Estimation of Silt Sediments in Dewerige Dam Reservoir Mayssan province

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Abstract

The study deals with amount of sediment yield in flooding condition in reservoir of Dewerige dam .Since the Dewerige River is seasonal river, therefore the study achievement during dry season. The study aims to calculate amount of siltation which accumulated in reservoir and its impact on reservoir storage capacity, thus reducing economic life time of the dam. Topographic map (dwg file) considered the base map .The final field survey in field work during January 2017 was measured thickness of siltation in reservoir. By chosen cross-sections area in channel of Dewerige River based on Trapezoidal rule the volume of siltation can be calculated. Finally, siltation volume used to calculate: rate of sediment, economic life time of the dam, sediment yield and specific sediment yield in reservoir of Dewerige dam. Deposition of sediments in reservoir assumed as 514000 m^3 during designing stage report of Ministry of Irrigation, the general commission of dams and reservoirs, nevertheless the study proved sediment yield is 8242950.6 m^3 /y that is a very big amount of sediment for a small dam reservoir. Economic life time take into account during designing stage was 50 years, while the economic life time depend upon this study is 3 years.

الخلاصة

البحث الحالي يتعلق بحساب كمية الرواسب في خزان سد الدويريج بعد عام واحد من ادخال السد للتشغيل الفعلي. تم اجراء الدراسة الحالية في موسم الجفاف ليتسنى قياس سمك ترسبات السلت مباشرة.تم اخذ 12 مقطع عرضي على امتداد بحيرة السد وحسبت مساحة كل مقطع وبعد ذلك تم حساب الحجم الكلي للرواسب بطريقة شبه المنحرف. تم طرح الحجم الكلي من الحجم الحقيقي للخزان قبل عملية المليء وبالتالي تم قياس حجم الرواسب. بعد ذلك حددت الدراسة العمر الاقتصادي للسد وقد بلغ 3 سنوات على عكس العمر التشغيلي والبالغ 50 سنة. بينت الدراسة بان اختيار الموقع الحالي للسد لم يكن موفقا وان المحافظة بحاجة الى دراسة تقييمية

متكاملة لتديد موقع اخر مساعد للسد او تحويل المياه الى موقع يتم اعداده لخزن المياه جوفيا او مايسمى بحصاد المياه.

1. INTRODUCTION

The study area is located in semi-arid region of Mayssan province, in addition to flooding of Dewerige river .Its require to construction a vital project like a dam. Dewerige dam is a small concrete dam (Weir with length 512m. In addition, height 3.5m. The total storage capacity about (1870000) m^3. It is a multi-purpose dam. Used for flooding control, water storage for irrigation projects and ground water storage. To assessment of siltation in reservoir the procedure as the following:

Computing sediment volume by using (Tigray,2010) :

SV= AREA ×DEPTH..... (1)

Where:

Area= reservoir area, depth = reservoir depth

Computing sediment rate by this equation

SR= SV / Y..... (2)

Where:

y= age of reservoir in year

Computing economic life time of reservoir by:

LE= RSC / RS..... (3)

Where:

LE= economic life time,

RSC = reservoir storage capacity (dead).

Computing sediment yield in this equation:

SY= SV × dBD..... (4)

Where:

SY = sediment yield

dBD = dry bulk density

Finally, calculate specific sediment yield by equation:

SSY = SY / A̓..... (5)

Where:

SSY= specific sediment yield

Ȧ= Catchment area.

Dewerige River comes from Iranian territory, about 90% of the river lies within Iran. It's a common border river between Iraq and Iran which depends on rainfall in

discharge. The length of river about (202) km and width less than (800) m with catchment area (3270) km2. Enters Iraq from south - eastern parts at elevation 35m and flow in North West direction to hurt in Hor Al- Sinaf(The Republic of Iraq, Ministry of Irrigation,2009).

