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Architecture as a Framework for People's Life in the Deltas of Large Rivers

Ahmet Hadrovic
Faculty of Architecture, University of Sarajevo, Sarajevo, Bosnia and Herzegovina

* Corresponding Author: **Ahmet Hadrovic**

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Abstract
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Keywords: Deltas of large rivers, Synergy of natural environment, social environment and man

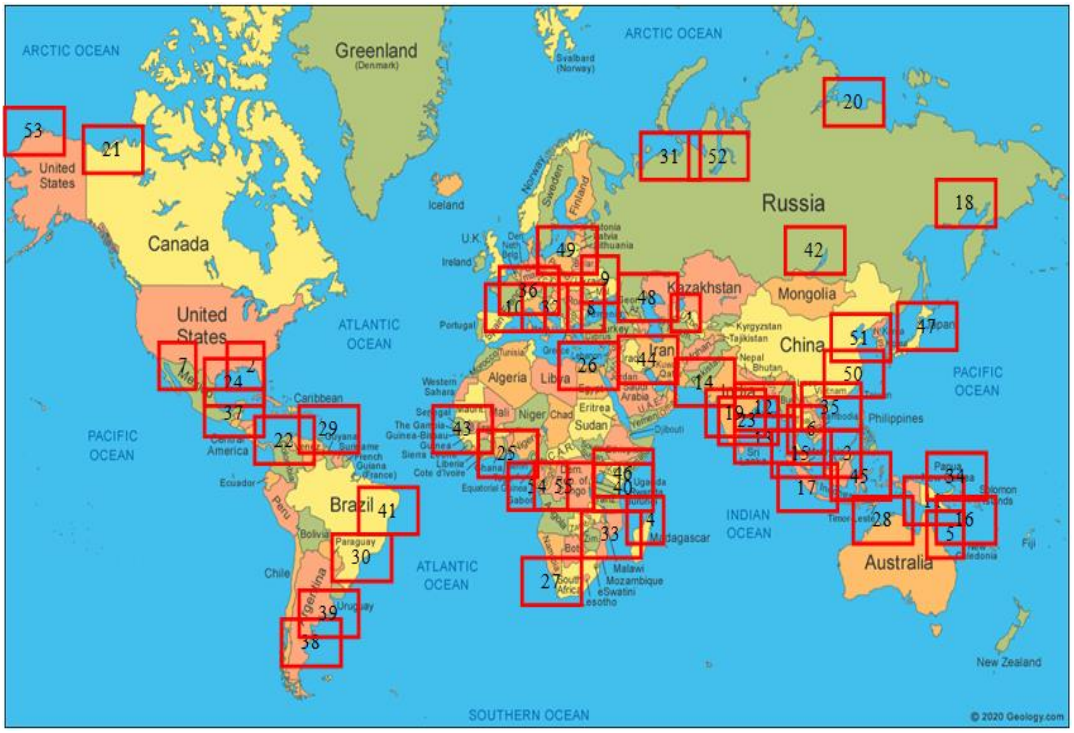
1. Introduction

Following his theory of "Architecturally Defined Space" [1], the Author has investigated various architectural programs – open spaces in nature, cities, villages and individual architectural objects. In addition to architecture in 'common natural environments', the Author has studied 'architecture in extreme climatic conditions' [2,3], 'architecture on water' [4], 'architecture in water' (underwater architecture) [5], 'architecture in the air' [6] and '(potentially possible) architecture on other celestial bodies' [7]. This paper deals with the topic of architecture in large river deltas. Although these deltas have been inhabited since prehistoric times to the present day, large river deltas are extreme natural environments where construction in them is very complex and engineeringly demanding. In all these works, the Author discovered the synergy of the natural environment, the social environment and man and thereby created a rich kaleidoscope of architectural images.
[8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73].

2. Deltas of large rivers

Deltas of large rivers are important, highly dynamic ecosystems formed by the deposition of sediment at the mouths of rivers. They are 'great natural events' where vast quantities of fresh water flow into salty seas (or freshwater lakes). These fertile landscapes are often densely populated, but face significant threats from rising sea levels and erosion. Deltas are often classified by shape, such as arcuate (Nile), 'bird's foot' (Mississippi), or pointed. Many of the world's largest deltas are sinking faster than sea levels are rising, increasing the risk of flooding for millions of people. They form when river currents slow down as they enter larger bodies of water, depositing sand, silt, and clay. Here are some of the world's major river deltas: Ganges-Brahmaputra-Meghna Delta (Bangladesh/India). The largest delta in the world. Mekong Delta (Vietnam): known as a major agricultural hub, especially for rice production, covering over 93,240 km^2; Nile Delta (Egypt): a classic arched (fan) delta that has supported agriculture for millennia; Mississippi Delta (USA): a prominent example of a 'bird's foot' delta, where multiple tributaries spread out like a bird's foot into the Gulf of Mexico; Lena Delta (Russia): located in the Arctic, this is a massive, protected ecosystem covering 30,000 km^2; Orinoco Delta (Venezuela). A vast wetland area covering 22533 km^2. Volga Delta (Russia): Europe's largest delta, flowing into the Caspian Sea; Huang He (Yellow River).

Delta (China): known for its high sediment load and rapid coastal changes. Niger Delta (Nigeria). A key region for biodiversity and oil resources in Africa; Amazon Delta (Brazil): although a mixture of estuary and delta, it is among the largest, depositing enormous amounts of sediment into the Atlantic (Figure 1) [74].



Source: Author (April 24, 2026.)

Fig 1: The most famous deltas of large rivers in the world

Amu Darya River Delta (Uzbekistan, Asia), 2. Apalachicola River Delta (Florida, USA, North America), 3. Baram River Delta (Malaysia, Asia), 4. Betsiboka River Delta (Madagascar, Africa), 5. Burdekin River Delta (Queensland, Australia), 6. Chao Phraya River Delta (Thailand, Asia), 7. Colorado River Delta (Mexico, North America), 8. Danube River Delta (Romania, Europe), 9. Dnieper River Delta (Ukraine, Europe), 10. Ebro River Delta (Spain, Europe), 11. Fly River Delta (Papua New Guinea, Asia), 12. Ganges-Brahmaputra River Delta (India, Asia), 13. Ganges-Brahmaputra River Delta (India, Asia), 14. Indus River Delta (Pakistan, Asia), 15. Irrawaddy River Delta (Myanmar, Asia), 16. Jaba River Delta (Papua New Guinea, Asia), 17. Kelang River Delta (Malaysia, Asia), 18. Kolyma River Delta (Russia, Asia), 19. Krishna River Delta (India, Asia), 20. Lena River Delta (Russia, Asia), 21. Mackenzie River Delta (Canada, North America), 22. Magdalena River Delta (Colombia, South America), 23. Mahanadi River Delta (India, Asia), 24. Mississippi River Delta (USA, North America), 25. Niger River Delta (Nigeria, Africa), 26. Nile River Delta (Egypt, Africa), 27. Orange River Delta (South Africa, Africa), 28. Ord River Delta (Australia), 29. Orinoco River Delta (Venezuela, South America), 30. Paraiba Do Sol River Delta (Brazil, South America), 31. Pechora River Delta (Russia, Asia), 32. Po River Delta (Italy, Europe), 33. Pungue River Delta (Mozambique, Africa), 34. Purari River Delta (Papua New Guinea, Asia), 35. Red River Delta (Vietnam, Asia), 36. Rhône River Delta (France, Europe), 37. Rio Grijalva River Delta (Mexico, North America), 38. Rio Negro River Delta (Argentina, South America), 39. Rio Parana River Delta (Argentina, South America), 40. Rufiji River Delta (Tanzania, Africa), 41. Sao Francisco River Delta (Brazil, South America), 42. Selenga River Delta (Siberian Arctic, Asia), 43. Senegal River Delta (Senegal, Africa), 44. Shatt Al-Arab River Delta (Iraq, Asia), 45. Sungai Mahakam River Delta (Indonesia, Asia), 46. Tana River Delta (Kenya, Africa), 47. Tone-gawa River Delta (Japan, Asia), 48. Volga River Delta (Russia, Asia), 49. Wisla River Delta (Poland, Europe), 50. Yangtze River Delta (China, Asia), 51. Yellow River (Huang He) Delta (China, Asia), 52. Yenisey River Delta (Siberia, Asia), 53. Yukon River Delta (USA, North America), 54. Zaire River Delta (Congo, Africa), 55. Zambezi River Delta (Mozambique, Africa).

