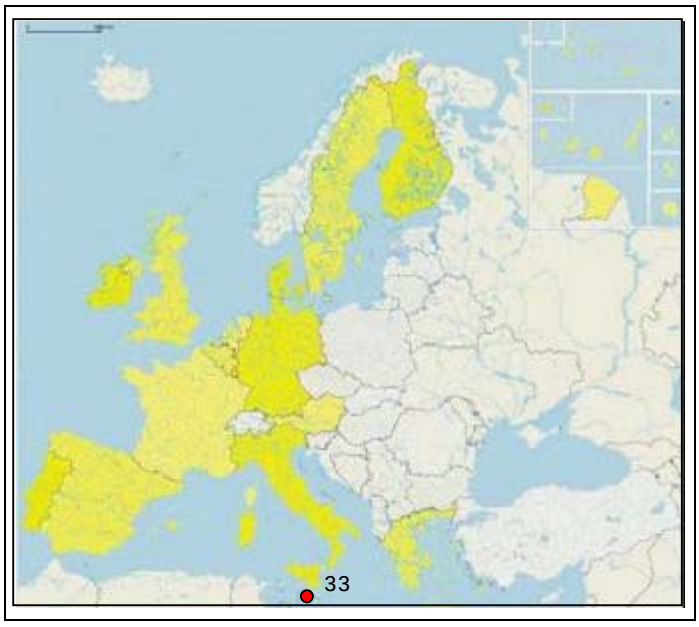
XEMXIJA - GHAJN TUFFIEHA (MALTA)



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1. GENERAL DESCRIPTION OF THE AREA

1.1 Physical process level

1.1.1 Classification

- Ghajn Tuffieha Bay: Soft rock coasts with sandy beaches
- Xemxija Bay: Soft rock coasts with sandy beach and artificial coastline

1.1.2 Geology

The Maltese Islands are almost entirely made up of sedimentary rock deposited in a marine environment during the Oligo-Miocene period. These limestones and clays form a series of stratigraphic layers of varying composition and hardness. In a few localised places, these are uncomformably overlain by sparse Quaternary terrestrial and raised beach deposits, most of which are of high palaeontological importance. Igneous, intrusive, extrusive or metamorphic rocks do not exist.

The stratigraphy of the Maltese Islands is comprised of the following limestone formations. The Upper Coralline Limestone (UCL) formation is largely crystalline or semi-crystalline and is the youngest of the rock layers. This formation is sub-divided into four layers and it characteristically forms the mesa-type plateaux and boulder screes. The Greensand formation found underneath the UCL is a very thin layer with a maximum thickness of 12m in Malta and 16m in Gozo, but often as little as 30cm. Its exposures are often buried under the talus deposits of the UCL. The next formation is the Blue Clay which forms an impermeable base (aquiclude) to the water-bearing Greensand and Upper Coralline Limestone (aquifers) above. They hold rainwater that manages to percolate through the rock layers thereby forming so-called “perched aquifers”. Where the interface between the Blue Clay formation and the Greensand/UCL formation is exposed, high level springs can form.

The Globigerina Limestone formation is characterised by a predominantly massive, soft, yellow, cream or white, intensely burrowed limestone with few interbeds of phosphate pebbles mainly at the interface between the sub-component members of the formation. This formation outcrops widely in the southeastern part of Malta extending over two-thirds of the island’s surface area. Underneath this layer is the Lower Coralline Limestone member, which is especially exposed along the North West, West and South West coasts of the islands where it forms massive cliffs in view of the northeasterly tilt of the archipelago. This member is generally semi-crystalline or crystalline in nature.

Quaternary Deposits of terrestrial origin dating from the Pleistocene period are also present in isolated patches.

Geomorphology

Structurally Malta is divided into two major blocks by the Victoria Lines Fault, which down throws north and runs from the west coast at Fomm ir-Rih to the east coast at Madliena Tower. The northern block is characterised by a series of normal faults striking ENE, which divide the region into horsts, grabens and half grabens. In contrast, the southern block is characterised by less pronounced faulting striking NE. The Maltese Islands have an

undulating tilt towards the northeast thus producing two types of coastline, a gently sloping rocky coast on the northeastern side and a steep cliff-dominated coastline on the southwest and west side of the Islands. Superimposed on this general dip are the effects of faulting and differential erosion. The structural properties of the various rock layers influences the rate of erosion under the action of wind, waves and rain and thus give rise to different formations that include:

- Wave cut notches or wave cut platforms at the base of the Lower Coralline Limestone cliffs (often extending below sea level).
- Smooth gently sloping coastal platforms on Globigerina limestone shores.
- Bays where clays and marls have been eroded away at a fast rate.
- Boulder screes (both on land and in the sea) where erosion of the blue clay undermines the upper coralline limestone cap above it forming the typical drum coastline.
- Karstland.

Case study areas

The case study areas of Xemxija and Ghajn Tuffieha (refer to Figure 1) are located within the Pwales graben, which is defined by two faults, the Golden Bay/Fekruna Fault in the north and the Ghajn Tuffieha/St. Paul's Bay Fault in the south (refer to Figure 1). The latter fault throws to the north by approximately 70m. The intervening graben tilts slightly to the NNE to plunge gently below sea level at St. Paul's Bay; the head of this bay is the case study area of Xemxija. In contrast there are low cliffs in the west along the coast between Golden Bay and Ghajn Tuffieha Bay. Wardija Ridge is the horst defined by Ghajn Tuffieha/St. Paul's Bay Fault in the north and Gnejna/Salina Bay Fault in the south. The horst is also cut, particularly in the west, by a number of minor faults striking in the same general direction as the bounding major faults. As the Maltese Islands are predominantly composed of limestone, the presence of sandy beaches is limited.

