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Economic Potential of the Mesopotamian Plain: A Critical Review

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Abstract

The main material with economic potential in the plain is the clay. The clay is used for brick production; either with modernized technology or primitive industry. It is also used for cement industry. The creeping sand dunes have decreasing the potentiality of the clay for both uses. Salt is another economic material which is produced from Smawa saltern and other small primitive salt basins. The subsurface oil fields in the plain remain as the main source with economic potential.

Keywords: Clay for brick and cement industry, salt, sub surface oil fields.

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1. Introduction

Mesopotamia is a historical region in West Asia situated within the Tigris–Euphrates river system. In modern days, roughly corresponding to most of Iraq, Kuwait, parts of Northern Saudi Arabia, the eastern parts of Syria, Southeastern Turkey, and regions along the Turkish–Syrian and Iran – Iraq borders (Collon, 2011) (Figure 1). Mesopotamia means "(Land) between two rivers" in ancient Greek. The oldest known occurrence of the name Mesopotamia dates to the 4th century BCE, when it was used to designate the land east of the Euphrates in north Syria (Finkelstein, 1962). In modern times, it has been more generally applied to all the lands between the Euphrates and the Tigris, thereby incorporating not only parts of Syria but also almost all of Iraq and southeastern Turkey (Foster and Polinger Foster, 2009). The neighboring steppes to the west of the Euphrates and the western part of the Zagros Mountains are also often included under the wider term Mesopotamia (Canard, 2011, Wilkinson, 2000 and Mathews, 2000). A further distinction is usually made between Upper or Northern Mesopotamia and Lower or Southern Mesopotamia (Miquel et al., 2011). Upper Mesopotamia, also known as the Jazirah, is the area between the Euphrates and the Tigris from their sources down to Baghdad (Canard, 2011). Lower Mesopotamia is the area from Baghdad to the Persian Gulf (Miquel, 2011). In modern scientific usage, the term Mesopotamia often also has a chronological connotation. In modern Western historiography of the region, the term "Mesopotamia" is usually used to designate the area from the beginning of time, until the Muslim conquest in the 630s, with the Arabic names Iraq and Jazirah being used to describe the region after that event (Foster and Polinger Foster, 2009 and Bahrani, 1998).