3. Architecture as a framework for people's lives in the deltas of large rivers

Designing architecture in large river deltas requires a shift from traditional 'hard' engineering to nature-based systems that are adaptive and resilient. These designs must manage the intersection of heavy sedimentation, tidal impacts, subsidence and flooding, often involving raised structures, floating communities and hydrological buffer zones to coexist with changing water levels. Designing for flexibility, such as using amphibious houses, floating foundations or raised structures, to cope with changing water levels and potential flooding. Integrating ecological elements such as mangroves, wetlands and mudflats to act as natural buffer zones against storm surges and erosion. Moving away from levees alone towards 'multi-layered security', which includes increasing water storage capacity, improving evacuation planning and limiting development in high-risk areas. Using 'soft' engineering instead of relying solely on 'hard'

structures. This includes 'building with nature' principles, such as allowing rivers to flow more freely and using sedimentary deposits to raise ground levels. The development of polders, water storage basins and retention areas that allow for the storage of excess water during high river flows or sea level rise. The 'room for the river' strategy is used in the Dutch delta, where floodplains are lowered and channels widened to accommodate higher volumes of water, reducing pressure on levees. The 'designing structures' method that encourage sediment deposition, such as coastal restoration to combat subsidence. The 'reconnecting rivers and floodplains' method involves demolishing or moving existing levees to allow rivers to deposit sediment and restore wetlands (for example, Mississippi Delta management projects). Notable examples of delta architecture and planning include: Reevediep (Netherlands): a project with an adjustable entrance system with a 'low cycle path' that integrates flood protection with landscape design, increasing both safety and recreational value; Pearl River Delta (China): focuses on 'transregional hydro-ecological corridors' and eco-dynamic regional design, aiming for resilient urbanization amidst rapid land-use change; Niger Delta (Nigeria): research into sustainable architecture aimed at addressing pollution and supporting coastal communities through water adaptation techniques; Yamuna River Project (India): focuses on restoring the ecological health of the river to manage the complex needs of a densely populated delta region; 'force of flow' (Netherlands): a conceptual, sustainable design for a Dutch delta that proposes using river processes to shape a landscape that 'goes with the flow'. Delta designs are increasingly being assessed for their ability to manage future sea-level rise and extreme weather events. Protecting existing communities and industrial sites by combining historic structures with new, resilient, water-friendly designs. Proposals such as 'Changing Course' for the Mississippi emphasize empowering local communities through transparency and participatory planning.

4. Shatt al-Arab River Delta

The Shatt al-Arab River (Arabic: شط العرب = Arabian Stream), which forms the border between Iraq and Iran, is approximately 193 kilometers long (Figure 2). Formed by the confluence of the Qarun, Euphrates, and Tigris rivers, this waterway is the main source of freshwater in the northern Gulf. After a long history of border disputes with Iran, Saddam Hussein sought to seize the waterway because it would give Iraq unhindered access to the Persian Gulf. Iran and Iraq fought a full-scale war between 1980 and 1988 over this conflict over sovereignty over the Shatt al-Arab, ruthlessly affecting marginalized groups and their access to water security. The Shatt Al-Arab River Delta is formed by the confluence of the Tigris and Euphrates rivers (Geographic coordinates: 30º21'49.28"N, 48º55'40.10"E, Elevation: 0 m). It is located at the northern end of the Persian Gulf, on the border with Iraq and Iran. It was formed mainly by the sediment load of the Karun River, and is characterized by tidal flats, salt marshes, and shallow coastal waters. The area is crucial for transportation, but faces severe salinity and environmental degradation. The delta serves as a key maritime navigation channel for Iraqi and Iranian ports, including Basra and Abadan. Although formed by the Tigris and Euphrates, the modern structure of the delta is strongly influenced by the sediment load of the Karun River, which contributes significantly to the suspended load of the upper Persian Gulf. The region consists of extensive marshes, shallow tidal flats, and mudflats/sandbanks in the prograding foreland of the delta. Significant human activity and reduced river flow have led to high salinity intrusion, which has affected agriculture and reduced the surrounding wetlands. Studies show significant bank migration and lateral channel movement, indicating an active delta front and changing depositional patterns. The delta has a dry, hot desert climate (BWh according to the Köppen-Geiger climate classification).

Source: Google Eart, Accessed: April 25, 2026.

Fig 2: Shatt Al-Arab River Delta

5. Architecture as a framework for life in the Shatt Al-Arab River Delta

The Shatt al-Arab River is a key waterway as a westward-facing canal, especially for the people living along its banks. The 'Marsh Arabs', also known as the Ma'dān people (Arabic: معدان = dweller of the plains), inhabit the marshes of Mesopotamia in southern Iraq, the earliest civilization known to mankind. Said to be the original site of the Garden of Eden, this cradle of civilization saw early developments in writing, architecture, and a complex society (Figures 3-10). During the reign of Saddam Hussein, Da'esh (ISIL) drained the southern Iraqi marshes and destroyed agricultural fields and irrigation infrastructure, destroying the ancient way of life of the local Ma'dan people. By 1994, an estimated 200,000 people had lost their homes, and nearly 3,000 km^2 of marshland, almost two-thirds of its former area, had dried up. The World Heritage Committee, at its 40th session held in Istanbul (July 17, 2016), added the Ahwar of Southern Iraq: a Biodiversity Refuge and Relict Landscape of Mesopotamian Cities in Iraq to the UNESCO World Heritage List. The UNESCO World Heritage Convention describes the site as follows: "Ahwar consists of seven sites: three archaeological sites and four wetlands in southern Iraq. The archaeological cities of Uruk and Ur and the archaeological site of Tell Eridu are part of the remains of Sumerian cities and settlements that developed in southern Mesopotamia between the 4th and 3rd millennia BC in the marshy delta of the Tigris and Euphrates rivers. The Ahwar of Southern Iraq – also known as the Iraqi Marshes – is unique as one of the world's largest inland delta systems, in an exceptionally hot and arid environment" [75]. The wetlands are located at the confluence of the Tigris and Euphrates rivers. Despite being home to the Madan, or Marsh Arabs, as well as many different species of flora and fauna, the marshes are continuously being depleted for various economic and political reasons. The population has fallen from an estimated 500,000 in the 1950s to just 20,000, and the total area has shrunk considerably. However, following the 2003 US invasion, many of the dams were destroyed, and the United Nations Environment Programme (UNEP) has done much to help restore the marshes [75]. Top-level management of the property is provided by the National Committee for the Management of the Ahwar of Southern Iraq as a World Heritage Site. The committee is chaired by the Minister of Water Resources and includes the Ministry of Culture (State Committee for Antiquities and Heritage), the Ministry of Health (Department of Environment), the Ministry of Petroleum, the Ministry of Agriculture, and other relevant ministries. The committee coordinates all government decisions relevant to the property, including the allocation of budgetary resources and the implementation steps of the 2015 Consolidated Management Plan developed for the property. Uruk, Ur and Eridu are protected by the Antiquities and Heritage Law No. 55 of 2002, which takes precedence over any other public law, and each is registered in the Official Gazette as a separate archaeological site with its own boundaries and protection zones corresponding to those of the component sites of the property. The Iraqi State Board of Antiquities and Heritage (SBAH) is working with foreign archaeological missions to begin implementing the provisions of the management plan that specifically apply to the three archaeological ensembles. Priorities include staff training and capacity building, along with the exploration and conservation of the most fragile monuments and areas at each archaeological site. Furthermore, a monitoring system has been established covering the three component sites and their security zones, encompassing all factors that may affect their integrity and authenticity. Two dedicated management teams have been established: one overseeing the works at Uruk, and the other in charge of Ur and Eridu. These teams report to the provincial Antiquities and Heritage Directorates (DAH): the Dhi Qar Directorate has jurisdiction over Ur and Eridu, while the Muthanna Directorate has jurisdiction over Uruk. The DAHs are assisted by the Antiquities and Heritage Police, established in 2007 to monitor archaeological sites. The Antiquities and Heritage Police maintain a permanent presence in Uruk and Ur and regularly patrol Eridu. In order to address the very fragile conservation conditions in the three cities, a programme of surveys will be carried out to create a baseline assessment of the state of conservation of the property; conservation programmes will be developed for all three cities based on the surveys that clearly outline the different options for intervention before conservation works begin; and a detailed master plan/roadmap will be developed to ensure the conservation of the property on a sustainable basis. The Huwaizah Wetlands, the East and West Hammar, and the Central Wetlands have been designated as Ramsar Sites, and their protection is the responsibility of the Ministry of Water Resources. Each wetland component has been assigned a dedicated management staff responsible for managing the water resources project in the governorates of Dhi Qar, Maysan and Basra. Again, the provisions of the 2015 Consolidated Management Plan prioritize staff training and capacity building in all areas relevant to the conservation of the natural values of the property. The management plan also addresses the involvement of local stakeholders in the decision-making process and the ability of local communities to improve their living conditions and preserve their traditional way of life. Furthermore, the Ministry of Water Resources (MWR) has just completed its "Strategy for Water and Land Resources in Iraq (SWRLI)" covering the period up to 2035. This strategy outlines a path towards integrated land and water management in light of the prevailing physical, hydrological and climatic conditions. It also examined the nexus between water, food and energy in Iraq and recommended major investment plans in response to climate change adaptation measures and other development requirements [76].

Source: https://www.tarii.org/news/unesco-marshes, Accessed: April 25, 2026.

Fig 3: Iraq's al-Ahwar Marshes become UNESCO World Heritage Site

Source: https://www.youngausint.org.au/post/can-the-consequences-of-the-shatt-al-arab-waterway-dispute-be-resolved-35-years-later
Accessed: April 25, 2026.