Moreover, the configuration of the coastline restricts their size allowing only for the development of pocket beaches. The main examples all occur where the Blue Clay and Greensand outcrop on the actual coastline. The bays also receive additional material from run-off and deposits from valley systems. The beach material thus comprises of sand with a varying admixture of silt and some clay. No information is available with respect to granulometry in the case study areas.

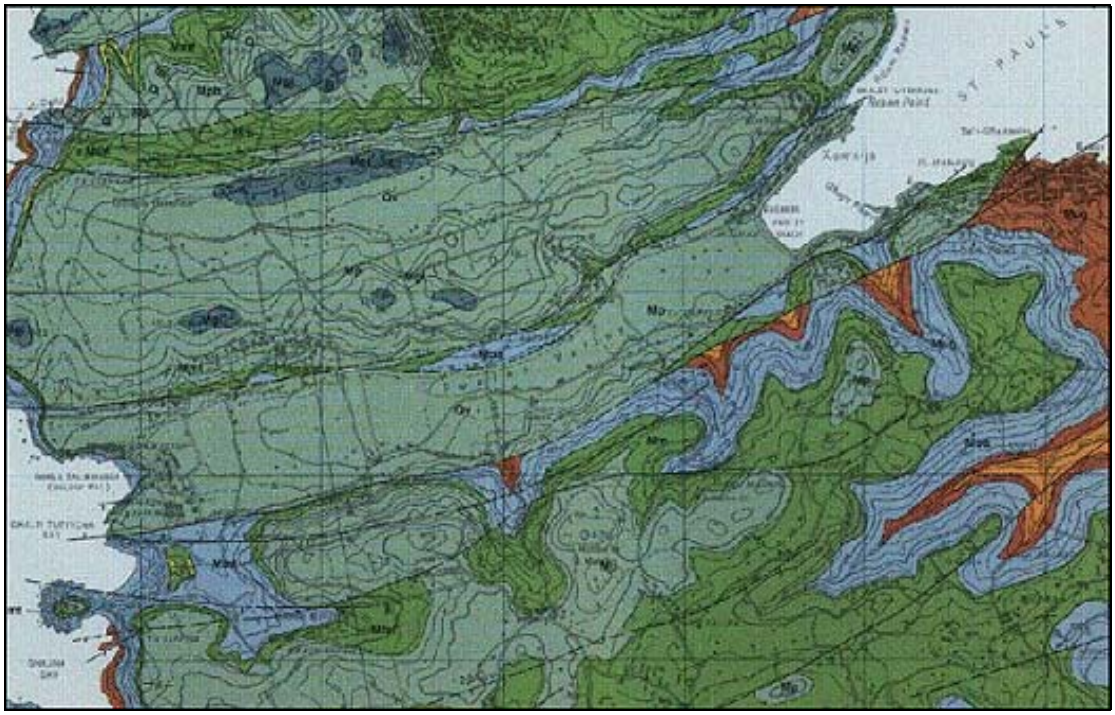

Fig.1: Geological Map of case study areas. Source: Geological Map of the Maltese Islands (1993) Oil Exploration Directorate, Office of the Prime Minister, Malta.

1.1.3 Morphology

Ghajn Tuffieha

The geomorphology of the Ghajn Tuffieha Area is typical of that found in the northern structural block. Morphology is controlled primarily by structural endogenetic processes producing an initial landform made up of block faulted horst and graben system, with subsequent drainage, karst and shoreline processes playing a secondary exogenetic role to yield a variety of sequential erosional landforms typical of areas where horizontal weak and resistant strata are found adjacent to each other.

Features in the Ghajn Tuffieha area are represented in Figure 2 and include:

- A gently tilted basin-floor of Upper Coralline Limestone making up the headland between Golden Bay and Ghajn Tuffieha Bay.
- A high eroded Upper Coralline Limestone ridge marked by well defined escarpments making up il-Hotba l-Bajda, Ghajn Tuffieha and it-Tafal.
- A well-preserved Upper Coralline Limestone step marked by well defined escarpments making up Tal-Lippija, Ix-Xaghra Tat-Torri and Il-Lippija.
- Blue Clay slopes at the back and on the sides of Ghajn Tuffieha Bay.
- Undercliffs beneath Ghajn Tuffieha Tower and il-Qarraba, where the Upper Coralline Limestone lies adjacent to the sea.
- A pronounced promontory at il-Qarraba capped by a fine example of a butte.
- A sharp isthmus linking il-Qarraba promontory to the mainland.
- Three sandy beaches.
- A wave cut terrace and soils.

The sea bed in Ghajn Tuffieha is relatively shallow in the embayment and reaches a depth of 14m at Il-Qarraba (refer to Figure 2). Depths of more than 30m are reached within a relatively short distance, reflecting the NE tilt of the islands marked by the coastal cliffs.

