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Tigris River Stability (Islands And Course) At Aziziya Meander -Kut Region

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Abstract : Tigris River south of Baghdad reach his old stage with more wide width and low slop degree for flood plain , some typical meanders appear before Kut area also some cut off menders with many point bars around the course , last dry decays at Iraq (decrease of annual rain rate and increase of annual Temperature rate) , but river still show some activities can happen there , lateral shifting and change in mid river Islands (number and size) , to know more about that ,one main meander at Azizya town chosen , Serials of Satellite images and maps companied to detect the total changes, results show with one century Tigris shift about 3120 m, width of main course change with periods about 1098 m. by effect of weather and discharge , two mean Islands appear and grow up then one merge with bank , all that results give clear idea about Tigris still active even its dry seasons and must put plans to stop some dangerous activates of River .

Keywords : Tigris river ;Change detection ;Stability ; meander ; Iraq .

المخلص

يدخل نهر دجلة جنوب بغداد مرحلة الشيخوخة النهرية بتميزه بعرض اكبر و درجة ميل قليلة تتناسب مع السهل الفيضي المحيط به , كذلك ظهور عدة التواءات مميزة و قد تتطور الى انقطاعات نهريّة و تشكل بعض البحيرات القوسية . بالرغم من العقود الأخيرة الجافة التي مرت على كل المنطقة الا ان النهر مازال يظهر بعض الفعاليات كالزحف الجانبي لمجرى النهر او ظهور عدد من الجزرات الوسطية ضمن مجرى الرئيسي , و لدراسة هذه الظواهر تم اختيار احد الالتواءات قرب منطقة العزيزية , سلسلة من تسجيلات الصور الفضائية و الخرائط الأرشيفية استخدمت و تم بعدها إجراء تطابق لكشف اي تغيير حصل في تلك المنطقة , أوضحت النتائج ان النهر في تلك المنطقة زحف 3120 متر خلال قرن كامل و قل عرض النهر بمقدار 1098 متر , و ظهور جزيرتين رئيسيتين وسطيتين استمرت بالنمو مؤثرة على عرض المجرى , كل هذه الظواهر يتوجب القيام بخطوات لوقف استمرارها و خاصة الزحف الجانبي لما له خطورة كبيرة على القرى الفلاحية المجاورة للمجرى و كذلك الجزرات التي تهدد الملاحة النهرية و عمليات سحب المياه للأغراض الزراعية .

الكلمات المفتاحية: نهر دجلة ، كشف التغيير ، الاستقرار ، تعرج. العراق .

1.Introduction : Geological studies dealing with different parts of any river are a very common; however, dealing with the whole course within the catchment basin of a certain river with its tributaries are extremely rare, especially in Iraq. But studying of some parts of the Tigris River can give primary ideas about other parts through the river , many factors can affect the stability of River with different ways , results of all that appear as changes in river course shape and shifting also at number and places of river islands , north of Kut area the river showed many changes within last decades , Aziziya place sample of that changes .

2.Studied area

2.1Location:Al-Aziziya is one of the districts of Wasit Governorate (80 km south of Baghdad), Fig (1) show the location of studied area by using zoom for Landsat satellite images ,the area located on the banks of the Tigris River , surrounded by a number of villages with fertile soil such as the monastery and Bering (located on the opposite bank of the Tigris River. In view of the availability of water, Al-Aziziyah city is characterized by economic and abundant agricultural crops such as wheat and cotton, which is a mainly agricultural region and also famous for the production of quality fruit The good, its geographical location near the capital gained it commercial importance as well, especially in the 1940s and 1950s. The population of the city of Aziziya and the surrounding villages exceeds 100,000 according to the 2014 census(opensooq.com, 2019).

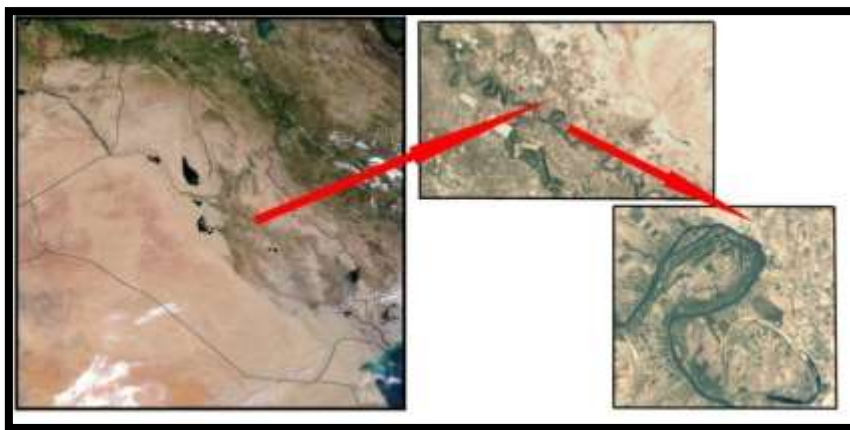


Fig (1) Location of stayed area (Landsat TM Image 1991)