Fig 4: Shatt Al-Arab River Delta

Source: https://eseh.org/nextgate-blog-what-does-home-look-like-now-the-marshes-of-mesopotamia-and-sustainable-academia/
Accessed: April 25, 2026.

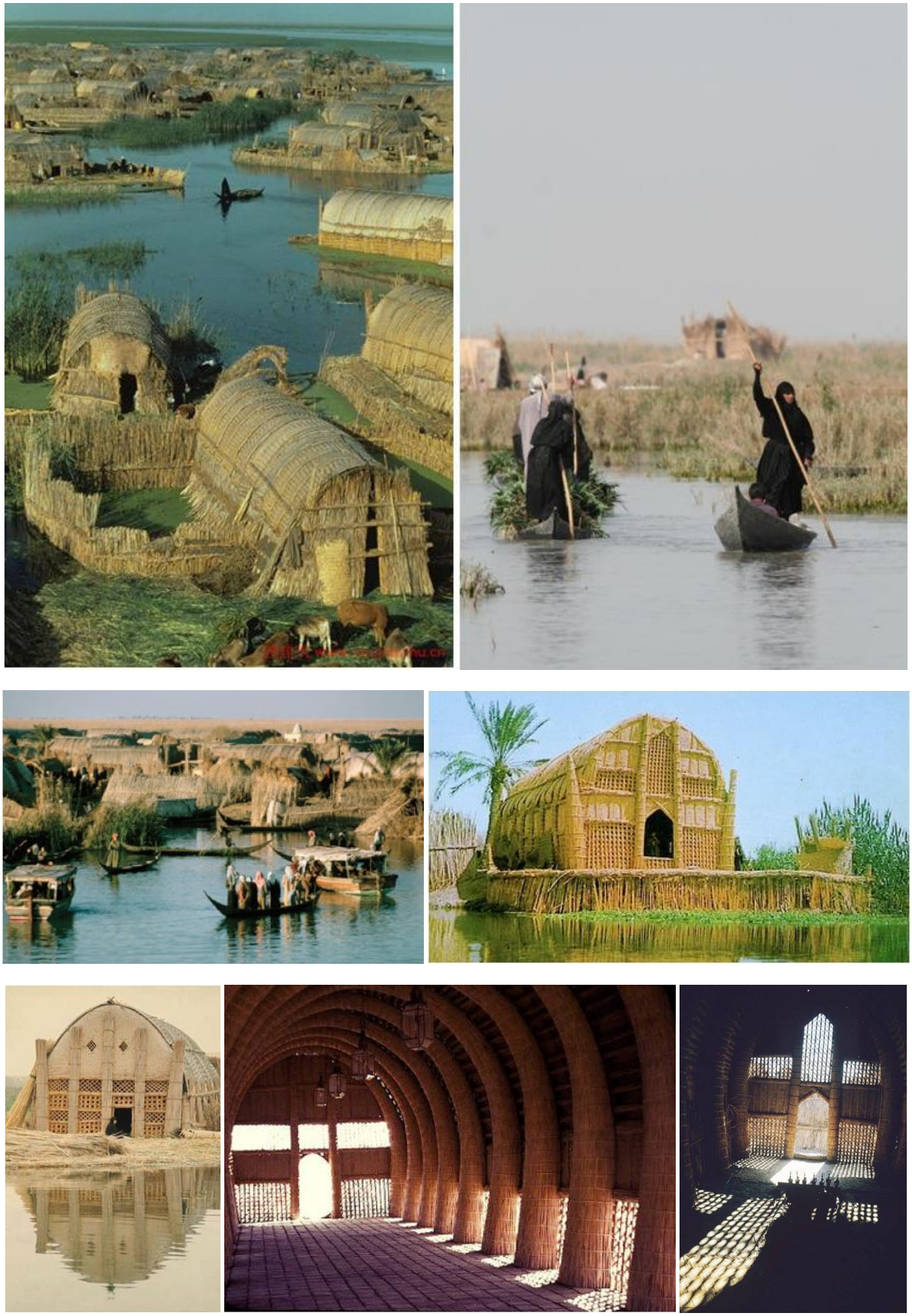
Fig 5: A settlement in the Shatt Al-Arab River Delta

Source: https://en.wikipedia.org/wiki/Marsh_Arabs#/media/File:Marsh_Arabs_in_a_mashoof.jpg, Accessed: April 25, 2026.h

Fig 6: Marsh Arabs cut traditional mashuf in the swamps of southern Iraq

Source: https://en.wikipedia.org/wiki/Marsh_Arabs#/media/File:Kerkini_lake_-_Kerkini_village.jpg, Accessed: April 25, 2026.

Fig 7: Water buffalo are found in swamps.



Source: https://www.newarab.com/features/iraqs-vast-marshes-reborn-after-saddam-peril-again#article-0-slider-0, Accessed: April 25, 2026
Source: https://architectureindevelopment.org/news/120, Accessed: April 25, 2026.

Fig 8: In the Shatt al-Arab River Delta, all buildings are made of reeds

Source: https://www.facebook.com/photo/?fbid=1274002490401394&set=gm.8718909384869175&idorvanity=1305395626220625 Accessed: April 25, 2026.

Fig 9: A Sumerian mural (left) shows a reed house that is over 5,000 years old. These reed houses are still being built in Iraq today (right), in the same way that the Sumerians built their homes thousands of years ago

Mudhif: houses made of reeds and found in the Iraqi marshes of southern Iraq (Figures 10,11). The houses are built in a specific way that uses some reparative patterns to shape the walls and structure. Mudhif is a special type of sarifa; a structure made of reeds that grow naturally in the marshes and used as a guest house by the village sheikh. Other types of reed dwellings, such as the rabah (wisth entrances at both ends and used as a family home) or the bayt (a strictly one-room house), are usually smaller than the mudhif and can be used for residential and other purposes. In building the mudhif, the reeds are bundled and woven into thick poles; the larger and thicker reeds are bent and tied to form parabolic arches that form the spine of the building. These arches are strengthened by prestressing the poles, as they are initially inserted into the ground at opposite angles. The series of arches defines the shape of the building. Long crossbeams made of smaller bundles of reeds are laid across the arches and tied. Woven reed mats form the building's envelope. Some of the mats are woven with mesh-like perforations to allow light and ventilation.

Source: https://designediniraq.org/entry/mudhif-reeds-houses/, Accessed: April 25, 2026.

Fig 10: Guest house

Source: https://designediniraq.org/entry/mudhif-reeds-houses/, Accessed: April 25, 2026.

Fig 11: Traditional reed construction

6. Ganges-Brahmaputra River Delta

The Ganges-Brahmaputra Delta (or Bengal Delta) is the largest river delta in the world, located in Bangladesh and West Bengal in India, and flows into the Bay of Bengal (Geographic coordinates: 21º59'02.71"N, 89º04'17.75"E, Elevation: 11 m). It is formed by the rivers Ganges, Brahmaputra and Meghna, creating fertile soil ('Green Delta') and encompassing the Sundarban, the world's largest mangrove forest (area 10,000 km²). The delta area is about 100,000 km² (which is larger than the area of Hungary (93,030 km2, for example). The delta has a tropical rainforest climate (type Am, according to the Köppen-Geiger climate classification). Temperatures range from 9.3°C to 40.4°C. It is a massive sediment trap that transports sediment from the Himalayas. A dynamic, active delta (about 355 km along the coast) that constantly changes its course, eroding the soil and creating new islands. The Sundarbans, a UNESCO World Heritage Site, is known for its rich biodiversity, including the Bengal tiger [77,78]. The Ganges-Brahmaputra Delta is one of the most densely populated regions on Earth, with over 170 million people. The extremely fertile soils support intensive agriculture, with rice and jute as the main crops. The delta faces serious risks from sea level rise (projected to rise by 40–90 cm by 2100), tropical cyclones and storm surges. Monsoons bring severe flooding and riverbank erosion, while dry spells bring salinity intrusion and groundwater pollution. Land subsidence, partly due to groundwater extraction, exacerbates the impact of sea level rise (Figure 12).

Source: Google Eart, Accessed: April 25, 2026.
Source: https://smartwatermagazine.com/news/centre-national-de-la-recherche-cnrs/a-better-estimate-water-level-rise-ganges-delta Accessed: April 25, 2026.

6.1. Architecture as a framework for life in the Ganges-Brahmaputra Delta

Vernacular houses in the Ganges-Brahmaputra Delta are characterized by their remarkable adaptability to the tropical, flood-prone, and monsoonal environment (Figures 13-17). These structures are often built on raised earthen mounds, known as bhiti, to provide protection from seasonal flooding. The architecture typically consists of a central courtyard surrounded by three or four separate rooms, creating a private yet airy living space. Traditional houses, often called Bangla Ghar, are lightweight and designed to be mobile or easily rebuilt due to constant soil erosion. Common materials include timber frames, bamboo walls (often in woven patterns), and corrugated iron (CI) roofs, which have replaced traditional thatched roofs. A distinctive feature is the steeply pitched roof, designed to shed heavy monsoon rains. The roofline often extends beyond the walls, supported by pillars, creating a covered veranda (baranda), which serves as a shaded living space and protects the walls from direct sun and rain. The houses are porous, allowing air to circulate through the bamboo walls to manage high humidity and heat. The structures are designed to be quickly dismantled and reassembled, which is essential for communities living on sandbanks (chars). Settlements are built on raised platforms, often constructed using soil excavated from nearby fishponds. In some areas, NGOs such as Friendship have introduced raised, oval communal platforms, 2.4–3.7 meters high, to shelter up to 30 families and their livestock from rising floodwaters. “Bengali style houses,” historically, are single-story structures with curved roofs and wide verandas. “Char households” are dwellings that are frequently renovated or completely replaced during the annual flood cycle, often using materials such as jute sticks, bamboo, and CI boards [79,80,81].

