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A polder is a low-lying tract of land protected from the sea by structures known as dikes.Mr Lee said the perimeter of the polder has been set in place and the construction of the dike wall is ongoing.The minister, who visited the project in Pulau Tekong last week, said that most of the low-lying polder land has been created and soil improvement works are currently being carried out to strengthen the ground.Infrastructure works have also started to prepare for the construction of key facilities such as pumping stations and electrical substations.The project, a first in Singapore, was announced in 2016 by the Housing Board and the Ministry of National Development.Said Mr Lee: "The team has been working hard over the last few years, and like all other projects, Covid-19 posed challenges to the polder project too."He added that the project will be complete around the end of 2024."We have partnered closely with the Dutch to design and construct the polder - drawing on their vast experience and adapting it to Singapore's tropical context," said Mr Lee.The Dutch have been honing their land reclamation technology and using polders since the 14th century.The early days of land reclamation in the Netherlands saw huge areas of forests cleared, resulting in negative environmental outcomes and biodiversity loss.Empoldering, on the other hand, substantially reduces the amount of sand needed to fill up the new land, reaping savings on upfront construction costs.Mr Lee mentioned in his Facebook post that significant parts of Singapore are 4m or less above mean sea level and are at risk when sea levels rise due to climate change.A report published by the Intergovernmental Panel on Climate Change, co-authored by more than 200 scientists from 66 countries including Singapore, said that sea levels may rise by about 0.2m by 2050. Sustainability With polders being looked at as a way for Singapore to cope with rising sea levels, CNA went to the Netherlands - which is the global leader in the technology - to find out how they work. 15 Sep 2019 06:02AM (Updated: 04 May 2021 11:37AM) DELFT/NIJMEGEN, Netherlands: “If I show you around, you won’t be aware that you are in a polder area,” said Tjitte Nauta from Dutch research institute Deltares. Turning to me, he continued: “Where you sit is 3 metres below sea level.”While they be unfamiliar to many, polders are a crucial part of the Dutch landscape - a key defence in the European country’s centuries-long battle against water.READ: Tides of change - Amid rising sea levels, the Dutch float new initiatives with farms and more homes on water READ: Tides of change - From fighting against the seas to living with it - How the Netherlands kept itself dry By building dykes alongside a network of drainage canals and water pumps, the Netherlands, which literally translates to “low lands”, has turned its flood-prone areas into usable land that is suitable for tens of millions of people to live, work and play. One example is where Deltares’ headquarters is located. Deltares, an independent applied research institute, sits on a polder that is 3 metres below sea level. (Photo: Tang See Kit) The polder, one of thousands across the country, was previously a vast swathe of swamps, according to Mr Nauta.This Dutch model of polders is now a “serious option” for Singapore’s eastern coastline, Prime Minister Lee Hsien Loong said at his National Day Rally speech last month.Already, a small polder is being built at Pulau Tekong to gain some experience. The new land will be used for military training, added Mr Lee.So how do polders work and how different are they from the typical reclamation method?READ: NDR 2019: It could cost S$100 billion or more to protect Singapore against rising sea levels, PM Lee says READ: New reclamation method aims to reduce Singapore's reliance on sand 1. WHAT ARE POLDERS?Polders are tracts of land that lie below sea level and are reclaimed from the ocean, lakes, rivers or wetlands through the building of dykes, drainage canals and pumping stations, according to Dutch experts that CNA spoke to. “Polders are land reclamations, but not all land reclamations are polders. When the level of the land is higher than sea level and no pumping is required, there is no polder,” said Associate Professor Mick van der Wegen from the IHE Delft Institute for Water Education. Hence a key feature of polders, according to Mr Nauta from Deltares, is that they are “hydrologically separated” from their surroundings. “This means you can control the water within a polder through pumping stations usually.” It works like this: The submerged area is first enclosed, or sometimes partially, by a dyke to keep water out. Water from within is then drained, creating a polder – dry land that is lower than sea level. A polder is kept dry by an extensive grid of canals – from small drains to big canals with sluice gates to control water flow – and pumps. Retention areas may be created to store water in case of emergencies.