2.2Quaternary deposits : Deposits of Pleistocene and Holocene are common in the area. The Quaternary sediment of Iraq is not precisely de-

terminated, however, relative ages of the main stratigraphic divisions are suggested depending on the geomorphic position, (Yacoub and Barwary, 2002). These consist of alluvium deposits as mixture of gravel, sand, silt, clay and conglomerate of post Pliocene deposits, (Hamza et al., 1989).

2.2.1 Flood Plain: A Flood plain is broad strip lands built up by sedimentation on both sides of stream channel during floods, flood plains may contain water carrying suspended silt and clay, when the flood waters recede; these fine-grained sediments are left behind as a horizontal deposit on the flood plain.

A river has one flood plain but may have one set or more terraces abandoned flood plains. Sandy and clayey sediment deposited by river water that was spread out over a flood plain; a deposit beneath and forming a flood plain, being thickest near the river and thinning out toward the valley slopes. Many features are associated with flood plains including old meander, channels, a box lakes, natural levees, point bar, and various levels of terracing, (Way, 1983).

2.2.2. Natural levees : Some rivers occupy valleys with broad flood plains and build natural levees that run parallel to their channels on both banks. When a stream overflows its banks, its velocity immediately reduce, leaving coarse sediment deposited in strips boarding the channel, (Lutgens and Tarbuck, 2012).

2.2.3 Point Bars : Along the river, sediments tend to become finer downstream, so meandering is common in the lower of river. The low velocity on the inside of a curve promotes sediment deposition. The sandbars have been deposited on the inside of curve because of the lower velocity there. Such a bar is called a Point bar and usually consists of a series arcade ridges of sand or gravel (Plummer, et al. 2007).

2.2.4 Meandering streams : A stream has a pattern of meanders. Streams that transport much of their load in suspension move in sweeping bends called meanders. These streams flow in relatively deep, smooth

channels and transport mainly mud (silt and clay) because of the cohesiveness' of consolidated mud, the bank of stream channel carrying fine particles tend to resist erosion. As a consequence most of the erosion in such channels occurs on the outside of the meander, where velocity and turbulence are greatest, (Tarbck and Lutgens, 2009).

In Baghdad city, the Tigris River flows in many meanders, indicating that the river started its mature stage. The river leaves Baghdad, and the fifth and last tributary called the Diyala River merges in near the small town called Selman Pack, and the Tigris River continues its trend NW – SE until reaching Kut city. The river course between Baghdad and Kut city is characterized by many acute meanders. Some of the meanders are already abandoned forming ox bow lakes; others are still visible on satellite images and aerial photographs , (Sissakian et. Al , 2018)

3.Calculation for Tigris River stability : The evaluation of river islands is one of the negative phenomena that affect the course of the river. By these processes (Erosion, transporting , sedimentation) are activated with increased water discharge in the course of the Tigris River at certain times of the year, and these processes change when the discharge of water in the river decreases . That phenomenon be very clear in recent decades due to high temperatures and general drought at all the areas also decrease of water feeding in the mountains resources of the river due to low amount of fallen snow there , (Al-Jarrah , 1996)

At the studied area the river had a meandering channel since past , many of ancient meander loop are preserved as meander scars . a wide and distinct meander belt can be noticed at region Baghdad – Kut river course , at later period Tigris shifted its course joined some Islands with the banks with general converted into an island therefore the island was not formed due to cumulative deposition of silt only , like any one of the large mid – channel bars stabilized subsequently by vegetation as islands .

detect these activities happened at last decades in the area by using Landsat data for past 40 years since 1972 - 2018 with Archive old maps to show the unstable course of Tigris (Islands and shifting) with that periods .

