

## **Abstract**

Kassala Town and the Gash Scheme are the gifts and victims of the Gash River waters. It is paradoxical that while the Gash River, which flow about 80 to 100 days per year, provides prosperity and survival it is also the main source of disasters to Kassala Town and its neighboring areas including its delta. Kassala Town and its neighboring areas are subjected to flooding problems every four to five years from the Gash River. The ground water which is used during the remaining part of the year is not fully known. The objective is to solve the problem of Kassala Town and its neighboring areas from the Gash River flooding on one hand and appraise the surface and ground water potential on the other. An Empirical Correlation Model applied at El Gira, the most upstream gauging station with three other downstream stations including K.1.5 Kassala indicated that Kassala is continuously subjected to high floods risks. Application of the well known Gumbel Distribution Model supplemented with digitized map of the Gash River catchment area gave the same degree of risk.

The four to five years flood return period was found to be about  $600 \text{ m}^3/\text{sec}$  with a probability of occurrence of 25% and 20% at K.1.5 Kassala Station respectively and a corresponding discharge at El Gira of about  $750 \text{ m}^3/\text{sec}$ . Only 5 % of the surface water passing Kassala Town is consumed irrigating an area of 20 000 feddans per year. It was found that the agricultural area can be reclaimed through a buy pass upstream Kassala Town, making Kassala safe on one hand and using the excess water in cultivation on the other.

Using HEC-HMS Model at the confluence of Khor Abu Alaga with the Gash River a hydrograph was obtained. The hydrograph indicated that the rainfall loss has a maximum depth of 80 mm and a minimum depth of 10 mm while the rainfall maximum depth is 145 mm with a minimum less than 60 mm. Further interpretation of the hydrograph indicated that the base flow has a maximum of  $400\text{m}^3/\text{sec}$ . It also revealed that the observed surface flow has a maximum of  $900\text{m}^3/\text{sec}$ . The outflow reading has a maximum of  $2900\text{ m}^3/\text{sec}$  and then it merges to be equal to the observed flow. These results indicate that the flood of 2007 was significantly high. They also indicate that the ground water as well as the surface water are basically fed from the Gash River. Hence the HEC-HMS Model besides indicating ground water base verified the results of the surface flow upstream K.1.5 Kassala gauging station obtained by both the Empirical and Gumbel Distribution Models. The observed surface flow being  $900\text{m}^3/\text{sec}$  is logical and consistent with the result obtained at K.1.5 Kassala which was found to be a maximum of  $750\text{m}^3/\text{sec}$ , which is less than that upstream K.1.5 Kassala due to the flood of Abu Alaga at the application point.

Using G.I.S. available facilities contour maps were plotted, and ground water potential being both quantitatively and qualitatively excellent were found to be  $3897.6\text{ Mm}^3$ .

The study recommended cooperation between Sudan, Eritrea and Ethiopia in the management of the Gash River Basin to avoid floods hazards. It also recommended establishment of an early warning system to reduce the risk hazards suffered by Kassala and its neighboring areas.

## التجريد:

كلاً من مدينة كسلا ومشروع القاش يعتبران هبتان وضحيتان لمياه نهر القاش. ومن المتناقضات ان نهر القاش الذى يجرى حوالى 80 الى 100 يوما فى العام يهب الحياه والرفاهيه لكنه فى نفس الوقت مكنن ومصدر الخطر والدمار لمدينة كسلا وما جاورها بما فى ذلك الدلتا. مدينة كسلا وما جاورها تتعرض لمشاكل الفيضان من نهر القاش كل اربعة الى خمسة سنوات. والمياه الجوفية والتي تستعمل خلال الفترة الباقية من السنة غير معروفه.

الهدف من هذه الدراسة هو حل مشكلة الفيضان لمدينة كسلا وما جاورها من جهة و تقييم كميات المياه الجوفية والسطحية من الجهة الأخرى . بتطبيق نموذج الارتباط التجريبي لمحطة قياس الجيرة في أعالي النهر مع الثلاث محطات الأخرى بما في ذلك مدينة كسلا أوضح أن مدينة كسلا وما جاورها تتعرض لأخطار الفيضانات باستمرار . تطبيق نموذج قامبل المعروف بالإضافة إلى الخريطة الرقمية لحوض نهر القاش الساكب أتت بنفس نتيجة المخاطر . أوضح نموذج الارتباط أن تكرار الفيضان الخطر كل ثلاث سنوات يبلغ  $550 \text{ m}^3/\text{sec}$  عند كيلو 1.5 محطة كسلا . بإستعمال نموذج HEC-HMS متكاملًا مع آلية المعلومات الجغرافية تم رسم خرائط كنتورية بينت أن المياه الجوفية المتوفرة هي  $185.6 \text{ Mm}^3$ .