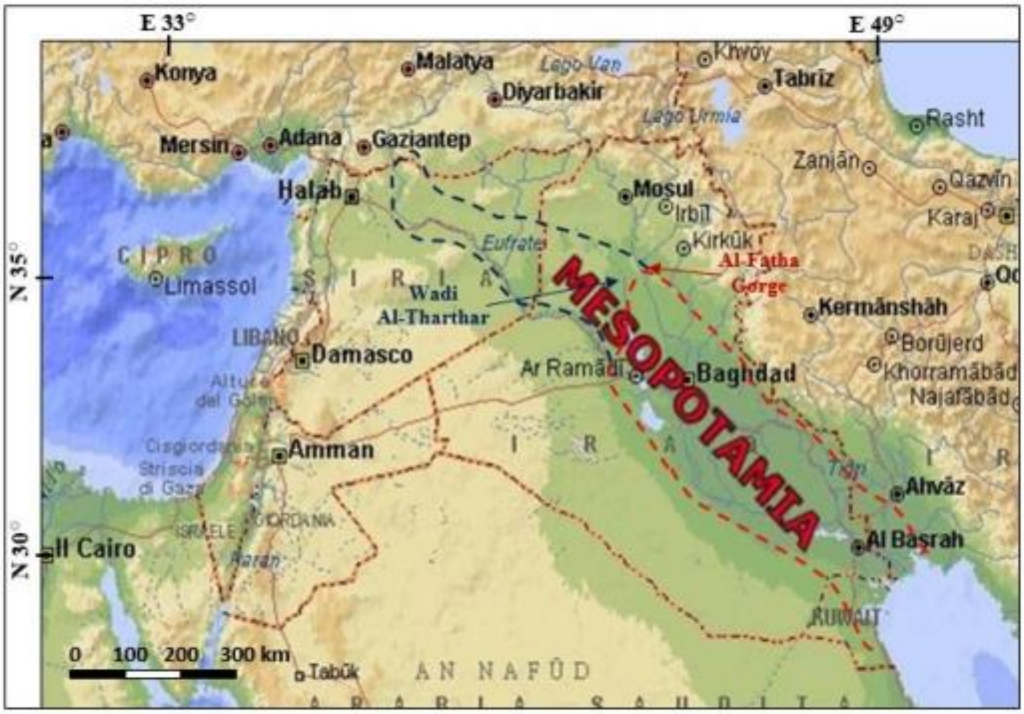

Figure 1: Geographical extension of Mesopotamia (Approximately limited by the dashed blue line including the Mesopotamian Plain) showing the Mesopotamian Plain (Approximately limited by the dashed red line). (Internet data, 2013). (Limits are added by the authors).

The Mesopotamian Plain; however, is different geographically, geologically and historically from the Mesopotamia. The Mesopotamian Plain represents part of the Mesopotamia, and nowadays it represents the existing plain between the Tigris and Euphrates rivers, which is limited south of Al-Fatha gorge in the north. The alluvial plains along the Iraqi – Iranian borders in the east. From the west, it is limited by wadi Al-Tharthar and the eastern limits of the Western Desert; then extending with the northern limits of the Southern Desert (almost parallel to the Euphrates River); forming the southern limits of the plain. From the southeast, it is limited by the upper reaches of the Arabian Gulf (Figure 1).

The majority of the published data about Mesopotamia is related and concerned with the historical data about different civilizations; since it was the cradle of the civilizations. Therefore, the available published data is related to the late Holocene Period (less than 10,000 years). The majority of the available data is related to irrigation channels, changing and shifting of the river courses, dams' construction and flood controls.

The age of the Mesopotamian Plain goes backs to the Pleistocene (2.558 Ma), and because the alluvial sediments of the plain are not concerned with oil explorations; therefore, very limited data is available from the drilled oil wells, as well as from the water wells; since the water wells very rarely encounter the Pleistocene sediments. Moreover, there is a large similarity between the alluvial sediments of the plain and the underlying Pre-Quaternary sediments (Yacoub, 2011); especially, when the Bai Hassan Formation underlies the Mesopotamian Plain sediments.

2. Economic Potential of the Mesopotamian Plain

To explain the economic potentiality of the Mesopotamian Plane we have divided them into two main parts: 1) Economic potential of the Mesopotamian Plain related to sediments, and 2) Economic potential of the Mesopotamian Plane not related to sediments. Both of them are briefed hereinafter.

2.1 Economic Potential of the Mesopotamian Plain related to Sediments

The Mesopotamian Plane is totally covered by Quaternary sediments (Figure 2) which are clay, silt and sand with usual intercalations between the three main types (Yacoub, 2011). However, other sediments occur in certain places of the plain; like sand and gravels, salt, and gypcrete. The main sediments which show economic potential in the plain are mentioned briefly; hereinafter.

2.1.1 Clay

One of the main constituents of the Mesopotamian Plain sediments is the clay because the whole plain is covered by Quaternary sediments, among them, the flood plain sediments are the most prevailing in all parts of the plain. The clay of the Mesopotamia Plain has different uses; these are:

1. **Cement Production:** Clay is mixed with the limestone as one of the main raw materials used in cement production. The percentage of the used claystone may reach 45 % of the raw mix for cement production (I.S.C.P, 1984). The clay is quarried from Quaternary sediments for cement production; usually from the flood plain sediments and or shallow depression. However, due to shallow depth of the ground water and being highly saline the existing clay is highly contaminated by NaCl; accordingly, its potential is highly reduced.
2. **Brick Production:** Clay is the main constituent of the brick production. Enormous amounts of clay from the Mesopotamian Plain sediments are quarried for brick production. The main complex of brick plants is located southeast of Baghdad at Al-Nahrawan Complex. Downwards from AlNahrawan, many other brick plants are located in the Mesopotamian Plain; such as near Mahaweel town (5km north of Hilla city) south of Baghdad, Samawa, and almost near all the main cities along the Tigris and Euphrates rivers. It is worth to mention, that majority of clay deposits are highly contaminated by the saline groundwater which causes efflorescence to the produced bricks. Moreover, the shallow depth of the groundwater decreases the quarrying ability.

2.1.2 Gravels and Sand

Although both the Tigris and Euphrates rivers have no terrace deposits along their courses in the Mesopotamian Plain, apart from two large terrace bodies along the Euphrates River near Falluja town and Iskandariyah town, however, enormous amounts of gravels and sand deposits exist in the plain. One of the main deposits is at Al-Niba'i north of Baghdad at a distance of about 65km. These gravel deposits are the distal part of Al-Fatha Alluvial Fan (Jassim, 1981) (Figure 2). Al-Niba'i gravel deposits supplies all constructional demands of the central part of the Mesopotamian Plain. Along the Euphrates River, the terrace remnants near Falluja and Iskandariyah towns form the main gravel source in the western part of the plain, and the cities located along the Euphrates River. Other sources for the gravels is the alluvial fans in the eastern part of the plain (Figure 2), at Badra vicinity and east of Amara town such as Chlat, Al-Teeb, and near Basra at Safwan and Chwaibda. Al-Batin alluvial fan is the source for the last two deposits. The alluvial fans supply gravels for the whole cities located along the Tigris River, south of Baghdad.