Source: https://whc.unesco.org/en/list/798/#:~:text=The%20site%20includes%20the%20entire,potential%20threats%20to%20the%20attributes, Accessed: April 26, 2026.

Fig 13: Vernacular houses in the Ganges-Brahmaputra River Delta

Fig 14: Bags of soil placed along the edge of charred land to prevent river erosion during monsoon floods

Ansari, M. S., Warner, J., Sukhwani, V., & Shaw, R. (2022). Implications of flood risk reduction interventions on community resilience: An assessment of community perception in Bangladesh. Climate, 10(2), 20. doi:10.3390/cli10020020

Source:
https://whc.unesco.org/en/list/798/#:~:text=The%20site%20includes%20the%20entire,potential%20threats%20to%20the%20attributes, Accessed: April 26, 2026.

Fig 15: House being built on stilts on an earthen mound in Bangladesh

People living in char settlements are usually poor. Some of the relatively better-off in these areas have long adopted the practice of raising the elevation of their properties during the monsoon, when huge amounts of water flow through the transboundary rivers that cut through Bangladesh on their way to the Bay of Bengal. Between November and March, when the water level is low, these char dwellers raise the elevation of their homes by building foundations with soil collected from elsewhere. They also build ghats, or steps, to access the elevated platform, and plant grass and water vegetables along the borders to prevent erosion. This traditional char practice is now being adopted across the region, even by people who previously could not afford it, with support from the government and NGOs, as a form of adaptation to weather extremes. Initiatives supporting this practice include the Char Livelihood Programme and the Community Climate Change Project (CCCP) of the Palli Karma-Sahayak Foundation (PKSF), all of which aim to reduce the vulnerability of char dwellers [82].

Source: https://en.wikipedia.org/wiki/Ganges_Delta#/media/File:SunderbanFarmHouse.JPG, Accessed: April 26, 2026.
Source: Ansari, M. S., Warner, J., Sukhwani, V., & Shaw, R. (2022). Implications of flood risk reduction interventions on community resilience: An assessment of community perception in Bangladesh. Climate, 10(2), 20. doi:10.3390/cli10020020

Fig 16: Villagers from the coal fields grow crops on the land around their houses

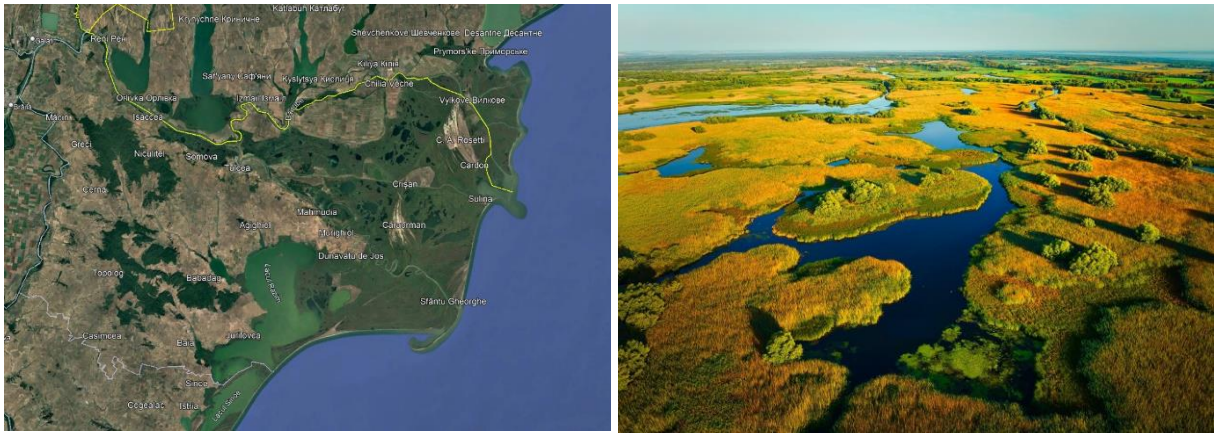
Source: Ansari, M. S., Warner, J., Sukhwani, V., & Shaw, R. (2022). Implications of flood risk reduction interventions on community resilience: An assessment of community perception in Bangladesh. Climate, 10(2), 20. doi:10.3390/cli10020020

Fig 17: Settlement formation in The Ganges-Brahmaputra Delta. According to the non-governmental organization Friendship, each stand houses about 120 to 200 families with their livestock

7. Danube River Delta

The Danube River flows 2857 km from its sources in the German Black Forest to the Black Sea (Geographic coordinates: 45º02'43.42"N, 29º17'58.46"E, Elevation: 2 m). Just before reaching the sea, it forms the second largest and best preserved European delta with an area of 4700 km^2 (Figures 18-23). More than half of the Delta Biosphere Reserve is almost untouched. The climate in The Danube

River Delta is humid continental (type Da, according to the Köppen-Geiger climate classification) with temperatures from -0.5°C to 25.9°C. The Danube Delta is a paradise for wildlife lovers, especially bird watchers. Visitors can spend several days exploring the canals and passages of the Danube Delta, which team up with the highest concentration of bird colonies in all of Europe. The labyrinth of canals surrounded by thatch, willows and oaks entwined with vines offers the perfect breeding ground for countless species of birds, some of which come from as far away as China and Africa. Egyptian white pelicans come to the Danube Delta every spring to raise their young. In late October and mid-November, Arctic geese, especially the red-necked goose, which nests in the Arctic tundra, come to the delta to escape the harsh winters of northern Europe. Around 300 species of birds make the Danube Delta their home, including cormorants, white-tailed eagles and glossy ibises. Birds are not the only "inhabitants" of the delta. Over 50 species of fish and several species of mammals, from wild cats, foxes and wolves, to otters, golden jackals and European martens, and even the occasional wild boar or deer, are part of the Danube Delta ecosystem. In total, 3,450 animal species and 1,700 plant species call the Danube Delta home (Figures 19,20) [83]. The Danube River is the 'most international' river on the planet. It flows through ten countries: Germany, Austria, Slovakia, Hungary, Croatia, Serbia, Romania, Bulgaria, the Republic of Moldova and Ukraine, and divides four European capitals: Vienna, Bratislava, Budapest and Belgrade. The Danube Delta, formed over a period of more than 10,000 years, continues to grow due to the over 68 million tons of alluvium deposited by the Danube River each year. The delta is formed around three branches of the Danube: Chilia (north), Sulina (middle) and Sfantu Gheorghe (south). The Danube Delta Biosphere Reserve has the third highest biodiversity in the world, with over 5,500 species of flora and fauna, surpassed only by the Great Barrier Reef in Australia and the Galapagos Archipelago in Ecuador. The Danube Delta is home to over 60% of the world's population of pygmy cormorants (Phalacrocorax Pygmeus), 50% of red-necked geese (Branta Ruficollis), and the largest number of white pelicans (Pelecanus Onocrotalus) and Dalmatian pelicans (Pelecanus Crispus) in Europe. The Danube Delta is also home to the world's largest expanse of reedbeds - 240,000 hectares.



Source: Google Eart, Accessed: April 26, 2026.
Source: https://romaniatourism.com/danube-delta.html, Accessed: April 26, 2026.

Fig 18: Danube River Delta

Source: https://romaniatourism.com/danube-delta.html, Accessed: April 26, 2026

Fig 19: Danube Delta pelicans

Source: https://romaniatourism.com/danube-delta.html, Accessed: April 26, 2026.

Fig 20: Flora i fauna u Danube River Delta

Source: https://emerging-europe.com/exploring-romanias-danube-delta-on-street-view/, Accessed: April 26, 2026.

Fig 21: Ribolov u Danube Delta

Source: https://visit-delta.ro/en/traditions/architecture/, Accessed: April 26, 2026.

Fig 22: Poljoprivreda u Danube Delta

Source: https://romaniatourism.com/danube-delta.html, Accessed: April 26, 2026.

