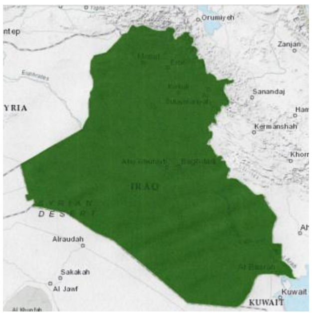
IRAQ



Source: esri

General

Iraq - officially known as the Republic of Iraq - is located in Western Asia, bordered by Türkiye in the North, Iran in the East, Kuwait in the Southeast, Saudi Arabia in the South, Jordan in the Southwest and Syria in the West. The area of Iraq is 43.7 Mha (million hectares) with, in 2022, a population of 44.5 million, or 1.02 persons per ha (Wikipedia and United Nations, 2022).

Climate and geography

Most of Iraq has a hot arid climate with subtropical influence. Summer temperatures average above 40 °C for most of the country and frequently exceed 48 °C. Winter temperatures infrequently exceed 21 °C with maxima roughly 15 to 19 °C and night-time lows 2 to 5 °C. Precipitation is low. Most places receive less than 250 mm annually, with maximum rainfall occurring during the winter months. Rainfall during the summer is extremely rare, except in the far north of the country. The northern mountainous regions have cold winters with occasional heavy snow, sometimes causing extensive flooding. Climate change in Iraq is leading to higher temperatures, reduced precipitation, and increasing water scarcity, which will likely have serious implications for the country for years to come (source: Wikipedia).

Iraq has a coastline on the northern Persian Gulf and encompasses the Mesopotamian Plain, the northwestern end of the Zagros mountain range and the eastern part of the Syrian Desert. Two major rivers, the Tigris and Euphrates, run South through Iraq and into the Shatt al-Arab near the Persian Gulf. These rivers provide Iraq with significant amounts of fertile land.

Sissakian *et al*. (2020) have analysed the long-term changes in the Mesopotamian Plain and in the Persian Gulf (Figure 1). They also show the transgression of the Mesopotamian Plain into the Persian Gulf over the millennia (Figure 2).

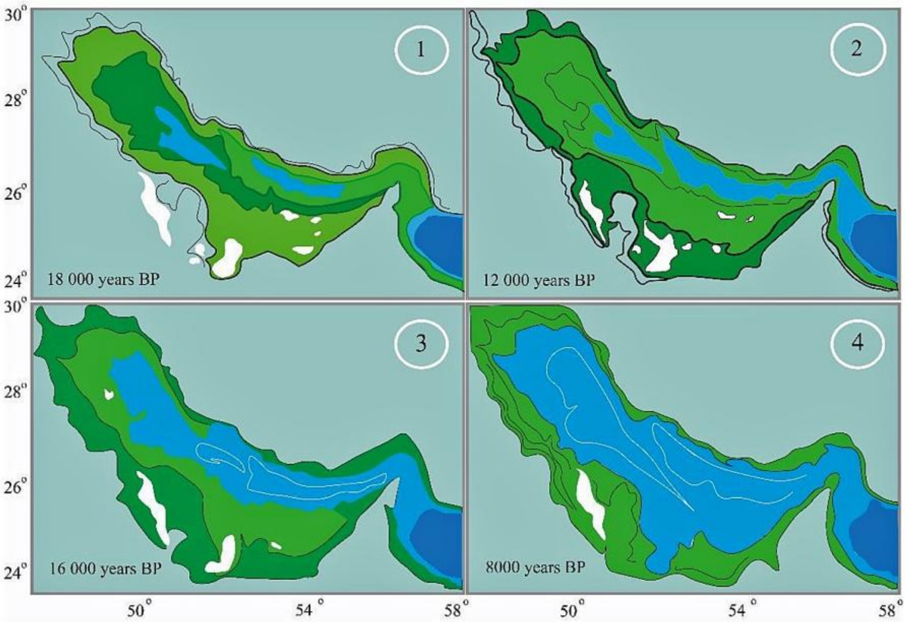


Figure 1. Reconstruction of the shore lines in the Persian Gulf. 1 = 16,050 BC/18,000 BP[1], 2 = 10,050 BC/12,000 BP, 3 = 8050 BC/10,000 BP, and 4 = 6050 BC/8000 BP (The enclosed blue areas define the max. limits of the lakes that could form if filled to their sill levels. The blue – white areas define shallow topographic depressions) (Sissakian et al., 2020)