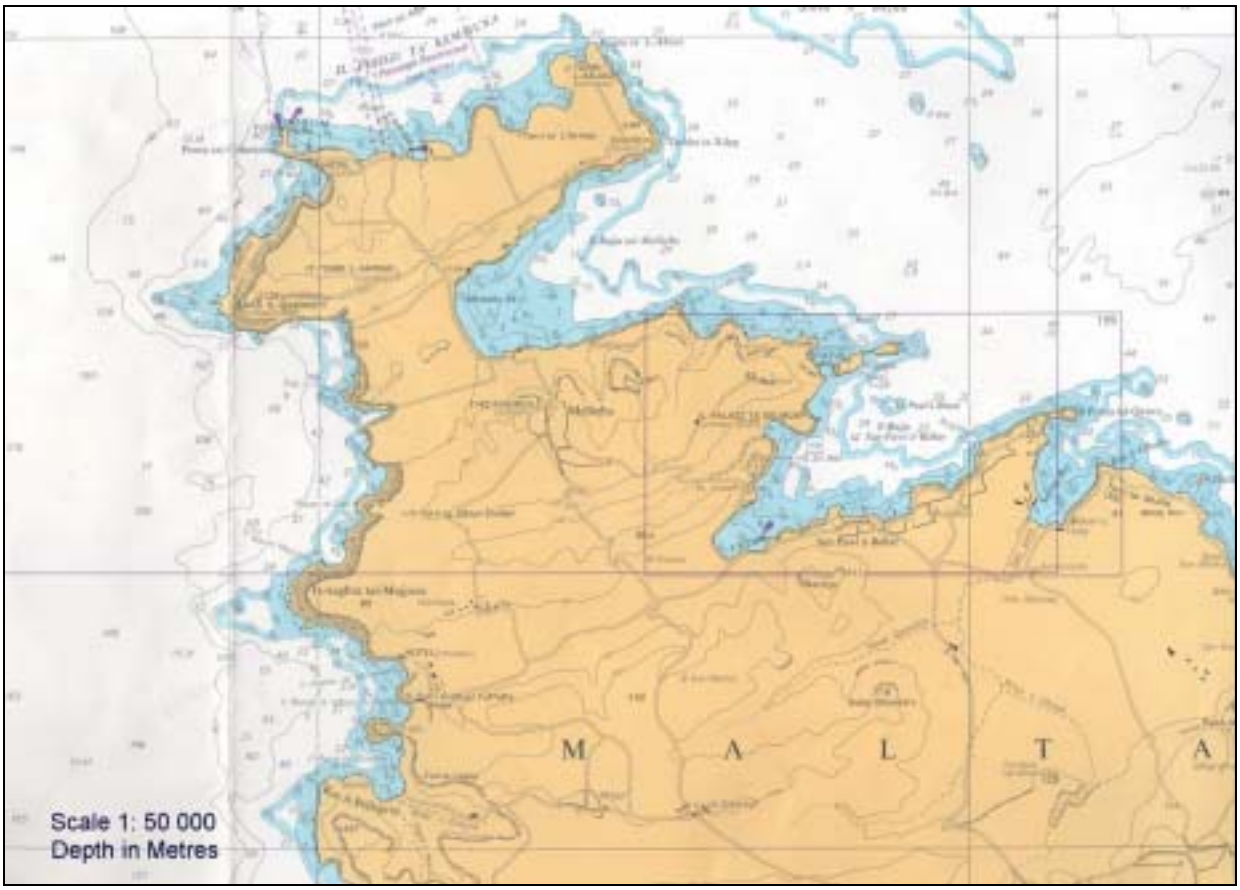

Fig. 2: Bathymetry of Case Study Areas. Source: Admiralty Charts, Crown Copyright (1989)

The *Posidonia oceanica* meadows in this area are patchily distributed; the meadows include *Posidonia* on sand, rock and matte, and are typically dense and healthy. Banquettes are formed on the beach during the winter months as indicated in Figure 3. The banquette system is a specialised community of Mediterranean coasts that develops on masses of drying and decaying plant debris (normally shed leaves of sea grasses), deposited on the shore by wave action during the autumn and winter storms. If left undisturbed the leaves may accumulate to form banks of up to two metres in height. There is a local debate with respect to the role of these banquettes in preventing beach erosion as they form a protective layer to the sand underneath. Damages to the *Posidonia* meadows in this area are typically caused by anchorage, mainly of pleasure craft mooring off the sandy beach.

Fig. 3: Dead Posidonia oceanica leaves accumulating at Ghajn Tuffieha Bay (grey layer along water line).

Xemxija

The landform is dominated by low-lying rocky shoreline with the adjacent ridges (Marfa Ridge and Wardija Ridge) having limited Blue Clay exposures. The head of the bay originally supported a sandy beach backed by a salt-marsh ecosystem. Extensive development along the bay and on the ridges has occurred in the last three decades of the 20th century and thus altered the morphology of the bay.

In contrast to Ghajn Tuffieha Bay, the seabed is marked by a gentle slope where depths reach 25m at the mouth of St. Paul's Bay. Preliminary data from the baseline survey of the extent of *Posidonia oceanica* meadows in Maltese waters (carried out in 2002) indicates that *Posidonia* with a matte system is extensive in this area. The main exception is around St. Paul's islands where there is a sea bream fishfarm; in this area, the substratum consists of sand. Banquettes are formed on the beach (or equivalent area alongside the road) during the winter months.

1.1.4 Physical processes

The climate of the Maltese islands is characterised by hot dry summers and mild, humid winters, typical of semi-arid Mediterranean climate. The mean annual rainfall is approximately 500mm with high seasonal and interannual variations and rainfall is characterised by several storms of high intensity but of relatively short duration. The predominant winds are the North Westerly and North Easterly bringing large swell waves during the autumn and winter storms.