Fig 23: Turistička krstarenja po kanalima u Danube Delta

7.1. Architecture as a framework for life in the Danube River Delta

The Danube Delta is home to 15,000 people, in 28 small villages and one town (Sulina). The Dobrogea region (southeastern Romania), which includes the Danube Delta, was first mentioned in a written document by the Greek historian and geographer Herodotus of Halicarnassus (484–425 BC) [84]. At the mouth of the Black Sea and between the Danube channels, there has always been a commercial and social exchange between the local population and Black Sea sailors coming from other shores or from the Mediterranean Sea. An area of ancient road crossings – from the North to the Black Sea and from here to the Mediterranean Sea or from the Russian steppe to Istanbul – it is the homeland of no less than 18 different ethnic groups: Romanians, Aromanians, Bulgarians, Turks, Tatars, Gypsies, Jews, Greeks, Armenians, Russians, Lipovans, Ukrainians, Gagauz, Germans, Italians, Albanians, Serbs, Hungarians and others. In some ways, it can be considered a land of geographical and cultural diversity [85]. Known in history as Lesser Scythia, this region was inhabited by the Dacians, but ruins from Greek and Roman antiquity testify to trade relations and cultural exchanges. It was part of the Roman Empire. It is the area where the apostle Andrew (who is considered the patron saint of Romania) preached. Migratory populations leave traces in Dobrogea, in the first centuries Anno Domini. On the border of the Ottoman Empire, it is periodically lost and conquered. As the sand line moved and separated the land from the sea, one of the ancient and medieval citadels - Enisala (built by the ancient Greeks as Heraclea, held by the Genoese in the 15th century as holders of a monopoly on navigation on the Black Sea, and by the Ottomans as Yeni-Sale as part of their empire, lost and conquered by Wallachia, Bulgaria, Russia...) was abandoned and destroyed over time [85]. The vernacular architecture of the Danube Delta is a sustainable, locally adapted style characterized by buildings made of wood, reed and clay (chirpić/adobe) on stone foundations, usually painted in shades of white and blue. These low, rectangular houses often have thick walls for thermal insulation, reed roofs and a 'lipovan' sauna-bath. The houses are usually built using local, natural materials: wooden posts and beams, mud bricks (chirpić) and thick reed roofs. Traditional houses are recognizable by their distinctive white, light blue or green facades, designed to reflect the sun and blend in with the landscape. A characteristic interior feature is the 'lijanca', a fireplace-powered, heated stove built into the wall between rooms. Many houses, especially those from the Lipovan community, include a sauna-bath ('banja') located on the property. The buildings are usually low, single-storey and rectangular, with a small front room and a 'clean room' or 'guest room' used specifically for visitors. The use of reeds for roofing provides excellent thermal insulation and protection from extreme temperatures. The gabled roofs often have wooden or reed decorations, sometimes including traditional symbols such as birds or fish. The kitchen or 'kuhnia' is often a separate building from the main house. Traditional building methods are increasingly being threatened by modern, less affordable building materials such as concrete and plastic, which can disrupt the environmental balance. Research has highlighted that vernacular techniques, such as the use of clay-based composites and plant fibres, are highly sustainable and efficient for the region's climate. There are efforts to preserve this unique architectural heritage through research and sustainable design practices, often using the UNESCO World Heritage Site of the Danube Delta as a model [86]. (The Danube River Delta was inscribed on the UNESCO World Heritage List in 1991).

Source: https://visit-delta.ro/en/traditions/architecture/, Accessed: April 26, 2026.

Fig 24: Reed is an important building material in the Danube Delta

Source: https://visit-delta.ro/en/traditions/architecture/, Accessed: April 26, 2026.
Source: https://romaniatourism.com/danube-delta.html, Accessed: April 26, 2026.

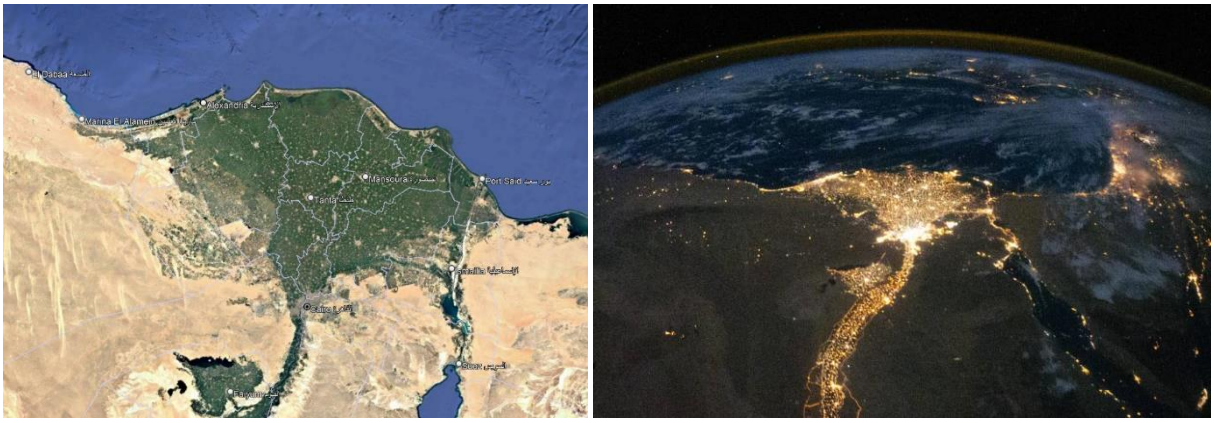
Fig 25: Traditional houses in Danube Delta

Source: https://www.tripadvisor.com/AttractionProductReview-g294458-d23845453-Danube_Delta_day_trip_from_Bucharest-Bucharest.html, Accessed: April 26, 2026.

Fig 26: Newer constructions in the Danube Delta

8. Nile River Delta

The Nile Delta (Arabic: دلتا النيل = Delta an-Nīl) is one of the most fascinating natural areas of Egypt where the Nile, in northern Egypt, flows into the Mediterranean Sea. Seen from the air, it has the shape of a huge fan (Geographic coordinates: 30º49'40.07"N, 31º11'05.75"E, Elevation: 9 m), (Figures 27,28,29). The delta starts from Cairo [87] and extends about 175 km north to the coast of the Mediterranean Sea. From Alexandria in the west to Port Said in the east, it covers 240 km of Mediterranean coastline and is a rich agricultural region [87]. The region has a Mediterranean climate (type Bwh, according to the Köppen-Geiger climate classification) with an average annual temperature of 14°C to 37°C. It hosts over 60 million people. For thousands of years, people have lived here because the soil is dark, soft, and perfect for growing crops like wheat, cotton, and corn. Farmers grew wheat for bread, corn for daily meals, and cotton, which became one of Egypt's most famous exports. Many other crops also thrived here: vegetables, beans, and even flax for making cloth. The soil always yielded, which is why people called the delta "the gift of the Nile." The location of the Nile Delta made it more than just farmland - it was a meeting point between Egypt and the world beyond the sea. It's not just geography; it's a place that has provided life, food, and stories for generations, and continues to do so today [88]. The delta covers more than 8,500 square miles (22,000 km^2). Its strategic location has long supported not only agriculture but also trade and travel. The delta stretches about 150 miles (240 km) from south to north and about 100 miles (160 km) from east to west. Two main branches of the Nile carry the river's waters to the sea: the Damietta in the east and the Rosetta in the west. In between, smaller waterways weave through the land, feeding farms, villages, and marshes. For centuries, annual floods covered the area with dark, rich soil, making it one of the most fertile places in the world. For the people of the ancient Nile Delta, the river was life itself. Each year, the Nile brought dark silt that made the land ideal for growing wheat and barley. Families settled here because food was plentiful and the river offered security. Towns and villages spread quickly, and some grew into famous cities - one of them was Tanis, once filled with temples and royal treasures. The delta was more than farmland; it was the foundation that allowed Egypt to grow, feed its people, and build a civilization that lasted for centuries. The economy of the Nile Delta was not limited to agriculture. Its coastline faced the Mediterranean Sea, making it an important trading center. Small ports along the delta welcomed ships carrying grain, papyrus, and flax from Egypt, while in return they brought wood, oil, and wine. This continuous exchange of goods brought Egypt wealth and strong cultural ties with neighboring civilizations. For centuries, the delta served as both a granary and a gateway, connecting local life to the wider world beyond its shores. Today, things are not as simple as they once were. The Aswan High Dam played a major role in stemming the Nile's natural floods, so that a thick layer of silt no longer reaches the land each year. Farmers now have to rely on fertilizers - an expensive solution that can also damage the soil. In addition, the sea is slowly moving inland. Parts of the coastline are shrinking every year, and saltwater is seeping into the soil. Add to that the growing problem of climate change, with rising sea levels and hotter summers, and you can see why many are talking about the problems of the Nile Delta. The region still feeds millions, but it is under pressure like never before. The Nile Delta is not just about agriculture - it is full of life. Every season, flocks of birds fly across its skies: flamingos, pelicans, storks and many more. Some rest for weeks in the marshes, painting the water pink and white. Fishermen know these waters well, rich in tilapia and catfish. Tall reeds and papyrus grow along the banks, making the landscape colorful and wild. This is the living side of Egypt's Nile Delta - a place that changes and renews itself every day. A major agricultural initiative (the "New Delta" Project), announced in 2021, aims to irrigate over 9,000 km^2 of new land in the Western Desert by diverting agricultural wastewater, expanding Egypt's agricultural area by 23%.

