

NEW LAND BY THE SEA: ECONOMICALLY AND SOCIALLY, LAND RECLAMATION PAYS



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ABSTRACT

Port cities and other coastal areas are centres of economic activity and act as motors for national prosperity. They are magnets for people from surrounding, often rural, areas who seek jobs and want to share in the prosperity. This is true both in the developed world and in economically emerging nations.

The United Nations foresee a population growth up to 9 billion people in 2050 of which the majority will live in coastal zones. Adding population growth to the trend of migration from rural to urban areas means port cities face an enormous challenge to accommodate everyone in terms of housing, employment, education, recreation and transport.

More people create more economic activity, which attracts more people, which creates more economic activity. For governing authorities this self-perpetuating process is an enormous challenge. Often natural geographic limitations – such as mountains, rivers or deserts – prevent expansion into the hinterland. How do we meet this challenge? How do we create space to accommodate growing populations?

Land reclamation – making new land in the sea – can be the answer. To expand in the direction of the sea, port cities and coastal areas must fulfil specific technical and maritime requirements. When they do, land reclamation can be prepared in a way that preserves the maritime environment while providing new living and working spaces. The article will demonstrate through a case study that reclamation is a viable solution for seawards expansion. Early contractor involvement, stakeholder involvement, environmental monitoring and the business case itself will be addressed.

INTRODUCTION:

The old adage, “Buy land – they’re not making it any more” is no longer true

The global population was 6 billion in 2005. By 2050 the United Nations predicts it will be 9 billion. While vast areas of land are available throughout the interiors of many countries, the same rule that applied in the ancient times when people settled near seas, oceans and rivers, applies now: coastal areas attract people. Today about half the world’s population lives within 100 km of water. And this trend continues to grow. Eight of the largest ten cities are along a coast and urbanisation is evident around the world. The demand for additional land for housing, industry and recreation along the coasts is becoming steadily more acute. If cities can’t grow outward, they grow upwards resulting in more congestion in terms of industry, roads and demand for services.

While this trend might have at one time seemed insurmountable, from the 1970s onwards the dredging industry has developed new technologies for creating new land in the water. As a result, “buying” new land by “making” it through reclamation is turning out to be less expensive than developing old land.

PIONEERS IN LAND RECLAMATION

The first major land reclamations were done in the 1970s, when the Port of Rotterdam in the Netherlands was extended with sand suppletion from the sea with the first Maasvlakte reclamation. This extension allowed the port to continue to develop and to accommodate more ships and it helped Europoort to add container terminals and become the largest in Europe at the time, providing jobs and stimulating the economy without infringing upon an already congested city.



The first Maasvlakte expansion in the 1970s (left) was followed by the 2nd Maasvlakte expansion programme which is presently being executed (right).

This was the start of the modern era of land reclamation which rapidly spread around the world. In 1975 the government of Singapore decided to build a new airport on the eastern tip of Singapore. The now famous Changi airport was built with over 40 million cubic metres of sand reclaimed from the seabed, using 7 cutter suction dredgers working 24 hours a day. Reclamation is the highly populated island state has continued through the 1980s and '90s to the present. Hong Kong's Chek Lap Kok airport is now legendary for the skill and speed with which it was built – replacing the old airport that had passengers holding their breaths as they cruised in to land between skyscrapers.



Far eastern airports in the sea include from top to bottom: Singapore's Changi (where vertical drains were used to expedite subsoil consolidation), Hong Kong's Chek Lap Kok (where a natural habitat was preserved and integrated into the land reclamation) and Japan's Kansai airport (the 2nd phase expansion is shown here).

But elsewhere airports were also being built on reclaimed land – in Brisbane and Sydney, Australia, and Kansai airport near Osaka, Japan. This trend has continued in the 21st century with projects such as the New Doha International Airport in Qatar.



Left, Sydney, Australia's third runway being built on reclaimed land in the 1990s and right, the New Doha International Airport, Qatar in 2004.

