HUMAN AND DELTAIC ENVIRONMENTS IN NORTHERN EGYPT IN LATE ANTIQUITY

ABSTRACT

This paper analyses the relationship between archaeological sites from the Roman-Late Roman period in the north-central Delta of Egypt and the palaeotopography and environmental conditions from the first millennium BC to first millennium AD. The location of the archaeological sites is mapped according to survey maps of the nineteenth and twentieth century and digital topographic models from satellite data. The Ptolemaic and Roman context for the apparent 'boom' in settlement during the Late Antique period (3rd-7th c. A.D.) is described to assess the way in which the diverse environments of floodplain, wetland and marsh, sand-bars were managed and the possible reconstruction of the ancient landscape. The results of the correlation are discussed in terms of connectivity to waterways, lagoons and the sea, spatial organisation and hierarchy and site function. The way in which the evidence from this time period may provide a potential proxy for understanding earlier and later settlement density is explored, where changes in historical trajectory and the environment provide the background for the development of the Delta in the medieval and modern period.

INTRODUCTION

The classical archaeologist and explorer David George Hogarth described the 'fens' of the northern Delta in 1910 as an endless, trackless area of salty mud flats, succeeded northward by a shallow lake until the sand dunes and fishing towns of the northern Mediterranean coast. He noted there the remnants of 'Ptolemaic and Roman' waterways, former Nile channels, agricultural field systems and the mounds of at least forty town-sites that had once existed there and wondered how an area that looked so primeval could ever have been tilled and inhabited by large numbers of people.[1] Modern technology and the irrigation and drainage projects of the nineteenth and twentieth century, beginning from the modernisation projects of Mohamed Ali, have created a new landscape, and it is now a complex mixture of agricultural land and fish-farms, combined with the modern complications of urban sprawl and waste management.[2] In confirmation of Hogarth's observations and as a result of preliminary archaeological survey work in the area, over one hundred and fifty potential ancient sites have been identified in the area north of modern Kafr el Sheikh and ancient Buto and between the Rosetta and Damietta Nile branches.[3] Of the thirty per cent for which there is some archaeological information, many have material that can be dated to the Roman era (30 B.C. to A.D. 324), and most have Late Roman pottery and glass (4th to 7th century), with some sites showing continuation of activity after the Arab invasion in 641 A.D.[4]

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[1] Hogarth (1910) 99-107. His viewpoint may be orientalising or colonialist in that he did not notice smaller communities and villages existing here and living a life different to the urban type familiar to him as a classical archaeologist.

[2] Fanchette (1997); Alfiky et al.(2012) 97.

[3] Data from individual sites in the Egypt Exploration Society Delta Survey database http://www.deltasurvey.ees.ac.uk/ds-home.html and http://www.dur.ac.uk/penelope.wilson/Delta/Burullus.html. I am grateful to the Ministry of Antiquities for their support for the fieldwork from 2004 to the present day.

[4] Wilson and Grigoropoulos (2009) 41 Table 1.4; Ballet and von der Way (1993); Schiestl (2012a); Wilson (2014), (2015), (2017).

This paper aims to discuss why the area was so well populated in the Roman and Late Roman periods, the way in which the environments of the north were conducive to large scale agricultural management, and what might have happened to create the landscape encountered by Hogarth, where ancient sites apparently dominated the medieval and early twentieth century landscape.[5] Furthermore the meaning of the presence of 'settlements' of non-standard type and their relationship to earlier settlement patterns may contradict the model of the gradual settlement of the Delta over time[6] and suggest that the area was always settled and, perhaps, well settled since earlier times. The human and environmental interactions are thus part of the wider cultural identity of the Delta, with peaks in archaeological evidence a proxy-measure for a dynamic and populated region.

GEOLOGY AND HISTORICAL DEVELOPMENT

In antiquity, the environment of the Northern Nile Delta was different to the modern day. Geological work across the northern Delta has reconstructed the ancient coastline and shown how it developed during the Holocene period and, specifically, from about 10,000 BC onwards.[7] By modelling the emerging Delta floodplain, its progradation into the Mediterranean and then its retraction and destruction phases, geologists have been able to combine sea-level data, geological augers and radiocarbon dates to create the framework for human development.[8] Frihy has also modelled the underlying topography and contouring of the north in an evaluation of the changes in the 'modern' period due to seismic activity, sea-level rise and the gradual subsidence and uplift of parts of the northern delta.[9] It is possible that the reduction of the delta cone as sea-levels rose also removed archaeological evidence, but the evidence has been difficult to detect in any quantity and its depositional history and date unclear.[10] The most obvious differences between the classical period and the modern day are in the number and trajectory of Nile branches running through the delta and debouching into the Mediterranean Sea, with the coastline and northern lagoons also not being in their modern configuration. In the Classsical and Late Antique period (7th c. B.C. to 7th c. A.D.), the main outlet channels debouching into the Mediterranean were, to the west, the Canopic branch, its mouth at Canopus-Thonis, the Bolbitine branch, perhaps in the Rosetta area, the Sebennytic branch running up the centre of the Delta, its mouth somewhere in the extreme north; to the east the Phatnitic, Mendesian, Tanitic and Pelusiac branches and mouths and, two 'false-mouths', the Pineptimi (for the Athribic branch) and Dioclus east of the Sebennytic branch.[11] Claudius Ptolemy notes some points of river branch division in the Delta, including the point where the Thermutic branch branched off from the Canopic Branch and then joined the Sebennytic; similarly, the Taly river branched away from the Canopic and it debouched through the Bolbitine mouth.[12]

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[5] By which I mean the natural inland scenery and the influence of humans on it in the Delta after Förster et al. (2013).

[6] Butzer (1976) PAGE

[7] Stanley et al. (1996).

[8] Butzer (1959), (2016), Stanley and Warne (1993), Chen and Stanley (1993).

[9] Frihy (1992), especially 390, fig. 1; Frihy, et al. (2010).

[10] The Smithsonian drill programme detected pottery buried at a drill (S44) depth of 9.5m from the south shore of Lake Burullus dated to late Second Intermediate Period (Stanley et al (1992))and another (S50) at 7.5m from the north shore of Burullus with no date, (Stanley 1996: 110 and 126). A stone tool was also found at 7.41 m in this core and AMS dated to 3940-3850 BC probably a lagoon at that time (Stanley et al (2008)).

[11] Herodotus, *Histories*, Book 2.15 and 17; Strabo, *Geography* Book 17.1.18; Bietak (1975) 149-177; confirmed by geological work Stanley, Warne and Schnepp (2004).

[12] Claudius Ptolemaeus (ca. A.D. 90-168 *Geography*). The location given by Claudius Ptolemy for this point was converted to coordinates 30 50 N, 30 25E; Ball (1942) 27, 107 corrects the reading to Damanhur

The position and configuration of the ancient coastline could once have been as far south as old dunes at the south margin of the present delta lakes, due to the effects of sedimentation from old Nile branches.[13] The formation of the present Delta lagoons/lakes has been ascribed to a combination of general sea-level rise since the 2nd century A.D., marine transgressions, such as a historical event in 961 A.D. recorded by Makhzumi,[14] ongoing subsidence and uplift,[15] as well as major earthquakes combined with tsunamis.[16] Drill cores from the Burullus Lagoon, the most northern of the lagoonal areas, suggest that at around A.D. 450 there was a marine-influenced mud flat in the Burullus area, but by A.D. 750 the lake had formed, separated from the sea by a sand dune barrier.[17] Similarly, the area was a wetland like Idku and Abu Qir lagoons until they were flooded.[18] The reconstruction shows the ancient remnants of the Sebennytic promontory, eroded to islands and levees, which provided high ground for all kinds of settlements and land exploitation in the Roman and Late Roman period, according to archaeological material.

The environments of the Nile Delta in Late Antiquity can be characterised as a floodplain as far as the modern 1 metre above sea-level contour line. As the sea-level was most likely lower by 1-2 metres in antiquity, the floodplain was drained naturally through the many distributaries and main branches of the Nile. Northward, beyond this area, there may have been marshy swamps, sometimes affected by sea-water from storm surges, reed beds and some open tracts of water. There were also ancient levee-islands — providing high ground — inside the trackless marshes and the lake-like area to the north, before the northernmost fringe of sand dunes and limestone outcrops provided a partially protective ridge between the sea and marsh. The area may not have seemed very connected and, once the floodplain proper had been left behind, the area until the open sea would have been a classic delta-land, much like the Brahmaputra in Bangladesh or the Niger in Nigeria. The multiple channels within the floodplain established levee systems over thousands of years, however, which could have been exploited for drainage and basin agriculture to a greater or lesser extent during the Pharaonic period and later. Such systems have recently been reconstructed and described for the Nile Valley in Middle Egypt by using a combination of textual sources, satellite and map data.[19] The sustainability of the system depended upon well-managed dykes crossing the valley from Nile channel to parallel canal. The dykes enabled water to be held back after the flood and let out as needed for longer periods of irrigation to ensure successful cropping and, in some places, double cropping, as seems to have been practised in the Fayum.[20] Although the dykes could be breached, they were rebuilt after floods, creating bowed and irregular dykes, some of which can be detected in the modern landscape, in field patterns and in digital elevation models. The dates of the systems detected in the Valley seem to correlate to the Ptolemaic and Roman periods and have survived because of the relative lack of interference in the floodplain until the modern era, but also because it was a system which lasted at least 700 years, if not more, and was well consolidated during that time.