Fig. 1 Hydrological map of Dewerige basin
(Alwan,2014)

2. Geological setting :

2.1 Lithology

Lithology of dam site consist mainly of Quaternary deposit , especially flood plain sediments (sandstone ,siltstone and claystone),which covering Tertiary deposit Mukdadya and Bai Hassan formation. Mukdadya (lower Bakhtiari) lithologically, consist of (Gravely sandstone -sandstone - clay stone) with fining upward grained. There are conglomerate beds represent the border between Mukdadya and Bai Hassan, however Bai Hassan formation comprise (conglomerate - claystone - sandy conglomerate)(Geotechnical investigation report,2009) .

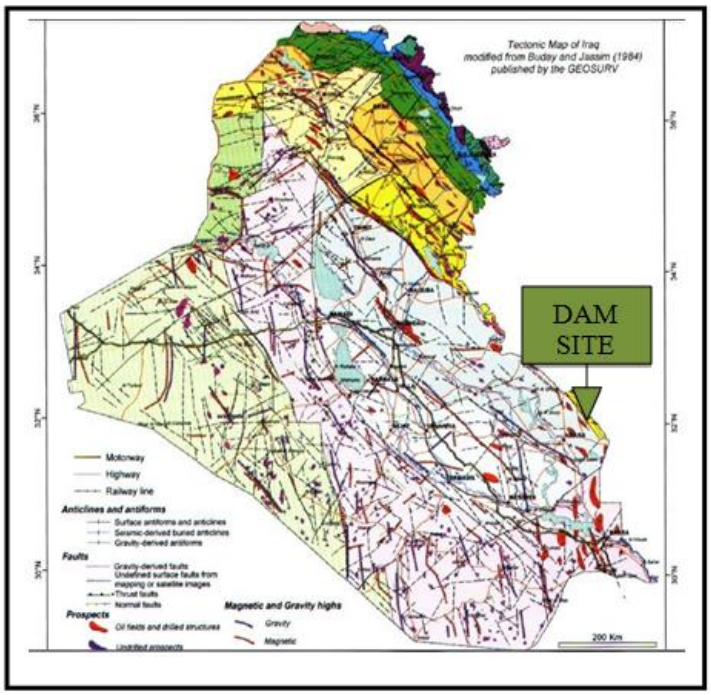

Fig .2 Tectonic map of Iraq (Jassim and Goff, 2006) showing location of the study area

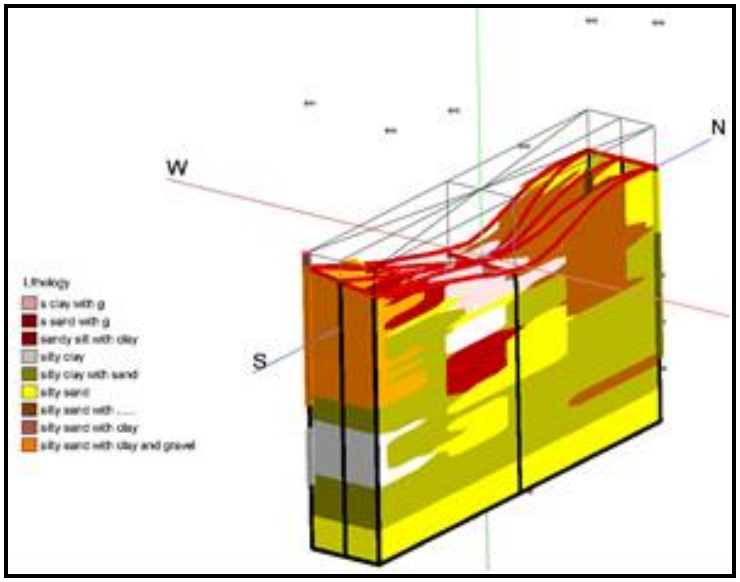

Fig.3 Lithology fence of study area

2.2 Structural

The area is located in Foothill zone, which characterized by higher terrain ,in south-east part next to Mesopotamian zone as shown in fig.2.1The study area comprise faulted structure beneath Quaternary cover, isolated by wide synclines

(Buday and Jassim,1987).The main trends of the fold structures are NW-SE in the eastern part of the zone.