أوضحت الدراسة أهمية إمكانية زيادة المساحة المروية بإستعمال مجرى تصرف وري امام مدينة كسلا. كما اوضحت دراسته تواجد كميات وافره من المياه الجوفيه بنوعيه جيده تصلح للاستعمالات المنزليه والصناعيه والزراعيه والتي تقود الى تطوير المنطقه فى الريف والحضر امام وخلف مدينة كسلا.

وأوصت الدراسة بضرورة التعاون الادارى فى حوض نهر القاش بين كل من ارتريا واثيوبيا والسودان لتجنب مخاطر الفيضانات. كما اوصت بانشاء آليه انذار مبكر لتقليل حجم المخاطر التى تعاني منها مدينة كسلا وما جاورها.

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## TABLE OF CONTENTS

<b>Item</b>	<b>Description</b>	<b>Page</b>
	Abstract English	I
	Abstract Arabic	III
	Preface and Acknowledgement	IV
	Table of contents	v
	List of Tables	VII
	List of Illustrations or Figures	VIII
<b><i>CHAPTER ONE</i></b>		
1	Introduction	1
1.1	Background	1
1.2	Statement of the problem	7
1.3	Objectives	8
1.4	Outline Of The Research	9
<b><i>CHAPTER TWO</i></b>		
2	LITERATURE REVIEW	10
2.1	The Concept Of Floods Impacts	10
2.2	Discharge Measurement by the Float Method	14
2.3	River Morphology	16
2.3.1	The Straight River	17
2.3.2	The Meandering River	18
2.3.3	The Braiding River	19
2.4	River Training	21
2.4.1	Revetments	23
2.4.2	Groynes	24
2.4.3	Guide Banks	29
2.4.4	Gabion Gravity Structures	29
2.5	Causes Of Banks Failure	31
2.6	Sediment Transport And Sediment Deposition	34
2.6.1	Sediment Transport	35
2.6.2	Incipient motion	36
2.6.3	Sediment Characteristics	38
2.7	Modeling Techniques System Concept	44
<b><i>CHAPTER THREE</i></b>		
3	METHODOLOGY	55

3.1	River Behavior And Plan Of Study	55
3.1.1	Behavior Of River Gash	57
3.2	The Existing Protection Works	59
3.3	Type Of Soil And Sediment	62
3.4	Upraise Surface Flow And Ground Water Aquifers	63
3.5	Social and Economic Situation	66
3.6	Use Of HEC-HMS Model For Flood Management	66
<b>CHAPTER Four</b>		
4	DATA COLLECTION AND DATA ANALYSIS	74
4.1	Rainfall Consideration	74
4.2	Discharge Measurements Of Surface Water	78
4.3	Flood Frequency Analysis	82
4.4	Flood Hydrograph Fluctuations	83
4.5	Runoff Rainfall Relationship	85
4.6	Ground Water Measurements Fluctuations	87
4.7	Sedimentation Measurement	88
4.8	HEC- HMS Model Input Data	94
4.9	Rise In Bed Level	95
<b>CHAPTER Five</b>		
5	RESULTS AND DISCUSSIONS	97
5.1	Development of the selected empirical model	97
5.2	Flood frequency Estimate:	103
5.3	HEC-HMS Model	110
5.4	Sedimentation In Gash River	115
5.5	Ground water fluctuation	120
5.6	Contour map of Ground water levels	121
<b>CHAPTER Six</b>		
6	CONCLUSION AND RECOMMENDATIONS	125
6.1	Conclusion	125
6.2	Recommendations	125
	References	126
	Appendix	

## **LIST OF TABLES**

<i>Table No.</i>	<i>Table Description</i>	<i>Page</i>
3.1	Initial estimates of hydrological parameters of Sub basin	71
3.2	Total storm distribution in catchment area	72
3.3	Shown Observation Discharge at Kassala Bridge Station	73
4.1	Rainfall Data In The Gash River Catchment Area	74
4.2	Average Rainfall (mm) data 1990 – 2010 of Kassala, Eritrea and Ethiopia.	75
4.3	The temperature variation for the three countries	77
4.4	Kassala Bridge Gauging Station Total Discharges(Mm <sup>3</sup> ) And Maximum Instantaneous Discharge(m <sup>3</sup> /s)	79
4.5	Statistical Data For Gash River 1907 to 2010	82
4.6	Maximum, Maximum Minimum And Average Flood Gauge	85
4.7	Values Of The Runoff Coefficient In The Gash River Area.	86
4.8a	Sediment Measurements At Kassala Bridge Gauging Station	89
4.8b	Sediment Measurements At Kassala Bridge Gauging Station	90
5.1	The Empirical Model Coefficient For The Three Station	102
5.2	Discharges Correlation Results	103
5.3	Gumbel Distribution Rainfall Versus Return Period Gash River Catchment Area	105
5.4	Gumbel Distribution K.1.5 Kassala Maximum Discharge Versus Return Period	106
5.5a	Losses And Damages Details	113
5.5b	Losses And Damages Summary	115
5.6	Laboratory Data Analysis Of Bed Load	116
5.7	Data of Sediment Taken At Kassala Gauging Station	117