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31 02N, 30 28E, in contrast to O. Toussoun. In fact, Kafr el Zayyat (or Zawiyet el Bahr) which is the actual geological branch point of the Canopic and 'Rosetta' branch (Toussoun 1922-1923) is at 30 50N, 30 47E and the location-point given by Ptolemy is the branch point of the 'Dragon' Canal (check) in the neighbourhood of Kom Firin at the western Delta edge. Perhaps Ptolemy confused the locations of the two west branches.

[13] Butzer (1959), Frihy (1992) 392.

[14] Abou Hassan Al Makhzumi (1203) *El-Minhâg*, preserved in Makrisi and cited by Toussoun (1922-1923) 117.

[15] Sestini (1989).

[16] Toussoun (1934).

[17] Arbouille and Stanley (1991), Dumont and El Shabrawy (2007) 678 and fig. 2A after dated cores by Toubar.

[18] Chen et al (1992) 554.

[19] Subias el al (2013); Willems et al (2017).

[20] Garbrecht (1996).

The geological information provides a timeframe into which human interactions can be set and for Egypt this means an extremely long period, from the Neolithic period around 6000 BC to the present day. In the historic period, descriptions of the geography of the area are limited and archaeology is also limited by the burial of early occupation under the sediments deposited on the land surface each year during the Nile inundation. It is likely, however, that the delta as a whole was already settled in the Neolithic period and thus played a key role in the period of state formation around 3100 BC[21] and in the resultant Egyptian state, with the capital Memphis at the apex of the Delta and centre of the first northern nome. In all, twenty cult and administrative centres were established in the delta, with Xois on the Sebennytic branch as the most northern nome centre, as if there were a line across the delta creating a fringe or boundary before the marshlands of the north.[22] Yet, the large town and cult centre at Buto (Djabet, Tell Farain 4) was most probably already a port in Predynastic times[23] and perhaps earlier, in Neolithic times, like its neighbour, Sais, to the south.[24]

The Delta in relation to the Valley to the south may always have been more economically viable because of its trade links and agricultural surpluses. Memphis, at the delta head had been Egypt's natural capital city since 3100 BC, and, from the first millennium the royal capital of Egypt was situated in the north, culminating in the foundation of Alexandria, at the centre of the Ptolemaic Empire from 323 BC. In the Satrap Stela of Ptolemy Lagus[25] (later Ptolemy I), there is a 'description' of 'The Land of Wadjet' (Phtenotes), the term for the area north of Buto between the extant river branches and bounded by the sea and sand bars to the north and a line somewhere across the delta. The lands in this area were rededicated by the Satrap to the goddess Wadjet and include 'all of its cities (*niwt*), all of its towns (*dmiw*), all of its people (*mryw*), all of its acreage, all its waters, all its cattle, all its flocks of birds, all of its animal herds (determinatives of cattle (3), sheep and goat, pigs, donkeys), everything which comes from it, which was there before and whatever is added to it'.[26] Earlier Pharaonic expansion, such as the establishment of the town of 'Island of Amun' (Tell el Balamun, Diospolis Parva) in the north-east Delta, was followed by an interest in the very north during the Late Period and Ptolemaic period. Comprising agricultural and grazing lands, desert fringes, marshes and swamps, levees and depressions, lagoons, islands and coastal sand bars and limestone ridges the delta as a whole and the north in particular contained diverse environments, to say the least. The resources of the marshlands included abundant natural fishing and wildfowl hunting, as well as reed and aquatic plant harvesting. Pastoral areas for cattle may have also followed modern practices of grazing cattle on high ground amongst the marshes, protected from thieves and explaining the large number of historical references to cattle lands in the north.[27]

The Ptolemaic period sites recorded in the north are so far only a few, and it is noticeable that they all are within the 2m asl contour line across the delta.[28] (Figure 1) The area of the delta as a whole has been estimated at up to 16,000 km^2, and the extent of agricultural, pasture and marshland areas most likely varied between the nomes in the Delta heartland, the desert fringes

[21] Butzer (2002); Köhler 2008; Maczynska (2014); compare with the importance of the marshes in early Mesopotamia, Pournelle (2007).
[22] Wilson (1955), 210 Map 1.
[23] Wunderlich (1993); Faltings (1998).
[24] Wilson et al. (2014).
[25] Cairo Museum, *JdE* 22182, Sethe (1904) 11-122; translated by Ritner in Simpson (2003) 392-397.
[26] Sethe (1904), 19, 7-20,16. Although seemingly formulaic, especially within the context of the inscription, the list of 'possessions' is inclusive of all that an agricultural environment might contain.
[27] Kees (1961) 30, 88, 183-221.
[28] Such a phenomenon has also been noted from a study of toponyms in the paper of Engsheden (2008).

and the marshlands.[29] By the Ptolemaic period the majority of the population of Egypt lived in the cities and towns of the north.[30] The recent discovery of a Ptolemaic period tower-house at Kom el Daba (EES 269)[31] suggests that the paucity of excavated or survey material is the problem in understanding the population density of the area, not the actual lack of settlement. A further piece of evidence for the expansion of interest in the north was the creation of a new administrative centre by the early Roman period at the town of Cabasa,[32] somewhere in the area between Buto and Sais and perhaps responsible for the new and growing agricultural hinterlands. Although the location of Cabasa is not known for sure – for example, it could be one of the four towns named Shabas, a derivation of Cabasa,[33] or it could have been at Tell el Kebir (582), north-east of Disuq, a strategically well-placed site about which very little is known.[34]

Although there are few textual sources from the Delta, the carbonised papyri archive from Tell Timai (Thmouis) in the Mendesian nome gives very detailed agricultural information for the second century AD and a fourth century cadastral survey, coincidentally of the same area, provides further data for understanding the disposition and management of villages in the Delta.[35] In the Mendesian area, excessive taxation and mismanagement of the irrigation canals, resulting in saline soils, led to the abandonment of the farmlands and villages in the area, which was then flooded by a sea incursion, creating the salty fenland of the Daqaliyah Plain. Similar problems were noted to the south, in the Fayum, another area of agricultural expansion from the Ptolemaic period onwards, which is richly documented and, in some places, a similar trajectory of abandonment of villages due to land and tax issues can also be detected by the Late Roman period. [36]

THE ROMAN AND LATE ROMAN PERIOD

Without the details provided by textual material, the north of Egypt is reliant upon its archaeology to provide information, which is still rather patchy, but the preliminary steps in creating a model for understanding the relationship between environment, agriculture and settlement and agriculture have been suggested.[37] The authorities of the Roman Empire seem to have undertaken large-scale projects to bring 'fringe' lands under control from the reign of Augustus onwards. From the wetland fens of East Anglia in Britannia to the North African coastal areas, the Levant, the oases areas of Egypt and also the Fayum and Nile Delta the Roman technical achievements in irrigation and drainage transformed and maximised agricultural

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[29] Rathbone (1990) 122 and n. 54 suggests a total land area for the whole of Egypt of 25,000 km^2, perhaps similar to Egypt at the end of the nineteenth century, see Barois (1911) Delta 14, 026 km^2, Fayum 12,33 km^2, Nile Valley 8,846 km^2, Total 24,105 km^2; the upper fgure used here comes from Bowman (2011) 320-322, Table 11.2 after Butzer (1976) 83 Table 4.

[30] Bagnall (1993) 19-20.

[31] Spencer (2016)7-10. There are several sites named Tell or Kom el Daba (anglicised version) in Egypt. This site and others of the same name in the Delta are not to be confused with Tell el Dab'a in Sharqiya province, the site of Avaris.

[32] Pliny the Elder (ca. A.D. 23-79) *Natural History*, Book V, Chapter 9 and Chapter 11 mentions 18 Delta cities by name and and also the Cabasite nome. Claudius Ptolemy, *Geography*, mentions the town Cabasa at 30 40N, 30 55E.

[33] Ball (1942) 109 Shabâs el Shuhada; the others are Shabas Ummayir, Shabas Melh, Shabas Bilul el Sakhawiya (south); Timm (1984-2007) 5, 2218-2222 and comments of Engsheden (2008) 42.

[34] Ballet and von der Way (1993) 12.

[35] Blouin (2014).

[36] Rathbone (1991) 407-408, Haug (2015) stresses the need for flexibility in dealing with the Fayum irrigation system and lands and the problems that occurred when the water bureaucrats were not so minded.