1.1.5 Erosion

In the absence of baseline and monitoring data on coastal erosion, the information provided in this report is limited to a report of a survey conducted on the geology and geomorphological features of Ghajn Tuffieha area carried out for the purpose of developing a management plan for the area and general observations made at Xemxija.

Ghajn Tuffieha

The plateaux at Ghajn Tuffieha (Il-Hotba l-Bajda, Ghajn Tuffieha and it-Tafal) represent karst topography in an advanced stage of solution activity where the original limestone plateau of the step has been removed by karst weathering. This exogenetic geomorphological process of erosion is in its initial stages at Ix-Xaghra tat-Torri and Golden Bay headland where lapis can be seen in the exposed limestone. The limestone plateau between Golden Bay and Ghajn Tuffieha overlies the Blue Clay Formation above sea level to form a perched aquifer, which drains in the direction of Pwales yet no groundwater is extracted. Ix-Xaghra tat-Torri Step has an elevation varying between 70m and 100m above sea level and is composed of a top limestone plateau overlying the Blue Clay Formation. The limestone is relatively much less karstified and stands at a higher level than the ridge at il-Hotba l-Bajda. Rock fins separated by deep grooves developed by the weathering of the exposed limestone are seen in many places.

Fig. 4: Channels formed along the clay slopes.

When exposed the Blue Clay formation often forms steep smooth slopes of dark grey marls. These exposures are very vulnerable to weathering and erosion, the former by exfoliation and the later by sheet erosion, stream erosion and splash erosion. Associated with these processes are found various erosional and depositional features such as rills, gullies and slope wash. Concentration of sheet flow into streams gives rise to intense runoff particularly after a dry period. Two such intermitent watercourses run down the slopes from il-Hotba to the bayhead.

Runoff also forms long narrow channels and shoestring rills, the coalescence and deepening of which produced numerous gullies particularly at the base of the slopes at the back of the bayhead. Off-track motorcycling and 4-wheel driving has also contributed to this process in recent years. Splash erosion is significant over the barren slopes of the isthmus of il-Qarraba promontory. This problem is accentuated by the steep slopes, which amplify the flow velocity to give rise to turbulent flow, strong enough to erode the clay and carry the sediments to the beach.

The coastal low-cliffs at Ghajn Tuffieha Tower and il-Qarraba promontory are characterised by a profile made up of a low vertical drop against the edges of Upper Coralline Limestone plateaux and a steep slope against the Blue Clay underneath. The clay slopes, particularly those at the base of these cliffs, are hardly exposed as they are overlain by a combination of rockslides, slumps and rockfall made up of coralline limestone detached from the edge of the plateaux.

Fig. 5: Undercliff boulder scree at Golden Bay headland with accumulated debris at the back of the sandy beach at the forefront.

The formation of these talus slopes is facilitated by accelerated weathering and erosion of Blue Clay, which undermines the overlying coralline limestone. The cliffs have recesses that tend to funnel the rock fragments, particularly rock fall, into chute-like exits causing the formation of minor talus cones. The freshly exposed surface of coralline talus is easily weathered as it slides down the clay slopes to reach the shore. Strong wave action on the exposed clay tends to subject the UCL butte at il-Qarraba to accelerated erosion to produce rockslides, slumps and rockfalls, which from a well developed undercliff facing the open sea.

The sandy beach at Ghajn Tuffieha occupies half of the bayhead in the form of a wedge-shaped belt, approximately 150m long and 25m wide, tapering gradually towards the south where it turns into a narrow, 100m long sand/cobble beach. Like all other sandy embayments in Malta, the trend in evolution of Ghajn Tuffieha bay is the progressive erosion of the promontories on the sides and the widening of the bayhead by a widening beach as littoral drift brings in the product of erosion in the form of sand. Erosion of the UCL is the main source of sand as the Mtarfa Member is easily broken down to fine sand by weathering.

The wider berm in the north is attributed to longshore drift. It is suggested that the north-westerly waves entering the bay change course as they strike the promontory of il-Qarraba to surf obliquely on the shore of the bayhead to produce this drift.

The active surf lens appears to be in equilibrium with a surf-base at a depth of about 10m. Seasonal adjustments of the lens as well as adjustments accompanying periods of storm waves and calm sea are normal and do not appear to cause long-term changes in the lens profile itself. The determination of trend in the condition of the beach however requires a long period of monitoring to ascertain whether the sandy beach is static, expanding or contracting. Some preliminary conclusions have been drawn from two observations. The absence of sand ridges on the beach would exclude propagation taking place. The narrow berm of the beach contrasts sharply with the abundant supply of source rock within the bay, suggesting that retrogradation is most likely taking place and that shrinkage is likely to have reached its maximum level. This is also supported by the absence of aeolian dunes in the bay.

Fig. 6: Il-Qarraba promontory and sandy beach at Ghajn Tuffieha.

There is another small sandy beach on the southern shore of the isthmus very similar to that of Ghajn Tuffieha Bay except in size, being only about 90m long and 8m wide. The source of sand is the weathering of Mtarfa Member detached from the limestone butte of the promontory in the form of rock-fall and boulder scree. A limited supply of sand may also reach the beach as littoral drift from the direction of Gnejna Bay, on the other side of il-Qarraba.