NEW TECHNOLOGY MAKES LAND RECLAMATION POSSIBLE

Expansion into the sea is not just for airports. In the 1970s and '80s, land reclamation projects continued to increase. In Japan, near Kawasaki in Tokyo Bay land was developed for industrial estates where for the first time sand was extracted from the seabed from depths that exceeded 80 metres. This was made possible by a deep-suction dredging technique that opened up possibilities for large-scale reclamation. Jurong and Tuas along the coast of Singapore, Keelung and Yun Lin in Taiwan, and big parts of Hong Kong like Penny's Bay have benefited from the large-scale applications of the centrifugal pump and the ever-increasing size of dredging ships, which takes advantage of economies of scale.

In the waters near Amsterdam, the Netherlands new land was created called IJburg, which combined land reclamation and new techniques to build areas for residential areas that are now thriving. Even in the Maldives, new land has been claimed from the sea to build a new island called Hulhumale next to Male, the country's capital. What motivated these reclamations so far from each other was the same challenge: crowded, overpopulated urban areas and the availability of modern dredging technology.



In the Maldives, new land has been reclaimed from the sea to build a new island called Hulhumale next to Male. This has relieved some of the overcrowding on Male itself.

Beach nourishment has long been seen as a necessity for coastal protection, but nowadays it is also a form of extending living and recreational possibilities. These improve the quality of life for millions of people. Australia's coastline and fine beaches are an essential part of the allure of Australia – for its own population as well as millions of tourists each year.



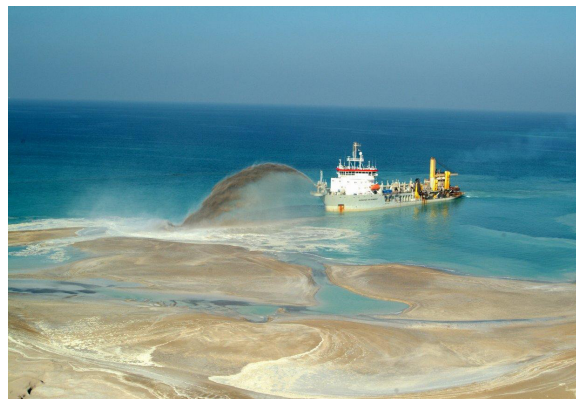
The Gold Coast of Australia before and after beach restoration.

Currumbin-Tugin Beach on the Gold Coast of Australia was in dire straits before reclamation took place. The same can be said of Spain's Mediterranean and Atlantic coasts and many other coastal areas. The east and west coasts of the United States are also replenished each year and the coastlines of India, Sri Lanka and Indonesia have been restored after the tsunami. The coasts of the Netherlands and Belgium are also replenished annually and new projects such as the Flanders Bays and EcoShape / Building with Nature programmes initiated in those countries are researching more sustainable systems of maintaining these beaches such as the 'sand motor'. These land reclamation projects are as much for coastal protection as for providing more land for overcrowded cities.



Aerial photo (June 2011) of the sand motor, a pilot project along the Dutch coast which seeks to find more sustainable means to combine beach replenishment and coastal protection.

Perhaps the most famous recent coastline and waterfront improvement projects for expansion purposes have taken place in the 21st century, centred in the Middle East, with massive development projects. Amongst them, the Palm Islands near Dubai, UAE which through land reclamation and construction, has increased Dubai's coastline with some 150 kilometres. Off the coast of Doha land reclamation has added 400 ha of land, 30 kilometres of coastline and will eventually house 30,000 residents. Development in Bahrain since 2001 has also been extensive and includes the 4.6-km Sheikh Khalifa bin Salman Causeway, the Bahrain Financial Harbour reclamations works, the Bahrain Bay project, Ritz Carlton II and the North Bahrain New Town project, as well as the North Manama Causeway. Although Bahrain, unlike Dubai, has an abundance of coastline, being an archipelago of thirty-three islands with 161 km of coast, its government as well was seeking ways to diversify its economic base.



Doha, Qatar (top left), Dubai (top right) and Bahrein (under) have all benefited from new dredging technologies that have made land reclamation more feasible and economical.

IS LAND RECLAMATION REALLY LESS EXPENSIVE THAN “OLD” LAND?

