

Bank Erosion and Land Use Change of a Part of the Euphrates River between Al-Sadda and Al-Hindia Cities

تاكل ضفة النهر والتغيير في استخدام الارض لمقطع من نهر الفرات بين مدينتي السدة والهندية

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Abstract:

Euphrates river is one of the longest rivers in the world, one of the two rivers in Iraq. In the study area it's bounded by agricultural land that's belongs to Mesopotamian plain. Human activities include tourism, fishing, settlement and mainly agricultural land considering the predominant land use.

During this research, the researcher traveled the entire length of the studied part of the river by boats. During this trip, a number of bank erosion sites were identified, bank material samples were collected, photographs were taken, and field evaluations of the causative factor or factors were noted.

Most bank erosion sites are occurring due to a combination of hydraulic and geotechnical forces. The agricultural land reduction and loss of property regards as the predominant problem of bank erosion. The periodically monitor of the river bank, the best way to determine new bank erosion site or sites and to treat it at the first stage without more losses. Cane and bulrush that's growing naturally at both river sides, the friendly environment protection method to stabilize new bank.

الخلاصة:

نهر الفرات من احد أطول الانهار في العالم، و احد النهرين في العراق. يقع على جانبي النهر في منطقة الدراسة الاراضي الزراعية والعائدة للسهل الرسوبي. النشاطات البشرية في المنطقة تتمثل بالصيد، السياحة النهرية، السكن والزراعة، استخدام الارض لغرض الزراعة هو من الاستخدامات الاكثر شيوعا في المنطقة. في هذه الورقة، سار الباحث على طول المقطع المدروس من نهر الفرات باستخدام الزورق. وخلال هذه الرحلة تم تحديد مجموعة من مواقع التعرية الجانبية لضفة النهر، جمع نماذج من التربة، التقاط الصور وكذلك تم تحديد العوامل المسببة لتعرية ضفة النهر.

تحدث التعرية لضفة النهر بفعل التيارات المائية وتترافق معها الانهيارات بسبب العوامل الجيوتكنيكية لضفة النهر. النقصان في مساحة الاراضي الزراعية وخسارة الملكيات هي من المشاكل المهمة الناتجة من تعرية ضفة النهر. تعتبر المراقبة الدورية لضفة النهر من السبل الجيدة لتحديد مواقع تعرية ضفة النهر الجديدة ومعالجتها عند بداية حدوثها وباقل الخسائر. استخدام النبات الطبيعي الذي ينمو على ضفتي النهر مثل القصب والبردي هو من الطرق الصديقة للبيئة لغرض حماية وتثبيت الضفة الجديدة للنهر.

Introduction:

River meandering is a result of an ongoing bed and bank deformation by the flow in a self formed alluvial channel thus the meander sinuosity increases with the passage of time. In other words, meandering rivers shift their courses across the valley bottom by depositing sediment on the inside of bends while simultaneously eroding on the concave side of banks of the meander.

Meandering is a natural geomorphic feature in rivers which results in gradual migration of the river's course and erosion of banks. Most rivers in the world are subject to meandering due for natural and human activities, specially the rivers that pass through flood plains^(1, 2, 3). The River Nile, Illinois River and Amazon River regarded as the best example of meandering rivers in the world.

Euphrates river is one of the longest rivers in the world, one of the two rivers in Iraq. The Euphrates river flowing from the high mountains in south of Turkey, then passing through Syria. In Al-Qaim city the Euphrates river entering Iraq, and generally flowing north west to south east direction.

(Fig.1).South of Iraq, Euphrates river joining with Tigris river, forming Shat Al-Arab, Shat Al-Arab enters the Arabian Gulf. The studied part of the Euphrates river in this paper flowing through alluvial plain, mainly consist of fine particles of sediments like clay and silt.

Human activities along the studied part of the river include urbanization, settlement, agriculture, fishing and tourism. These activities create great stress on river bank stability. From the other hand, meandering and bank erosion could lead to huge problem on human activities.



Fig. 1. Location of the study area.

On going bank erosion of the river results in social problems among the settlers of land adjacent to the bank. A diffuse understanding about the causative factors for bank erosion will allow for decision makers and specialists to good management of river and to choose a proper method for treatment.