1-Map of Baghdad – kut river course area , 1917 , produce by History press , lower Mesopotamia – England , with history of world war I

2-Map of Kut Al -Imara , 1940 , produce by university of Texas Libraries – G7400-s253-G7

3-Satellite Landsat MSS data , 26 Dec 1972 , Path 168 – Raw 37 , C N33-16

4-Satellite Landsat TM data , 24 Apr 1991 , Path 168 – Raw 37 , C N33-15

5-Quick bird data 2018 , Google Earth

We matched all these data sources together by using **ERDAS** (version 9.2) and **ArcGIS** (version 9.3)with unification the scales and coordinates to produce new maps to the river course at that periods , then by using classification for each one of these maps (supervise classification – maximum likelihood) procedure for only 2 classes land and water to get best identification to the Islands growing and river shifting . get these classified maps

1- Classified Map of 1917 : the map show the active meander south of Azizya town with two limbs and wide width of the river course , no islands appear mid the river. (Fig 2)

2- Classified Map of 1940 : some clear changes can notice easily , the two limbs of the meander still have same shape but it be more close together because the shifting of right limb leaving many point bar behind , also two islands begin to appear in the middle of left limb, river width show more less than its width at 1917 . (Fig 3)

3- Classified map of 1972 : Growing of two islands and right limb of meander still active , give the general shape at the period , river width show more narrowing . (Fig 4)

4 - Classified map of 1991 (flood time) : it's very clear to notice high level of water at the course of river , water covers the outer edges of the islands appear as begin to be smaller than past calculated period .(Fig 5)

5 - Classified map of 2018 : some important changes happed at that period . huge growing of both islands almost extent with all river width , The

southern island is beginning to merge with the main bank of the river , also the two limbs of meander be more close together as a first stage of cutoff meander later . (Fig 6)