In contrast to the larger sand beach, this one has no apparent longshore drift as wave action, of a predominant reflective nature, reaches the beach perpendicularly. The sand at the back of the berm has an admixture of material derived from the erosion of adjacent steep Blue Clay slopes. The berm crest is practically non-existent suggesting a very small active lens and weak wave action.

Some boulders from the undercliff of il-Qarraba promontory protrude out into Ghajn Tuffieha Bay to trap sand as it drifts bayward to from a small sandy beach, about 50m long on the northern shore of the promontory. The berm of this beach is curved and only 5m wide. The sand lens probably forms part of the main beach.

Xemxija

The sandy beach was not extensive as indicated by the 1957 aerial photographs and geological formation of the area in the absence of significant clay exposures, suggests limited material availability. However, it is noticeable that with intensified urbanisation along the valley sides and the construction of the road has led to the depletion of the sandy beach and degradation of the saltmarsh habitat. The artificial coastline is itself under pressure as is indicated by Figure 7 where the road alignment itself
is gradually subsiding.

Fig. 7: Damaged road alignment at Xemxija showing remaining sandy pocket.

1.2 Socio-economic aspects

1.2.1 Demography and population rate

With a total land area of 316 km^2 and a total population of 378,132 (Census, 1995) the Maltese Islands have one of the highest population densities in the world. Figure 8 illustrates the significant increase in density between 1931 and 1995 where it stood at approx. 1,200 persons per square kilometre. Most of the population lives towards the northeast of Malta: in the past, several small villages and towns grew and formed a large conurbation around the Grand Harbour and Marsamxett Harbour. Growth in population led to an increase in the demand for urbanisation whereby land (both agricultural land and natural habitats) has been utilised to accommodate development connected with infrastructure, services, public utilities, places of work and housing. Most of the infrastructure development, including desalination plants, sewage outfalls and even municipal waste landfills, are accommodated along the low-lying coastal areas for operational purposes and need to protect aquifers inland.

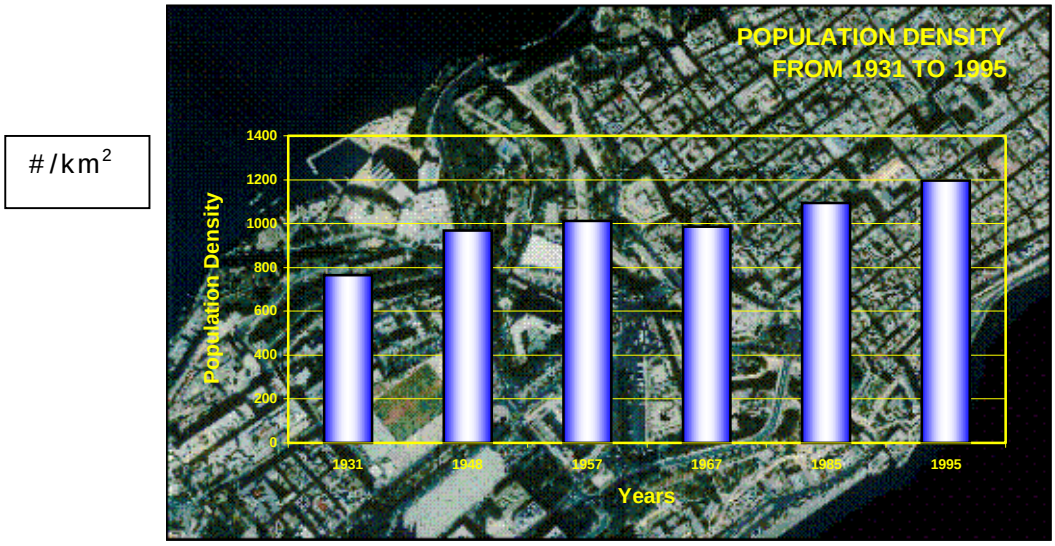

Fig. 8: Population density from 1931 to 1995. Source: Government of Malta (Census from 1931to 1995).

1.2.2 Major functions of the coastal zone

The Maltese economy can be described as one of the smallest in the world. However in terms of income per capita, Malta's average GNP per capita in 2000 amounted to approximately US$ 9,000 one of the highest amongst developing countries. In terms of purchasing power, this figure is approximately 55% of the average for the European Union. Due to its small size the economy depends heavily of foreign trade and the Islands rely substantially on imports for energy, industrial supplies and consumer goods. This dependence renders Malta very susceptible to economic conditions in the rest of the world. With a small domestic market, the economy relies on exports of goods and services, which are dominated by electronic and electrical equipment, chemicals, printing and medical equipment. Export services are dominated by tourism, transportation and financial services.

Table 1: Sectoral contribution to the GDP. Source: Economic Policy Division, Ministry for Economic Services (Economic Surveys January to September 1998 and 2001).

Sectors of the Economy	1995	1996	1997	1998	1999	2000	2001
	LM'000	LM'000	LM'000	LM'000	LM'000	LM'000	LM'000
Agriculture and Fisheries	22	24	25	25	24	24	25
Construction and Quarrying	27	27	29	27	25	26	29
Manufacturing	178	184	181	208	216	246	241
Public Utilities	44	43	53	71	73	66	65
Transport and Communication	47	53	52	60	65	67	74
Wholesale and Retail Trades	98	98	100	101	102	108	112
Insurance, Banking and Real Estate	52	64	68	70	73	88	91
Public Administration	123	136	136	134	141	146	168
Property Income	67	76	84	96	109	112	114
Private Services	74	80	87	100	110	112	118
GDP at factor cost	732	785	814	892	937	993	1037

Tourism is a significant contributor to the local economy. According to the Malta Tourism Authority (2000), tourism in Malta has grown from 12,583 tourists in 1959 to a record of 1,214,230 in 1999. Furthermore, foreign earnings from tourism have become an important contributor to the national GDP, accounting for over 25 per cent of the total exports of goods and services. Over the years, the importance of tourism grew and therefore, Malta has also suffered from significant development pressure for tourism purposes in low-lying coastal areas, which still continues, despite the ever decreasing space. Consequently, urbanisation has had significant impacts upon natural resources and the use of land in coastal areas.