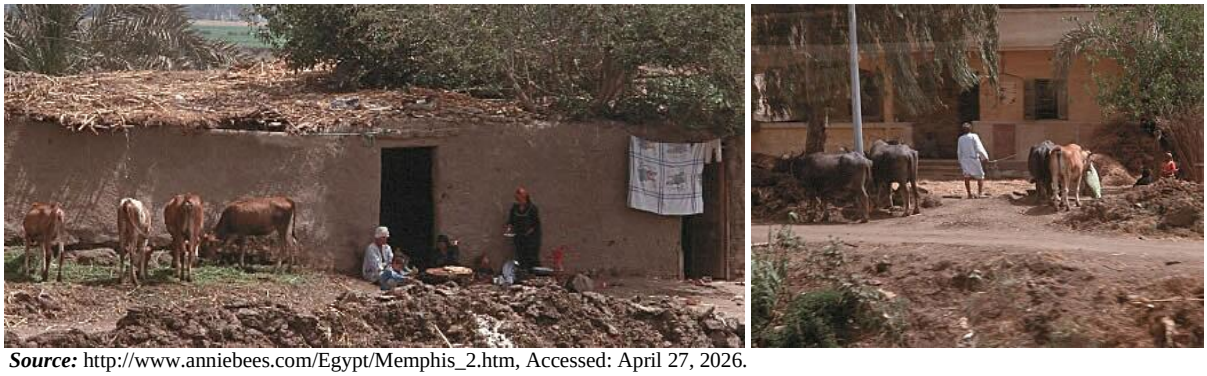


Source: Google Eart, Accessed: April 25, 2026.
Source: https://www.nasa.gov/wp-content/uploads/2023/03/537063main_nileatnight_full.jpg, Accessed: April 25, 2026.

Fig 27: Nile River Delta. Right: Nile River Delta at Night

Source: https://www.britannica.com/place/Egypt/Demographic-trends, Accessed: April 27, 2026.
Source: http://www.anniebees.com/Egypt/Memphis_2.htm, Accessed: April 27, 2026.
Source: https://egyptunitedtours.com/the-egyptian-countryside/, Accessed: April 27, 2026.

Fig 28: Traditional farming in the Nile River Delta



Source: http://www.anniebees.com/Egypt/Memphis_2.htm, Accessed: April 27, 2026.

Fig 29: Life of traditional families in the Nile River Delta

8.1. Architecture as a framework for life in the Nile River Delta

The settlements in the Nile Delta, which span governorates such as Beheira, Gharbiya, and Dakahlia, are characterized by dense, often unplanned rural villages mixed with agriculture, and historically significant cities such as Alexandria and Damietta. The region, which thrives on fertile Nile sediment, has witnessed continuous human settlement from the Neolithic to modern, densely populated development. Early settlements date from the late 5th millennium BC (Tell el-Samara, for example), with major developments in the 3rd millennium BC influenced by river trade and environmental factors such as silt deposition. While many residents are engaged in agriculture, the delta includes significant cities. The region is experiencing rapid, largely unregulated urbanization, with concrete houses often encroaching on agricultural land. Historically, settlements were established on higher ground (turtles/embankments) to avoid flooding. Traditional mud-brick architecture [89], especially in rural areas, is now increasingly being replaced by modern, multi-storey brick residential buildings. Major centres and governorate centres include Cairo, Alexandria, Beheira, Kafr el Sheikh, Gharbia, Minufiya, Qalyubiyya, Dakahlia, Damietta, Sharqiyah, Port Said and Ismailia. Villages often have narrow, unpaved streets and experience dense, unpredictable growth that leaves little room for infrastructure planning. The Nile Delta remains the most densely populated area of Egypt, and its settlement patterns are strongly influenced by the interplay of the river, irrigation and urbanisation [90] (Figures 30,31).

Source:https://lh3.googleusercontent.com/grass-cs/ANxoTn304lh7kdgykSJolvItcxkWh5G0JQmY1A0aiv7cgS5qVoZjR0caG8HC28LtZMIvc1eswmZazqCLZqMrUia3OOYX2LZZJucGXgPs_4u1dPQERfRJDNmbLyr9mXhQBad2z56AqY4t=h720, Accessed: April 27, 2026.
Source: https://sahistory.org.za/article/nile-river-and-its-influence-settlement, Accessed: April 27, 2026.
Source: https://www.habitatforhumanity.org.uk/country/egypt/, Accessed: April 27, 2026.
Source: http://www.anniebees.com/Egypt/Memphis_2.htm, Accessed: April 27, 2026.

Fig 30: Traditional house in The Nile River Delta

Source:https://lh3.googleusercontent.com/grass-cs/ANxoTn3XQXTyRyCKLb9rC6byOz7caiZMFV6kvjwAPhOfa_NmrLmntBEkZCEzgxLlsDkR-ivq9qNrpOfHveipKatl1IIEn6exeNezzk21XlGRRpBRHpvq8R66TRR9woSndHbTjL81UyU2=h720, Accessed: April 27, 2026.
Source:https://lh3.googleusercontent.com/grass-cs/ANxoTn0T_DHzPGhnGEGgZip0pY4Qkp64yTWjp8CxNULIOHwXPSsDWY1CerVjvqTeMc7pV-wsW1xUV0v1g6VcrbeIdPomaffXCrmwN9z16EMcRx6p155jE2vrFJYELrd7ELZ9nMcm7jhs=w1440-h1440-pd, Accessed: April 27, 2026.

Fig 31: Newer architecture in The Nile River Delta. Left: School Hosseinieh Secondary School For Boys; right: Mosque in El Hosayneya

9. Irrawaddy River Delta

The Irrawaddy River Delta (Ayeyarwadyja Delta) lies in the Irrawaddy Division, the lowest part of land in Myanmar that stretches from the tidal limit at Myan Aung to the Bay of Bengal and the Andaman Sea, 290 kilometers south at the mouth of the Ayeyarwady River (Geographic coordinates: 16º27'36.55"N, 95º00'06.82"E, Elevation: 6 m) [91 ,92]. The climate in the delta area is a tropical monsoon climate (type Aw/Am, according to the Köppen-Geiger climate classification) with an average annual temperature of 32 °C. The delta area is densely populated and plays a dominant role in rice cultivation in its rich alluvial soil, which is only 3 meters above sea level. It also includes fishing communities in a vast area full of rivers and streams (Figures 32,33). The Irrawaddy delta system extends in a large alluvial fan from the tidal limit near Myanaung to the Bay of Bengal and the Andaman Sea, 290 km south. This alluvial plain is bounded on the west by the southern Arakan Yoma mountain range and on the east by the Pegu Yoma. The maximum flow occurs in July or August. Most of the waterways are natural waterways and there is no extensive system of dug canals, the only major canal being the Twante Canal which connects Rangoon with the western part of the delta. The upper and central parts of the delta are almost entirely cultivated, mainly for rice. Until about 1850, much of this region consisted of a complex of permanent and seasonal lakes, swamps and marshes, and extensive areas of seasonally flooded plains and swamp forests. However, after the influx of settlers from Upper to Lower Burma in the late 19th century, the construction of embankments and the reclamation of land for agriculture accompanied the increase in population. The construction of levees was initiated by the government as early as 1861, and many levees were built around 1880 and 1920. Currently, there are about 1,300 km of main levees in the delta, protecting over 600,000 hectares of rice fields. The levee system provides a unique example of partial flood protection. The main levees form a horseshoe around the area between the main rivers, with the downstream ends remaining open. In the event of extreme floods, the lower parts act as flood basins, slightly reducing the peak flood. The old levees have been maintained, and projects are being considered to further expand the system. Despite these reclamation programs, there are still large areas of land that are deeply flooded during the monsoon and retain water even during the dry season. In addition, there are numerous permanent backwater lakes and associated wetlands, especially along the Irrawaddy between Myanaung and Henzada, along the Myitmak, and along the upper reaches of the Bassein and Daga rivers. The lower, marine third of the delta, which extends 130 km from east to west, is completely flat with no local relief. About 520,000 hectares of land lies below the level of high spring tide and is subject to tidal flooding. Much of this area is covered by mangrove forests, and cultivation is limited to the higher ground. Sand ridges, such as old beaches and sandbars, provide refuge for wildlife during the highest tides. Although the mangrove vegetation has been exploited for a very long time, some relatively intact stands remain. The area is divided into numerous islands and peninsulas by a series of large rivers flowing southwards and a complex of smaller, interconnected waterways, all of which are at least occasionally saline due to tidal intrusion. Drainage is direct to the Bay of Bengal through nine major river mouths, the Bassein, Thetkethaung, Ywe, Pyamalaw, Irrawaddy, Bogale, Pyapon, China Bakir and Rangoon. These rivers carry a heavy silt load and their waters are very turbid. The delta is actively growing towards the sea, so the sea is very shallow at a certain distance towards the sea. The water depth is less than 5.5 m along the entire coast, which extends towards the delta and up to 28 km from the coast in the east. The current rate of delta advance is estimated at 5-6 km per 100 years, which is equivalent to about 1000 ha per year. Several small islands, some of which are only visible at low tide, have developed in the open sea. These include Kain Thaung Kyun at the mouth of the Irrawaddy River and