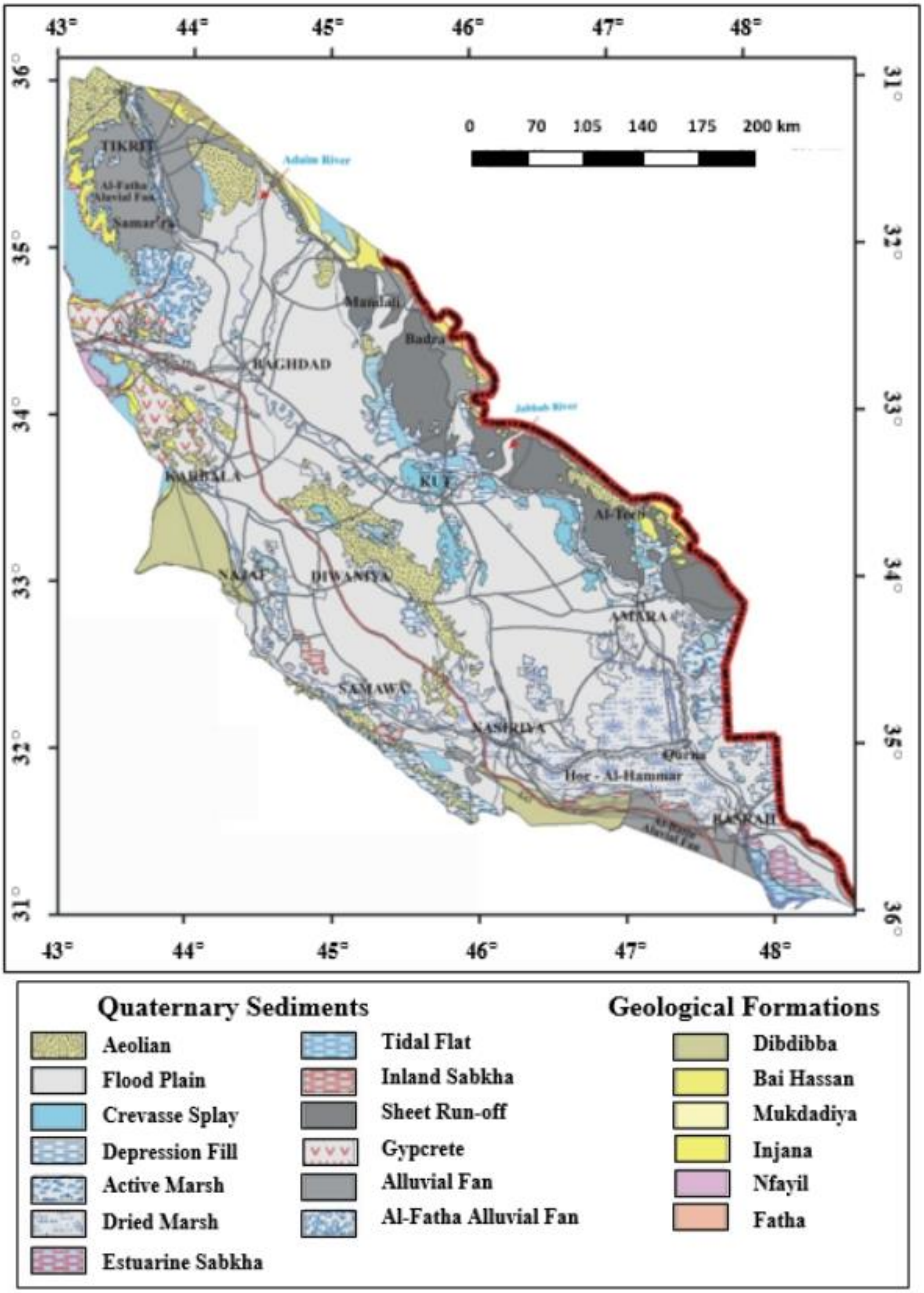

Figure 2: Geological map of the Mesopotamian Plain (After Yacoub, 2011)

2.1.3 Salt Pans

Many salt pans occur in the Mesopotamian Plain, in some of them modern technology for harvesting the accumulated salt is used, whereas others are small and primitive. The main salt pans are briefly described hereinafter:

2.1.3.1 Shari Salt Pan

It is located about 35km NE of Samarra town, covering an area of about 80km^2. The salt pan represents shallow depression of tectonic origin located south of Hemren Mountain. The main water source is rain and springs water which supplies the pan with the dissolved salts. The salt is composed of about 22% Na2SO4 and 53% glauberite and 26% Halite. The sodium sulphate reserve was estimated to be about 22 million tons and glauberite is about 34 million tons (Jassim, 2019).

2.1.3.2 Samawa Salt Pan

It is located 35km SW of Samawa city, represented by an elongated depression, about 3.5km long and 1.5km wide with few meters lower than the surrounding area. The source of the brine water is the several springs of salt water which are most probably related to the Abu Jir – Euphrates Fault Zone. It is an active fault zone and the depression is related to the active fault zone too. The first upper meter is composed of alternation of salts and clay, followed by 5m thick rock salt The main salt layer is very tough with a thickness of about 7 meters in the central area and about (1 – 2)meters at the periphery extending over an area 450m long and 1500m wide containing halite crystals of different sizes (few millimeters to 30cm) (Jassim, 2019). Al-Badri et al. (1984) suggested the presence of some evaporite beds at depth in the saltern area. These evaporite beds most probably belong to the Rus Formation (Lower Eocene) and dissolved by the ground water that migrated upward through the faults and/ or Abu Jir active fault zone in the area. Tens of salty springs are observed inside the saltern. In order to prove this suggestion a deep borehole was drilled to pass Rus Formation layers, and it was found that the Rus Formation is composed of gypsum, anhydrite and claystone, which eliminates the possibility of being the origin of salts in the saltern. The drilling of the Iraqi National Oil Company in the area (Well Samawa-1) proved that there are very salty brines from the Gotnia and Shiranish formations in the area (Jassim, 2019). The salt is deposited in artificial basins by evaporation and then harvested after completion of deposition (Figure 3). The calculated reserve is about 42 million tons (Al-Badri et al., 1984).


