Managing Risks in Ruhunu Basins, Sri Lanka - Droughts

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1. Introduction

Potential exposure to loss, damage, harm or any danger is considered as risks and water resources related risks in the Ruhunu Basin in general can involve droughts, floods, pollution and other water related hazards such as earth slips and silting of reservoirs.

The three rivers in the Ruhunu Basin are not reputed for floods, but few local floods have occurred in the past. The area has little or no risk of coastal erosion, cyclones and earthquakes. Though pollution of water bodies, health and sanitation problems caused by water and, landslides in the upper cathment, are hazards related to water that could exist in the basin; the major type of natural hazard in the area is droughts.

2. Droughts

2.1 General

Though in general terms, the term Drought can be defined as the prolonged deficiency of water, specific definitions of Drought that are being currently used are specific and are relative to the context within which they are used. Drought is a temporary condition due to changes in climate but not the general aridness, which is a permanent feature that exists in areas where rainfall is generally low. However, the possibility for variation in rainfall in arid and semi arid is high and thus the frequency of receiving below normal rainfalls during certain periods is also high in these areas. Major part of Ruhunu Basin is located in the driest part of the country and, hence such variation in climate relative to other areas of the country too has to be high.

Three main definitions used for Droughts refer to Meteorological Droughts, Hydrological Droughts and Agricultural Droughts.

2.2 Meteorological Droughts

Meteorological Drought is prolonged deficiency of rainfall over a given area below meteorological expectations. In Sri Lanka, if any Administrative District receives less than 75% probable rainfall during any of the two seasons Maha (October to March) and Yala (April to September) then that area is considered as affected by drought during that season. Similarly, if in any given year consisting of the two seasons Maha and Yala (from October to September of the following year), the total rainfall is less than the 75% probable rainfall that year is considered a Drought year. (Meteorological Department, Sri Lanka)

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2.3 Hydrological Drought

Hydrological Droughts result from either sustained deficit of surface runoff, below normal or depletion of ground water levels.

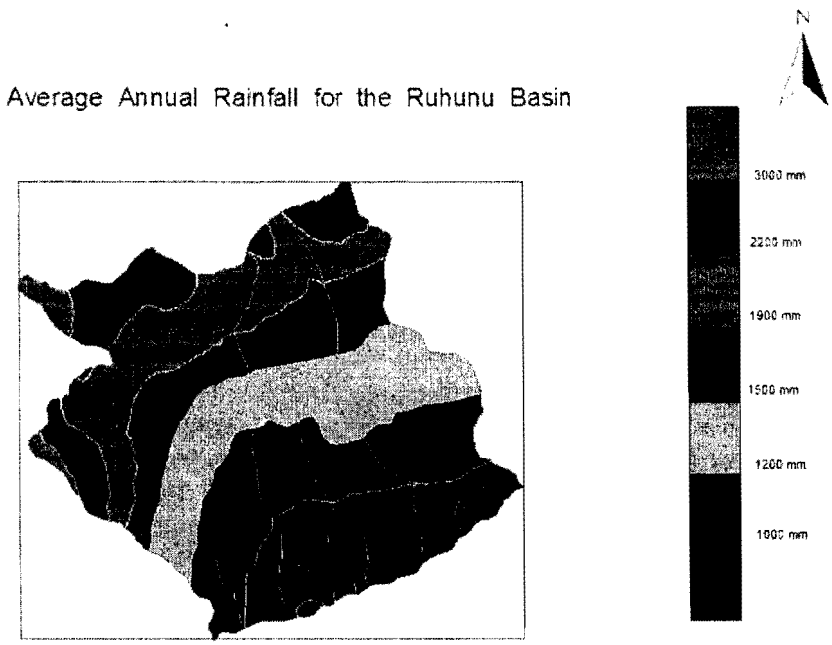
2.4. Agricultural Drought

Agricultural Drought occurs when the rainfall intensity, duration and distribution together with evaporation losses combine to create soil moisture deficit to cause a substantial drop in agriculture.

3. Rainfall and Rainfall Variation in Ruhunu Basin

In Sri Lanka areas where the average annual rainfall is less than of 1750mm and with a pronounced dry season are classified as "Dry Zone". Major part of Ruhunu Basin falls in the Dry Zone with lower basin consisting of Hambantota District being one of the driest parts, receiving a Mean Annual Rainfall of less than 1000 mm. Figure1 gives a map showing the distribution of the annual rainfall over the basin.