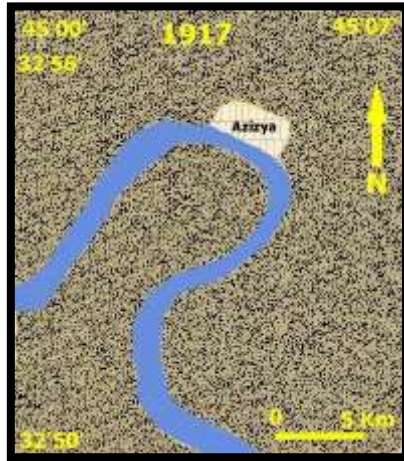


Fig (2) Classified map of Azizya meander 1917

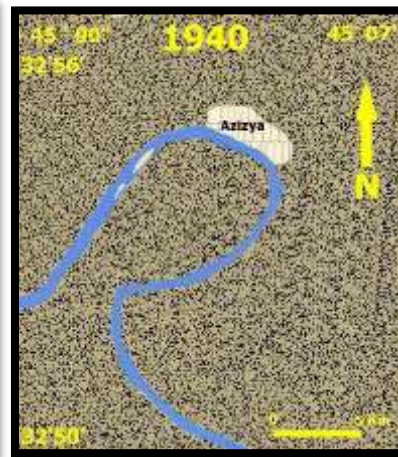


Fig (3) Classified map of Azizya meander 1940

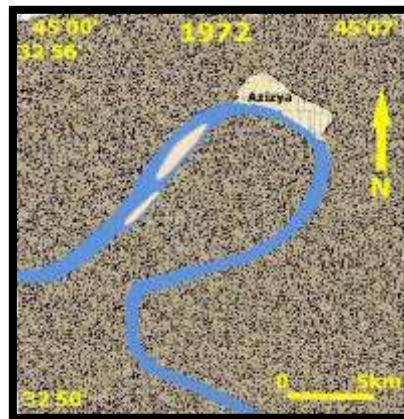


Fig (4) Classified map of Azizya meander 1972

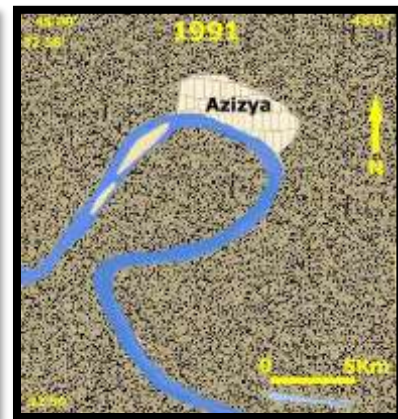


Fig (5) classified map of Azizya meander 1991

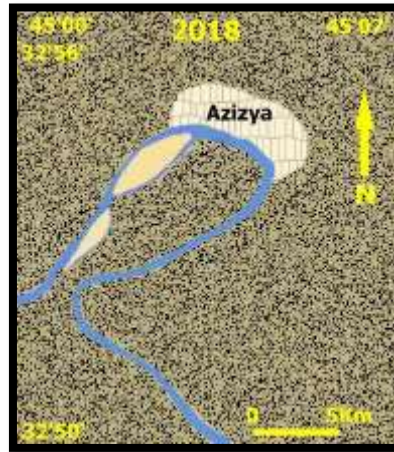


Fig (6) classified map of Azizya meander 2018

All these serial data and calculations for classified maps can give many evidences about the stability of that meander (course shifting limbs and mid islands born and growing) . River shorelines were digitized using the water boundary because it is clearly defined in the aerial photography and Ortho photo images (Lovric, , 2016 . as example for all river course between Baghdad – kut area , these calculations and measurements give at Table (1) below

Table (1) River calculation and measurements for Azizya meander (by Author)

Date	River course		Island 1		Island 2	
	Width m.	Distance between limbs m.	Long m.	Width m.	Long m.	Width m.
1917	1417	4600	Not exist	Not exist	Not exist	Not exist
1940	531	1875	1863	401	1000	181
1972	483	1690	4537	879	2777	416
1991	833	1486	4318	863	2454	454
2018	319	1480	5090	1236	4181 merged	909 merged

4.Discussion the results : It can be noted many of the changes in this table above, which can appear in general that the average is unstable during the calculation periods about 100 years, and every change that must be studied as a result of some factors affecting the region in different periods of calculations.

1- The most width in the river within all these time records at 1917 , that because there are no any dams or irrigation projects established in that period , the river with all energy and water quantities pass throw course without any storage and discharge control , dams began to established since fifties till eighties of last century, Table (2)

2- After that the river be controlled with discharge which can notice easily in river width and other activists excepts at 1991 that was flood year in all Tigris river Fig (7) shows the effect of Dams and other factors on river discharge .

Table (2) Dams in the Tigris River Basin (Al-Murib,2014)

Name	City	River	Year	Height (m)	Capacity (Mm ³)	Main use
Mosul	Mosul	Tigris	1983	131	12,500	I
Dokan	Sulaymaniyah	Lesser Zab	1961	116	6,800	I
Dibis	Dibis, Kirkuk	Lesser Zab	1965	15	3,000	I
Samarra	Samarra	Tigris	1954	-	73,800	F
Adhaim	Adhaim	Adhaim	1999	-	-	I
Himrin	Ba'qubah	Diyalah	1980	40	4,000	I
Derbendi Khan	Ba'qubah	Diyalah River	1962	128	3,000	I

I = Irrigation

F = Flood

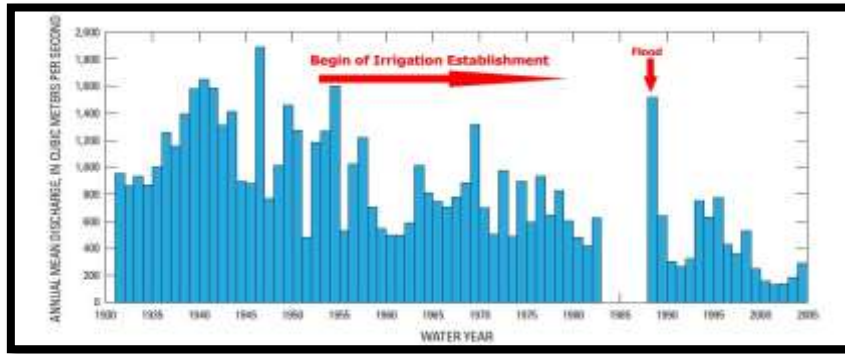
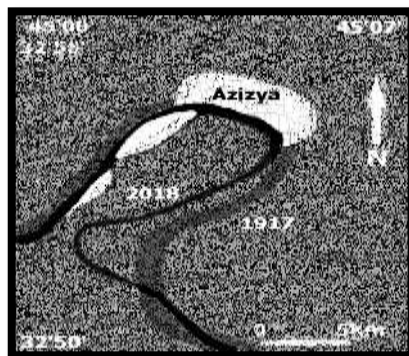


Fig (7) annual discharge at Tigris river , kut gaging station (Saleh ,2010)

phenomenon of drought in the region and high temperatures for the whole world, cause lack of water resources in the headwaters and rains , mean annual temperature at 1953 was 24.9 C° changed at 2015 to 26.3 C° (effect of Global warming) also mean of Rain precipitation at 1953 was 208.78 mm. changed at 2015 to 178.79 mm. (Saleh ,2010)