[37] Butzer (1976) 22-27.

practices on a large scale[38] and provided systems which lasted into the Late Antique period.[39] Building on Ptolemaic expansion in Egypt, a decree of Augustus organised the dredging of irrigation ditches and the completion of Trajan's canal opened up a transport link between the Delta and the Red Sea. Banaji has suggested how the ecclesiastical authorities in Egypt mapped onto the Roman pattern from the fourth century, with the elite in Alexandria, senators based in Constantinople and ecclesiastical institutions owning large estates throughout Egypt.[40] Documentation such as the *Synecdemus* of Hierocles, from around AD 535, describes the new administrative division of Egypt into eight eparchies, of which Aegyptiaca, including the western Delta as far east as the modern Damietta branch, was the most important and under the control of the King of the Romans at Constantinople. By the Late Roman period such nomenclature could suggest that the Delta was representative of 'Egypt' as a whole with the most productive lands and settlements to match. The *Synecdemus* also confirms the existence of important towns in the north, including Pachnemoês (Pachnemounis, Kom el Khanziri 262) and Phrauynes (Phragonis – Kom Khawaled 272).[41] Other lists mention other town names, but without further information it is difficult to place them.[42] The Peutinger map (between AD 335 and 366) shows the many distributaries of the delta with lands between them as islands, upon which there are some temples, mainly dedicated to Serapis or Isis.[43] Although the Notitia Dignitatum (395-413) shows only one Nile branch in the Delta in the *comes limitis Aegypti*, it does enumerate eight towns before Babylon-Cairo.[44] Other toponymic evidence is slender, dependent as it is upon textual evidence, for example, although there are 186 toponyms known from the eight northern nomes, there are only 94 actual places — many of them the nome capitals, partial names or unplaced locations.[45] Conversely, the ancient names of some of the largest known archaeological sites such as Tell Mutubis and Kom Nashwein are unknown.

The archaeological evidence and its preliminary interpretation thus provide confirmation for the potential for the north of Egypt and suggest that the area was well settled in Late Antique times, although with the caveat that such settlement may originate much earlier.[46] Far from being a marshy wasteland and uninhabitable, it is likely that there was an area of around 60 km by 40 km, that is 2,400 km^2, north of Buto, which sustained an intricate network of large and small settlements within an environment connected by extensive waterways, perhaps containing irrigation basins and responsive to different, local conditions. Survey work has identified a number of sites within this network, many of which are not attested in textual sources and about which information is limited. The dates for sites are based on pottery dating, but there is a possibility that for actual Late Roman settlements the number is much larger, as they may be buried under modern settlements or have been ploughed back into agricultural areas or fish-farms.[47] Even if the numbers are imprecise, the size of some of the sites (Table 1) requires some explanation; for example, Tell Mutubis is 35 hectares in area and 12 m high; Kom Arab 30 hectares and 10 m high; Kom Khawaled 66 hectares and 15 m high; Nashwein 55 hectares and 10

[38] A few examples show the extent and success of the transformative projects of the Roman Empire, but this list is not exhaustive: Honnor and Lane (2002), North Africa, Levant, oases irrigation, Fayum, Burkhalter (1997), technology Öhlig (2016), Wilson (2000).
[39] Summary by Alleaume (1992).
[40] Banaji (2001) 101-133.
[41] Ball (1942) 163-4.
[42] For example George of Cyprus (ca. A.D. 606) names Costos and Psaneôs cômê in Eparchy A of Egypt, thus in the north Ball (1942) 177.
[43] Dilke (1987) 241.
[44] Kamal (1932) 308-311 illustrations from manuscripts of the 15th century; Dilke (1987) Fig. 14.5.
[45] Verreth (2013).
[46] Until more detailed work can be undertaken at each site, the survey-surface material is discussed here only in terms of its dating to the Late Antique period.
[47] Schiestl (2012b).

m high. The variety in alignments and size from 60 hectares to under 1 hectare also suggests a settlement hierarchy.[48] The placement and relationship to 'high ground', the delta sediment fan, defunct waterways and field patterns also suggest that the area had a complex management and socio-economic structure.

By the medieval Arab period after the Arab invasion in 641, the dynamic of the area had changed, with the two modern Nile branches, the Rosetta and Damietta branches, as the main functioning branches, and providing the main means of communication through the Delta from Cairo to the sea.[49] Settlements along the branches of the river were known from itineraries of merchants but others away from the main routes are not very well known and the archaeological evidence may have been hidden under modern towns or removed, some settlement was displaced to smaller centres and other, 'new' places seem to have become important, such as Rashid/Rosetta and Fuwa on the Rosetta branch and Dumyat to the east.[50] The new network may have made the central northern area less accessible or economically viable, but the merchant itineraries may not be reliable for such an estimate.[51] In order to understand and reconstruct the palaeotopography of the Northern Delta and its relationship to human settlement and management from the Roman Period to the Arab invasion it has long been known that the topography and contours of the modern delta surface, especially before 1970 could be used to reconstruct,[52] at least, relatively recent landscapes.[53] Extensive land irrigation and soil removal and redistribution are likely to make such reconstructions tentative.

The first detailed cartography of the north which shows the complexity of the Burullus Lagoon and its shoreline is the mapping of the Napoleonic Commission from 1799 to 1803, attributed to Pierre Jacotin and Gratien around 1810[54] perhaps using the work of Edme-François Jomard, ca. 1810 at 1:100,000[55] that shows main channels and the Burullus lagoon outline. A map by Girard, ca. 1835,[56] shows similar details, but also basins in the Valley as well as ancient sites in the north. Although the mapping of the Napoleonic Commission was sometimes not as accurate as might be hoped,[57] it is quite invaluable. The hydrological map of Linant de Bellefonds from 1882[58] is even more detailed for the canal, irrigation and railway infrastructure of the Delta, showing the changes that had been made in the intervening eighty years. The value of the pre-irrigation and post-irrigation maps is that they provide some information about the pre-existing canals, drains and dykes which were often reused within the new systems of canals (bringing water) and drains (taking it away). Ancient Nile channels were converted into modern canals to use pre-existing gradients and links as well as to make the canal construction more efficient.[59] Linant de Bellefond's map shows that a dyke seems to have been constructed to the south of the lagoonal and marsh zone, perhaps to ensure communication across the delta as well as provide protection and drainage for the north lands, keeping salt water at bay. The 'finger-like' peninsula-levees extending into the lake or inlets of wetland interwoven with 'solid' land suggest that the maps show unmanaged wetlands. The irrigation engineer Henry Willcocks suggested that there

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[48] Wilson (2014).
[49] Guest (1912) map.
[50] Wilson (2015).
[51] Cooper (2014).
[52] The Aswan dam was inaugurated in 1970 ending the ancient cycle of the inundation and thus depositions of silt onto the land. Earlier dams and barrages from the end of the nineteenth and early twentieth century has already had an impact on the flood regime and silt deposition.
[53] Toussoun (1922) 57; Ball (1942) 23.
[54] Jacotin (1810).
[55] Jomard (1810).
[56] Girard (ca. 1835).
[57] Godlewska (1988).
[58] Linant de Bellefonds (1882).
[59] Barois (1911) 22.

had been a basin irrigation system in place in Lower Egypt at the time of the Arab conquest, mainly based on the presence of the ruins of the ancient towns. He stated that the system was abandoned so that by the beginning of the twentieth century, basin irrigation was confined to south (upstream) of a line connecting Delingat-Damanhur-Shubrakheit-Rahmania-Disuq, Sanhur, Nashart, Qallin, M. Kobra, Mansoura, Fakus and Bilbeis. Beyond this line it was possible to observe depressions between the canals leading to abandoned villages, becoming more obvious as one approached the lakes.[60] When Willcocks began his work to extend the irrigation network, the Public Works Department devised a strategic plan, by which each area would be assessed on its own merits and the most appropriate drainage/canal system put in place. The results of this assessment can be seen in the map produced of the irrigation network and published in 1904. The abbreviated drainage network is shown as parallel systems of canals and drains, with the long main canals up the central delta plain, towards the marshy edge of Burullus Lagoon.[61] The more detailed drainage system compiled from the Survey of Egypt maps of 1997 and based on earlier maps of the Survey Department show that the overall irrigation network actually constitutes a series of 'systems' linked together into one overall network and that, in different areas, the irrigation system takes account of the specific 'drainage' conditions of each area.[62]

After the irrigation system was put in place and extended through land reclamation projects in the twentieth century, especially after the building of the Aswan Dam, the ancient land surface disappeared at an extremely fast rate. Satellite data,[63] however, provides further information which, in conjunction with maps and archaeological data, shows what may have been the Late Antique landscape. The satellite data also has the capacity to show soil differentials, for example, soil that holds more water (possible in-filled depressions or channels) or soil that is drier (more saline or overlying clays) and a digital topographic model has the capacity to show relatively small changes in topography. In the Delta, where the land is very flat (topographically undifferentiated), from 2m below sea level up to 17m above sea level at the floodplain in Cairo, a distance of 180km from north to south, small changes could indicate buried features, which may be significant when linked with other information. Ancient sites on mounds or tells also show up well in this data and their relationship with high ground, such as ancient levees, can be informative, as well as their relationship with modern villages or towns, which may be built upon ancient sites or levee systems and thus highlight them for future investigation, predicting the presence of buried ancient sites. Some of the towns or ezbet-villages have 'old centres' with a round ground plan and compressed and winding streets and are typical of villages settled in the pre-modern period, contrasting with the straight streets and grids of modern planned towns. Occasionally they also have a cemetery mound adjacent to the villages or set aside from it, but which is also an area of high ground. There may be an interesting relationship between sites which continued to be settled and those that did not. The reasons may have been social, economic or environmental.

According to levee and channel reconstructions in conjunction with the placement of Roman-Late Roman sites, five specific networks are discussed below in order to provide a baseline discussion for understanding the relationships between different environments and sites in the northern Nile Delta, but within one larger deltaic network.