3. DESCRIPTION OF PROJECT AREA

Dewerige dam site located in south eastern parts of Mayssan Governorate, south of Iraq as shown in fig.1 .the coordinates of two sides of dam are (E746239.862, N3551456.909) - (E746256, N3550931) .

4. METHODOLOGY

a - Topographic survey map by Ministry of water resource / Center studies and engineering design) is used as base map as *the following* procedure:

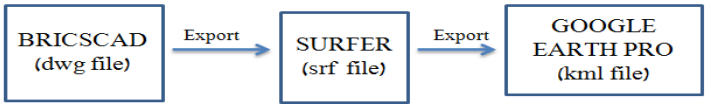

Fig. 4 Software used

b - Georeferencing the based map by using SURFER 14 Software.

c - Exporting the topographic map (base map) dwg file to Google earth.

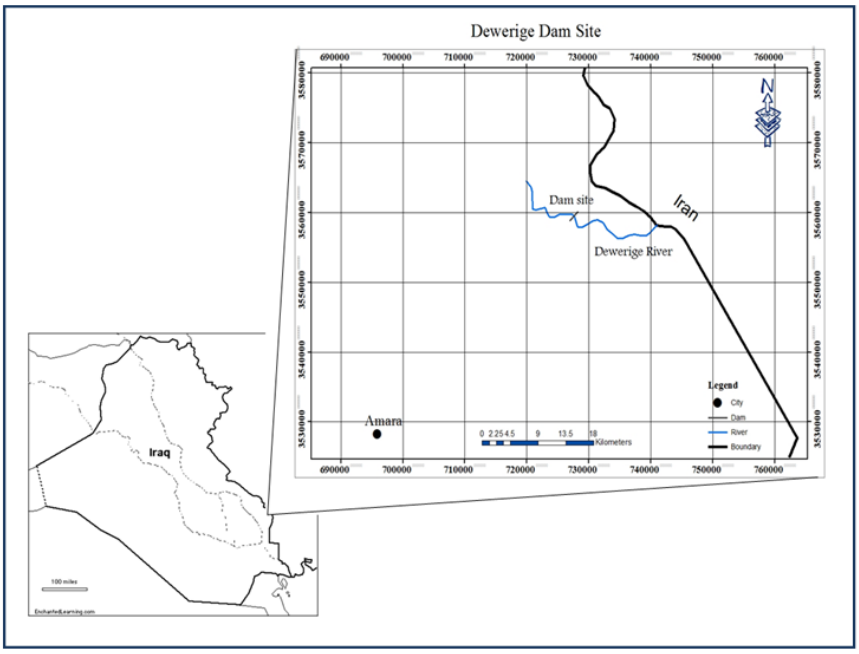

Fig. 5 Location of the Dam project

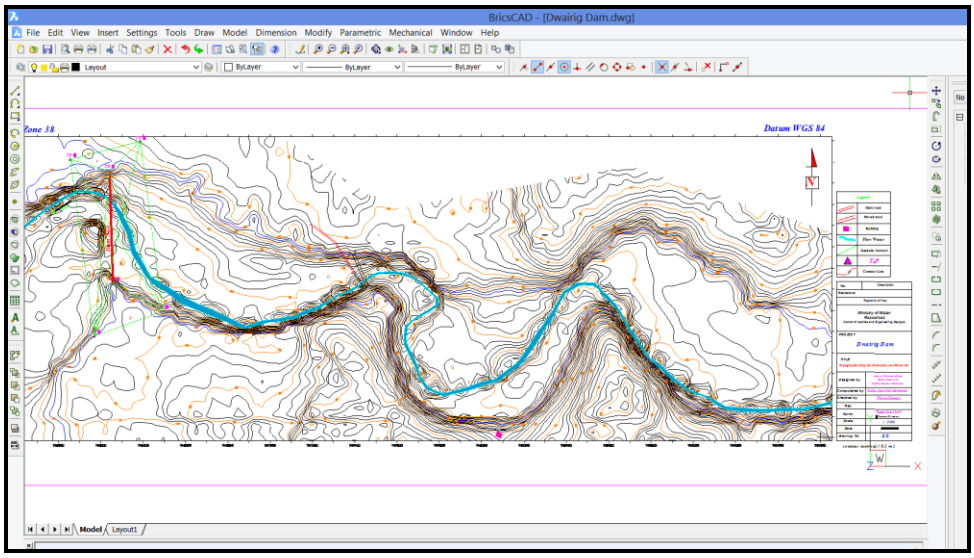

Fig. 6 base map

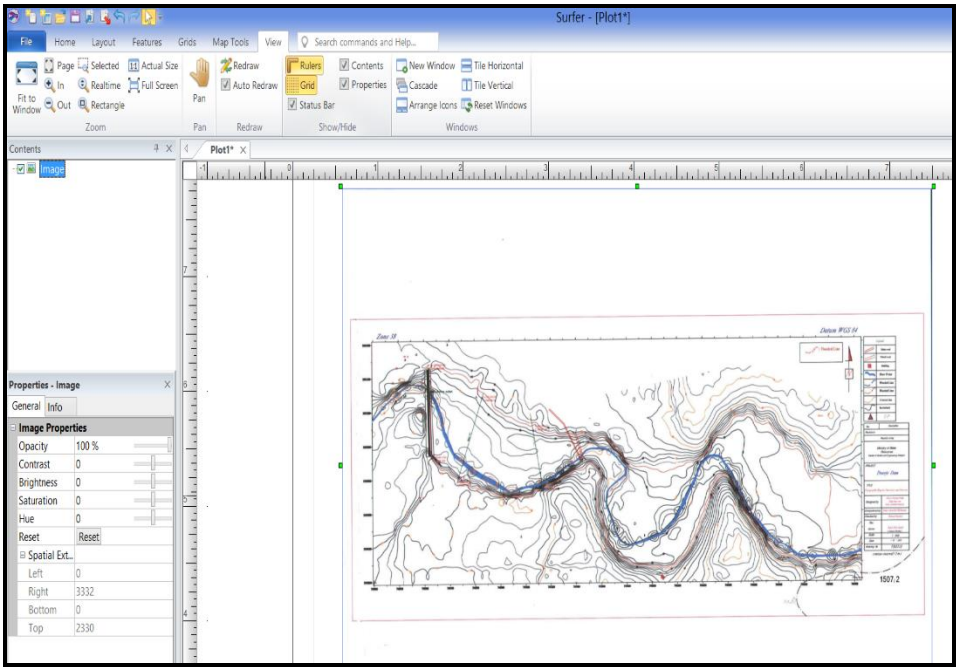

Fig.7 Base map Georeferencing

