GROWING PART II: IRRIGATION AGRICULTURE IN MESOPOTAMIA & EGYPT
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Introduction
In the 4th millennium BCE, agriculture spread from the rain watered hills of the Levant and the mountains of southern Turkey, northern Iraq and Western Iran into the southern reaches of the Tigris-Euphrates river valley (the south of modern Iraq) and to the northern reaches of the Nile Valley in Egypt.

At the same time, cities and unprecedentedly complex societies grew up in which larger and larger percentages of the population lived in densely settled communities (cities) and many of these people became specialists with professions other than that of peasant farmer: craftsmen, priests, rulers, bureaucrats, soldiers, etc. During this time, a second Agricultural revolution took place, one aimed at the expansion of the land under agricultural exploitation and intensification aimed at increasing crop yields on the land under cultivation. The result was a huge growth in crop yields which led to and supported an ever increasing population. Larger numbers of these populations were technological specialists who often worked at the service of powerful state and temple-based economies.

Historians used to believe that the organizational demands of large-scale irrigation projects served as an impetus for the rise of strongly centralized states in Egypt, China & Mesopotamia. This theory has now largely been rejected because the evidence seems to point to a lack of central government control over communal irrigation. Instead, local leaders and populations managed these projects.
Local construction and management of irrigation controls in modern Egypt.

Farming spreads to river valleys

Early farming in parts of the Nile Valley, such as the Fayum, dates to about 6,000 BCE, and later spread to the Southern Mesopotamian flood plains by 4000 BCE. The river valleys were not as easy to farm as rain watered mountains were – the river valleys were flooded annually, but faced dry seasons with a lack of rain. In addition, the gather/hunter pattern did not entirely disappear with farming, and huge varieties of wild plants and animals were collected to support the growing population (and also today – e.g., fishing). The people hunted desert game, fished and fowled in the river, and collected wild varieties of plants that are usually not cultivated, such as rushes, papyrus, sedge tubers, lotus, and mandrake.

The earliest farming in the river valley relied on the natural irrigation of the rivers during their annual cycles of flood and drought.
The Nile River Valley in Egypt & Tigris and the Euphrates River Valleys in Mesopotamia.

The Nile River & Basin Irrigation in Egypt

The ancient Greek historian called Egypt the “Gift of the Nile River.” The Nile forms the main geographical division of the country, which is mainly centered around the river and what it does to the landscape. Southern, or “Upper Egypt,” is delineated by the narrow strip along the river, bounded by desert hills. The northern, or “Lower Egypt,” is considered the Delta (where the river splits into several channels in ancient historical times). The ancient name for the Delta is Ta-Mehu, or “Marsh Land.”

Egypt was called the “Black Land,” after the rich alluvial silt deposited by the annual flood. The desert was called the “Red Land,” although it appear more beige or yellow to modern eyes.
The desert or “Red land” where the dead were buried as with this early royal pyramid, and the “Black Land” where crops grew.

Ta Kemet “the Black Land,” named for the rich alluvial soil deposited by the Nile flood each year. It remains some of the richest agricultural land in the world.
Annual Inundation

The natural cycle of the Nile was, and still is, very hospitable to human development. The flood begins in June/July, after the harvest (unlike Mesopotamia), peaks in August, and recedes in late October/early November.

Inundation

Until construction of the Aswan High Dam in the 1960s, the Nile inundation did three things for Egypt: 1) The water irrigated and flushed the salts from the soil, unlike in Mesopotamia where salinization of the fields was a problem; 2) It deposited fresh silt (fresh nitrogenated soil, which is naturally fertilized – this is the traditional view, though it is doubted today, as most Egyptians rely on crop rotation and animal fertilizers; and 3) It provided enough moisture to the grain crops throughout the growing season. Crops were planted after the flood receded and were harvested before the new flood began.
The Nile flood in the mid-Twentieth Century before it came to an end with the construction of the Aswan High Dam in the 1960s.

Basin Irrigation in Egypt

**Natural Irrigation**

In Egypt, farmers utilized the natural basins created by the old natural levees abandoned by the river when it shifted course. The levees ran parallel to the river, and formed natural basins which trapped water during and after the annual flood. The basins allowed for the crops to be watered long enough in order for them to grow. Many Egyptians also relied on natural irrigation early in Predynastic times.

Cross-section of the Egyptian Nile valley. River levees created natural basins that trapped flood waters after the annual inundation receded. This natural irrigation system could be augmented with artificial basins, dykes and canals.
Artificial Irrigation

Human intervention reinforced and accentuated these natural basins by reinforcing levees with earthworks and creating canals and dykes to move and distribute water. These irrigation works were easier to build and maintain than more complicated ones in Mesopotamia, and were not as endangered from annual flooding of the Nile.