1.2.3 Land use

The Economic Surveys show that Government expenditure from 1995 to 2001 has focused upon the productive sectors and infrastructural development (refer to Figure 9). As a result of development pressure, around 22 per cent of the total land area of the Maltese Islands is built-up (this figure excludes roads development).

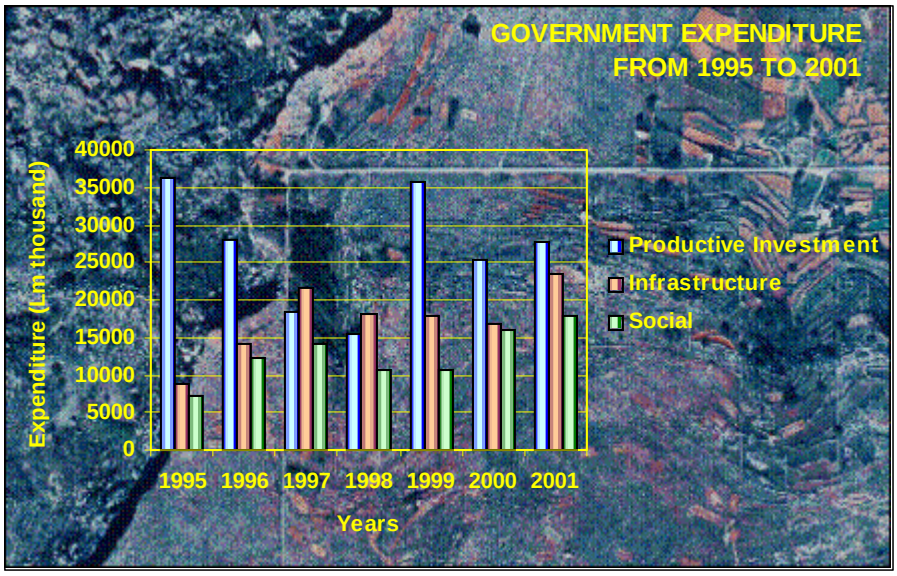

Fig. 9: Government capital expenditure from 1995 to 2001. Source: Economic Policy Division, Ministry for Economic Services (Economic Surveys January to September 1998 and 2001).

Roads were developed along the Northern coast, cutting through salt-marshes and beach systems and catering establishments were located on beaches and rocky coasts. Development along this side of the island has been taken right up to the water's edge in most areas and considerable stretches of natural coast was replaced by artificial structures. The Southern coast, dominated by cliffs has been dominated by agriculture development. The inaccessibility of the coastal cliffs has retained most of the important ecological and scientifically important sites on the islands. The limited areas accessible to the sea include some of the major sandy beaches on Malta and narrow rocky inlets that have been promoted as recreational beaches for tourists and locals alike. With a growing resident population and increasing visitor numbers, these areas have come under additional pressure with demands for ancillary facilities associated with beaches, such as parking areas, catering and hygiene facilities.

1.2.4 Assessment of capitol at risk

Case Study Areas

To date there are no published studies addressing the rates and risks of coastal erosion around the Maltese Islands. The main factor that accelerates erosion is human intervention through development. In the absence of data, alterations of the coast associated with infrastructure development and urbanisation, have led to loss of special habitats such as sand dunes and saline marshlands. Development on the limestone coastal cliffs may accelerate the rate of erosion through destabilisation from engineering works during construction as well as increased load over the underlying rock. Abandonment of agricultural activities leads to breaching of rubble walls and extensive soil erosion particularly during flooding after heavy rainfall. The impact of such run-off may lead to a further destabilisation along drum (cliffs with boulder screes) areas.

Sandy beaches in the Maltese Islands are very limited, constituting around 2.5% of its coastline. The ecological importance is mainly related to their association with sand dunes and clay slope communities located at the back of the beach and infralittoral communities, particularly of sea grasses, namely *Posidonia oceanica*. Sandy beaches constitute an economic asset to the tourism and recreation industry. Some of these beaches and their adjacent coastline are also important for their heritage value as they have archaeological and historical remains, where in some cases these are located under the sand itself. Coastal erosion as such has only received attention with respect to the importance of beaches for tourism and in relation to damage to sand dune habitats associated with sand mining. In the absence of comprehensive studies very little quantitative information is available regarding the extent of coastal erosion. Very few published investigations are available and these are mainly general reviews.

Xemxija

Xemxija is a settlement located on low-lying coast towards the north of Malta. It forms part of St. Paul's Bay Local Council, a popular tourist area with a total land area of 15.7 km^2 (refer to Figure 1). The population density of St. Paul's Bay is 471 persons per km^2 nevertheless the built-up area in St. Paul's Bay amounts to approximately 2.3 km^2. St. Paul's Bay is characterised by tourism accommodation and other services and infrastructure connected with tourism and recreation, reflecting the predominant recreational use of the area relative to the other urban areas in Malta. Most of the built-up area in Xemxija is characterised by dwellings, garages, clubs, pubs and restaurants, tourism development and roads. The physical impact from development that has encroached along the coast is significant especially when considering that 311 dwellings are used as summer residences and therefore are unoccupied for most of the year.