Figure 1. Map Showing the Distribution of Annual Rainfall in Ruhunu Basin.



Temporal variation of rainfall in Hambantota District in Ruhunu Basins is also one of the highest in Sri Lanka with 75% of Annual rainfall being in the Maha season while only around 25% of annual rainfall being in the Yala season. Major part of the lower basin receives less than 200 mm average rain during Yala Season. Figure 2 and Figure 3 give maps showing rainfall and the distribution of rainfall over the basin during the two seasons.

Figure 2. Map Showing the Rainfall Distribution in Ruhunu Basin during the Maha Season.

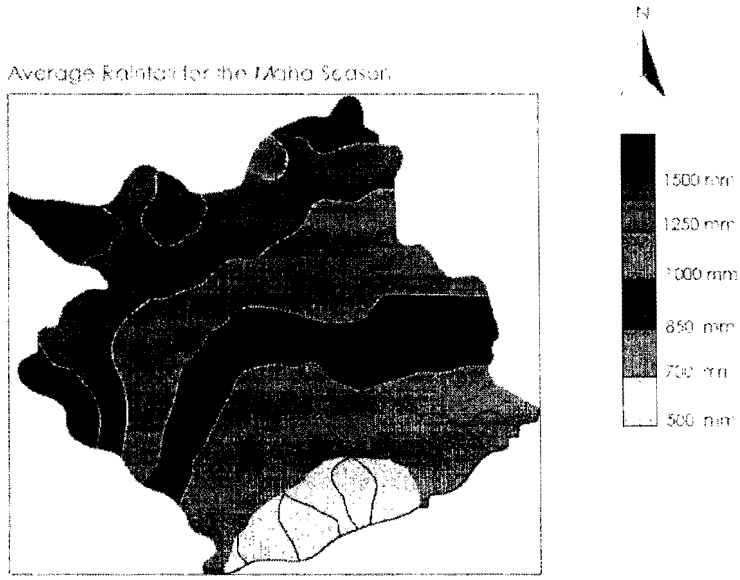
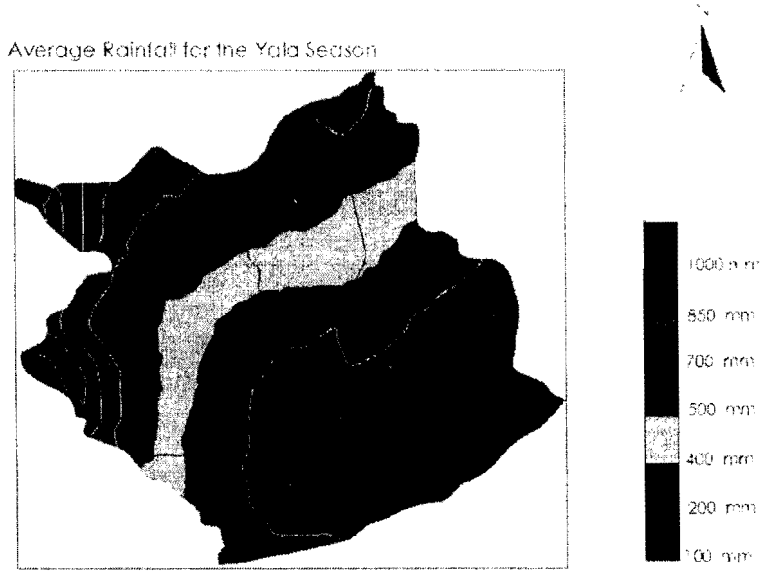


Figure 3. Map Showing the Rainfall Distribution in Ruhunu Basin during the Yala Season.



4. Drought Occurrence

In Sri Lanka as there are no river flows due to snow melting and so on and the main cause for both the Hydrological Droughts and the Agricultural Droughts are Meteorological Droughts. Hence an analysis of meteorological droughts of the drought prawn Districts of the country will help in better understanding of the nature of the droughts in the basin in comparison to the rest of the country.

4.1 Probability of Meteorological Drought

Probability of occurrence of a drought of a given season over a given period (DPs) is defined as:

$$DPs = \frac{\text{Number of occurrence of seasons of drought (Seasons with < 75\% probable rainfall)}}{\text{Total number of years}}$$

Where, s denotes the season and s = m for Maha and s = y for Yala.