Irrigation basins in modern Iraq. Each is surrounded by a low wall of earth to contain the water in the basin. This makes it easy to water fields and store excess water after the flood recedes.
A modern Egyptian peasant works in a flooded field. On the left side of the photograph is a dyke and small irrigation channel.

Diagram of a typical irrigation system in Ancient Egypt. Feeder and siphon canals move water to and from fields contained in numerous basins.
Advantages of Artificial Irrigation

There were three advantages of artificial irrigation: 1) It increased the area available for irrigation by extending crops beyond the natural flood plain, which made supporting larger populations possible; 2) The basins retained water longer, which helped when the flood was not ideally high enough, and; 3) They permitted second or third crops in the garden plots near river, which meant more vegetables.

However, Egyptians were still subject to too low or too high Nile inundations, which posed problems: too high inundations drowned crops, and too low inundations did not deliver enough water to the fields, which created famine.

Agriculture and Land Use in Egypt

In Egypt, gathering/hunting activities did not cease. Many still fished, fowled, gathered and hunted to supplement the crops. The Egyptians grew one major crop per year until Ptolemaic times. Farming in Egypt centered on major cereal crops, such as emmer wheat, barley, and flax. Dates were grown in orchards, and vegetables were grown in garden plots on the levees near the river, which were intensively watered by small canals and the Shaduf, and instrument that helped to bring fresh water from the Nile. The Egyptians used crop rotation and the fallow system in order to keep fields fertile. The fallow fields were given to the animals to pasture, with the idea that the manure would fertilize the soil. The crop rotation was used to nitrogenate the soil as well, as legumes expel nitrogen while growing.

A “Shaduf” was an ancient water-lifting device used to water smaller garden plots and orchards.
Hard Work: Egyptian workers reaping, treading it with cattle to separate the kernels and winnowing the grain to separate the wheat from the chaff.
The Pay-off: Huge surpluses of grain to feed growing populations. Scribes count up this agricultural wealth on behalf of the Pharaoh who collected much of it as taxes from the peasants.

Farming in Mesopotamia
Agriculture in Mesopotamia was largely devoted to cereal crops. Smaller plots were planted with legumes, and orchards were filled with lentils, flax & other vegetables. Flax was used for linen (fibers) and oil (seeds). Other orchards were planted with date palms, pomegranates, and other fruit trees. The seeds were planted in the autumn, and harvested in April/May.

Tigris & Euphrates River Valleys
Mesopotamia had a river situation which was opposite of Egypt’s Nile river. Unlike Egypt’s yearly flood, the rivers flooded in the spring, at around harvest time, and were lowest in the autumn, which was bad for planting. Cereal crops were harvested in late April and May, just as the rivers’ flood would have endangered crops, as water was not needed. Planting still took place in the autumn, but the river was at its lowest just as the fields needed to be flooded to prepare the ground for plowing and planting. The annual floods in Mesopotamia were much different from Egypt’s flood. Unlike the gentle Nile inundation, the flooding from the Tigris and the Euphrates rivers were more violent and unpredictable, as they were spring runoff from the mountain snows.
Sumer in southern Mesopotamia (modern Iraq) was the birthplace of river valley civilization in the Near East.

Artificial Irrigation in Mesopotamia

Originally, the settlement in southern Mesopotamia stayed near to thin ribbon of green bordering the river. This area was naturally watered by the rivers, and the land beyond was desert. Once the population expanded and the settlements occupied all of the naturally irrigated land, the people had to find ways to expand the irrigated land. There were two basic strategies to artificially irrigate the new land beside the river: 1) Lead off small canals laterally from the main river at successive points; and 2) Make new channels off one bank upstream and running them parallel to the river, creating a new strip of cultivation.

Typical cross-section of irrigation works in Mesopotamia.

The irrigation works in Mesopotamia were much more complex and difficult to
manage than in Egypt and were also more easily destabilized through human (war, political disruption) and natural (severe floods) interventions.

Flooding on the Tigris and Euphrates Rivers could be devastating, washing away crops and irrigation works.

The Euphrates was preferred over the Tigris in the central plains of Mesopotamia – it is where more settlements have been found. This is because the Euphrates was slower and had less water, which made it easier to control, at a steeper gradient (higher than the Tigris where it enters the floodplain), and the soil sediments were richer in chemical nutrients, which yielded 20% more crops.

Levees & Flood plains

Most often, the river was higher than the surrounding land, and flowed in the channel with natural levees on either side. The levee soil was richer in nutrients, and the levees drained better, which prevented salting when the standing water evaporated. The levees were conveniently close to the river, and had fresh water in the water table. However, the further away from the freshwater source, salt water seeped in. Therefore, orchards and vegetable gardens were tended on the levees, and cereal fields were further out, since cereals need watering every two weeks.
Irrigation: Supplying & Controlling Water

There were four challenges for irrigation: Supply (getting water to land); Storage (keeping the water there as long as needed); Drainage (disposing of water when no longer needed); and, Protection (keeping unwanted water away from crops). Each of these will be addressed in order.