Figure 3: Samawa Saltern: Left) Salt harvesting, and Right) Salt washing (From Jassim, 2019).

2.1.3.3 Al-Fao Salt Plant

Al- Fao Salt plant is located near Al-Fao town south of Basrah City. It is a large saltern, consists of tens of salt ponds. The gulf water is pumped through a feeding long canal which is about 4 km to the salt ponds, where concentration and crystallization of the salt takes place. The brine is passed from one pond to the other by gravity, the flow being controlled by means of small gates. The ponds are separated from each other by clay embankments. In the harvesting ponds, evaporation is carried out to the point where all the salt separates out. After deposition and crystallization of salt, the remaining bitter solution is pumped back to the gulf from the harvesting ponds (Jassim, 2019). Unfortunately, this saltern was destroyed during the first gulf war (1980 – 1988).

2.1.3.4 Small Salt Pans

There are many small salt pans within different parts of the Mesopotamian Plain; usually in small depressions developed in the flood plain of the Tigris and Euphrates rivers. The main salt in the small pans is NaCl contaminated with Mg and Aeolian sand. The reserves of salt range between (500 – 1000)tons. The harvesting of the salt is by using buckets by hands of the workers.

2.1.4 Gypcrete

Gypcrete is secondary gypsum, formed in semi-arid climate derived from highly concentrated sulphatic solution by means of the ground water and deposited in different sediments within the Mesopotamian Plain. The ground water rises to the surface by capillary action leaving the dissolved sulphate as porous impure gypsum; after evaporation. The gypcrete is of low quality because it is highly contaminated with clay and sand admixture. Such type of deposits is used as a binding material between bricks, produced by primitive plants. The average thickness of the gypcrete is about (1 – 4)m; however, very rarely it may exceed 5m.

2.2 Economic Potential of the Mesopotamian Plain not related to Sediments

The main economic potential in the Mesopotamian Plain which is not related to the sediments of the plain is the oil and gas. Tens of oil fields exist in the plain (Figure 4) with different sizes and different amount of crude oil and/ or gas production. They occur in N-S trend in the southern part of the plain and change their trend to NW-SE north of latitude N 33º. All of them are subsurface fields (Figure 4) located mainly along the eastern limits of the plain with different depths. However, some of them have direct effect on the migration of the Tigris and Euphrates rivers with their distributaries and abandoning their courses. Among the fields are: Majnoon, Rumaila, Zubair, West Qurna, West Baghdad, Ahdab, Subba, and others.

3. Discussion

The following main aspects are discussed hereinafter.

3.1 Uses of Clay

The main uses of the clay deposits in the Mesopotamian Plain are in cement and brick production. However, their usability is decreasing and the produced cement and bricks are not of good types. This is attributed to:

1. The increased concentration of the salt in the soil which is used as clay,
2. The groundwater depth is decreasing (becomes shallower) which decreases the quarrying abilities, and
3. The abandoning of the agricultural lands increases desertification; accordingly, increases the percentage of the sand in the clay deposits which are used for cement and bricks production; accordingly, will be not suitable for cement production.