“Excess water will flow over land if you don’t create space so you will always see canals in polders. From there, we will pump it out,” said Mr Mark van Zanten, a senior project manager at Dutch engineering consultancy firm Royal HaskoningDHV, who is involved in the polder development on Pulau Tekong.While the most iconic images of the Dutch landscape usually show polders as rectangular plots of flat land, they can come in other shapes and have various heights – still below sea level.These height variations can be naturally-occurring from sea or river beds. They can also be man-made, when sand is added to make the land suitable for residential and other purposes, said experts. The 4,450-hectare Noordwaard polder is one of the thousands of polders that form a crucial part of the Dutch landscape. (Photo: Dutch Ministry of Infrastructure and Water Management) 2. HOW DID THEY COME ABOUT? Having been around for a long time, some have said that the Netherlands would look very different without polders. “If you look at the maps through the centuries, you’d see the country growing,” said Mr van Zanten. “We wouldn’t be who we are without polders.” Bounded on one end by the North Sea and with three of Europe’s major rivers – the Rhine, Meuse and Scheldt – running through the heart of the country, the very first polders were built some 2,000 years ago by farmers who wanted to protect their land against flooding. They built dykes, dug canals and began draining the waterlogged areas. By the 15th century, the now-iconic windmills were built to help drive water pumps, making polder-draining much more efficient and reclaiming larger swamps and lakes possible. Traditional windmills seen at tourist hotspot Zaanse Schans in the Netherlands. (Photo: Tang See Kit) Steam-driven pumping stations arrived at the end of the 18th century, followed later by diesel and electricity-run ones. These days, almost all pumping stations in the Netherlands are driven by electricity.According to figures from the Union of Water Boards, there were 3,700 water pumping stations across the Netherlands in 2018.3. WHAT ARE POLDERS USED FOR?Agriculture remains a common use, as seen by vast fields dotted by farmhouses and grazing cows, as well as canals and the occasional windmill. Polders are also used for other purposes in the Netherlands, including providing land for residential, commercial, industrial and military needs. Amsterdam’s Schiphol Airport is built on polder land, which was created by the draining of the Haarlemmer Lake in 1852. “Technically, the airport lies on the bottom of the lake, over four metres below sea level ... making Schiphol one of the world's most low-lying airports,” according to its website. Houses are built on this polder area in the city of Delft which lies more than 6 metres below the sea level. (Photo: Tang See Kit) 4. WHAT ARE THE PROS AND CONS?Experts said the Dutch model of polders uses less sand compared with regular reclamation, which heightens the land above sea level. However polders will require constant pumping to be kept dry, while dykes have to be maintained regularly. “There is a larger flood risk due to precipitation or dyke breaches,” said Assoc Prof van der Wegen. “On the other hand, high reclaimed land has less flooding risk and may be cheaper in maintenance (as it requires) no pumping”. Echoing that, Mr van Zanten said: “Construction costs are higher for land reclamation but the annual costs after that are much lower. “But for a polder, operations and maintenance of the system, like the pumps, are important so the annual costs are higher though initial costs are lower.”Highlighting another consideration in the area of energy consumption, Mr Nauta said: “From windmills to steam engines and now, pumping machines, we keep on pumping to keep the Netherlands dry. “If an energy crisis hits us, it will hit us badly.”The Netherlands is also facing the problem of land subsidence – shrinking and consolidation of land – especially in the country’s peat-rich land areas. “If you pump out water, the peat oxidises and becomes smaller. That means the land goes down,” explained Mr Nauta. “Peat and polders are unfortunately not the best combination.” Farmland in the Netherlands. (Photo: Tang See Kit) READ: Tides of change - Palau calls on ‘big brothers and sisters’ in the global effort against climate changeREAD: Tides of change - As fish and coral disappear, Palau faces the economic realities of climate change Climate change has also appeared to play a role in accelerating subsidence, with relatively warm summers dehydrating peat soils and speeding up land shrinkage.“There are other sources of subsidence in the Netherlands but the most severe part is in the western part on the peat lands. If you keep on pumping from these polder areas, the polder gets deeper and deeper.“So our ground is going down and the sea level is going up, which means we have to pump more and more water out – how long can you do this? That is the question,” said the Deltares expert.READ: Tides of change - Rising sea levels threaten homes on pristine paradise of Palau READ: Engineering solutions to tackle rising sea levels important but more research vital: Experts 5. HOW DOES IT APPLY TO SINGAPORE? “Carefully engineered reclamations and flood defences including polders” could be the “best option” for Singapore, Associate Professor Adam Switzer of Nanyang Technological University's Earth Observatory of Singapore (EOS), told CNA last month.