The distance between two limbs show continues of approaching between them within periods of calculations Fig (8) , This is the initial stage of the cut of meander when these two parts later join together , that area show many old ox-bow features happened past periods and maybe happen again if not ant arrangements will done , the total distance of shifting was 3120 m within about one century , with huge damage happened to the best agricultural areas (located between the two limbs with direction of shifting) was eroded and moves away , also the recent course of river later will change to isolated ox-bow lake all agricultural areas around it will be far from new course same to Azizya city located on top of meander act as a river dam or barrier is prevented the moving or shifting , and this city grows during periods of measurements, along the left bank of the river at the top of the meander .



Fig(8) Meander shifting

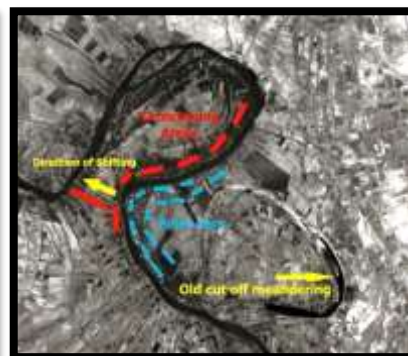


Fig (9) Direction of shift movement

At Figure (9) above the red dash lines show the most threatened area of river shifting .

3-Two main islands take place at left limb of meander , there are no exist of these islands at 1917 because of high river water energy and huge quantities of discharge without any chance for sediments to stale down and accumulate on river bed as a first stage of island forming . In 1940 at the left limb of the moaned, we can see two small islands located almost in the middle of the river, due to the presence of a large amount of sediments that comes with high water levels and floods that occurred during that period (till 1940 there were no large dams) , in 1972 the effect of dams for controlling water discharge make the river more stable and that gave chance to these islands to grow up (long and width) continues to next measurement period 1991, general changes happened at last period 2018 which show one on island merged totally with right bank of river because of narrow water path between the island and river bank with low current velocity and most accumulate sediments still trapped there , the other island almost extent to all river width, to get better idea about the mechanism of sediments trapping in the island 20 samples have been tacked in both front and back edges of island , the analysis showed in the front edge most sediments was more coarse than back edge , Table (3) , these results show that water current when strike front edge of island with velocity

about (4.2 m /s) its divide two parts one to right bank slow (0.77 – 1.54 m /s) and other one to left is more faster (2 – 3.86 m / s) all current velocity done with VTECH Propeller water current meter , that strike will reduce the main current velocity so Sand particles(the bigger) and other smaller particles will trapped in front edge of island , but at back edge the conditions was opposite because of the water current be more slower and most of big partical was trapped in front edge so the anaylysis show different result for higher percent to smaller particaled (Clay – Silt) .

the slower current can carry to more far places and less percent for bigger particaled (Sand) because most of it trapper before Fig (10) .



Fig(10) Current velocity and directions in the meander

Table(3) Analysis for samples (by Author)

Samples Front Edge	Sand	Silt	Clay	Samples Back Edge	Sand	Silt	Clay
S1	72	19	8	S1	6	60	34
S2	65	23	12	S2	5	66	28
S3	93	65	1	S3	4	58	38
S4	83	9	5	S4	6	63	31
S5	68	21	11	S5	3	69	28
S6	70	15	15	S6	8	72	20
S7	91	3	6	S7	4	55	41
S8	70	23	7	S8	5	62	32
S9	76	12	11	S9	3	63	33
S10	86	8	6	S10	3	58	39

5. Conclusion

at last decades the weather in all Iraq specially in middle and south showed more drought phenomena with increase of annual temperature (+1.4 C° within 60 years) and decrease of annual precipitation (- 29.99 mm. within 60 years) , that caused extremely reduce in river

discharge for all Tigris specially in south Iraq , but the serial measurements for changes happened within one century to the river and one chosen meander Azizya city , show the river still have energy to make changes as lateral shifting and mid river islands appear and merge , all that can effect badly on human life around the river specially with located on direction of next future shifting of meander limbs , also the town of Aziza itself threaded with river moving , other negative effect is the growing of islands which make the channel more narrow and that cause problem in river transportation also in take water pipes for human life to villages around river , all that results must study carefully to put a precise plans to face it in future .

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