[1] BP = before present = before 1950 (source: en.wikipedia)

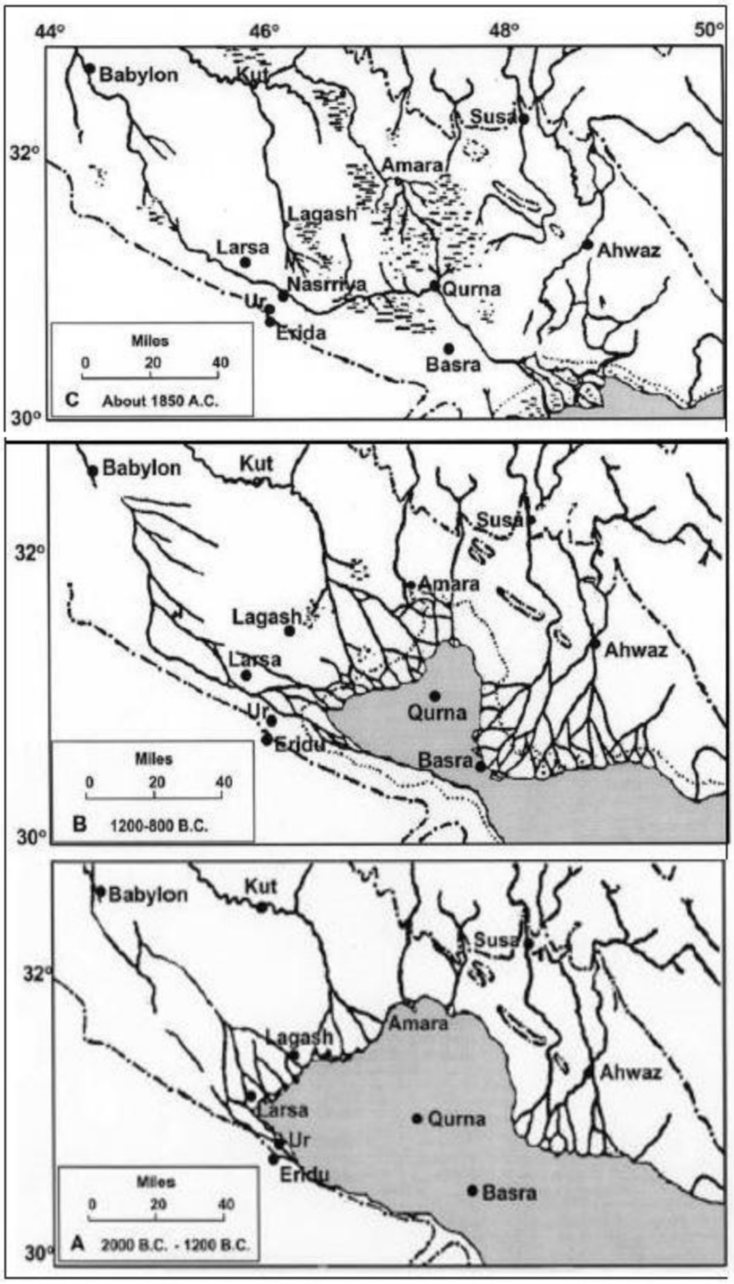


Figure 2. Selected archaeological maps of southern Mesopotamia showing the historical changes in the northern shorelines of the Persian Gulf (Sissakian et al., 2020)

The region between the Tigris and Euphrates rivers, historically known as Mesopotamia, is often referred to as the cradle of civilisation. It was here that mankind first began to read, write, create laws and live in cities under an organised government - notably Uruk, from which 'Iraq' is derived. The area has been home to successive civilisations since the 6th millennium BC. Iraq was the centre of the Akkadian, Sumerian, Assyrian and Babylonian empires. It was also part of the Median, Achaemenid, Hellenistic, Parthian, Sassanid, Roman, Rashidun, Umayyad, Abbasid, Ayyubid, Mongol, Safavid, Afsharid and Ottoman empires (source: Wikipedia).