Kadonlay Kyun and Gayedgyi Kyun at the mouth of the Bogale River. The tide is semidiurnal and has a range of 2.0-2.5 m along the outer coast. In Rangoon, 72 km from the open sea, the tidal range is 3.5-5 m. In some areas, sea dikes have been built to prevent flooding caused by high tides, and the government has recently implemented several polderisation projects in the outer delta [92]. Monsoon climate (type Am according to the Köppen-Geiger climate classification), with an average annual rainfall of about 1500–2000 mm in the north, increasing to 2500 mm in the southeast and 3500 mm in the southwest. Over 90% of the rainfall falls between mid-May and mid-November. During the monsoon season, maximum and minimum temperatures in the coastal area are around 37°C and 22°C, respectively. The sea can be very rough, and strong winds from the south and southwest often blow. The period from mid-October to mid-February is generally dry and cool. Temperatures rise after February, with April and early May characterized by hot, changeable weather with pre-monsoon storms. The natural vegetation of the lower, tidal delta is mangrove forest, but it has been heavily exploited and most of the remaining forest is in various stages of regrowth. Four forest types are recognized: low mangrove forest, which colonizes soft mud submerged at each tide; characterized by the species Ceriops, Avicennia, Kandelia and Bruguiera; tree mangrove forest, which develops on mud banks in the interior of the low mangrove forest and on the edges of tidal streams; dominated by Rhizophoraceae species; brackish Heritiera forest, on the landward side of the two types mentioned above, but still flooded at each tide; dominated by Heritiera tomes; freshwater Heritiera forest, a closed evergreen tall forest, flooded at high tide with only moderately brackish water; composed mainly of Bruguiera and Heritiera. Almost all areas not within the Reserved Forests are used for the cultivation of rice fields or other crops.

Source: Google Eart, Accessed: April 27, 2026.
Source: https://science.nasa.gov/earth/earth-observatory/irrawaddy-delta-burma-8767/, Accessed: April 27, 2026.

Fig 32: Irrawaddy River Delta

Source:
https://www.gettyimages.com/search/2/film?phrase=ayeyarwady+river&tracked_gsrp_landing=https%3A%2F%2Fwww.gettyimages.com%2Fvideos%2Fayeyarwady-river, Accessed: April 27, 2026.

Fig 33: Irrawaddy River Delta

9.1. Architecture as a framework for life in the Irrawaddy River Delta

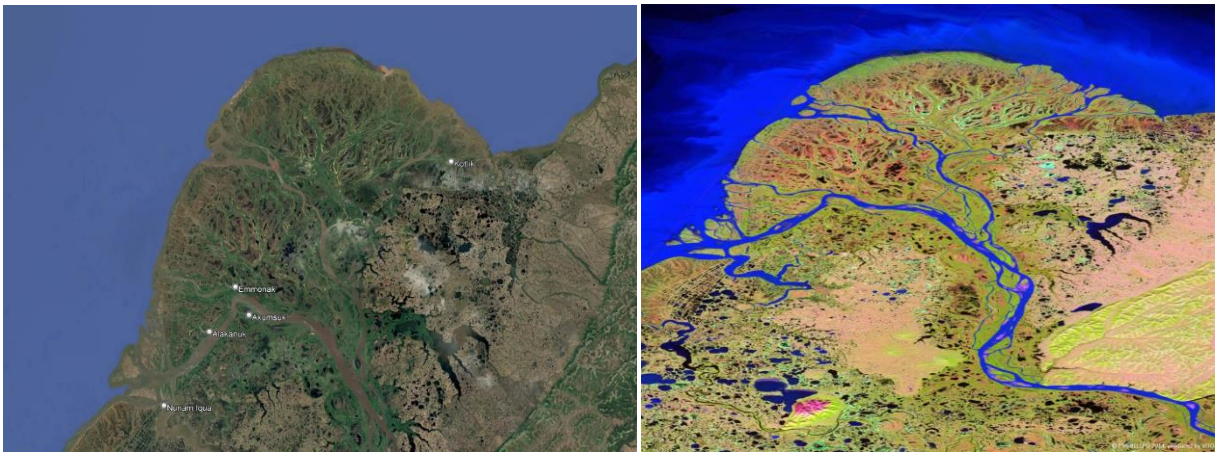
Traditional houses in the Irrawaddy River Delta are built on a raised platform above the ground on a solid teak frame, with bamboo walls and a thatched roof. The village house of this type embodies a centuries-old building culture in Myanmar. Such village houses were once common in Burmese villages throughout the central plains of Myanmar and around the Irrawaddy River Delta. Under successive kingdoms, dwellings in Myanmar were subject to luxury laws that ensured that building heights, materials, and construction techniques were in keeping with a person's status in society [93]. The end of the monarchy and the colonial period marked the end of luxury building restrictions, allowing for the construction of more opulent houses made of teak, a material once confined to monastic architecture. Drawing on the tradition of woodwork and carving, the village houses are built on solid pillars, supporting a wide platform and sparsely furnished main floor. A covered staircase provided access from below, while the space under the house provided shelter for livestock and a place to store agricultural tools. The roofs were made of straw, which always posed a fire risk, and after the nineteenth century they were increasingly replaced by corrugated zinc (Figure 34).

Source: https://issuu.com/inyainstitute/docs/summer_2023_newsletter/s/27967564, Accessed: April 27, 2026.
Source: https://www.wmf.org/projects/traditional-burmese-teak-farmhouses, Accessed: April 27, 2026.
Source:https://www.inspiringvacations.com/nz/blog/travel-stories/visiting-irrawaddy-delta-meet-cherie-tseng?srsltid=AfmBOooZVE7SVn_XiA9tam-dszvT-qettrU1HQjhSM4smGC6P_0w4kiY, Accessed: April 27, 2026.

Fig 34: Traditional (vernacular) architecture in the Irrawaddy River Delta

10. Yukon River Delta

The Yukon River Delta is located where the Yukon and Kuskokwim rivers flow into the Bering Sea on the west coast of the U.S. state of Alaska (Geographic coordinates: 62º39'03.43"N, 164º15'29.08"W, Elevation: 6 m), (Figures 35,36). With an area of approximately 129,500 km2, it is one of the largest deltas in the world [94]. The delta, which consists mainly of tundra, is protected as part of the Yukon Delta National Wildlife Refuge. The climate in the delta area is harsh subarctic to arctic (type ET, according to the Köppen-Geiger climate classification). The delta is home to about 25,000 residents, of whom 85% are Alaska Natives - the Yupik and Athabaskan peoples. The main population center and service center is the city of Bethel, with an estimated population of about 6,219 (2011). Bethel is surrounded by 49 smaller villages, with the largest villages having over 1,000 people. Most of the inhabitants live a traditional way of life, engaged in hunting and fishing. The area is virtually roadless; travel is by wildlife plane or riverboat in the summer and by snowplows in the winter. The Yukon River Delta provides important seasonal habitat for numerous species of migratory birds, fish, and some marine mammals. The delta is characterized as a 'transient' system or export-type estuary, where physical processes (river flooding, ice transport, coastal currents, and tidal mixing) and biological processes (metabolism and migration) annually remove the energy reserves of the wetlands (plants, invertebrates, and fish). Most of the river-borne particles and dissolved nutrients are transported from the coast by the Yukon River current to the inner shelf waters of the northern Bering Sea. The residence of juvenile salmon in coastal habitats is short. Most salmon smolts appear to be carried 20 to 30 km from the coast to the delta front by strong river currents during the migration period. The delta front and inner shelf waters of Norton Sound may function as a ‘coastal estuary’ for salmon, providing an area for physiological adaptation to the marine environment. Coastal mudflat and marsh habitats are transitional zones between terrestrial and estuarine/marine systems and may provide important areas for nutrient cycling and processing within the Yukon Delta. Calculations of waterfowl energy requirements indicate an increased importance of coastal mudflats in the fall for swans, ducks, and shorebirds, providing a readily available food source in the form of plants and invertebrates. Aquatic insects and meiofauna appear to be key components of deltaic food webs. They provide an abundant food source for migrating shorebirds and fish at appropriate times of year when these higher organisms are present [94].



Source: Google Eart, Accessed: April 27, 2026.
Source: https://www.esa.int/ESA_Multimedia/Images/2016/04/Yukon_Delta_seen_by_Proba-V, Accessed: April 27, 2026.

Fig 35: Yukon River Delta


Source: https://alaskaoutdoorssupersite.com/places/yukon-delta, Accessed: April 27, 2026.
Source: https://cpawsyukon.org/its-time-to-speak-out-about-drilling-in-the-arctic-refuge/, Accessed: April 27, 2026.
Source: https://alaskabeacon.com/2025/07/28/there-is-no-place-for-oil-development-in-the-yukon-flats/, Accessed: April 27, 2026.
Source: https://whsrn.org/whsrn_sites/yukon-delta-nwr/, Accessed: April 27, 2026.
Source: thearmchairexplorer.com/alaska/yukon_delta_national_wildlife_refuge.php, Accessed: April 27, 2026.
Source: https://www.stamfordadvocate.com/opinion/article/Opinion-Who-are-belugas-The-answer-is-in-the-17304345.php Accessed: April 27, 2026.