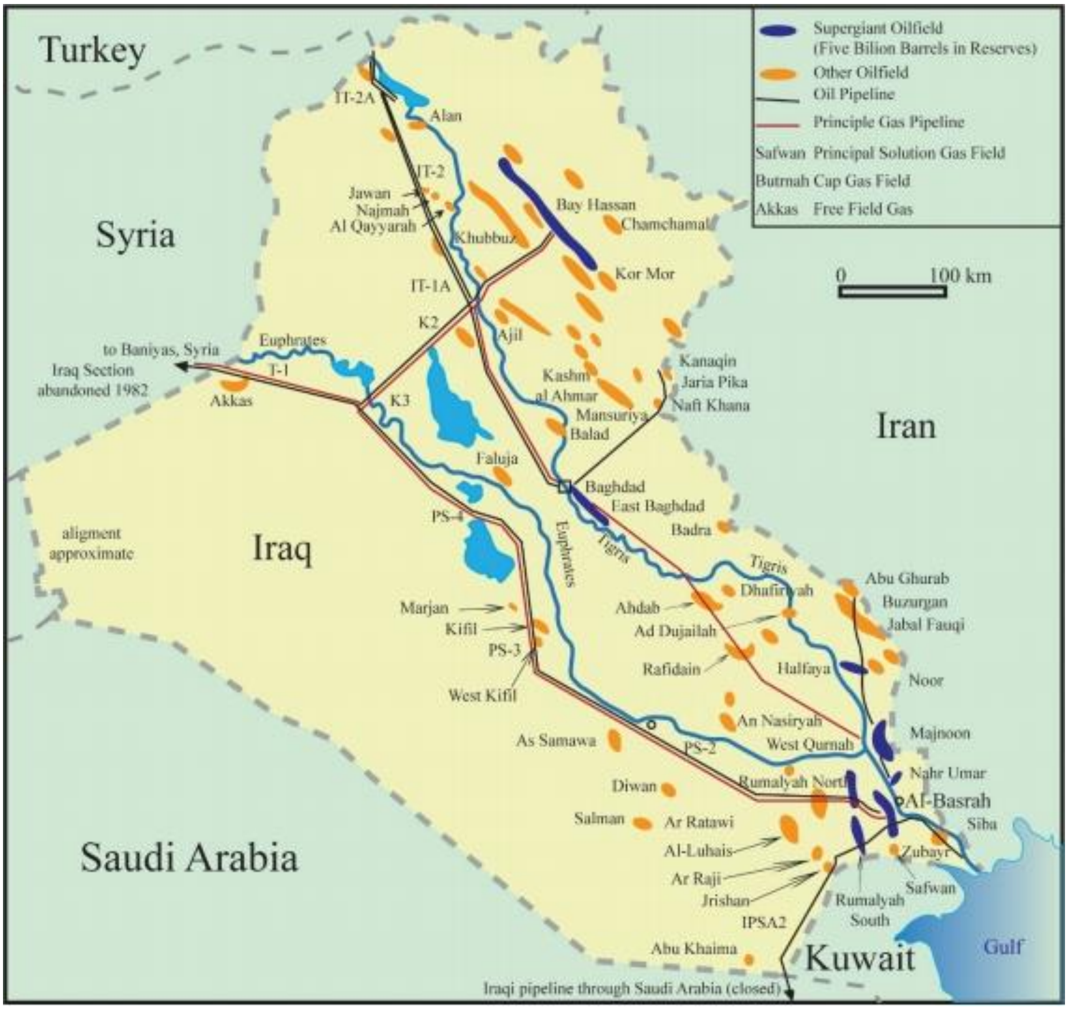

Figure 4: Distribution of oil and gas fields along the course of the Tigris River and its tributaries (from Judicial Watch, 2002).

3.2 Subsurface Oil Fields

Tens of subsurface oil fields exist in the Mesopotamian Plain (Figure 4). All of them are in large depth; therefore, no surface expression occurs. However, they have contributed in shifting of river courses during Pleistocene and even in Pliocene. At different parts of the plain the traces of old courses are still visible in satellite images; however, long distances of old courses are vanished either due to human activities or due to moving sand dunes.

4. Conclusions

The clay deposits of the flood plains which are used in cement and bricks production are also deteriorating due to increase of the salinity and continuous creeping of the sand dunes and sand sheets. The reconstruction and rehabilitation of Al-Fao saltern will increase the salt production and accordingly will be a new source for the national budget.

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