The gods must be angry: The Sumerian “Epic of Gilgamesh” tells how the Sumerian gods sent a flood to destroy mankind because people were making too much noise. Such divine cruelty was the only explanation they had for natural disasters.
Typical irrigation system in ancient Mesopotamia.

Supply

The size of the field directly related to the need of water supply. Gardens could be watered by hand from wells, or planted close to river. The cereal crops, which were planted in larger fields, were watered by gravity flow irrigation – this was moving water from the river past levees down gradient to cereal crops in the fields. The water moved through a series of successively smaller branching canals or through major channels which ran parallel to the main river. The flow of water was controlled with outlets & regulators.

Outlets were sluice gates which let water out of the canal into field. These could range from complicated to merely a hole. The outlets were opened in the side of a canal bank in order to divert water. Although helpful, outlets needed to be carefully watched in
order to make sure that no uncontrolled sluice flooded the fields, destroy dykes, and ruin other irrigation works.

Regulators were used to control the water flow in the canal in order to allow the water level to rise. The regulators had to be high enough to divert the water into side channels and to fields. Temporary barrages made of reeds were used, but permanent regulators were also built of fired brick and sealed with bitumen. Since there was a dearth of water in the autumn, when it was needed most for the harvest, the canal system had to be more efficient than in Egypt, and water rights were especially critical. Canal officials supervised water rights as individual farmers received their turn to use water for cereal crops. This system worked well, as grain needed less water.

Irrigation system construction & maintenance

As the canals were used, they tended to silt up and clog with reeds. Therefore, the canals needed regular annual maintenance, which was mostly done in the summer. The creation of new canals, which were usually two to three meters wide with a regulator, was a large investment of labor, and carried out communally by one or more villages. The larger projects, such as major canals and massive regulators, were a major undertaking. Huge projects, such as the shifting of river channels, were considered state projects.

An ancient Sumerian plan of a network of irrigation canals & basins.
An early Sumerian king named Ur-Nashne oversees an irrigation construction project.

Though the canals were considered important, canal officials, who were district or city-state level, were rarely mentioned in administrative texts. This reflects the largely autonomous local organization of irrigation, and undermines theories of hydraulic administration leading to state formation.

**Storage**

The water for individual fields and plots was surrounded by low field bank to keep water there once it had been flooded by the canal. The narrow basins also were constructed next to canals apparently to hold water, but the volume did not seem to have been significant to hold enough water.

**Drainage**

Drainage was considered important because it was difficult to remove surplus water when it was no longer needed. The surplus irrigation water would salt the fields but rising to the surface and evaporating. As the salt was deposited, crops were unable to grow in the hostile soil. In fact, the Mesopotamia term for famine was, in translation, “A whiteness of the fields!” Modern scholars are unsure how the ancient peoples might have dealt with the salted earth other than to leave those fields fallow. This salting may have caused shifts in crop patterns and even abandonment of whole cities in the south.
Drought (left) and salt build up (right) were two problems faced by Mesopotamian farmer.

**Protection**

The crops are most vulnerable when the floods come in April on the Tigris and in May on the Euphrates, and since the crops are being harvested at this time, the flooding could have caused the river to shift course and eat away at the fields. Therefore, regulators had to be kept open to let water flow through and out of system. Sluices and other weak spots had to be monitored to prevent them from breaking under the increased flood, and so earth dykes were created along the banks of canals and on the fields, and were considered a maintenance task for the local irrigation officials, as well as a communal task. Sometimes, huge dykes built along the borders between two states had symbolic as well as practical function – for example, the border dyke that was built between Umma and Lagash.

A lesser problem were careless farmers who failed to control the flow of water from their canals and allowed it to flood a neighbor’s field, where it washed away his furrow system (uprooting or drowning his crops). According to Hammurabi’s law code, farmers had to replace the lost crops at his own expense.

**Agriculture & Land Use in Egypt & Mesopotamia**

The ancient Mesopotamians used the land efficiently, and also conserved their seeds – they used a seed plough, and did not broadcast the seeds. Planting was achieved seed by seed, through a funnel in the seed plough. The goal was to yield the highest rate of crops per seed expended – not the maximum crop per acre. The crops were planted in wide furrows and with neat lines, which wasted less seed, and made weeding easier. Water could also be distributed uniformly to the crops, ensuring that each plant was more likely to bear fruit. This method is still used today in the Middle East, in places like eastern Turkey. Each plant was sowed in the season that maximized
their fruit bearing (e.g., onions planted in winter). Other plants became popular to fill a stop gap, such as the sesame plant (used for its oil), which was planted in April/May and harvested three months later (summer), when no other cereal crops were ready to reap. The fallow system was used, which was a biennial system where each field was left fallow every other year. There was, however, no crop rotation – instead, legumes were planted to recharge the nitrates in the soil. Fallow fields were left to grow weeds, and flocks and herds were passed over the field to deposit their manure.