As land reclamation techniques improved, so did the number of projects. Successful land reclamation is dependent on a number of factors:

- Removal of unsuitable mud layers
- Sailing distance to disposal areas
- Sailing distances to sand borrow areas
- Costs of dredging licences /permits
- Depth of the area to be filled
- Quality of fill material
- Wave and wind climate
- Available construction
- Availability of modern, hi-tech dredging equipment
- Production capacity of dredging equipment
- Quality of the contractor
- Early contractor involvement and partnering with the client



Modern hi-tech dredging equipment makes it possible to achieve land reclamation at a competitive price. Seen here, a trailer rainbowing with a double nozzle.

After these factors are taken into consideration, the real estate values of each specific case must be considered. Although after the global economic crisis in 2008, real estate values in some of the major cities of the world declined, this has to be seen in the long term as a temporary setback. Both based on demographics, the need to preserve nature and the effects of climate change and consequent sea-level rise, the cost of land in major cities will continue to increase (see Table 1). The need for urban space for residential and recreational facilities as well as for expanded ports for sea-borne trade will put pressure on all coastal areas.

Table 1: Seafront land prices per square metre (2006)

Place	Range of land prices in € / m ² in 2006
Monaco	25,000 - 35,000
Hong Kong	19,500 - 31,400
Singapore	4,600 - 6,200
Dubai	1,785 - 4,150
Tokyo	1,250 (average)
Rotterdam	485 - 625
Reclaimed land	< 250

Even when taking into account additional costs for elements like shore protection, soil improvement and site preparation, the all-inclusive costs of most reclamation projects have remained below € 500 per square metre.



Reclamation for residential and industrial purposes is on average less expensive than using existing land.

PRINCIPLES FOR COASTAL DEVELOPMENT

A publication from the Urban Land Institute (2007) suggests ten principles for developing coastal property. The report takes into account the vulnerabilities of coastal areas, as well as their attractiveness and consequently their intrinsic value. The aim of the publication is to draw attention to all aspects of the coasts and to encourage coastal development in a sustainable fashion. Reasonable planning – including dredging in a way that preserves natural habitats and increases accessibility for all citizens – are priorities. Seeking solutions that “Build with Nature” and take advantage of soft solutions instead of trying to stop or prevent erosion by hard solutions will increase the chances of success without disrupting the environment and the ecological balance.

Be it up and down the European coasts, or the east and west coasts of the United States or the long shorelines of Indonesia, Sri Lanka and India, or Australia and Japan, land reclamation is used for expansion as well as to preventing coastal erosion and has become an important instrument for the conservation, expansion and management of valuable resources offered by living along a coast.

TWO CASE STUDIES

Dubai's diversified economy based on land reclamation

Dubai's economy has traditionally been based on its oil reserves and the industry involved in retrieving it. A few years ago, the Government realised that these oil reserves no matter how rich cannot go on forever and they will not be adequate to ensure a high standard of living indefinitely. The rulers decided that it would be good policy to diversify and find other sources of revenue such as tourism.

Dubai's warm climate is inviting as a vacation destination, but with a coastline of only 70 kilometres the opportunities for recreational attractions were few. And then thoughts turned to land reclamation. The possibility of artificially expanding the coastline and creating more interesting residential and recreational water-related activities was seen as a viable alternative thanks to the innovative technologies of the modern dredging industry.

The results: 'Palm Jumeirah', completed in 2005, added 78 kilometres to the existing coastline, which more than doubled the length of Dubai's coastline. This was the first land reclamation project which used 110 million m³ of sand. It was soon followed by similar and even larger projects, like the 'Palm Jebel Ali', 'The World', which used 325 million m³ of sand, 'Deira Islands', 'Palm Deira' and 'the Dubai Waterfront'. The economic impact of these projects on Dubai has been quite remarkable and has clearly given Dubai a central role in the tourist industry.