THE MUTUBIS 'DELTA'[64]

[60] Willcocks (1899) 194-5.
[61] Willcocks (1904) pls. 17-18.
[62] Barois (1911) vii, 147.
[63] Combining maps, remote sensing data and ground truthing in the western Delta is described in Trampier (2014) 57-87, the 30m tile Shuttle Radar Tomography Mission (SRTM) data is available from United States Geological Service, https://dds.cr.usgs.gov/srtm/version2_1/SRTM30/
[64] Colour versions of the figures may be found at: http://www.dur.ac.uk/penelope.wilson/LAA.html.

The first case study (Figures 2 and 3) is north of modern Disuq, towards the Rosetta promontory, where the medieval towns of Rashid (Rosetta) and Fuwa are complemented by the ancient sites of Tell Ahmar-Mutubis (234), Qabrit (233), Amyat (249) and Matiur (250), as well as Kom el Qassabi (248).[65] The SRTM data shows a levee branching off from the Rosetta Nile at Birinbal, where there is a fork in a canal parallel to the modern Rashid branch, and proceeding northward in a gentle meander. The villages at Minyat al Murshid and Birinbal could stand on a much earlier site, now buried underneath the towns. Several small modern ezbets and villages with old centres stand upon the high ground and most of them have a canal connecting the village to the western side of the lake area.[66] It is possible that the levee could be part of the original northern mouth of the Rashid/Bolbitine branch, debouching somewhere along the coast, which has been eroded or covered in silt. The canals west of the ezbets suggest a potential area of small basins for irrigation, but they may be modern. If there was an ancient channel, the original mouth of the Bolbitine branch could have been in the area and later diverted, so the sand hill south of Rashid at Kom Abu Mandour/Tell Farah would have been a product of coastal deposition. Analysis and radiocarbon dating of material of drill core sediments from the area show no fluvial sands between 7,500-3000 yrs B.P. The upper Bolbitine channel may not have developed until the Ramesside period[67] splitting from the Canopic branch, and the lower Bolbitine is said to have been excavated perhaps in the late dynastic period ca. 2500 B.P. (ca. 550 B.C. Late Dynastic Period), after which time it developed rapidly.[68] The presence of Late Dynastic material at Tell el Farah/Mandour[69] may suggest that there was a coastal monitoring station there and the unsuitability of the river mouth due to currents and limestone outcrops may suggest a reason why the kings of Sais established their port at Naukratis on the Canopic branch and why, in the Roman period, the chief town in the area was at Tell Ahmar-Mutubis (234). The shallow channel of the modern Rosetta branch confirms that the outlet is a modern formation, apparently corroborated by the foundation of Rosetta/Rashid in 870 A.D., according to tradition.[70] The town from which the Nile branch called the Bolbitine may have taken its name is not yet known.[71]

In the area around Tell Mutubis (234) (Figure 3), the most notable feature from the topography is the low-lying basin to the south of the site and the evidence from drill augers at the site suggests that there were marshy areas to the east, almost giving the impression that the site was an island, as appears to be the case on the map in *Description de l'Egypte*.[72] A levee system extends from the Rosetta branch north-east, north of Mutubis, passing close to two smaller modern villages Ezbet el Quni and Ezbet Umar on the course of the Tirat Khali el Quni, which, because of its straightness looks like a modern irrigation drain. The modern Masraf No.11 in the area may be an instance where an ancient channel has been incorporated into the irrigation system, but the town of Beni Bakr looks like a double mound site, perhaps either side of a channel. Beni Bakr seems to be an old town, but whether this was an opportunistic use of a high area or ancient site is not known.

In the area north of Disuq (Figure 3), as far as the shore of Burullus, there seems to be an internal 'delta' supplied by one distributary north of Disuq and another from further south. Mutubis is to the west of this deltaic-system, along with Koms Qabrit (233), Amyat (249) and

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[65] The numbers relate to the Egypt Exploration Society database of sites.
[66] The connections are extant in the medieval period, Cooper (2014) 72-4.
[67] Bietak (1975) 171-176, Abb. 36-41; Stanley and Warne (1993).
[68] Chen et al. (1992) 550-1, 557; Herodotus, *Histories*, Book 2, 17.6.
[69] Wilson and Grigoropoulos (2009) 168-170.
[70] See the suggested historical shore-lines in reconstructions of Frihy (1992) 390, fig. 1, Timm (1984-2007) 5, 2198-2203.
[71] Ball (1942) 78 note †, although the geographical dictionary of Stephanus of Byzantium written in the reign of Justinian I does include Bolbitinê, from the writings of Hecateus, Ball (1942) 169.
[72] *Description de l'Égypte, Atlas* (1826) Plate 36.

Matiur (250), which may have been along a dyke or canal leading to the distributary feeding the 'delta'. The site of Kom el Qassabi (248) near the internal-delta apex would thus be a controlling focus for this system and Mutubis, to the west, a crucial link of the main river 'Bolbitine' channel and the lake inlet, with a very strategic position for transhipment of goods across the lake and into the Nile network. Extensive survey work at Mutubis has confirmed the Roman-Late Roman date of the site, with a potential harbour with Gazan and Late Roman amphorae on the north-eastern side at the lake; at least one church building and another central brick building with tiled roof; a bath-house; cemetery; food processing facilities with grindstones; houses and glass kilns.[73] With Qabrit (233) to the south, Mutubis was rich and well-resourced and was located in a strategic place for the import and export of goods between Egypt, the Eastern Mediterranean and North Africa.

The channel-system in the area could also have been fed from further southward by the old Saitic branch, probably in the course of the modern Qodaba canal and tracking between Kom Abu Tahun (252) and Buto (4), up to Kom el Sheikh Ismail (251). Geological survey also detected the last stages of the channels east of Mandura and Kom el Sheikh Ismail.[74] Finally, the idea of an ancient east-west dyke or channel is documented by the Butic river (Ptolemy Geography), from the 'Taly' river connecting the Thermutic, Athribic, Busiric and Bubastic rivers. Josephus confirmed the existence of the Butic channel by his account of Titus, who put the army onto ships at Nicopolis outside Alexandria and they then sailed upon the river as far east as Thmuis.[75] Ball mentions a series of ridges up to 3m high called Tell El-Qanan between Tell Timai and San el Hagar, perhaps the excavated earth from the Butic canal, forming a north bank and providing flood protection.[76] Segment VII of the Peutinger Map shows a cross-Delta route from Pelusium to Damanhur, south of the Menzala and Burullus lakes,[77] but whether it is a road or canal or both is not clear.[78] The general drainage pattern in the eastern side of the Delta is an east-west one,[79] which would facilitate the construction of a dyke alongside a canal taking water to Lake Menzala. Tracking through the Mansoura area the canal would have had to have crossed link with a main Nile branch before continuing on its way, probably to Sakha and then west to Buto and after that, to the Bolbitine branch and thus to the Alexandria canal. The SRTM imagery does not show a strong feature, however, suggesting that such a canal-dyke has disappeared, although to the north and north-west of Buto there is some kind of east-west high ground showing as a line in the SRTM imagery between Buto and Kom Gir. No road or canal is present on the satellite or map images, so the feature is worthy of investigation.[80]

KOM EL ARAB LEVEE

The second area (Figures 4 and 5) is a contour and levee system which extends east of the major and very ancient site of Buto-Tell Farain (4) to Kom el Arab (243) and north to Tell el Sarahig (460), finally tracking across Burullus lagoon in a series of mud islands as far as the coast, where there may once have been a mouth at the later medieval town of Nasatarua (501). To

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[73] Wilson (forthcoming).

[74] El-Gamili and Hassan (1989) 154.

[75] *Wars of the Jews* Bk. IV, c. xi.5.

[76] Ball (1942)129 the route of the Butic canal began at Rahmaniyah, went south of Buto, connected with the Thermuthiac branch near El-Hamra, went to the north of Tannikh connecting with the Athribitic branch, the Busiric east of Thmuis, then the canal went along Tell el Qanan, south of Tanis and curved south to join the Bubastic river near Kom Dafana.

[77] Ball (1942) pl.IV.

[78] The stations on the road are: Pelusion, Heracleo (Heracleopolis Parva), Th....o, Tha...u, an unnamed place, Buto, Ermupoli, Ball (1942) 154.

[79] Willcocks (1904), pl.17 and 18.

[80] The feature is most probably very recent, and can be checked in the field.

the south, the high ground is noted around the village of Al Khalafiyin and an ancient river channel can perhaps be tracked in a canal east of Masraf No 9, where the masraf-drain and canal seem to run on either side of a long levee. Towards the north, there are no real settlements until the massive Kom el Arab (243). The ancient sites of Quleiah (245) and Kom Sheikh Ibrahim (244) are almost equidistant on the east and west side of the levee respectively, perhaps reflecting a basin structure to the landscape. The settlements are situated on the agricultural land and the high mounds above the annual flooding, while the levee also provides a dyke or trackway and potential site for ancient settlements. The field pattern may suggest that there were once towns in this area. The levee continues north of Kom el Arab (243) on the eastern side, bends slightly to the east to come round to the Kom el Dahab (461) levee with Tell el Alawi (241) at the north end and then tracks north-west towards a peninsular promontory past the town of Ezbet Ghabayshah (modern) and the fish-farms, with the site of Kom Sarahig (460) on the eastern side of the promontory. It is not clear yet whether Kom Sarahig is an ancient site or a mud hill. Older maps show chains of mud-hills across the Burullus lagoon to the outlet at Tell Mastourah (501), ancient and medieval Nastaroua.[81] Such an extension across the lake, whether by canalised passage or levee, would have a significant effect on the importance of towns along this route and the end-port, which could have acted as a lake-seaward facing entrepôt.