The aims of this study are to make general conception about the bank river erosion and their effects on land use especially agricultural land. This requires:-

- 1- Determination of bank river erosion sites and determination the causative (possible) factors of bank river erosion.
- 2- Proposing some protection measures to stabilize the river bank in the area.

Study area:

The study area is a part of Euphrates river located between Al-Sadda and Al-Hindia cities, Middle of Iraq. The length of the studied part of Euphrates river is (10Km), (Fig. 1).

At both banks of river, land use categories differ along the studied part, mainly agricultural land considering the predominant land use. Settlement, fishing, tourism and recreation represents another use for land, cane and bulrush growing at both banks, and using as principal forage for droves of cattles. Field observations shows that the human and natural activities made great impact on river bank stability due to disturbance on river system, this disturbance represented by bank erosion problem and causing in big losses in agricultural land and put some of farmer houses under tangible dangerous (Fig. 2-a) and (Fig. 2-b).

Geology, climate and hydrology of the study area:

Stratigraphically the geologic sequence of the study area is mainly represented by the quaternary sediments of the Mesopotamian zone where deposited by the interacting of Tigris and Euphrates rivers. Quaternary sediments are up to 300 m thick and overlie the complete Mesozoic and Cenozoic section ^(4,5).

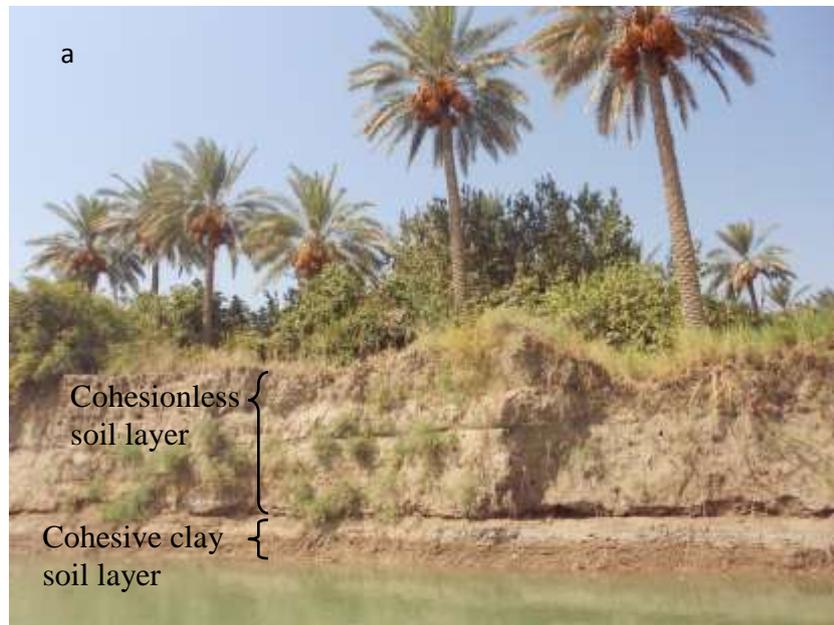


Fig. 2-a Bank erosion and big losses on agricultural land and groves.



Fig. 2-b Bank erosion and their effects on settlement land put peasants' houses under tangible dangerous. The distance between the house and the new river bank is (5 Meters).

Tectonically the studied area is located at Unstable Shelf within Mesopotamian Zone, Euphrates Subzone. Euphrates Subzone lies to the west of the Mesopotamian zone. Structurally the Mesopotamian Zone contains buried faulted and folded structures below the Quaternary cover^(4,5).

The climate of the study area characterized by hot and comparatively high summer temperature, moderate humidity, high evaporation, the rain is limited in winter and comparatively low temperature, with max. mean of wind speed about (3.9M\S) occurs in June and July, while lowest mean of wind speed about (1.8M\S) occurs in November and December⁽⁶⁾. Euphrates river, irrigation canals and rains in winter represents the principal Surface water resources.

River bank materials (soil type):

River bank failure is closely related to the composition of the river bank material. The river bank in the study area was characterized by stratified or interbedded bank. This bank is generally the most common bank type in fluvial systems because of the natural layering process. These soils consist of layers of materials of various textures, permeability, and cohesion.