Wagret (1968) states that up to the 5th millennium BC the Persian Gulf extended well beyond the present day Shatt al-Arab and that the Euphrates and the Tigris separately discharged in the gulf. Ur was originally built on an island in the marshes. In addition he states that in the 4th millennium BC the Sumerians drained the marshes and made prehistoric 'polders'. Wagret also states that between 5000 BC and 3500 BC there has been a devastating seaflood from the Persian Gulf that has destroyed that civilization.

Heyvaert and Baeteman (2008) describe that Paepe *et al*. (1978) identified four major flood phases in the Mesopotamian Plain: Ur-floods (3600-3500 BC/5550-5450 BP), Kish-floods (2900-2350 BC/4850-4300 BP), ed-Dër-floods (ca. 2000-1025 BC/3950-2975 BP) and Post-neo-Babylonian floods (539 BC – 300/2489-1650 BP).

In her *Myths of Mesopotamia* Dalley (2000) describes:

> *Atrahasis, the hero of the Flood story, was a citizen of Shuruppak in lower Mesopotamia. An extensive flood as a natural event sometimes took place in that region, where the Euphrates in spate can overflow and spill across the intervening land into the lower-lying Tigris, which itself often breaks its own banks in sudden spate, but a flood would be impossible on a similar scale in Palestine, Syria, Anatolia, or Greece. Such floods occur quite commonly in Iraq, and strata of silt deposits on Early Dynastic sites of the fourth millennium BC, found there by archaeologists, can be interpreted as recording various different floods in remote antiquity. That evidence does not, however, disclose whether one particular flood was more catastrophic than others; it only shows that no unusual break in cultural continuity was caused by such a deposit, and that the layer of flood silt found in excavations at Ur is certainly much earlier in date than the flood deposit found at Shuruppak.*

This, and other publications (Wagret, 1968; Volker, 1982; Violet, 2007; Wasserman, 2020) show that for several millennia floods have occurred in Mesopotamia, especially in lower Mesopotamia. Therefore, although polders are only specifically mentioned at much later dates, one may expect that also polders might have been here from older days.

Violet (2007) describes that major floods of Euphrates River occurred in Mesopotamia and shows a description of a flooding of the city of Shuruppak that dates from the first half of the 2nd millennium BC. He also describes that around 1800 BC the code of the Babilonia King Hammurabi, in addition to the regulation of irrigation, contained the requirement that riverside inhabitants had to maintain the dikes that protected the fertile lands near the river courses.

Partow (2001) shows a satellite map of the Mesopotamian Plain (Figure 3). Part of these areas are in their natural stage. The reclaimed areas are mainly used for Date palms, or have been abandoned. He shows reference to Rooks (1993) who stated that in the marshes mounds, known as *tells*, are believed to have been the sites of ancient cities, like Agar, Qubab, Ishan, Azizah, Dibin and Waquf. He also stated that irrigation and flood protection works date from 5000 years ago onwards, but that drainage of the marshes only started in the second half of the 20th century.

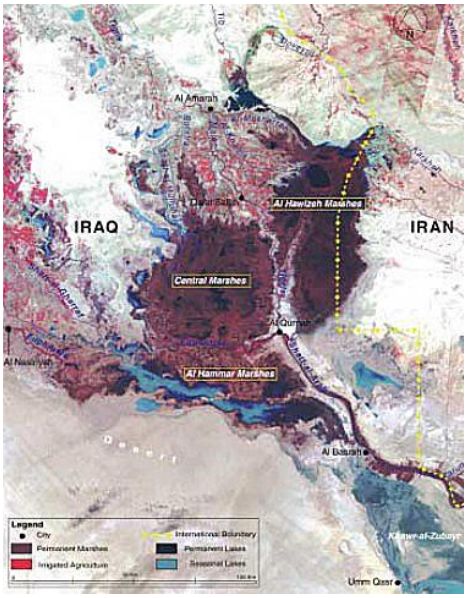


Figure 4. Landsat image of the Mesopotamian Plain composed from observations in 1973-1976. Dense marsh vegetation appears as dark red patches, while red elongated patches along river banks are Date palms (Partow, 2001)