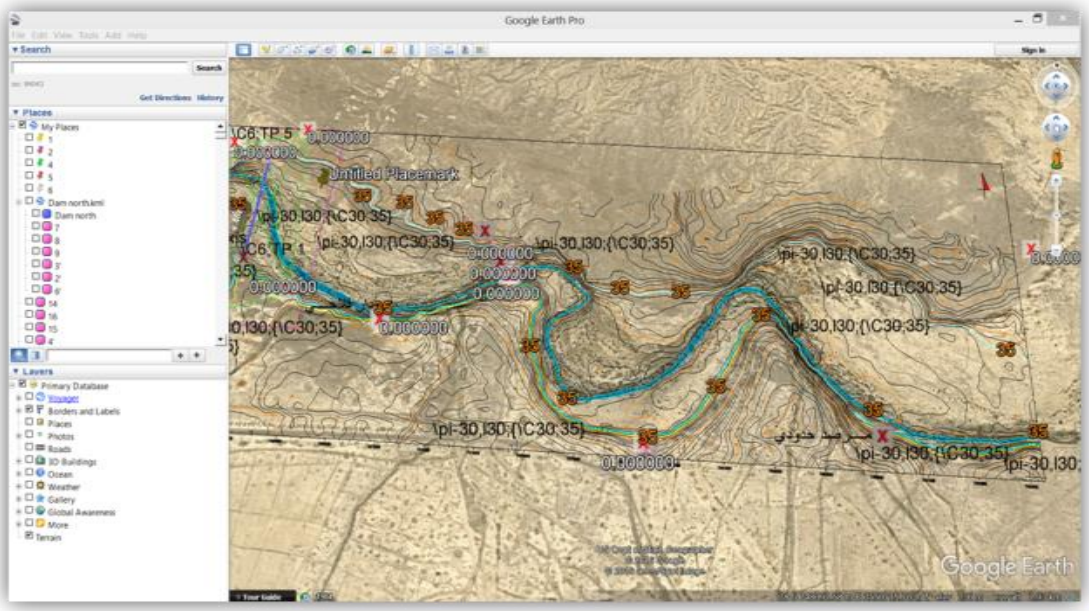

Fig. 8 Base map Georeferencing

Siltation volume has been estimated by:

Step 1: Choosing & drawing cross-sections on Dewerige channel:

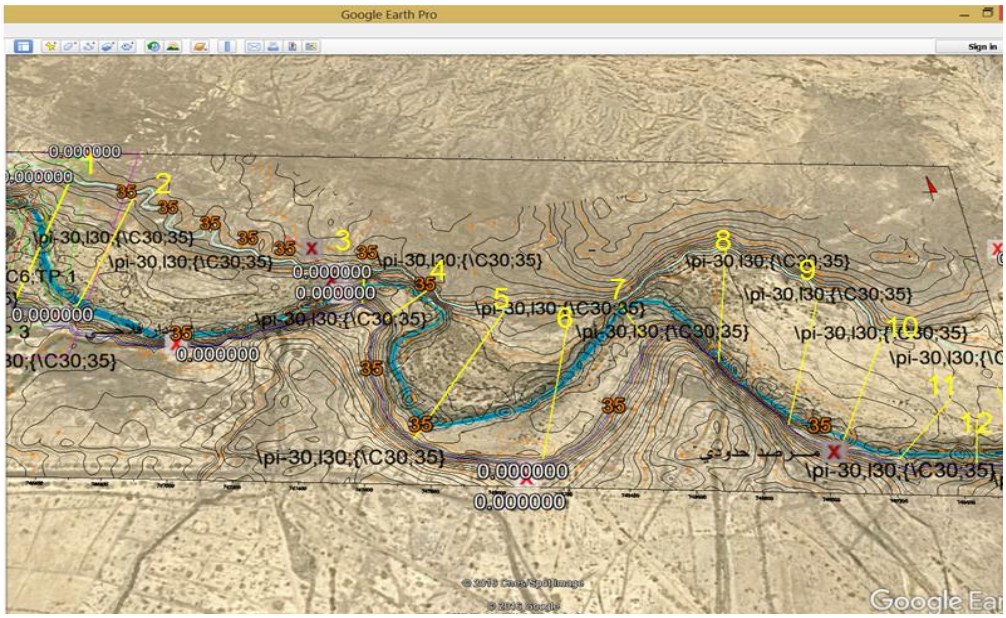

Fig. 9 exporting the base map to Google earth

Step 2 : Based on Trapezoidal rule to calculate the average of cross-sections area for Dewerige river. As shown below:

A= w × d ..... (6)