The built-up area of Xemxija and the southern part of St. Paul's Bay was developed along the coastline around a bay known as Ir-Ramla tal-Pwales. This bay used to be characterised by a sandy beach with a salt marsh habitat developed behind it. Aerial photography dating from 1957 suggests that the size of the sandy beach was not large, relative to other sandy beaches in Malta, however as is indicated clearly from the 1994 aerial photo it has diminished mainly due to the physical impact of development. An arterial road that provides an access route to the Northern Ferry terminal at Cirkewwa, linking most of the population in Malta with the island of Gozo, passes along the edge of the coastline. Furthermore, large concrete areas were constructed to provide additional services for tourism and recreational purposes as well as for boat owners. Most of the bay is being used for boat mooring purposes. Consequently, most of the coastline has been altered through human intervention and replaced by vertical walls.

Ghajn Tuffieha

Ghajn Tuffieha is located towards the northwest coast of Malta (refer to Figure 1) and therefore is situated further away from the congested, northeastern urban areas of Malta. It forms part of the Mgarr Local Council, which has a total land area of 16 km^2, more or less equivalent to the land area of St. Paul's Bay Local Council. However, the built-up area within the Mgarr Local Council amount to only 0.5 km^2 with a population density of only 166 persons per square kilometre. The Mgarr Local Council is characterised by two small distinct settlements: Mgarr and Zebbiegh. There are no settlements and/or major development sites within the Ghajn Tuffieha case study are. Ghajn Tuffieha's land cover consists of boulder screes, clay slopes, maquis, garigue, afforested areas, agricultural fields and the sandy beach. Like all sandy beaches in the Maltese Islands, Ghajn Tuffieha is characterised by development connected with tourism and recreation. Two other sandy beaches are found adjacent to Ghajn Tuffieha Bay, Golden Bay (Ir-Ramla tal-Mixquqa) to the north and Gnejna

Bay to the south. A common access road services Ghajn Tuffieha and Golden Bays. With Golden Bay being the larger of the three beaches, it attracts more visitors and consequently more development efforts were made to enhance access to the beach and provide facilities. However with an ever increasing number of summer visitors and limited beach space, more pressure has been placed at Ghajn Tuffieha in recent years.

2. PROBLEMS OF EROSION

2.1 Eroding sites

As indicated in section 1.1 the absence of any scientific research addressing coastal erosion, limits any discussion in this section.

Xemxija

Evidence from aerial photography suggests that the sandy beach at Xemxija Bay (although relatively small) has eroded in a period of almost 4 decades (refer to Photos 6 and 7), as a result of measures to artificially realign the coastline.

Fig. 10: Aerial image of Ghajn Tuffieha (1967). Source: Malta Environment and Planning Authority.

Fig. 11: Aerial image of Ghajn Tuffieha (1994). Source: Malta Environment and Planning Authority.

3. SOLUTIONS / MEASURES

3.1 Policy options

In the absence of information with respect to coastal erosion in the Maltese Islands, measures to address this issue have been practically negligible. Considering that coastal engineering works were carried out to primarily serve maritime related activities and transport services rather than for the purpose of combatting coastal erosion, within Xemxija Bay, the policy option indirectly adopted for this area can be identified as the **do-nothing** approach.

With respect to Ghajn Tuffieha, policy options are not directed towards coastal erosion however, in view of precautionary measures adopted recently in the absence of data, efforts in the area approach the policy option of ***limited intervention***.

3.2 Strategy

3.2.1 Approach related to the problem

Xemxija Bay

Due to the development level already present the Draft North West Local Plan, a 10 year development plan prepared for the North West of Malta) Ir-Ramla tal-Pwales Bay is designated for the development of a yacht marina. Consequently, it is envisaged that further human alteration is likely to take place in this bay, such as dredging and construction of breakwater. This development may have subsequent impacts upon the seabed in the area, particularly on the *Posidonia oceanica* present there.

Ghajn Tuffieha Bay

Ghajn Tuffieha was subjected to development in the mid 1990s when a road was cleared along the clay slopes to provide access for the construction of a catering facility on the beach. The disruption caused to the clay slopes is still felt today with the wide channels created from the dislodged material.

In 1996 Ghajn Tuffieha Bay was afforded legal protection as an Area of Ecological Importance and an Area of High Landscape Value under Section 46 of the Development Planning Act of 1992 (as amended in 2001). As a Scheduled property it is protected from further development whilst ensuring the continuation of traditional activities like agriculture. Provisions for conservation orders to control activities within particular scheduled properties are possible under the Scheduling Process, where such Orders make provision to guide the management of protected areas. The Conservation Order for Ghajn Tuffieha was published as per Government Notice No. 73 of 2002 with measures ranging from restoration, regulation of activities, enforcement and general management of the area. In controlling the type and scale of development and activities taking place in Ghajn Tuffieha, the Conservation Order aims to safeguard the fragile environment present primarily to prevention.