Partow also describes the work on a Main Outfall Drain (MOD) to remove saline drainage waters, later known as the Third River or Saddam River, starting in 1953. As construction of the MOD progressed in the 1970s and 1980s, the focus gradually shifted from building a drainage system to remove excess irrigation water to reclaim the marshes. Engineering proposals were developed to drain the marshes (Nippon Koei, 1972). On the Euphrates River this was achieved by diverting the river flow from the Al Hammar Marshes and discharging it into the Persian Gulf. While drainage of the Central and Al Hawizeh Marshes was to be accomplished by discharging the flow of the lower Tigris distributaries into a canal system, which would channel the water to the Persian Gulf via the Shatt al-Arab. These works were not implemented due to the Iran-Iraq war (1980-1988). Following the end of the second Gulf War in 1991 a programme was launched to drain the marshes. By the end of 1992 the Third River or Saddam River was inaugurated to collect return flows from irrigated lands in the central interfluve of the Mesopotamian Plain. Running down the right bank of the Shatt al-Gharraf, the canal intersects the Euphrates. It then skirts around the southwestern edge of the Al Hammar Marshes. Passing through the desert for 60 km between dikes, it then cuts through the south-eastern section of the marshes where it joins the Shatt al-Basrah canal before discharging in the Persian Gulf at Umm Qasr via the Khawr al-Zubair. This was followed by the construction of another water diversion scheme called the Mother of Battles River *(Umm-al-Maarik)* in 1993 and 1994.

Pournelle (2003) gives a summarised overview of the large scale canal construction and reclamation works that have taken place in the Mesopotamian Plain, especially during the second part of the 20th century (Figure 4). She refers to Willcocks's map which showed approximately 20,000 km^2 of primary (year-round) and secondary (seasonal) submersible areas. Flood control and drainage projects have reduced that area to less than 1000 km^2 of marshlands (black, arrow) east of Amara. Most of that reduction has occurred since 1990.