Just over 2km to the east of the 'internal delta' is another very strong levee system (Figure 5), upon which is the site of Kom Sheikh Ibrahim (244), with the modern Ezbet Uqlah al Qibliyah and Ezbet el Qinn to the east, taking advantage of a long levee-like finger of land. If this levee is traced northward it appears to continue into the lake with a series of islands forming a linear alignment as far as the modern coast and Tells Maqasaba (458) and Maqlouba (455).

The area between the Kom el Arab and Kom Sheikh Ibrahim levees could have been the old channel outlet and the levees were thus an ancient formation upon which the ancient and modern villages were built. The field pattern in this area suggests the meander of a waterway in the area and well-silted agricultural land. Although this ancient channel cannot be tracked as far south as Buto, to the south of Kom Sheikh Ibrahim the in-field pattern as well as contours suggest that there was a circular, low-lying area there, perhaps an agricultural basin.

TELL FOQAA SYSTEM

The third example (Figure 4) is strong levee system detectable in the area at Kom el Noweish (5), perhaps a Ptolemaic site at least, tracking northward to the shore at Tell Foqaa (254) and thence across the lake to the north coast at Kom Maqlouba (455).

The modern town of Sidi Selim is around half a kilometre from the mound of Tell Sidi Selim (282) to the east, a good example of displaced ancient to modern settlement. The ancient site stands on an area of relatively high ground and in fact the modern canal pattern circumvents the high area. In the area there is another potential double levee system, tracking north of Sidi Selim, also visible in the field patterns to the west of Kom Haddadi (284) and then north, west of Tell Foqaa (254) and through the modern fishing town of Shaklouba to the lake. Kom Haddadi (284) seems to be the confluence for two levee systems, with another levee beginning at the mound of Kom Sidi Selim and trending north-west towards Kom Haddadi, east of Tell el Misk (600) and west of Kom Bunduq (283), thence to Haddadi through the Ezbet Sayyed al Ballasi. There is low-lying land before the next linear feature of high ground, which may have been a gulf or marshes. North of Tell Foqaa (254) on the west and Kom el Qeid el Ghash (256) on the east, there may be a channel pattern in the fish farms, which could track directly to a levee-like peninsula and island system, across the lake, including Kom el Dakhla (260), with an outlet near the site of Tell Maqlouba (455) on the north coast. The very ancient system here could have provided a direct link from south to north, explaining the size of the sites on its trajectory. Parallel

[81] Timm (1984-2007) 4, 1739-1742.

water channels seem to be linked by east-west short canals in a modern irrigation system, but the presence of one ancient site for each 'basin' is suggestive of an ancient basin irrigation pattern.

At the southern end, the system continued past Kom Asfar (279) and Kom Salih (278) southward to Kom el Noweish (5), perhaps on the same line as the ancient Thermutic branch.

KOM EL KHAWALID SYSTEM

A fourth area (Figure 4) is further east beginning at the site of Kom el Khawalid (272) located upon an area of high ground and there is a possible waterway channel to the east of it, which may be detected in the field pattern. This channel can be tracked to the south as far as Tell el Daba (277). Kom el Khawalid (272) has Kom Khirbeh (268) to the north of it, also perhaps a former levee chain, but not so well preserved as the others. A north-east extension of the Kom Khawalid levee system can be traced to the new town of Manshayah el Jedida and then the small site of Kom el Garad (264). There is an impressive bend of a channel visible in the field pattern as well as in the DTM (digital terrain model), which approaches Kom Nashwein (263) from the south and bisects the site completely (Figure 6). Kom Nashwein is an excellent example of a twin site, its Arabic name a dual-form, straddling a river channel, but also confirming that the site perhaps owes its existence to the channel, for once it was silted up, the site was abandoned. According to the archaeological material at the site, it may have continued until after the Arab conquest and into the 9th-10th century.[82]

The ancient town of Pachnemounis[83] (Kom el Khanziri 262) was on the next area of levee-like land to the west (Figure 7) and the waterway may be preserved in the field system to the east of the town of Qaryat Abu Moustafa. Perhaps at the south/north end of that levee is the site of Tell el Daba (269), with Tell el Mikhezein (266) to the north and Kom el Hamra (267) to the south. An archaeological assessment of these mounds is urgently needed to confirm that they are ancient settlements, because their position within the system suggests that they may be natural mud mounds.

There are other places that seem not to fit into this reconstruction, such as the site at Kom Khubeiza (257), which looks as if it is not on an old levee system. To the south there is a sharp bend of a modern canal, but more noticeable is the pattern of the fish farms in a long north-south alignment with the bend and as far as the level of the site. It may be that the slightly high ground here represents the edge of the lake in antiquity and there could have been a shore-line linking Kom el Ahmar el Ain (256), Tell Foqaa (254), Kom Saharig (460) to the east and others at this end of the lake having been subsumed completely by the fish farms. To the west Kom Nashwein (263) and Kom el Khanziri (262) provide the western sites to control access to the lake, perhaps as far east as Kom Niqeiza (132). An east-west drainage channel or dyke may well have supported such a busy lakeside, but no real evidence supports this idea and perhaps it was not necessary.

THE SEBENNYTIC BRANCH

Finally, a comment on the course of the Sebennytic channel is also warranted as there are very few ancient sites associated with it (Figure 7). The Sebennytic inlet looks very low-lying but has mud hills in it or embankments, which may be a result of modern fish farm activity. The ancient Sebennytic branch seems to have become extinct between the 7th and 10th century[84] and is now well buried, especially in its later downstream stages, and is not very clear even on the SRTM. It should be remembered that the branch at any one time would have been within a wider

[82] For information see http://www.dur.ac.uk/penelope.wilson/Delta/Burullus.html
[83] Timm (1984-2007) 4, 1805-1808.
[84] Stanley and Warne (1993) 632.

channel created by avulsions of the main branch, levee intercutting and crevasse splays due to the variation in the water budget of the inundation and sediment deposition.[85] One of the Sebennytic channels, perhaps the latest one, may be visible in the field patterns and then in the SRTM information. Starting around 14km due east of Kafr el Sheikh, the field patterns become disorganised and plant growth shows evidence of high water retention in the soil. The Bahr Tirah and the drain Masraf al Gharbiyah al Ra'si[86] converge on Al Hamul (a modern town with old centre), and it may be that they occupy two ancient Sebennytic channels or lie just along a levee; certainly the eastern Bahr Tirah is an elevated area. To the south of Al Hamul, the drain cuts through the meanders shown in the field patterns and levee villages and continues south of Biyala, with the old towns of Kom el Tawil on the west and Ibshan situated in the channel zone. Sites in the northern area include Kom Handaquqah (490) to the east, which is so far unexplored. The Bahr Tirah canal continues north of Al Hamul, with a road and ditch running parallel to it. Together the canal and ditch enclose a strip of fields, between 700m and 1.2km wide, as far north as the fish farms. Another 7km north is an area within a new field system, which may have an ancient site on it,[87] but it is so far unnumbered and unknown. Along the track of the potential channel from north to south, there are few ancient places, although at Al Majaz an irregular field enclosure, with relatively high ground (already absent in the 1968 Corona imagery),[88] may suggest that there was once a settlement here; an irregular small canal west of Qaryat Abu Sikkin may suggest the inside bend of a meander; and there is an eastern meander visible in the field patterns east of Kom el Hagar, 'Mound of Stone',[89] with possible settlement areas on the inside of the bend, suggested by the high ground there.

To the west of this channel is the low lying Sebennytic Plain around 30km from north to south and 11km wide. It is a crescent-shaped area, with an east-west area of high ground to the south, an east-west road system and possible earlier bank to the north of that and then low-lying fields. There are sites bordering the area, some of which have been explored; others have already been converted into fields or fish-farms, but there is a sense of some isolated high land which could have been used for temporary or more permanent settlement beside a marshy fringe area. Where the actual mouth of the Sebennytic branch was is difficult to say. Most reconstructions have the river debouching in the area of modern El Burg, an area now dominated by high sand dunes and some rocky outcrops, but the island-sites of Mehgara and Singar (599) could have been important ports at the Sebennytic mouth.

On the other hand, to the east, there is some high ground, which could be the levees for two other discharge channels, one north of Kafr el Jaraydah and the other north of Bilqas itself (Figure 1), a town with an old centre. The latter may have been fed by two channels, one from the south-west coming through Buhut (and now no longer extant except in DTM data) and the other from the south-east and perhaps still the Bahr Bilqas, which continues north of the town. There are several villages along this route, but most look new or have very small old centres and some have unidentified open areas or irregular field patterns, as at Ezbet al Kardud. The Bahr Bilqas continues as two channels, with Al Shawami having an old centre and Abu Dishisah on high ground. Although there is a modern road between the two channels, the SRTM shows older dykes north and south of Shawami, which may be old or more recent basin dykes. The northern dyke can be tracked in the DTM 7km to the other channel and joining it at Ezbet al Ayqah al Kebira/Ezbet Saidayyah, having passed through the town of Kafr el Qinan. The track then continues into the canalised northern area and large town of Al Satamuni.