The Importance of Florida's Beaches to Tourism

Florida has always been an important tourist destination for Americans and it has one of the longest coastlines in the US with more than 800 miles of sandy beaches along the Atlantic Ocean and Gulf of Mexico. Floridians themselves, needless to say, also enjoy the pleasures of their beaches. For these reasons the Florida Department of Environmental Protection, Bureau of Beaches and Wetland Resources commissioned a study for the Economic Benefits Analysis/Florida Beach Restoration. The information here is adapted from this report, prepared by Catanese Center for Urban and Environmental Solutions at Florida Atlantic University.

To understand the importance of Florida's beaches, in 1995 nearly 80% of Florida's residents live in coastal counties and over 60% of Florida's population lived within five miles of the coast. Over \$25 billion, or approximately 25% of the value of Florida's coastal real estate, could be attributed to beaches. Beaches in Florida are clearly an important economic engine, but erosion is a serious issue and over 80% of erosion on Florida's east coast is attributable to impacts of navigation inlets. Mitigating these impacts is of essential to the economic health of the State.

According to the Catanese analysis, the economic impact of Florida's beach visitors in 2000 included 442,000 jobs and over \$700 million in sales tax directly paid by Florida beach tourists. According to the study, of the 71 million annual tourists who visit Florida, over 23 million reported going to Florida beaches as a primary vacation activity during their stay. In summary, the total direct and indirect spending by Florida's beach visitors in 2000 was estimated at \$41.6 billion, and over \$8 billion in payroll resulted from additional spending related to the state's beaches.

Using Miami Beach as an example of value for money of beach restoration, for every \$1.00 spent on restoration, \$700 in foreign revenue is returned. Over a long period the beaches at Miami Beach had eroded considerably, losing their appeal as a tourist destination. Along the East Coast of the US, the Caribbean islands provide significant competition for the tourist trade. To revitalise the tourist trade as an economic force, Miami had to do something. Beach nourishment was undertaken in the 1970s and the investment paid off. Miami attracted 21 million tourists in 1983 compared to 8 million in 1978 (Literature Review, 2003). Project costs were \$64 million in 1980 covering 16 km and had a huge impact on the declining tourism industry: 8 million tourists visited a year before the beach nourishment and 21 million visited a year after the beaches were improved. Although this nourishment costs \$2 million per year, the tourists in Miami spend \$4.4 billion annually of which more than half comes from foreign tourists (Houston, 2002).

The same is true for the entire State of Florida. Data from 2001 shows 62.3 million out-of-state visitors to Florida, with an additional 8.0 million international visitors. Of the 62.3 million domestic visitors, a total of 22.4 million indicated that going to the beach was a primary activity during their stay in Florida.

Maintaining Florida's lengthy shoreline is no easy task, but in terms of recreation for its residents and for both US and foreign tourists, the investment has proven well worth it. In addition, from an environmental perspective, the beaches provide marine habitat for many species, including endangered and threatened species, as well as storm protection for public infrastructure and private upland development.



Beach restoration along Florida's east coast is annual necessity which increases economic and environmental values.

IN CONCLUSION

Globally speaking, land reclamation has provided an important solution to increasing land areas for a variety of purposes. From a commercial perspective reclamations have been used for new airports and airport expansions as well as new ports and their expansions. Residential and recreational developments along waterfronts have been successfully constructed through land reclamation. And environmentally, the restoration of coastlines also provides coastal protection for the growing populations as well as for natural habitats of various habitats and species.

But can this land reclamation continue at the same pace as it has in the last 20 years? Does the international dredging industry have sufficient capacity to cope with the present demand for the realisation of maritime infrastructure projects? This is a realistic question that has no simple answer. To look at the international dredging contractors' level of activity is to realise that their portfolios are quite full and that long-term planning is necessary.

On the other hand, these companies continue to invest in in-house R&D, as well as extensive co-operation with universities and knowledge institutes to maintain the economic advantage of offering land reclamation at a reasonable price. The purchase of innovative dredging plant, larger vessels and hi-tech systems also allows them to keep their cubic-metre price sharp. But the demand for new land is high and involving a dredging contractor early on in land development plans ("early contractor involvement") is certainly the most economical way of ensuring the best cost price and finding the most feasible solution to match the needs assessment of the client.

All photographs are courtesy of IADC, its member companies and Terra et Aqua magazine.

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