A Mesopotamian “seed plough.” A funnel attached to the plow allowed seeds to be fed directly into the ploughed field, increasing crop yields.

Animal Husbandry

Domestication of Animals

The domestication of animals occurred well before civilization in both Mesopotamia and Egypt. The animal herds (cattle, sheep, goats) represented an important, stable source of income and capital. They were less risky than cereal crops (i.e., bad harvest, insects) and were easier to liquidate as unknown financial situations occurred, especially for commercial transactions.

Sheep and Goats

Sheep and goats were originally kept more for their milk and wool than for their meat. Sheep were a perfect compliment to grain farming. The sheep would graze on the fringes of cultivated lands where the wild grasses and weeds grew, and then would graze on fallow fields and even on some planted fields. This was to both manure and till the soil!

Most of the small herds were comprised of flocks of sheep with about a 25% mix of goats, which ate anything and everything. Most of the herd was female, and while mostly kept for the milk and meat, a few were slaughtered, especially the males. Sheep and goats were also important offerings to the Mesopotamian gods, and also slaughtered for omen readings.
Donkeys & Other Beasts of Burden

Donkeys were the main beast of burden in Egypt and Mesopotamia, and are still the most important beast of burden in modern Egypt. They hauled ploughs and carts, and donkey caravans hauled sacks of grain and other materials. While most think of the camel as a mainly Middle Eastern animal, they only came to Mesopotamia in the 1st Millennium CE, and even later in Egypt. Water Buffalo were briefly domesticated in Akkadian times in Mesopotamia, and then later reintroduced in Mesopotamia and introduced for the first time during the Islamic Period.

Onagers, the wild version of the domestic donkey, were faster and stronger, but more wild. However, sterile hybrids of the onagers became the ancient version of the mule (a donkey-horse hybrid). Horses appeared at first in the Ur III period, and became important as a military animal than a beast of burden.

Cattle

Cattle, what we usually think of as the most common domesticated animal. Cattle were mainly used as plow & traction animals, and in Mesopotamia, were rarely used for meat. They were mostly offered to gods, and not used for omens like sheep or goats. Egyptians used cattle for threshing grain as well. It was common for farmers to keep one or two cattle for plowing and other types of manual labor. There was no need for large herds of cattle, as most of the burden of work was on the small farmer. The cattle were kept close to home and fed with reeds and barley, unlike sheep and goats, which graze. Some Mesopotamian cattle were a part of the family, often given names, and even asked about in personal letters! A cow’s death was considered potential economic disaster for a family, since cows were expensive to replace, and were a source of capital in emergencies.
Large herds of cattle were kept in the Delta marshes for milk, hides and meat.

Egyptians bred large herds of cattle, which were mainly located in the Delta marshlands, and were thought of as mostly institutional – for example, temples kept large herds of cattle for many different purposes. Both the meat and the fat from a cow as highly prized and thought of as valuable. The cattle were also prized for their hides, which were made into leather, and also for their milk, which was used to make various foodstuffs. The cattle were also used for draft animals to do all sorts of labor, including pulling stone blocks weighing tons.

The cattle census in Egypt attests to the importance of cattle in this early society. The census originated in the protodynastic (right before the early dynastic period), and can be found in early records. Later, in the early dynastic system (the Early pharaonic period), it became the basis for the regnal year system.

**Dogs & Cats**

Dogs, one of the earliest domesticates, were raised to be hunting partners, and used for defense. Cats, also domesticated quickly, were used to kill rats, vermin, and snakes.
Dogs and cats were highly valued as pets and as working animals for hunting and controlling snakes and rodents.

**Pigs**

Pigs were less frequently mentioned in Egyptian and Mesopotamian texts, but archaeological evidence indicates that pigs were quite common. Except for the limited taboo (Seth) in Egypt and strict kashrut laws in early Judaism (Kosher), Pigs were not taboo in the Ancient Near East, unlike modern Islam and Judaism. Pigs were actually valued in Mesopotamia as garbage disposals, and for their grease!

*Ancient Egyptian statuette of a sow with nursing piglets.*
Although chickens were unknown to them, the Egyptians kept domestic ducks and geese and hunted wild ones.

By 1550 BCE, Horses to pull chariots had been introduced into Egypt.