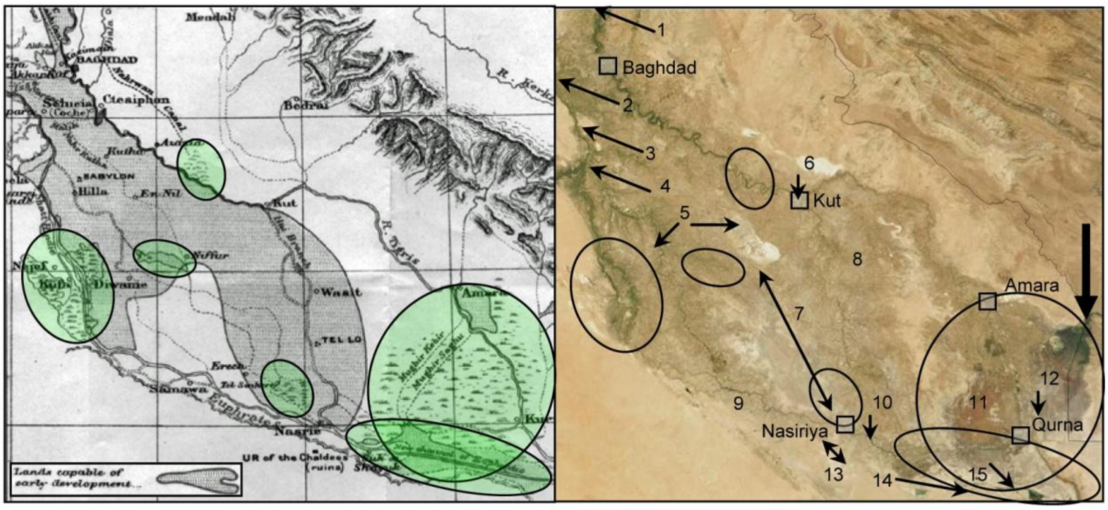


Figure 4. Marshes of the Mesopotamian Plain (circles), 1908 (left) versus 2000 (right). (1) Samarra–Tharthar Dam and canal, 1954; (2) Ramadi–Habbaniya dams and canals, 1956; (3) Felluja Dam, 1985; (4) Al Hindiyah Dam, al-Hilla Canal, 1918, 1989; (5) Greater Mussayib reclamation, 1956–1999; (6) al-Kut dam, 1939; Dujailia reclamation, 1953–1957; (7) Main Outfall Drain–Third River 1953, 1972, 1990–1992; (8) East Gharraf reclamation 1952–1968; (9) Al-Qadissiyah River, 1993; (10) Suq el-Shuyoukh regulators, 1956; (11) Polder dikes and canals, 1993–1994; (12) Military causeway, 1980–1988; East–West canal, 1992; Prosperity River, 1993; (13) Mother of Battles River, 1994; (14) Fidelity canal, 1997; (15) Shatt al-Basrah canal (Pournelle, 2003)

By the end of 1997, a new canal called Fidelity to the Leader *(Wafaa lil-Qaid)* was inaugurated. Work to drain the Central Marshes was simultaneously underway since 1992. A large eastern swath of the marshes had already partially been reclaimed by 1990 as a result of the construction of causeways to facilitate transport of armoured units during the Iran-Iraq war. Initially, water control structures, such as locks and sluice gates, were constructed to manage water flows in the Tigris distributaries feeding the marshes. Dikes, ranging from 6 to 18 km long, were built on the banks of the seven main distributaries of the Tigris River to prevent overtopping. The combined flow of these and other distributaries was captured in a 40 km West-East canal located along the northern boundary of the main Central Marshes. Between one and two km wide, the canal channels the flow from the village of Al Jandallah in the West to Abu Ajil in the East, 10 km south of Qalat Saleh where it joins a larger North-South canal – the centrepiece of the drainage scheme – called Prosperity River *(Nahr al-Izz)*. Cutting through the Central Marshes, this 2 km wide canal runs 50 km South before it discharges into the Euphrates. Completed in April 1993, these canals, which run from West to East and then from North to South effectively act as a moat structure preventing replenishment of the Central Marshes. In addition, the Euphrates had another dam added in the West of its intersection with the Prosperity River preventing backflow into the marshes (Pearce, 1993). Finally, the Crown of Battles River *(Tajj al-Maarik)* played an important role in diverting Tigris waters upstream of the Central Marshes, which were discharged in the Al Hawizeh Marshes. In the Al Hammar and Central marshes polders were constructed. Canals of 20-30 km long were built to drain the land. The canals divided the polders into smaller blocks and the remaining standing water was left to evaporate. Most of the reclaimed lands as depicted in Figure 5 have remained barren since the works were completed in 1994, and there is little actual cultivation (Partow, 2001).