Fig 36: Flora and Fauna of the Yukon River Delta

10.1. Architecture as a framework for life in the Yukon River Delta

The Inuit are an indigenous people living in Alaska (and in the Arctic and subarctic regions of Greenland, Canada, and Russia). They built winter homes of stone and sod. By the mid-nineteenth century, they lived in snow houses (igloos) made of snow blocks. Inuit winter settlements consisted of several domed structures and could support several dozen people. Snow houses varied throughout the central Arctic. There are two types of transitional seasonal houses (qarmaq), which the Inuit inhabited in the fall. The common form of qarmaq was a semi-permanent small structure made of stone, whalebone, sod, a stone platform, and a skin roof. Dwelling during the summer months consisted of various variations of tents. Arctic winter houses of any construction method consisted of a network of intimate locations where private activities took place and communal and public spaces where community activities took place [95]. Sleeping quarters were located at the rear or at the edges of the network, separated and regulated by wooden partitions, passages and thresholds. Entrance porches, tunnels and tunnel niches, kitchens and storage areas were common components of the community. The history of the American Arctic regions is long (about 5000 years) and follows numerous climatic and technological changes and challenges. The extreme cold and limited access to building materials such as wood and clay bricks led to innovations in this area, using trees (brought ashore by water), marine mammal bones, sod and snow as building materials (Figure 37-42). The basic forms used and developed by the first people in the American Arctic still exist, with new developments and innovations as time and climate change warranted:

- Tipis or Tent Houses
- Snow Houses - Innovative Architecture of Eskimo-Inuit
- Whale Bone Houses - Thule Culture Ceremonial Structures
- Semi-Subterranean Winter Houses
- Qarmat or Transitional House. Qarmat are transitional seasonal, but more or less permanent dwellings that are built with roofs made of wooden skeleton, sod and leather. They were used in the transitional season when it was too warm to live in semi-underground houses, but too cold to stay in a skin tent.
- Ceremonial Houses/Dance Houses. They were designed with special functions in mind and were used as festival or dance houses, for communal activities such as singing, dancing, drumming and competitive games. They were built using the same construction as the semi-subterranean houses, but on a larger scale, large enough to accommodate all members of the community. In large villages, multiple dance houses were required. Ceremonial houses contain few domestic objects (no kitchens or sleeping areas), but often contain benches placed along the interior walls.
- Chief's Houses. Some Arctic houses were reserved for elite members of societies: political or religious leaders, the best hunters or the most successful captains. These houses are archaeologically identified by their size, usually larger than standard dwellings, and their composition of artifacts: many chief's houses contain whale or other marine mammal skulls.
- Men's Houses-Kasigi. In Arctic Alaska during the Bow and Arrow period, one important structure was the men's house, a 3,000-year-old tradition of separating men and women, according to Frink. Men slept, socialized, politicized, and worked in these structures, from the ages of 5 to 10. The structures were made of wood and wood, and could hold 40-200 people. Larger villages had multiple men's houses. The houses were arranged so that the best hunters, elders, and guests slept on driftwood benches in the warmer, better-lit back of the building, while less fortunate men and orphaned boys slept on the floors near the entrance. Women were excluded, except for part of the feast, when they brought in food.
- Family village dwellings (Again during the Bow and Arrow Wars, the other houses in the village were the domain of the women, where men were allowed to visit in the evening, but had to return to the men's house before morning. Frink, who describes the ethnographic situation of these two types of houses, hesitates to put a label on the balance of power that this represents - are single-sex schools good or bad for sex education? - but suggests that we should not jump to unwarranted conclusions).

- Tunnels. Tunnels were an important part of Arctic settlements during the Bow and Arrow Wars - they acted as escape routes, in addition to semi-subterranean conduits for social communication. Long and complex underground tunnels ran between the residences and the men's houses, tunnels that also served as cold traps, storage facilities, and sleeping quarters for sled dogs [2,3].

Source: https://en.wikipedia.org/wiki/Tupiq#/media/File:Eskimo_family_with_Malamute_from_1915.JPG, Accessed: April 17, 2026.
Source: https://firstpeoplesofcanada.com/fp_groups/fp_inuit6.html, Accessed: April 17, 2026.

Fig 37: Inuit family next to a tent-summer house (tupiq), around 1915.

Source: https://www.thoughtco.com/paleo-and-neo-eskimo-houses-169871, Accessed: April 17, 2026.
Source: https://www.nps.gov/articles/analyzing-early-driftwood-houses-of-coastal-alaska.htm, Accessed: April 17, 2026.

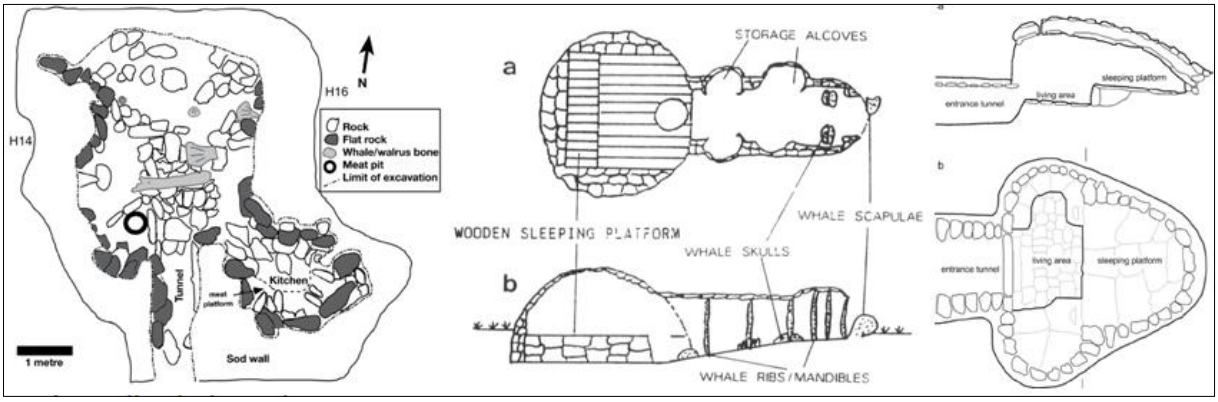
Fig 38: The structure of an Inuit semi-buried house (left) and the archaeological remains of one such house (right)

Source: https://www.britannica.com/topic/Eskimo-people, Accessed: April 17, 2026.
Source: https://www.theguardian.com/artanddesign/gallery/2017/feb/15/geraldine-moodie-douglas-moodie-photographers-1900s-canada-inuit, Accessed: April 17, 2026.

Fig 39: Eskimos (Inuit) build a snow house (igloo) from blocks of snow

Source: https://www.newberyphotoarchives.ca/en/photos/5-qarmaq, Accessed: April 17, 2026.

Fig 40: Qarmaq (house with a construction made of whale bones)



Source:https://www.researchgate.net/figure/Plan-of-Early-Thule-Inuit-house-15-Skraeling-Island-after-McCullough-1989-55_fig2_264004582, Accessed: April 17, 2026.
Source: https://www.erudit.org/en/journals/etudinuit/2006-v30-n2-etudinuit1994/017569ar/, Accessed: April 17, 2026.
Source:https://www.researchgate.net/figure/Illustration-of-an-Inughuit-winter-house-a-cross-section-b-plan-Image-modified-from_fig3_256464063, Accessed: April 17, 2026.

Fig 41: Houses of the early Thule Inuit

Source: https://www.thoughtco.com/paleo-and-neo-eskimo-houses-169871, Accessed: April 17, 2026.

Fig 42: Semi-buried winter houses of the Inuit community 'Indian Point' (1897)

11. Conclusion

Deltas of large rivers are one of the most fascinating natural environments on Earth. They are, as a rule, the most populated areas on Earth, with a continuity of settlement – from prehistoric times to the present day. This fact is based on the wealth of natural resources available in deltas, which humans use in all aspects of their lives: fertile soil (which can be abundantly irrigated if necessary), the presence of building materials (soil-clay, wood (sometimes bamboo), reeds. However, large deltas also have one latent disadvantage – fluctuating water levels, where low water levels allow the penetration of salty seawater (which adversely affects the performance of fertile soil), while high water levels (once abundant floods) destroy embankments and endanger built settlements. Although these deltas have been inhabited since prehistoric times, deltas of large rivers are 'extreme natural environments' where construction in them is very complex and very demanding in terms of engineering. However, well-designed planning and engineering solutions will already today, and even more so in the future, make these natural environments even more suitable for human life. A good example is the development of the Rhône River Delta

(Switzerland), the Rhine-Meuse-Scheldt Delta (Netherlands), (Figures 42,43).

https://magazines.hachettelearning.com/magazine/wideworld/22/4/the-river-rhone-delta/, Accessed: April 28, 2026.

Fig 43: Rhône River delta

https://link.springer.com/chapter/10.1007/978-981-97-7259-9_14, Accessed: April 28, 2026.

Fig 44: Rhine-Meuse-Scheldt delta

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