When cohesionless layers are interbedded with cohesive soils, the erosion rate is determined by the characteristics of the cohesionless soil. When the cohesionless soil is at the toe of the bank, it will generally control the erosion rate of the overlaying cohesive layer. When a cohesive soil is at the toe of the bank, it will generally protect any cohesionless layers above (although these layers will still be subject to surface erosion)⁽⁷⁾.

Sieve analysis for soil of bank River for the study area shows that the soil layers consist of cohesive clay soil layer and cohesionless silt soil layer. With presence and absence of cohesive soil layer at the toe of the soil slope in the study area, the bank erosion rate differs from place to place.

Methodology:

Field surveys were carried out and the researcher traveled the entire length of the studied part of river by boats to determine bank erosion sites. During fieldwork, bank erosion sites were recognized, beginning and ending for each bank erosion site was determined and naming by coordination's that's taken by GPS technique, the coordination's was marked at the aerial photo for the study area by GIS program, soil sample was picked up for laboratory sieve analysis test, photograph pictures was taken for documentation and a field evaluation of the causative factors were noted.

Results:

A- Possible causative factors:

River bank erosion is a very complex process, caused by natural and/or humane activities. The most effective factors for bank erosion in the study area are eddy currents, disturbed flows due to exposed trees roots, surface drainage (irrigation and rainfall), bank material (type of soil), relationship between the fluctuations of water level and type of bank material (type of soil), waves action and hydraulic force (is usually connected to flow velocity and/or flow direction).

B- Bank erosion mechanism:

All the collected informations were analyzed and appointed to understand the mechanism of bank erosion in the study area. Mainly natural causative factors regarded as more effective factors for bank erosion. Most failures are occur due to a combination of hydraulic and geotechnical forces, bed degradation due to hydraulic forces can lead to an oversteepening (overhanging) of the banks which can result in a geotechnical failure of soil slope.

C-Bank erosion impact:

Here it should be noted that the all land bounded the studied part of the Euphrates river it is belong to the Mesopotamian plain, where the best agricultural land in central of Iraq. Therefore, bank erosion process led to, and on going to decrease in agricultural lands, which reflect in decreasing in agricultural production.

The on going erosional process at the concave side and losing land, the on going depositional process at the convex side and forming a new land, this situation lead to lose a property (agricultural land, trees, houses, cattles ...els.), property problem may arise between farmers or between farmers and government (local administration).

D-Bank erosion sites determination and mapping:

The coordination's that was taken for beginning and ending for each bank erosion site by GPS technique, was remarked at the aerial photo for the study area by GIS program. Bank erosion sites map was prepare for the study area, to help decision maker, local administration and specialists to prepare urgent plan to stabilize the new and unprotect soil slope and to protect the bank that is still with out bank erosion problem (Fig. 3).

This map shows (7) bank erosion sites, three of them was very long with more losing in agricultural land and more reduction in agricultural production (Fig. 2-a).