“Land reclamation has a long history in Singapore and no doubt more reclamations will be needed in the future as Singapore grows,” he added. But polders require energy and continued upkeep to drive extensive pumping systems, added Dr Switzer. “All options need to be considered.” Additional reporting by Matthew Mohan. Climate change Netherlands sustainability This article does not have any sources. You can help Wikipedia by finding good sources, and adding them. (February 2025) Polder at Neßmersiel, Germany, aerial view (2012) The Zuiderzee in the Netherlands is a Polder. Old land is mostly green, new land is darker in color. Empoldering is a method of reclaiming land from the sea or from inland lakes, and a way to control floods. Empoldering involves the use of a polder, a piece of land in a low-lying area that has been reclaimed from a body of water by building dikes and drainage canals. Although empoldering is usually carried out in low-lying coastal areas, it can also be done in inland areas such as lakes and rivers. It is common in countries like the Netherlands, where much of the country is below sea level and subject to flooding. About one-fifth of the land in the Netherlands has been reclaimed from the sea. Their largest and most successful project is the Zuiderzee Works. Polders have two distinct features. Firstly, they are enclosed by dikes to keep the water out. The dikes also serve to protect the polder from erosion. Secondly, polders are continually maintained by systems of drainage canals and pumps which prevent them from becoming waterlogged and hence, suitable for cultivation. Stage 1: Dike constructed around the area to be reclaimed to keep water from coming in. Stage 2: The area is drained using pumps and drainage canals. Stage 3: "Reeds" (a type of salt tolerant plant) are sown by aircraft to help the soil form. Stage 4: After 3 years, reeds are burnt and the ash is used as fertilizers for the soil. Stage 5: After a period of up to 15 years, the polder is ready for growing crops, building houses and constructing roads. 1. Cost of reclaiming from deeper waters 2. Availability of sand 3. Dispute over territorial boundaries This short article about a place or feature can be made longer. You can help Wikipedia by adding to it. Retrieved from " SINGAPORE — When Prime Minister Lee Hsien Loong devoted a big part of his National Day Rally speech on Aug 18 to climate change, many listening may have encountered an unfamiliar word — “polders”.In his speech, Mr Lee warned that significant areas of Singapore are 4m above mean sea level or lower, and they will increasingly be at risk of going underwater when sea levels rise.To address this, he said that the Government is prepared to invest about S$100 billion or more over the next 50 to 100 years to strengthen its coastlines against the threat of rising sea levels.And that’s where polders come in. The money will mainly be spent on coastal defences, including plans to build polders, along with reclaiming offshore islands or building dykes.But what exactly are polders, and how do they work? Speaking to some experts, TODAY takes a look at polders to understand the potential challenges of using them to defend Singapore against climate change.WHAT ARE POLDERS?Responding to queries from TODAY on Sept 3, Professor Benjamin Horton of Nanyang Technological University’s Asian School of the Environment said that a polder is “a low-lying area of land surrounded by embankments known as dykes”.Prof Horton, who is also a principal investigator of the Earth Observatory of Singapore, added that there are three types of polders: Land reclaimed from a body of water, such as from a lake or the sea bed, through the construction of a dyke and a network of drains, water pumping systems and canals Floodplains separated from the sea or river by a dyke. A floodplain is an area of low-lying ground adjacent to a river, formed mainly of river sediment, which is vulnerable to flooding Marshes separated from the surrounding water by a dyke which are subsequently drained Singapore plans to investigate the first option, he said.Civil and structural engineer David Ng said that the main materials used to build a polder are sand and stones for the dykes and cement which is used to strengthen the soft clay of the sea bed during deep soil mixing.Deep soil mixing is an engineering method which is used to strengthen weak soil by mixing it mechanically with a slurry — a semi-liquid mixture — that includes either a dry or wet binder, depending on the method used.HOW DO THEY WORK?Mr Piet Dircke, who is the global leader for water management at global engineering and design consultancy Arcadis, told TODAY that polders are essentially man-made water management systems.To create a polder, he said, three things are required: A dyke around the land area, pumps to get rid of the excess rainfall and to drain the sea water and storage space to retain the excess rainwater before it is removed.When water enters the low-lying polder through infiltration and the water pressure of ground water, Prof Horton said that the water is “pumped out or drained by opening sluices” — gates or other devices that control the flow of water — at low tide.Because