In addition to the Scheduling Process and the issue of the Conservation Order, the Malta Environment and Planning Authority has been trying to introduce measures to protect the

banquettes that develop over the winter months and prevent the removal of the dead leaves until late Spring. Although their protective effect against erosion has not been scientifically proven locally, it is assumed that the removal of such banquettes prior to the end of the stormy season would still expose the sandy beaches to strong wave action. Other preventative measures that are in the pipeline include the management of boating activity in order to safeguard the *Posidonia oceanica* meadows present. The leaves, reefs and matte[1] structures afford protection for the sandy beach by buffering wave energy and the rhizome/matte structures stabilise the sediment. This implies that damage to *Posidonia oceanica* meadows may affect beach dynamics. Activities that contribute to the damage to *Posidonia oceanica* meadows include:

- Anchorage of vessels, resulting in the detachment of shoots and ripping the matte structure.
- Trawling, where the gear causes extensive damage to the structure of the seagrass meadow.
- Discharge of polluting materials, including those that increase nutrient levels; increased nutrient levels leads to increased epiphytic growth on the leaves, stressing the plant.

Local research indicates that *Posidonia* meadows have regressed or been extirpated in areas where they have been subjected to anthropogenic pressures. The relation between this regression and coastal erosion has not been studied.

The control of maritime activities to prevent such impacts is possible through the provisions of the Conservation Order. Some of the measures of the Conservation Order include the following:

- The prohibition of activities that contribute to the degradation of the area; these include off-roading, abseiling, any function which attracts a significant number of people and beach users driving down the clay slopes.
- The removal of sand, pebbles, stones and clay is strictly prohibited.
- The removal of alien trees, shrubs and plants and their replacement with native species. Furthermore, the order calls for plantation of the grass-binding shrub along the clay slopes.
- The prohibition of camping on the clay slopes.
- The prohibition of the removal of indigenous species of flora
- The restriction of various activities to specific zones. Trampling and other forms of degradation would hence be very limited.
- The rationalisation of existing footpaths; some footpaths are to be defined; others closed and re-vegetated (i.e. reducing erosion), whilst those that constitute a danger to recreational users shall be rehabilitated.

3.2.2 Issues concerning threat to life and property

The only relevant issue relates to the stability of Golden Bay Headland at Ghajn Tuffieha, where one of the coastal defence towers that encircle the coastline of the Maltese archipelago, dating back from the Knights of St. John is threatened. The fissures along the cliff face cut across in front of the tower. The Conservation Order recognises that heritage is

[1] *Posidonia oceanica* has an extensive rhizome system that is called matte; this consists of a fibrous root system incorporating trapped sediment, which can form matte walls.

at risk and calls for the undertaking of a study to establish the time scales involved in the erosion of the cliff edge and put forward strategic options to restore and/or relocate the tower.

The hotel that was constructed approximately 30 years ago has been closed for more than two thirds of that time due to the instability of the undercliff.

Fig. 12: Dilapidated hotel structure at the forefront, and coastal tower at tip of Golden Bay headland.

3.3 Technical measures

3.3.1 Historic measures

Ghajn Tuffieha Bay

An afforestation project was carried out along the clay slopes at Ghajn Tuffieha, in the late 1960s. The aerial photograph from 1967 (refer to Figure 10) illustrates the terracing that was undertaken in preparation for the project. It is assumed that such a project was undertaken to stabilise the slopes. The Conservation Order is targeting the removal of these alien species and to replace them with more suitable vegetation for clay slopes (e.g. esparto grass).

3.3.2 Type

Information is not available

3.3.3 Technical details

Information is not available

3.3.4 Costs

Information is not available

4. EFFECTS AND LESSONS LEARNT

4.1 Effects related to the problem

Xemxija Bay

It is evident that throughout the development of Xemxija and provision of infrastructure, no consideration has been given to coastal erosion issues. In the absence of any policy measure, the shoreline has been subjected to considerable changes that have led to the loss of the sandy beach and the saline marshland behind it as well. The ecological value of the site has been undermined together with the tourism potential in one of the major tourist resorts on the islands, where sandy beaches are limited assets.

Ghajn Tuffieha Bay

The legal protection afforded to Ghajn Tuffieha has slowed down the process if not eradicated completely the source of coastal erosion. The adoption of preventative and proactive policy measures has been effective, as activities have been regulated since 1996 via Scheduling process. The impacts of the Conservation Order are still to be evaluated given that the order has only been issued in less than 12 months and an agreed management plan has not been established.

4.2 Effects related to socio-economic aspects

Information is not available

4.3 Aspects in neighbouring regions

Information is not available

4.4 Relation with ICZM

Principles of ICZM have only recently been introduced in the Maltese Islands and primarily within the spatial planning system. The Scheduling of Ghajn Tuffieha bay is part of an extensive area of coastal cliffs that has been scheduled under the planning system. The goals of the Conservation Order have taken into consideration the recreational potential of the site for tourism purposes and in effect do not prohibit recreational use of the area. It is envisaged that once the management plan for the site is in place it may serve as an example of sustainable coastal management where conservation and tourism goals can be reached harmoniously within a highly sensitive area.

4.5 Conclusions

It needs to be said that natural processes do not allow for coastal erosion to be a major issue in the case study areas. Erosion is visible where human intervention occurred in the form of development or incompatible activities. The policy measures taken at Ghajn Tuffieha are targeted to regulate and eliminate such activities as well as reverse the impact in certain instances (e.g. replacing alien plant species with esparto grass). Working with natural processes to regulate activities both on land and from the marine side in a precautionary approach may prove successful in a situation where information on erosion processes is absent.

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