Table 1 gives the Drought Probabilities of drought prone Districts namely those in the Northern, Eastern and the Southeastern parts of Sri Lanka. The period of analysis is the 30-year period from 1961 to 1990.

Table 1. Drought Probability of Selected drought Prone Areas of Sri Lanka.

Station	Probability of Occurrence of 75% Probable Drought DPm	Probability of Occurrence of 75% Probable Drought DPy
Anuradhapura	0.110	0.174
Polonnaruwa	0.084	0.305
Puttalam	0.183	0.357
Mannar	0.209	0.304
Jaffna	0.220	0.350
Trincomalee	0.146	0.220
Batticaloa	0.146	0.266
Hambantota	0.284	0.321

It is seen that the Drought probability is normally high in the Yala Season compared to Maha Season but in Hambantota District which form major part of Ruhunu Basin even during the Maha Season the Drought probability is high. During Yala Season too Hambantota District has a very high probability of drought occurrence with probability values very close to Puttalam and Jaffna Districts.

Table 2 gives the Coefficient of Variation in rainfall of the same stations during the two seasons over the same period.

Table 2. Coefficient of Variation in Rainfall in Drought Prone Areas in Sri Lanka.

Station	Coefficient of Variation – Maha CVm	Coefficient of Variation – Yala CVy
Anuradhapura	0.275	0.405
Polonnaruwa	0.278	0.516
Puttalam	0.276	0.416
Mannar	0.384	0.551
Jaffna	0.287	0.628
Trincomalee	0.257	0.402
Batticaloa	0.283	0.433
Hambantota	0.333	0.405

It is seen that while almost all the drought prone areas have high variability during the Yala Season, Hambantota together with Mannar has a high variability even during the Maha Season.

4. Hydrological Droughts

Three indications can be used to gauge the susceptibility of an area to hydrological droughts. One is the low-flows expected to recur at a given frequency, which is usually denoted by the return period of the low flow. The results of their analysis are shown in the Table 3.

Another indication will be to analyze the distribution of average daily flows as a percentage of time of occurrence. This gives a picture of the flow profile of the river. (Table 4 & Figure 4)

Finally the actual lowest flows observed in a river serve as a cross check with the analyzed results and are shown in the Table 5.

Table 3. Low Flows - m3/sec.

Return Period Years	Walawe at Embilipitiya*	Kirindi Oya at Wellawaya	Kirindi Oya at Lunugamwehera	Menik Ganga at Kataragama
1.11	9.5	0.803	2.501	0.223
2	5.31	0.369	1.472	0.128
10	2.53	0.159	0.704	0.053
25	1.87	0.127	0.517	0.034
50	1.56	0.115	0.425	0.025
100	1.34	0.108	0.361	0.018

**Data taken before the construction of Udawalawe Reservoir*

Table 4. Water Availability in Average Daily Flows – m3/sec.

Percentage of Time	Walawe at Embilipitiya*	Kirindi Oya at Wellawaya	Kirindi Oya at Tanamalwila	Kirindi Oya at Lunugamwehera	Menik Gang at Kataragam
10-20	71.0	8.0	18.0	26.0	15.0
20-30	60.0	6.6	14.5	20.0	11.5
30-40	51.0	5.8	12.0	16.0	9.5
40-50	43.0	5.0	10.0	13.0	8.5
50-60	35.0	4.2	8.2	10.0	6.5
60-70	30.0	3.8	6.5	8.5	4.0
70-80	24.0	3.3	5.0	6.5	3.5
80-90	20.0	2.9	3.7	5.0	2.5
90-100	11.0	2.0	2.0	4.5	1.7

**Data taken before the construction of Udawalawe Reservoir*

Figure 4. Water Availability – Average Daily Flows Vs Percentage time of occurrence.