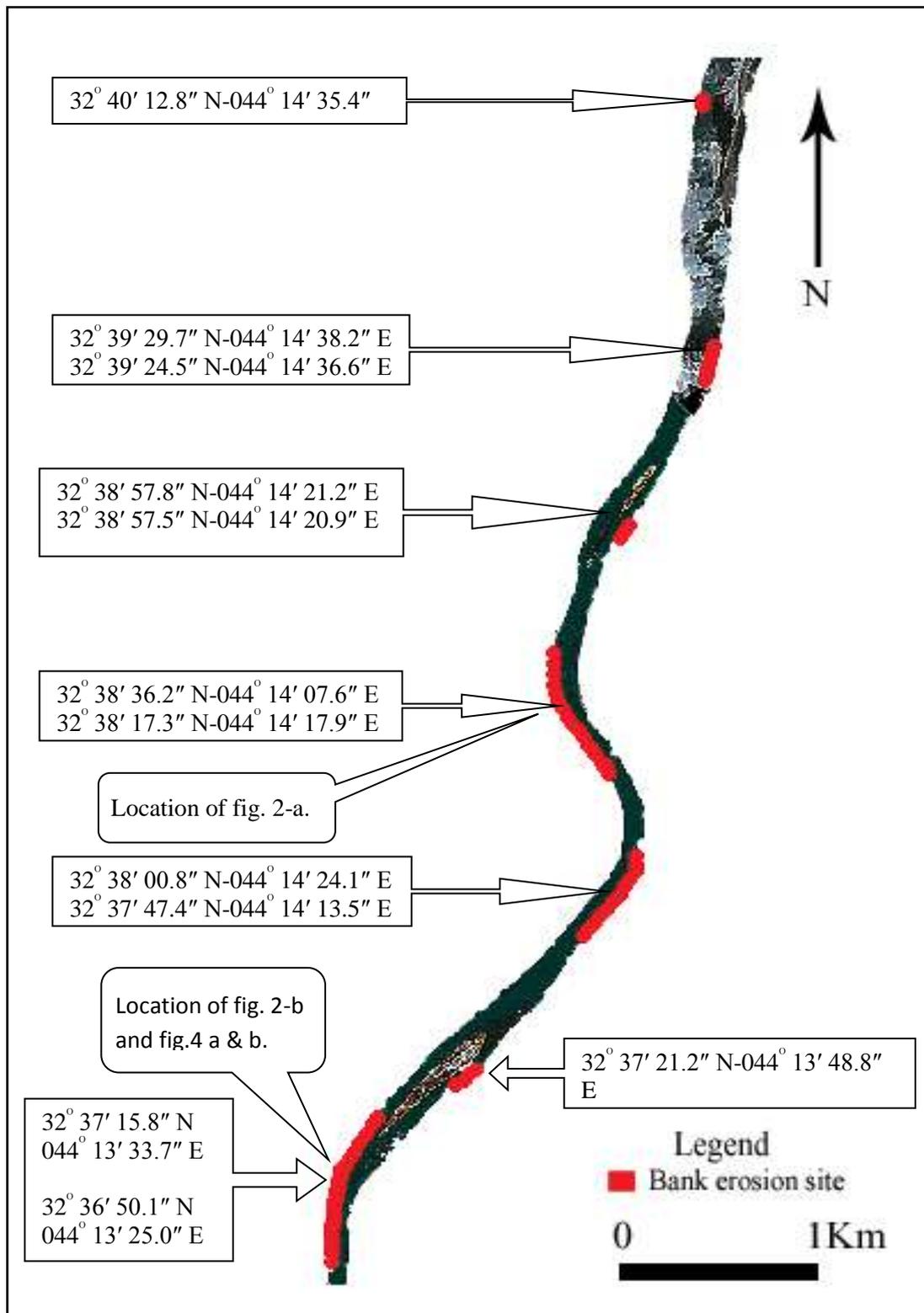


Fig. 3 Location of the study area showing the locations of sits of bank erosion.

One of them, it is so dangerous because the new bank backing away to be more close to the farmer house and putting his house under tangible dangerous (Fig. 2-b).

Conclusion:

- 1- The study area belongs to the Mesopotamian plain, Middle of Iraq. The geologic sequence of the study area is mainly represented by the quaternary sediments of the Mesopotamian zone.
- 2- The river bank in the study area characterized by stratified layers bank. The big variations in soil forming river bank, the fluctuation of water level, the controlling intensity of bank erosion.
- 3- The presence of cohesive clay soil layers at the toe of the soil slope protects the cohesionless soil layers above it.
- 4- Bank erosion problem raised by natural factors, and its going on to increase their extending and to create new sites of bank erosion.
- 5- Cohesionless soil layers mostly eroded faster than the cohesive soil layers especially at the contact with river water, helping in forming very steep and\ or overhanging unstable slopes (Fig.4 a & b).
- 6- Hydraulic force took place at the foot of the bank leading to remove the material at the toe of the slope helping in forming very steep and\ or overhanging unstable slopes, shear crack will forming, then the separated blocks of the soil will be ultimately collapse in the water to be removed out to deposition side. (Fig.4 a & b).
- 7- The steep and overhanging slopes mostly failed by a geotechnical failure of mass wasting.