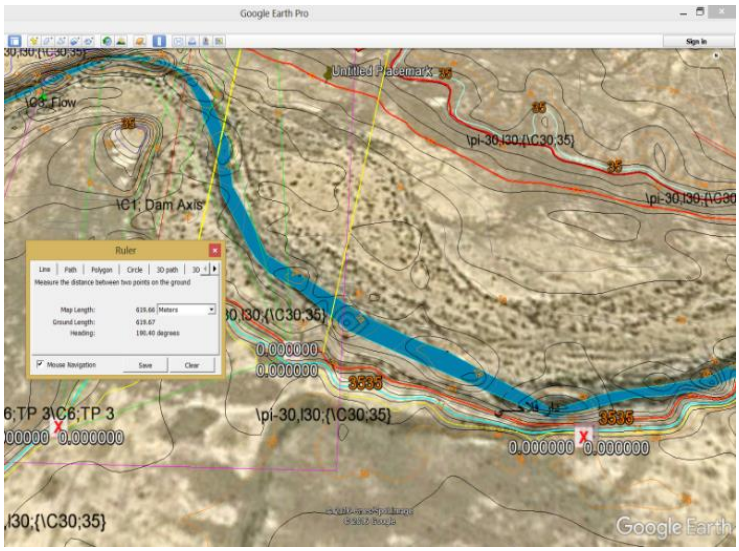

Fig.10 drawing cross-sections

Step 3: Final field survey to measuring siltation thickness in reservoir ,based on dam crest as a bench mark 32.5m elevation.

where:
A= cross -section area (sq. m)
w= width of channel (m)
d= dry channel depth in m (siltation thickness)

SV = A × Channel length ..... (7)

measuring the length of all cross-section as shown
in figure below:

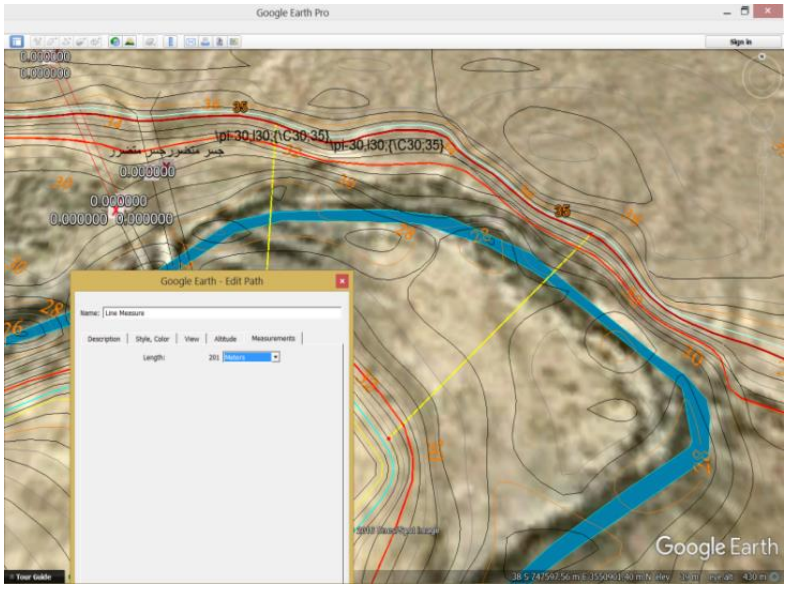

Fig. 10 measuring for all cross-sections

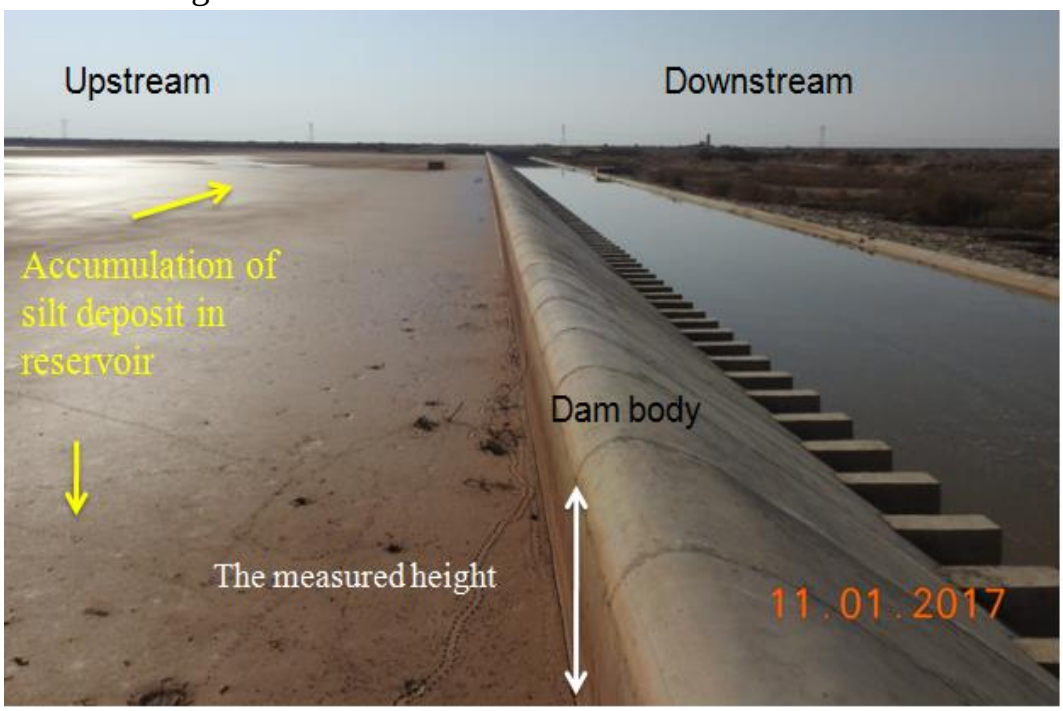

Fig. 11 accumulation of silt in reservoir

Fig.12 A , B show accumulation of silt in dry reservoir in January 2017 .C shows bed sediment of Dewerige river . D shows upstream & downstream of dam.

Fig. 13 E ,F show dam reservoir in September

5. THE RUSULTS:

Table :1 illustrate results of step 2 .

River cross- sections	Width	Depth average	Area
Cross-section1	594.97m	4.6m	2736.8m2
Cross-section2	614.97m	4.6m	2827m2
Cross-section3	161.46m	4.6m	742.7m2
Cross-section4	201.29m	5.7m	1147.3m2
Cross-section5	583.38m	3.6m	2100m2
Cross-section6	604.95m	3.6m	2177.8m2
Cross-section7	181m	2.5m	452.5m2
Cross-section8	505.98m	3.6m	1818m2
Cross-section9	571.83m	3.6m	2058.5m2
Cross-section10	500m	3.6m	1800m2
Cross-section11	315.90m	2.5m	7875m2
Cross-section12	170m	2.5m	425m2

Average of cross-sections area = 2180m2

Silt volume = Average of A × L

SV= 2180 m^2 × 3781.17 m = 8242950.6 m^3

SR = (SV) / age of reservoir (y)

SR = 8242950.6 m^3 /1 y = 8242950.6 m^3/y

LE = RSC / SR

LE = 25200000 m^3 / 8242950.6 m^3/y = 3 y

Sediment yield (SY) = SV × dBD

(SY) = 8242950.6 m^3 × 1.62 (t . m^{-3}) = 13353579.97 ($t.y^{-1}$)

Specific sediment yield (SSY)= SY / À

(SSY)= 13353579.97 t / 3270 Km^2 = 4.083.6 $t.\ km^{-2}.\ y^{-1}$)

6. CONCLUSION

The sediment volume in reservoir of Dewerige Dam represent amount of sediment in one year ago. Contour map of study area explains the steepness in project site, so the thickness of sediment around the reservoir various depend upon the reservoir topography. In addition decreasing the life time of the reservoir from 50 years to 3 years .This result shows there was a gap and failure in Data which use in designing stage of the Dam .which has a negative impact of the economic, social and environmental.

Table.2 Summary of siltation study in Dewerige Dam

Variables of the Dewerige Dam reservoir	
Sediment volume (m^3)	= 8242950.6
Age of reservoir (y)	= 1 y
Sediment rate (m^3/y)	= 618257.07
Reservoir storage capacity (m^3)	= 25200000
Designed life time (y)	= 50
Economic life time (y)	= 3
Catchment area (Km^2)	= 3270
Dry bulk density (t . m^{-3})	= 1.62
Sediment yield ($t.y^{-1}$)	= 13353579.97
SSY ($t.\ km^{-2}.\ y^{-1}$)	= 4.083.6

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