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[85] See the reconsruction of the Canopic branch mouth by Stanley and his team (2007).
[86] Ball suggests that the outfall of this drain is the false Pineptimi mouth, about 10km east-north-east of Baltim (1947) 105, 126.
[87] 31˚31'.43"N, 31˚07'.21"E.
[88] Compare 2017 satellites and 1968 Corona satellite images http://corona.cast.uark.edu/
[89] The settlement has not been surveyed and is unnumbered in the EES dataset.

To the north of Al Masara, the centre of the three large towns, is the ancient site of Yetwal wa Yuksur (307) (Figure 1), a place with folkloric traditions about a column at the site and some Late Dynastic and Late Roman material.[90] The satellite image shows a wider circular field pattern around the remaining site, suggesting that it may once have been larger, but the Corona images show that the change had already happened by 1968 and the DTM shows no real higher ground or connections. It may have been a control site on the west of the Sebennytic branch or low-lying marshland to the north.

DISCUSSION

The most ancient waterways of the northern delta had created a landscape of waterways, channels and ancient levee systems which could be turned into productive agricultural basins with settlements at strategic and 'high' places during the Roman and Late Roman periods, perhaps on the model of the system embedded in the Valley and as a continuity from earlier times. As in the nineteenth century when the irrigation and drainage engineers were assisted by the pre-existing ancient channels and canals, the ancient engineers were helped by the levee systems of earlier distributaries and applied their knowledge to an environment that they may have encountered elsewhere in Egypt or the wider Roman Empire. Whether this was imposed by the administration or organised at a more local level, depending upon the extent of artificial channels, is a question that should be borne in mind, but a more reflexive system based on local conditions would be ideal for the Nile Delta.[91] Once settlements had become established, the build-up of settlement debris would outstrip the deposition of sediments so that the mounds would increase in size at a faster rate and provide good, stable places for habitation, high above the marshes and flooded basins. Within this model, the settlement patterns — such as have been preserved — can perhaps be explained, suggesting that the modern landscape is a palimpsest of ancient, medieval and modern Egypt in the early twenty-first century, although increasingly under threat from development. Earlier changes in the river system might also mean some ancient phases were removed entirely and that focal areas in settlements changed, moving from place to place depending upon river/channel/levee position and so that settlements did not always map directly onto a preceding earlier settled area, but could be at a remove and then return as conditions changed, as seems to have happened at Sais (Wilson 2006). The sites from the survey represent specific points within the historical sequence, overlapping in chronology in some cases, continuing and being abandoned in others.

The spatial arrangement of the settlements suggests that the villages/towns were where people lived and they went out to their fields each day with their animals. During the flood-season people stayed in their towns, but could make journeys by boat to nearby villages for social and business purposes. The preserved archaeological sites show that there was often no more than 3km[92] between sites and, when the potential sites from under modern towns are included as well as smaller sites which have now been farmed[93] or overbuilt, the average distance is around 2.5 km. The pattern is of larger central units up to 10 hectares in area, with peripheral smaller units of

[90] Spencer (2010) and (2016) 3-6.

[91] Manning (2002) for state and irrigation in the Ptolemaic period, Hunt (1988) argues that scholars have been influenced by Wittfogel's *Oriental Despotism* model in suggesting that irrigation works represent a system of authority, but that each system should be looked at in context because the relationship between small and large canal systems, authority structures and local communities is more complex, with local irrigation communities able to operate larger canal systems.

[92] Bagnall (1993) 114 estimates land holding areas to have been most sustainable at 6 to 7km^2 , with the maxium radius around a village at 4km for intensive land use evidenced at Corinth, after Engels (1990) 2.

[93] Schiestl (2012a) has documented the disappearance of some smaller sites under 1ha in size in the Kafr el Sheikh-Buto area and comments that the smaller sites in general are under-represented in the archaeological record, originally they would have 'filled up' the landscape.

under 1 hectare, organised into a pattern of administrative centres with larger settlements of 30 hectares or over dominating the landscape. Davoli has discussed the Ptolemaic-Roman period patterns in the Fayum with towns and nome capitals in the first and second rank of 'cities', the smaller, densely inhabited settlements as third rank, and then with smaller, more numerous villages in the fourth rank filled out the picture of Ptolemaic-Roman urbanism and, even if they are not extant, they must be considered.[94] In the Late Roman period, mud-brick structures strengthened with fired-brick courses were built, as at Tell Mutubis. They were either farmhouse complexes or more urban tower-houses, which were practical in wet areas. Churches, monasteries and ecclesiastical estates would have added to the range of buildings, as can be seen at Amheida, where the structure of the Late Antique town is clear.[95] The high mounds, with their tall tower buildings and churches would have dominated the flat topography. Administratively, they could have been collection and storage hubs, as well as distribution centres for imported goods, such as fine pottery, wines and oils from outside Egypt.[96] Within the marshlands, reed shelters could have provided temporary 'settlements', but on the higher mud levees there were built structures, more apparent in the past as the sea levels were lower.[97] The interactions between them were made possible by the maintained waterway paths through the marshes into the main water channels. At times of high flood or in winter the larger sites would have formed refuges for many in the area, waiting out the bad weather or high floods until they could return to begin again each year. In the agricultural land, each town may have been responsible for a particular irrigation/drainage basin with or without an additional marsh area. The pattern is a classic Egyptian model of town (with cult centre) managing fields and pehu-backlands, the back lands of the Delta being greater than in the Valley. The suggestion that this represents a diverse system based on small family farms, estate-farms and main villages[98] rather than semi-feudalism, with rich landlords owning the land and renting it to tenants, as for the Fayum and other areas of the Eastern Empire,[99] could be supported by this arrangement although further evidence is needed. Within such a system the farms would be exposed to high or low floods or disasters, such as sea-incursions or famine after plague years, but the settlement hierarchy may actually have worked in favour of the dispersed settlement pattern. At a scalar level 'big' problems had a big effect on big cities, where the small scale effect on smaller settlements would be variable – either they would be wiped out or survive disaster. Cities were more likely to be detrimentally affected and such a process may be at the core of the displacement of larger settlement centres.

The phenomenon of displacement was identified archaeologically in the Valley at Tell Edfu by Gascoigne.[100] A survey of pottery across the mound at Edfu showed the settlement moving onto new, lower-lying lands during the Islamic and medieval period. The mound near modern Sidi Selim is perhaps a good example of the process in the north, but Tell Mutubis-Metoubes, Tell Daba-Tida and Sakha (Xois)-Kafr el Sheikh represent tells that were abandoned for 'new' locations, and, perhaps in some cases, the old centres of some towns represent continuous old settlements or new foundations after the Roman period. Taxation and agricultural sustainability may have affected individual, small villages, as in the Mendesian nome,[101] but the depopulation of the area in general would have affected the sustainability of the large centres as they depended upon the feeder-medium towns and small farms. Small farms could have ridden-out short-term problems and may survive as the 'old' centres of modern villages and towns. The

[94] Davoli (2011) 89-90.
[95] Davoli (2011) 83-85.
[96] Mondin (2016).
[97] For example on the Palestrina Mosaic, c. 110 B.C. Meyboom (1995).
[98] Banaji (2001) 21, 171-180 based on the Fayum and Middle Egypt.
[99] Bagnall (1993) 115-16, Kaplan (1986) 198-9, Bonneau (1993).
[100] Gascoigne (2005).
[101] Blouin (2014) 295-297.

Arab conquest of Egypt brought about reorganisation of the country as a whole, with the administrative and trading focus shifted towards Al-Fustat, and social and legal changes in conjunction with the kharaj-tax in the 8th century, one of the causes of the Bashmur revolts in the north-east delta in the 9th century, resulting in military repression of the area.[102] If at that time, drainage systems were not maintained, this would have caused the agricultural system to become more fragile and sea-incursions may have led to further problems. As soils became saline, then the lands became increasingly unproductive. A similar situation was recorded in the Daqaliya Plain, where seawater filled the low-lying depression, making it a deserted area.[103] The northern area was also abandoned and not revitalised until the modern era. From the caliphate of Al Mustansir in the Fatimid period, the figures of revenue for the provinces of Egypt show in general terms how populated and productive were Sharqiya and Gharbiya provinces, but the northern areas representing the lake and its western side of Fuwa, Nastarawiya and Rosetta were not.[104]

Although the idea of the trans-delta dyke/canal Butic canal was intended for military purposes, for a short time it may have been an effective method of holding back water for perennial irrigation, of keeping out saline water or of feeding water into defined drainage distributaries to manage the wetlands more effectively than leaving them as marshes. The western part of the southern Burullus zone could have benefited greatly from the establishment of a better-defined Rosetta channel, of the dredged and excavated 'Saitic' and Thermutic branches and of the protection from the sea to the north and east. This could explain the way in which Roman improvements established a framework for expansion in the Byzantine period. The settlements that followed have well defined hinterlands and, in antiquity, it is possible that smaller farmsteads could have existed as outlying agricultural producers for the main centres.