## LIST OF FIGURES

<i>Figure No.</i>	<i>Description</i>	<i>Page</i>
1.1	New Sudan political boundaries.	1
1.2	Gash River Tributaries Upstream Kassala Town	2
1.3	Catchment Area Of The Gash River	3
1.4	Locations Of The Gauging Stations.	5
1.5	The Existing Layout Of The Gash Scheme Main Canals.	6
2.1	Impacts of Flooding Inundation Examples	11
2.2	Flood Damages in USA 1923 – 2003	12
2.3	Discharge Measurement by Floats	14
2.4	Main Types Of Alluvial Rivers (NEDECYO 1959)	17
2.5	Straight River Channel	18
2.6	Examples Of Meandering River	19
2.7	A Typical Example Of A Braided Channel	20
2.8	Plot of Actual Straight-Line Water Surface Slope Against Discharge	21
2.9	Revetment structure	23
2.10	Types of Groynes	24
2.11	Some Photos of Groynes Made Of Gabions	25
2.12	Orientation of Groynes In Relation	26
2.13	Arrangements Of Gabion Gravity Structures	30
2.14	Dominant bank failure processes and mechanisms along the Sieve River during a significant in-bank flow event.	32
2.15	Bank stability analysis and bore water pressure distribution.	33
2.16	Geometry of the bank and failure mechanism.	34
2.17	Modes Of Sediment Transport	35
2.18	Shields Diagram Relating Dimensionless Shear Stress With Particle Reynolds Number	37
2.19	Grain Size Distribution Curve	39
2.20	Balance Between The Drag Force And The Submerged Weight	41
2.21	The Hydrological Cycle	46
2.22	System Operation	46
2.23	Water Shed Hydrologic System	47
2.24	Hydrologic Models Classification	50

2.25	Four Selected Types of Models	53
3.1	Geological Map Of Kassala Area	58
3.2	Computing Discharge by Float Method At Kassala Gauging Station	60
3.3	River Gash Discharge Fluctuation 2007.	61
3.4	Existing Spurs System Near Kassala Town	62
3.5	Water Surface Fluctuation In Wells( Abbas, 1980)	65
3.6	Pumping and observation wells distribution(Adil Balla Elkrail and Abdalla E. Ibrahim, 2008)	65
3.7	The HEC-HMS Environment	70
3.8	Starting a new project on hydrological modeling of Gash River basin	70
4.1	Chart of Average Rainfall(mm) data 1990 – 2010 of Kassala, Eritrea and Ethiopia.	76
4.2	The Temperature Variation For The Three Countries	78
4.3a	Hydrographs Of The Fluctuation Of The Gauges Reading During The Floods	84
4.3b	Hydrographs Of The Fluctuation Of The Gauges Reading During The Floods	84
4.4	Rainfall – Runoff Relationship	87
4.5a	Gash River Suspended sediment from 2004 to 2005	93
4.5b	Gash River Suspended sediment from 2008 to 2010	94
4.6	Storm Hydrograph At Kassala Bridges(2007)	94
5.1	Empirical Model Discharge Correlation Of El Gira And K1.5 Kassala	97
5.2	Empirical Model Discharge Correlation Of El Gira And Futa	98
5.3	Empirical Model Discharge Correlation Of El Gira And Sallam Alikum	98
5.4	Empirical Model Discharge Correlation Predicted And Measured Of K1.5 Kassala	102
5.5	Layout of Gash River catchment area	104
5.6	Gumbel Distribution Rainfall Versus Return Period Gash River Catchment Area	107
5.7	Gumbel Distribution K.1.5 Kassala Maximum Discharge Versus Return Period	107
5.8	Gumbel Distribution K.1.5 Kassala Maximum Discharge Versus Catchment Rainfall	108

5.9	Kassala Sub Basin Hydrograph 2007	111
5.10	Kassala Outflow Summary Data 2007	111
5.11	Kassala Time Series Summary Data 2007	112
5.12	Hydrograph Hec-Hms Model Result 2007	112
5.13	2006 Suspended Sediment Discharge Relationship	119
5.14	1999 Suspended Sediment Discharge Relationship	119
5.15	Bed Levels Changes In Kassala Reach	120
5.16	The ground water recharge	121
5.17	Ground water contour map –Jan2003	122
5.18	Ground water contour map –Mar2003	122
5.19	Ground water contour map –Aug2003	123
5.20	Ground water contour map –Oct2003	123