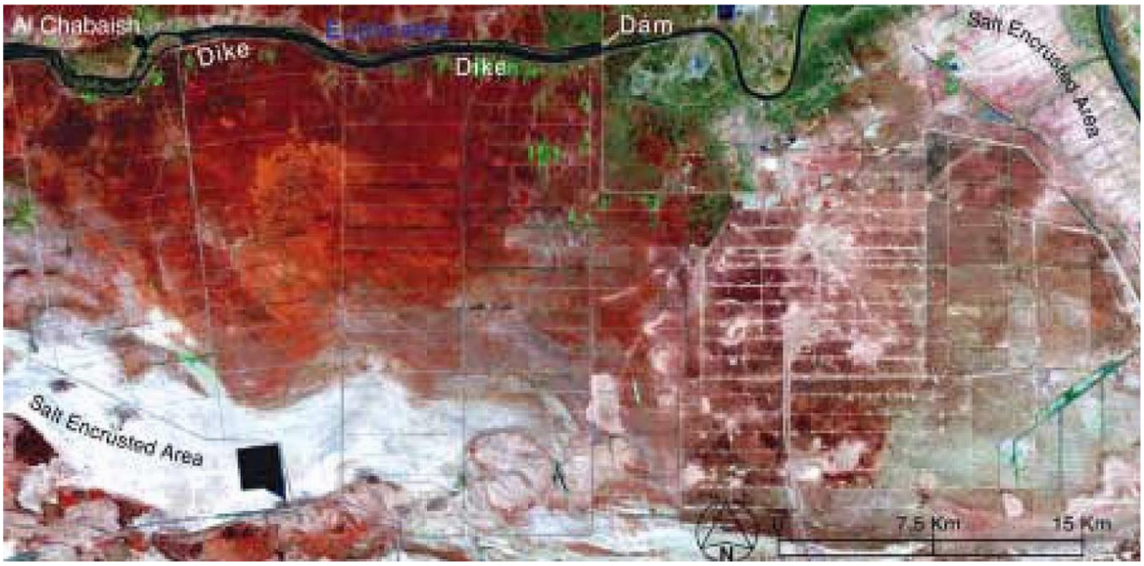


Figure 5. Landsat image of polders in the Al Hammar Marshes taken in 2000 (Partow, 2001)

In 1993-1994, no activities took place in the transboundary Al Hawizeh Marshes. By 1994 the Al Hawizeh Marshes were showing signs of rapid desiccation. The two main Tigris distributaries replenishing the Al Musharrah and Al Kahla marshes, were canalised at their lower stretches, forcing them to discharge deeper into the marshes. Dikes were constructed to keep the marshes back. This in turn led to the drying out of the north-western shores, which had traditionally been an important rice cultivation area. Further South, a 17 km long and 500 m wide canal was built to withdraw the waters of the Al Hawizeh Marshes and release them back into the lower Tigris River. The size of the Al Hawizeh Marshes was further constrained by the construction of dikes along the length of its perimeters. Multiple North-South and East-West drainage canals, some 500 m wide and 30 km long, have also been built through the marshes. All these canals flow South, channelling the marsh waters to the Shatt al-Arab via the Swaib River, 6 km south of the Tigris-Euphrates confluence. Large tracts of the Al Hawizeh Marshes have been impoldered into parcels so that the remaining water can be drained more quickly or left to evaporate (Partow, 2001).

Partow (2001) describes that because of all the works the Mesopotamian Marshes have significantly been reduced and composes a map of it (Figure 6). The white spots in the Figure are partly reclaimed lands and partly lands that felt dry because of the significantly reduced flow in the Euphrates and Tigris rivers.

Figure 6. The Mesopotamian Marshes in 2000 (Partow, 2001)

Existing polders

In addition to the polder areas mentioned above, the Group Polder Development (1982) states that polders can be found along the delta area of the Euphrates and the Tigris. River dikes have been built in the early Mesopotamian period.

Pournelle (2003) describes that in the area between Amirah, Nasiriya and Basra polders exist.

General characteristics of the polders in Iraq are shown in Table I.

Proposed polders

No proposed polders have been identified.

Location of the polders in Iraq as shown on the World polder map

The location of the polders in Iraq is shown in Figure 7.

Figure 7. Location of the polders in Iraq (source: esri – Batavialand)

References

Bienert, H-D. and J. Haser J., 2004. *Men of Dikes and Canals. The Archaeology of Water in the Middle East*. International Symposium held at Petra, Wadi Musa (H.K. of Jordan) 15-20 June, 1999. Verlag Marie Leidorf. Rahden/Westf. Germany.

Dalley, S., 2000. *Myths of Mesopotamia: creation, the floods, Gilgamesh, and others*. Oxford University Press. Oxford, United Kingdom.

Dundes, A., 1988. *The flood myth*. University of California Press.

Group Polder Development, Department of Civil Engineering, Delft University of Technology, 1982. *Polders of the World. Compendium of polder projects*. Delft, the Netherlands.

Gruber, J.W., 1948. Irrigation and land use in Ancient Mesopotamia. *Agricultural History*, Vol. 22, No. 2, pp. 69-77.

Heyvaert, V.M.A. and C. Baeteman, 2008. A middle to late Holocene avulsion history of the Euphrates river: a case study from Tell ed-Dër, Iraq, Lower Mesopotamia. *Quaterny Science Reviews*, 1-10.

History, 2019. *Summer*. https://www.history.com/topics/ancient-middle-east/sumer.

King, L.W., 2012. *The code of Hammurabi*. CreateSpace Independent Publishing Platform.