of this, Mr Dircke said that polders are not affected by “the challenges that (rising) sea levels pose” as long as the system is managed proficiently.COST AND DURATIONMr Ng, who is also a member of the civil and structural technical committee at the Institution of Engineers, Singapore said that the polder development project at Tekong Island — which involves a dyke that is 10km in length and 15km wide surrounding 810ha of reclaimed land — will cost S$1.23 billion to build. The area is about the size of two Toa Payoh towns.The project, which was announced by National Development Minister Lawrence Wong in 2016, started construction in 2017 and is slated to be completed in 2022.TODAY understands that the polder is under construction. No official updates have been issued since the initial announcement was made.Mr Ng noted that for future projects, “a project timeline and cost are dependent on the factors of the project site such as seabed depth where the dyke is and the geological makeup of the area”. These factors will affect the cost of materials and the manpower needed, he said.WHAT ARE SOME OF THE CHALLENGES?The experts that TODAY spoke to agreed that maintaining the polders will be one of the greatest challenges of using them to defend against climate change.Rising sea levels would mean that the dykes will have to be built higher and the polders would have to be deeper. This would make them more expensive to maintain, said Prof Horton.Similarly, Mr Ng said that as rain storms become more intense due to changing weather patterns, the pump systems installed in the polders will be more difficult to maintain.“The pumping system would need to be adequate and functional to pump excess rain water within the polder out into the sea, without causing flooding within the polder land,” he said.Mr Dircke also noted that land subsidence — where land sinks due to the withdrawal of large amounts of groundwater — is a potential challenge to maintaining the operation of the polder.Additionally, while polders are not affected by rising sea levels, he added that they are still vulnerable to other environmental phenomena. For example, giant storm surges can destroy the dykes that are protecting the low-lying reclaimed land and cause flooding.This is why Mr Dircke believes good governance is key to ensuring that polders remain functional and well-maintained.“When you build a polder system, you have to be sure that you are able to have the governance system to sustain it... it is a complicated system that requires excellent governance,” he said. Polders, the iconic reclaimed lands of the Netherlands, are not only a testament to human ingenuity but also an increasingly vital tool in urban development worldwide. As cities face mounting challenges from climate change, including rising sea levels and more frequent flooding, polders offer innovative solutions that balance technical, ecological, and social needs. This article examines the role of polders in urban planning, their ability to protect against flooding, and their implementation in various global contexts, with special attention to examples from the Netherlands and beyond. Understanding Polders: Definition and Historical Significance A polder is a low-lying tract of land reclaimed from a body of water—such as a lake, river, or sea—protected by dikes and managed through an intricate drainage system. This concept, pioneered in the Netherlands during the 16th century, allowed the Dutch to convert marshes and shallow waters into fertile farmland and habitable land. Historically, polders served agricultural purposes, enabling communities to expand their arable land. Over time, their function evolved to accommodate urban expansion and safeguard human settlements from the encroaching waters. Polders in Urban Development: A Strategic Solution Flood Protection and Water Management One of the most critical functions of polders in urban development is flood mitigation. By enclosing land and managing water levels through pumps and sluices, polders prevent areas from becoming inundated during storms or high tides. In cities like Rotterdam and Amsterdam, polders are integrated into urban flood defense strategies. For instance, the Noordoostpolder in Flevoland demonstrates how vast reclaimed areas can withstand extreme weather conditions through state-of-the-art drainage systems and flood barriers. Polders can also act as buffers, absorbing excess water from rivers or storm surges, reducing pressure on urban drainage systems. This is particularly relevant in regions prone to seasonal flooding or where rising sea levels threaten coastal cities. Sustainability and Ecological Benefits Modern polder designs emphasize ecological sustainability. Unlike traditional polders focused solely on land reclamation, today’s designs incorporate wetland habitats, promote biodiversity, and improve water quality. For example, the Marker Wadden, a man-made archipelago in the Netherlands, combines polder technology with environmental restoration. Here, reclaimed land serves as a nature reserve, fostering bird populations and aquatic ecosystems while acting as a natural water filter. Urban planners can replicate such designs to create green spaces within