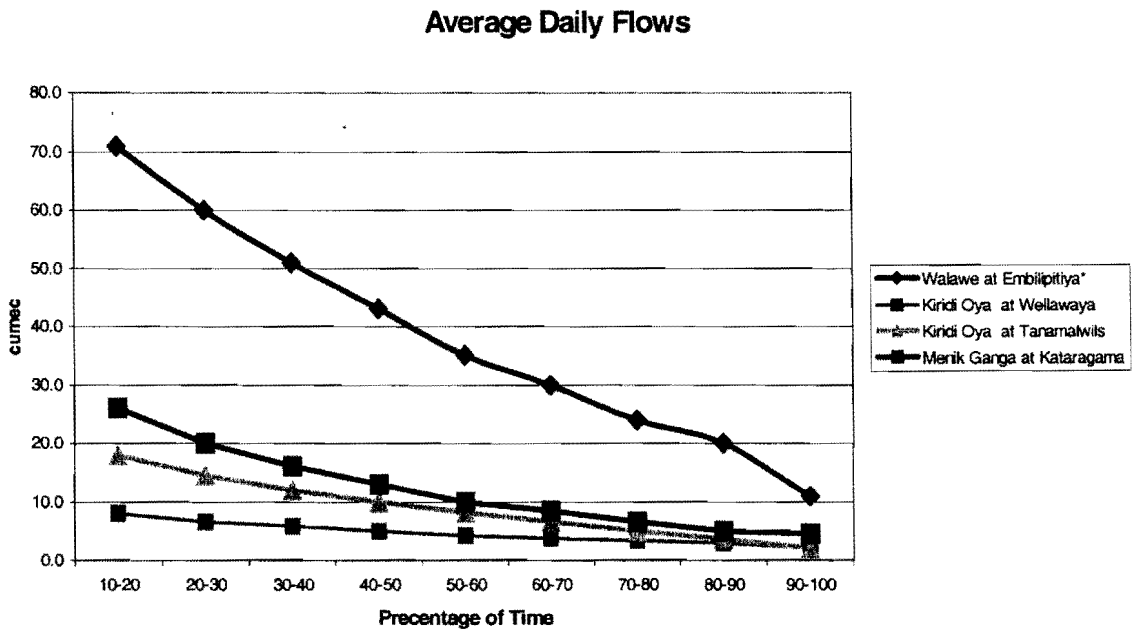


Table 5. Minimum Daily Flows (cumec).

Year	Walawe at Panamura	Kirindi Oya at Thanamalwila	Menik Ganga at Kataragama
99/00	0.1	0.5	0.0
98/99	0.08	0.5	0.0
97/98	0.12	0.5	0.0
96/97	0.09	0.5	0.0
95/96	0.1	0.5	0.0
94/95	0.18	0.5	0.42
93/94	0.12	0.5	0.0
92/93	0.12	0.5	0.0
91/92	0.05	0.0	0.0
90/91	0.09	0.5	0.0
89/90	0.09	0.5	0.0

5. Risk Management - Policies & strategies and problems & opportunities

The process of risk management in general consists of first the assessment of the risks involved and then taking risk reduction or control measures with follow up monitoring. Assessment of risks again can be taken in two components, with risk analysis in one hand with risk evaluation on the other. Risk assessment involves scoping the problem to identify nature of risk, the type of hazard, identification of vulnerable areas and groups, and the estimation of the extent of potential damage. Risk evaluation involves the evaluation of effects and impacts of the potential disasters and evaluation of tolerability options and mitigation measures. Risk reduction or control involves the activities from pre-disaster planning, implementation of risk alleviation or mitigation measures to post disaster relief mechanisms. Capacity building for improved disaster forecasting, disaster vulnerability awareness and communication and involvement of local communities are also requirements.

The Water Resources Secretariat/Interim National Water Resources Authority is in the process of formulating the National Water Resources Policy for Sri Lanka. Though the present draft Water Resources Policy does not address risk management directly as a major subject area, it carries several recommendations for identifying priorities during droughts and some recommendations for pollution control. A separate Disaster Management Policy is being formulated by the Government and it is expected that this policy will address the current gaps related to disaster management covering water related disasters eventually.

The major problems in the basin are mainly related to droughts causing periodic surface and ground water shortages. The effects of water shortages are numerous and affect the livelihoods, availability of domestic water, echo-systems and environment.

Ruhunu Basins have surface water storage capacity of over 25% of run off currently which is effective to a major extent in reducing the risks related to droughts in some areas of the basin. Potential for further development exists specially in the Menik Ganga Basin. However, at present the recognition of surface water storage as a risk management tool is not being properly recognized in the policies. Water resources development projects in the basin including those being undertaken currently are basically considered as agricultural development, economic development or poverty alleviation strategies. Examples are the Weli Oya Diversion Project

being implemented and the Mau Ara Diversion project nearing completion. There is a strong need in the future to look at these investments in the perspective of risk management angle as well.