CONCLUSION

Since ancient times the north of Egypt had a stereotypical reputation as marshland where rebels and refugees could hide[105] and at times of flood the area may have seemed to be a vast waterscape with multiple islands closed off by reed and papyrus beds. In fact, the ancient levees and existing Roman waterways drained water from the land and high places provided settlements, since Prehistoric times, consolidated during the Pharaonic and Ptolemaic periods. There may have been basins in favourable areas between channels, arable land, new agricultural-lands and the natural wetlands and marshlands. The precise interaction between different zones within these environments, the settlements and their inhabitants throughout the Roman and Late Roman period awaits further detailed study of each site and an eventual synthesis of that data. The overall conspectus as modelled by this paper, however, suggests that there was a sustainable environment, requiring some human input into canals, drains and dykes, but nevertheless capable of producing surpluses that were shipped between towns, as far as Alexandria or the coastal ports and beyond. The small amount of survey data together with the landscape basis has been interpreted here as representative of firstly, opportunistic use of ancient pre-existing settlements and/or geological features and secondly, of flexible adaptation to the small-scale Deltaic conditions and communities that took into consideration local and specific levee/basin/canal systems as appropriate. The pragmatic choices that were made within the water system resulted in

[102] Mikhail (2014) 107-113, 189-191.
[103] Blouin (2014) 108-109; Cooper (2014) 83-85.
[104] Ash-Sharqiyah 294 districts and 158 villages giving 694,121 dinars, Al Gharbiyah 149 districts, 165 villages giving 430,955 dinars, but Fuwa, Nastarawiyah and Rosetta together 22 districts and 3 villages giving 23,990 dinars (after Evetts (1895) 17 = Fol. 8a of the History of Shaikh Abû Sâlih containing an account of the districts and fiefs of Egypt, MS Bibliothèque National de Paris. See also the map of Guest (1912) for the medieval Delta and the 'emptiness' of the north.
[105] Blouin (2014) 32-34.

agricultural stability for the period of Late Antiquity as shown by the longevity of the settlements, so far as can be determined from site size and the pottery sequences. Changes in the natural hydrology, depopulation and instability perhaps after the Justinian plague (541-2), the Persian invasion in 617 and then the Arab invasion in 641 meant that although a certain amount of continuity was possible and at a reduced scale, there was some abandonment sites or relocation to more favourable sites with access to the newly forming dominant Rashid/Rosetta and Dumyat/Damietta channels. Sea incursions, such as that attributed to the 10th century, or storm surges seem to have flooded the Plains of Sebennytos and Daqaliya, making the areas saline, barren and prone to erosion. In the medieval period, the new towns of Rashid, Fuwa and Nastarua maintained contact with the Mediterranean trading routes and adapted to the new conditions, while other, formerly impressive cities were abandoned, as at Kom Sidi Selim, Tida-Kom Daba, Kom Sheikh Ibrahim and the lake-shore and intra-lake towns.

The modern Nile Delta is a "complex, diverse, landscape entity"[106] containing many, sometimes contradictory elements, each with their own interactions and under the influence of different external factors. In ancient times such elements are still poorly understood, but with further survey and excavation, alongside targeted geological work, the inter-relationships of settlements over the long duree in a continuous sequence, set against fluvial landscapes that changed at different rates and exposed to human and marine influences, may transform our understanding of the Delta and its role in political, social and economic life, and specifically in the Late Antique period.

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[106] Alfiky et al (2012) 95.

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List of figures

Table 1 Sites in Northern Egypt, size estimates and dates.

PLACE	EES number	DIMENSIONS	AREA (Ha)	DATE
Buto	4	1km by 1km	100	PD to early Islamic
Kom Khawalid	272	723x924x15m	66.8	Ptol.-11th AD
Kom el Nashwein	263	1000x550x10m	55	6-10th AD
Kom el Sheikh Ismail	251	632x569x8.5m	35.9	3rd-5th, 9-10th AD
Tell Ahmar-Mutubis	234	650x550x12	35.75	4th-10th AD
Kom Sheikh Ibrahim	244	660x521x10m	34.4	4th-7th AD
Tell Qabrit	233	585x560x0m	32.76	4th-11th AD
Tell Sidi Selim	282	528x608x13m	32.1	2nd AD-11th AD
Kom el Arab	243	556x545x10m	30.3	9-10th AD
Kom el Khanziri	262	500x500x12m	25	4th, 9-10th AD
Tell Foqaa	254	472x458x7.5m	21.6	5th-10th AD
Tell Khubeiza	257	660x285x8.5m	18.8	6-10th AD
Tell Amyat	244	460x320x8m	14.72	5th-10th AD
Kom Haddadi	284	450x320m	14.4	LRo? 7th c.
Tell el-Misk	600	347x270x8m	9.369	3rd-11th AD
Kom Qaalieh	245	440x210x6m	9.24	Not known
Kom el-Qeid el Ghash	256	360x250x10m	9	4th-10th AD
Kom Abu Tahun	252	130x100m, 350x250m	1.3/8.75	Not known
Kom el Sarahig	460	400x200m	8	Not known
Tell Matiur	255	300x200x2m	6	3rd-7th AD
Kom el Noweish	5	300x200m	6	Ptol., Ro, LRo
Kom el Qassabi	248	300 x 175 m	5.25	Not known
Geziret el Dakhlah	260	210x210x1	4.4	7th-9th AD
Kom Bunduq	283	220x200x10m	3.81	6-10th AD
Tell el Alawi	241	192x189x8.5m	3.63	5th-7th AD
Kom el-Akhdar	259	400x400x1.5m	16/2.43	Late Antique
Kom Mikhezein	266	200x100m	2	Not known
Tell el Retabi	258	154x100x2.4	1.54	6-10th AD
Singar	599	90x140x1m	1.26	7th-10th AD
Mastaruah	501	No estimate		Medieval +