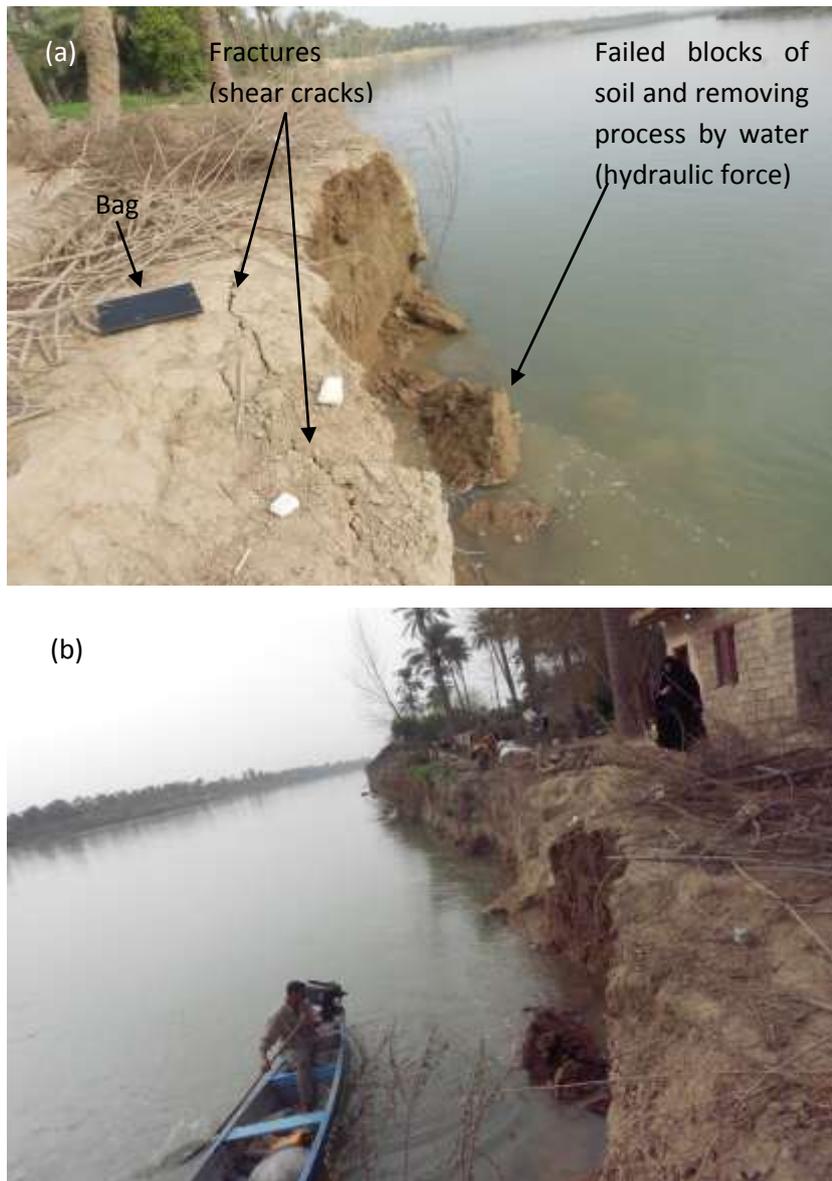


Fig. 4 a & b Hydraulic force affects the cohesionless soil layer helping in forming very steep and/or overhanging unstable slopes and fracturing the surface and ultimately collapse in the water to be removed out to deposition side. The length of the bag is (35cm).

Recommendations:

- 1- Monitoring the river banks and islands and measuring the rates of erosion and deposition to help decision making in their decisions.
- 2- Periodically monitoring considers a best way to recognize new erosion site at first stage to treat it without more losses or difficulties.
- 3- Using protection methods in the study area to protect the river bank from further migration and erosion.
- 4- Using retardation blocks to stabilize the new banks and to protect it from further failures.
- 5- Using cane and bulrush that's growing naturally and native plants at the river sides as one of the protection methods, for saving the ecosystem of the river and it's relatively low cost.
- 6- Broadcasting awareness between farmers about the hazards caused by river bank erosion, and exhorts them to be away from the dangerous eroding bank.
- 7- Civil structures (if proposed to construct in future) should be constructed far from the bank erosion sites (also far from the river bank side) to keep away from failure hazard.

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