cities, contributing to better air quality, reduced urban heat, and recreational opportunities for residents. Social and Economic Implications Polders also offer socio-economic advantages. They create land for housing and industry in densely populated areas, addressing urban overcrowding. Additionally, polder projects generate jobs in engineering, construction, and maintenance. However, the social aspect extends beyond economics. Well-planned polders can enhance community resilience by fostering a sense of security against natural disasters. Public parks, walking trails, and other communal amenities within polder areas improve quality of life and promote mental well-being. Technical Aspects of Polder Design and Management The effectiveness of a polder depends on meticulous design and robust management systems. Key technical elements include: Dikes and Levees: These barriers form the backbone of polders, preventing external water from entering the reclaimed land. Modern dikes are often reinforced with materials like clay and geotextiles to withstand intense pressures. Drainage Systems: Pumps and canals are essential for managing internal water levels. Innovations such as automated pumping stations and smart water management systems ensure efficient drainage even during extreme weather. Monitoring and Maintenance: Continuous monitoring of soil conditions, water levels, and structural integrity is vital. Sensors and AI-driven analytics are increasingly used to predict and address potential issues before they escalate. Case Studies: Polders in Action The Netherlands: Pioneers of Polder Technology The Netherlands boasts numerous examples of successful polder projects, including: Flevoland: The largest artificial island in the world, Flevoland exemplifies large-scale land reclamation. Its polders support agriculture, urban areas, and natural reserves, demonstrating multifunctional land use. Room for the River Program: Although not strictly a polder project, this initiative integrates floodplain reclamation with urban planning. By creating space for rivers to overflow into controlled areas, it reduces the need for higher dikes while improving ecological conditions. International Applications Bangladesh: In flood-prone Bangladesh, polder technology is used to protect rural communities and farmland. However, challenges such as sedimentation and maintenance costs highlight the need for context-specific solutions. China: Cities like Shanghai are exploring polder systems as part of their sponge city initiative, which focuses on water retention and flood control. Integrating green infrastructure with traditional polder methods has proven effective in managing urban flooding. United States: New Orleans has adopted polder-like systems to mitigate flooding risks following Hurricane Katrina. By combining levees, pumping stations, and wetlands, the city is gradually enhancing its flood resilience. Challenges and Limitations Despite their benefits, polders are not without challenges: Cost: Building and maintaining polders require significant investment in infrastructure and technology. Environmental Impact: Poorly designed polders can disrupt ecosystems, leading to loss of biodiversity and soil degradation. Social Equity: Projects must consider the needs of marginalized communities to ensure equitable access to resources and protection. Long-term Viability: Rising sea levels and extreme weather events may exceed the capacity of existing polder systems, necessitating ongoing innovation. Future Directions: Innovations in Polder Technology The future of polders lies in adaptive, multifunctional designs that address diverse urban needs. Emerging trends include: Floating Polders: As sea levels rise, floating structures could replace traditional reclaimed land, offering flood-resistant housing and agricultural options. Smart Polders: Integrating IoT sensors and AI can optimize water management, reduce energy consumption, and improve maintenance efficiency. Nature-Based Solutions: Combining polders with wetland restoration and other ecological approaches creates resilient systems that work in harmony with natural processes. Community-Centric Design: Engaging local populations in planning ensures that polders address specific social and cultural needs while promoting long-term stewardship. Conclusion: Polders as Catalysts for Sustainable Urban Growth Polders represent a bridge between tradition and innovation, offering proven methods to address contemporary challenges. By integrating technical, ecological, and social considerations, polders can protect cities from flooding, support sustainable development, and enhance quality of life. As the climate crisis intensifies, the lessons from the Netherlands and other regions highlight the need for global collaboration and investment in polder technology. Whether reclaiming land or creating multifunctional urban spaces, polders are not just about holding back water—they’re about building resilient, vibrant cities for the future. By embracing the polder approach, urban planners worldwide can transform adversity into opportunity, proving that with ingenuity and cooperation, even the most formidable challenges can be met head-on. Read more about the campagne here.