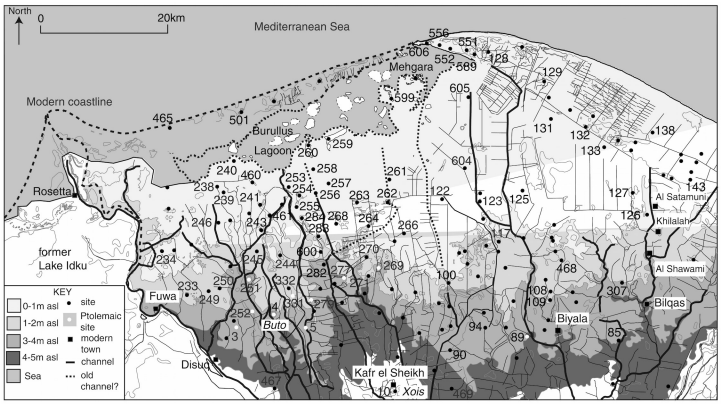


Figure 1

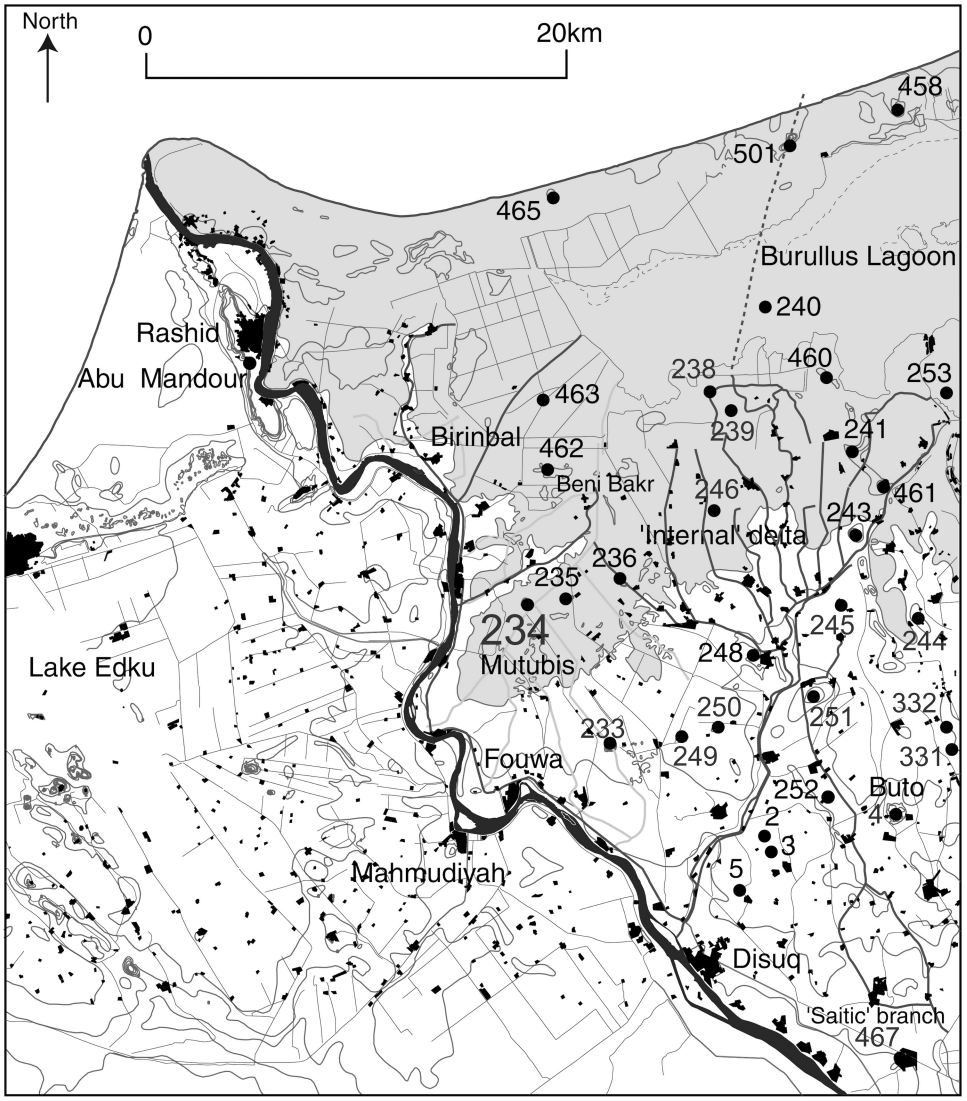


Figure 2

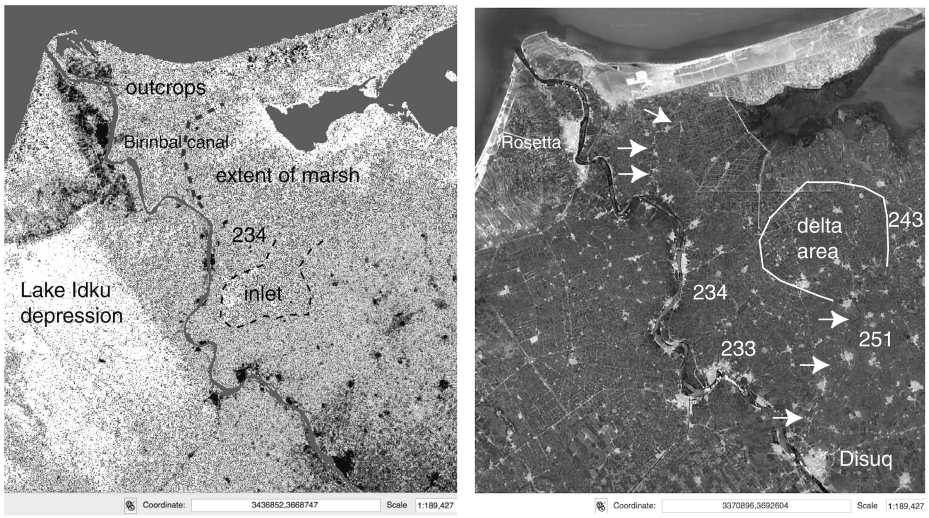


Figure 3

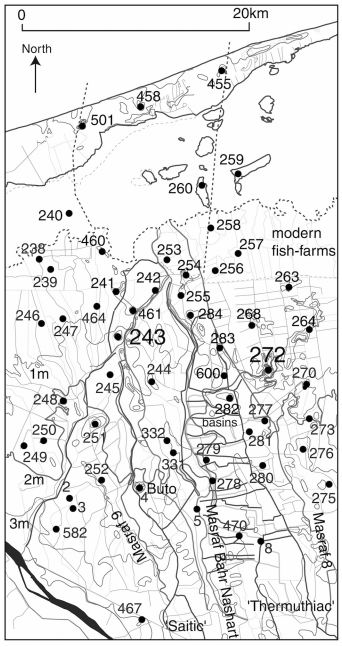


Figure 4

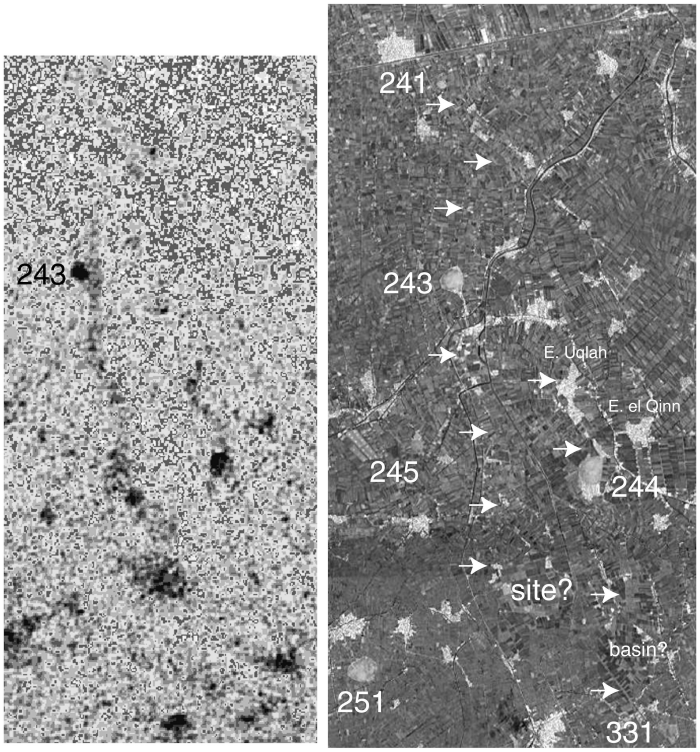


Figure 5

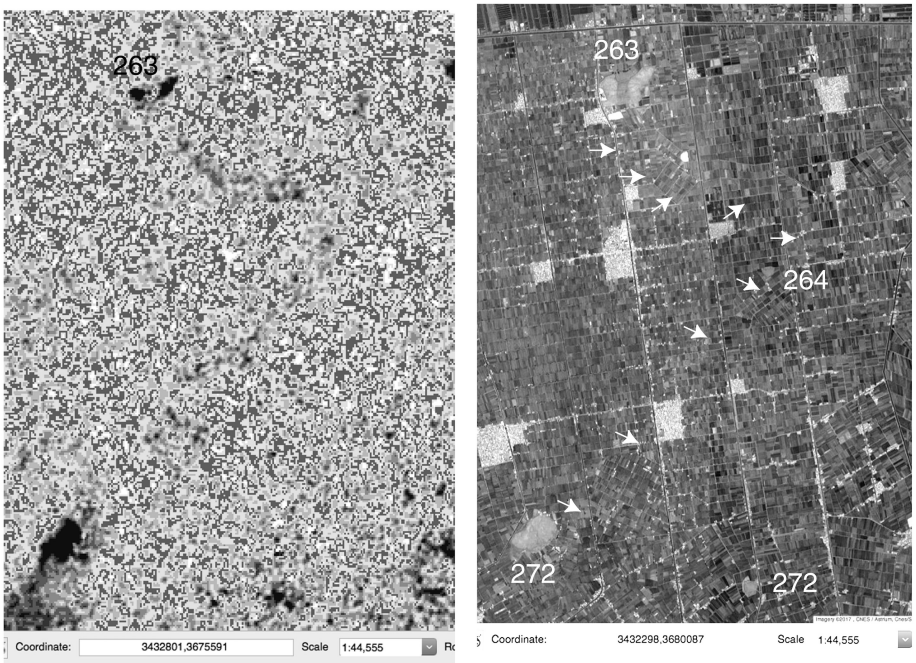
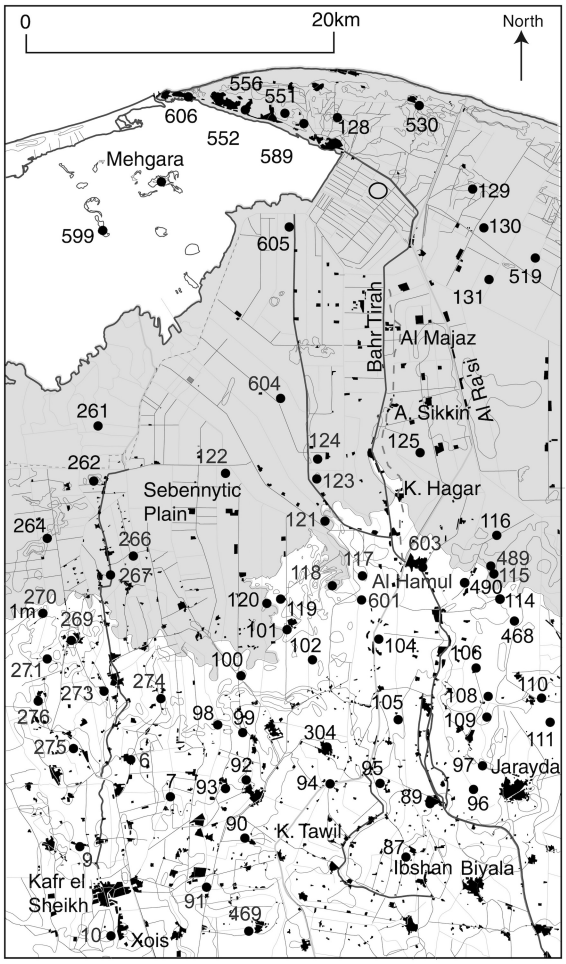


Figure 6


0
20km
North
556
551
606
552
128
530
Mehgara
589
129
599
605
130
519
131
Bahr Tirah
Al Majaz
Al Ra'si
604
A. Sikkin
261
124
125
262
122
123
K. Hagar
Sebennytic
Plain
121
116
264
266
603
117
489
267
118
Al Hamul
490
115
270
120
601
114
1m
269
119
101
468
102
104
106
100
271
273
274
105
108
110
276
98
99
304
109
111
275
6
92
95
97
Jarayda
7
93
94
89
96
90
K. Tawil
87
9
Ibshan Biyala
Kafr el
Sheikh
91
469
10
Xois
Figure 7