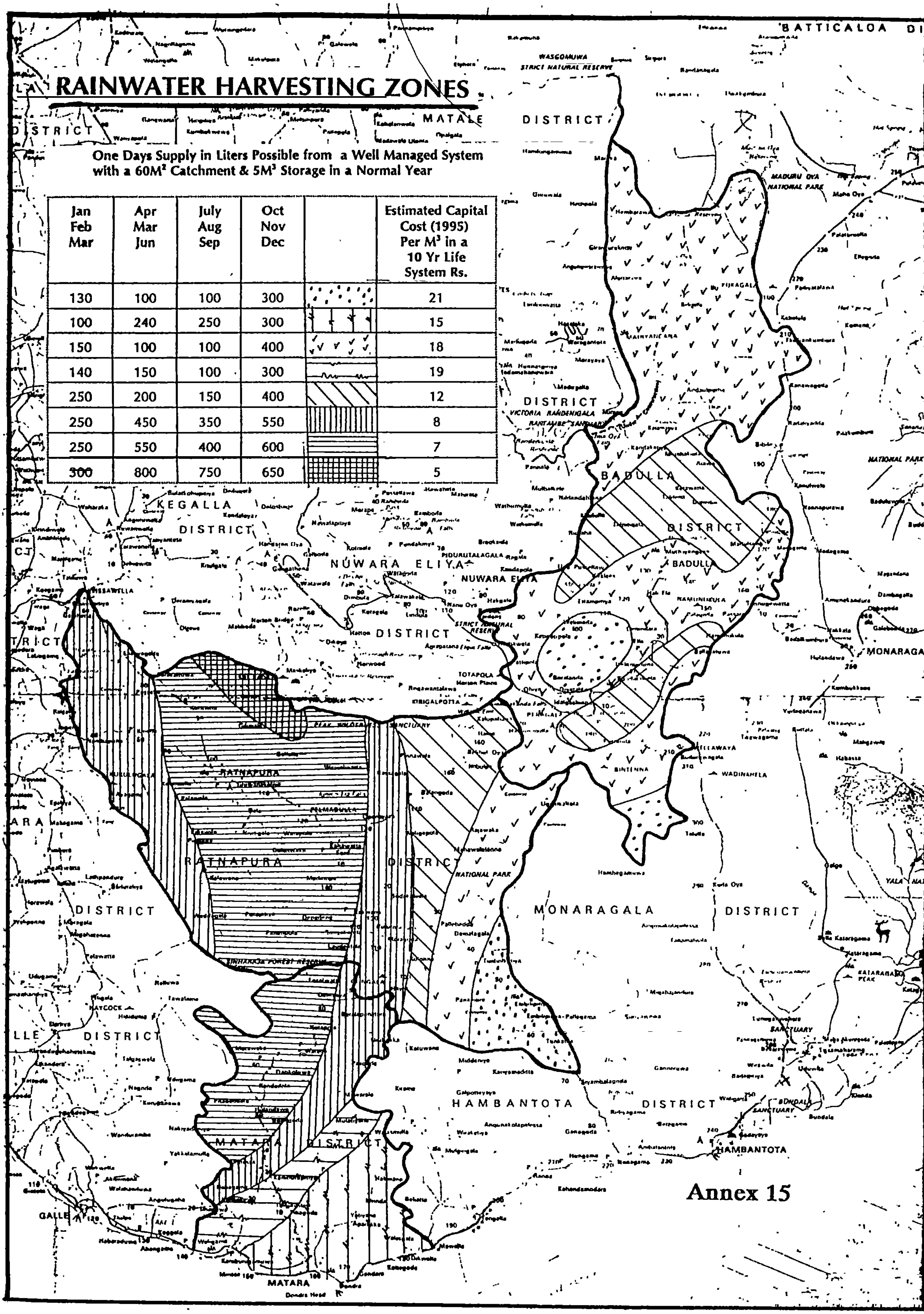
(1995) Rs.

	Ferro Cement Tank CWSSP Cost	Ferro Cement Tank HH Cost	Brick Dome Tank CWSSP Cost	Brick Dome Tank HH Cost	Material for Home Made Pump	Material for low cost Gutter for $60M^2$ RF	Material for Standard Gutter for $60M^2$ RF	Low Cost Ground Catchment $30M^2$	Labour for Low Cost Gutter	Labour for Standard Gutters	Labour for The Pump	Transport	Total Costs
	5500	1400	4300	1300 + 1000	450	850	2250	1550	200	400	100	500	
I	5500						2250			400			8150
II	5500					850			200				6550
III	5500						2250			400		500	8650
IV			4300		450		2250			400	100		7500
V			4300		450		850		200		100		5900
VI			4300		450		850		200		100	500	6400
VII			4300		450						100		4850

RAINWATER HARVESTING ZONES

One Days Supply in Liters Possible from a Well Managed System with a 60M^2 Catchment & 5M^3 Storage in a Normal Year

Jan Feb Mar	Apr Mar Jun	July Aug Sep	Oct Nov Dec		Estimated Capital Cost (1995) Per M^3 in a 10 Yr Life System Rs.
130	100	100	300		21
100	240	250	300		15
150	100	100	400		18
140	150	100	300		19
250	200	150	400		12
250	450	350	550		8
250	550	400	600		7
300	800	750	650		5



Annex 15