Nippon Koei Co. Ltd., 1972. *Study* R*eport on the Shatt Al-Arab Project: Iraq.* Government of the Republic of Iraq. Bagdad Iraq.

Nugteren, J., 1961. Cultuurtechniek in het stroomgebied van de Shatt-el-Arab. *Landbouwkundig Tijdschrift*. 73e jaargang, no. 21 (in Dutch).

Paepe, R., H. Gasche and L. De meyer, 1978. The surrounding wall of Tell el-Dër in relation to the regional fluvial system. *Tell el-Dër*, 2, 37-56

Partow, H., 2001. *The Mesopotamian Marshlands: Demise of an Ecosystem.* Early Warning and Assessment Technical Report, UNEP/DEWA/TR.01-3 Rev. 1 Division of Early Warning and Assessment United Nations Environment Programme (UNEP). Nairobi, Kenya.

Pearce, F., 1993. Draining Life from Iraq's marshes. *New Scientist*, No. 1869, pp.11-12.

Pearce, F., 2001. Iraqi wetlands face total destruction. *New Scientist*, 2291, pp. 4-5.

Pournelle, J.R., 2003. *Marshland of Cities: Deltaic Landscapes and the Evolution of Early Mesopotamian Civilization*. PhD thesis. University of California, San Diego, CA. USA.

Pournelle, J.R., C.A. Hritz, and J.R. Smith, 2010. *High risk: deltaic resilience and the Genesis of Mesopotamian cities (Iraq)*. Final Report: NSF HRRPAA Award # 1045974.

Rost, S., 2017. Water management in Mesopotamia from the sixth till the first millennium B.C. *Wires water*, vol. 5, issue 4.

Roux, G., 1993. *Ancient Iraq*. Penguin, Hamrondsworth, United Kingdom.

Sissakian, V.K., N. Adamo, N. Al-Ansari, M. Abdullah and J. Laue, 2020. Sea level changes in the Mesopotamian Plain and limits of the Arabian Gulf: a critical review. *Journal of Earth Sciences and Geotechnical Engineering*, Vol. 10, No. 4.

Sousa, A., 1983. *History of Mesopotamian civilization in the light of irrigation agricultural projects: Recent archaeological discoveries and historical sources*. Al-Huriya Printing House, Baghdad, Iraq.

United Nations, Department of Economic and Social Affairs, Population Division. 2019. *World population prospects, medium prognosis. The 2019 revision*. New York, USA.

Violet, P-L., 2007. *Water engineering in ancient civilizations. 5,000 years of history*. International Association of Hydraulic Engineering and Research (IAHR), Madrid, Spain.

Volker, A., 1982. *Lessen uit de geschiedenis*. Civiele & Bouwkundige techniek, nr.5. (in Dutch)

Wagret, P., 1968. *Polderlands*. Methuen & Co ltd. London United Kingdom.

Wasserman, N., 2020. *The flood: the Akkadian sources*. Peeters, Leuven – Paris – Bristol.

Wheat, E.R.J., 2013. *Terrestrial cartography in ancient Mesopotamia*. University of Birmingham, Birmingham, United Kingdom.

Willcocks, W.H.T., 1917. *Plans of the irrigation of Mesopotamia*, 2nd edition. E. and F.N. Spon and Spon and Chamberlain. London, United Kingdom and New York, USA.

Bart Schultz
Lelystad, September 2023

Table I. General characteristics of existing polders in Iraq

Name	Reclamation	Area in ha	Type *)	Latitudes	Longitudes	Elevation in m+MSL	Land use
Polders in the surrounding of Ur	4th millennium BC		RLL	33º 26' N	44º 25' E	35	Agriculture
Polders in the Al Hammar and Central Marshes	1993-1994		RLL	31º 07' N	47º 06' E	1	Agriculture
Polders in the Al Hawizeh Marshes			RLL	31º 25' N	47º 36' E	3	Agriculture
Polders in Euphrates and Tigris Delta			RLL	30º 01' N	48º 21' E	1	Agriculture
Total							

*) RLL = reclaimed low-lying land; LGS = land gained on the sea; DL = drained lake