PARTICULAR FORMS OF LAND AMELIORATION DEVELOPMENT OF COASTAL MARSHLANDS AND OTHER SALINE SOILS

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Summary

Within the coastal zone characteristic ecosystems are formed. They are all affected by the extent of water exchange between sea and inland areas depending on the shoreline form, sea level fluctuation and zonal-climatic conditions. Agricultural development of coastal ecosystems is related to control over the water and salt regimes of soils and methods of cultivation of the reclaimed soils. Polder meliorative systems have proved to be the main way to improve soils over vast coastal areas. The reclaimed soils are primary managed and used with strict regard to ecological and natural-climatic conditions. Polder systems convert intertidal and subtidal areas into agricultural land, and they are also used for expanding national territory. However, the economic

development of coastal areas and the sea bottom is attended by destruction of natural processes, thus causing unfavorable ecological consequences. This should be taken into consideration when projecting and planning amelioration of coastal lands.

1. Object of Research. Geographical Position, Particular Development and Amelioration of Soils in Coastal Areas

The coastal territory is a transitional zone between the sea and inland areas, comprising a part of coastal lands, the shoreline and the intertidal/subtidal zones. It is represented by ecosystems which occur in every natural zone on the Earth, including arctic and antarctic deserts and the equatorial belt. Within every natural zone coastal ecosystems are formed as a result of interacting processes between the sea and the land, being predominantly conditioned by water exchange. Their development depends on the form of the shoreline and the local lithologic-geomorphological features, on sea level fluctuations, tidal cycling, and finally on zonal-climatic conditions.

Coastal territories have been managed by humans since ancient times. They were used as natural administrative boundaries; many settlements, fortresses and commercial ports appeared along seashores. Being densely populated, coastal areas were not only of strategic significance, they also supported fertile soils, especially in river deltas, and they have been used for cropping for time immemorial. In countries where the land resources are limited, there has been much reclamation work, converting coastal areas, including part of the sea bottom, to agricultural and urban uses. This particularly applies to countries of western Europe and South-Eastern Asia, and island states.

Agricultural improvement of coastal areas is highly dependent on the level of amelioration development aimed at control over the water exchange between sea and land, and to increase the fertility of reclaimed soils. Several zones of coastal territories can be distinguished according to the intensity of water exchange between sea and inland areas. For example, the shorelines of the Wadden Sea in the Netherlands, receives high tides every day, and the marshlands are flooded by extra high tides or storms twice a month. The marshland area is affected by this, and periodically it is inundated by floodwaters. Within this zone the groundwater and much of the ground becomes salinized.

Amelioration of coastal areas and lowlands situated below sea level should be oriented to protect the land from high tides through construction of anti-flooding defenses, defending dikes, locks, pumping stations and drainage networks to govern the groundwater table. Reclamation plans for such work must take full account of the shoreline form, specific bioclimatic conditions and possible adverse consequences for the environment. Polder meliorative systems are considered to be one of the main methods of coastal reclamation in the different natural zones on our planet.

2. Polder Meliorative Systems. General Position.

Polder meliorative systems are the systems which provide hydromechanical waterways, where the water level in the collector is higher than that of the territory under reclamation. Therefore the soil drainage of polder systems is impossible by gravity alone using open or closed drains. A distinct feature of polder meliorative systems is the

requirement to remove excess water, which causes waterlogging, by means of pumping stations. In dry periods this pumped watercan be used for irrigating the soils (subirrigation, sprinkling, etc.) This is why polder meliorative systems create great scope for controlling the soil water regime.

Such systems are now used on a large scale in many countries, but they were initiated in Holland in the middle ages. They have been used not only for purposes of cropping but also for creating favorable conditions for human settlements. The early twentieth century saw some major polder construction in Holland, particularly between 1927 and 1959, e.g. Wieringermeer (20 000 hectares), Nord-Est (48 000 hectares), Flevoland-Est (54 000 hectares), Flevoland-Sud (43 000 hectares) and Markerwaard (56 000 hectares).

The construction of polders increased the land area by more than 200 000 hectares during 60-70 years, thus creating favorable conditions for farmers and new land for economic and cultural development. Overall, the territory of the Netherlands was increased by 20% at the expense of the sea bottom, through construction of polder meliorative systems.

It is worthy of note that the canvasses dating from the period of old Dutch painters give us an accurate impression of the prevailing landscapes, each with that indispensable element, the windmill. At all times windmills were used not only for grinding but also for continuous pumping of excess water into the sea, in order to reduce the water level on the polder.

The construction of polder meliorative systems embraces several stages, including dams and surrounding dikes in order to enclose a flooded or marshy coastal area, coastal plains or river floodplains. After that pumping stations are built to remove the surface water from the area, followed by the main drainage channels with a network of open or closed drains. Such a drainage system is designed to create a low groundwater table. Polders can be distinguished on the basis of whether they were created from sea bottom or river floodplain terraces.

The latter include non-flooded (or winter) and flooded (or summer) polders. They facilitate efficient double-sided control over the water in soils within the meliorative system by automatic governing of the inflow and outflow of surface and ground water. In terms of environmental conservation issues, the polder systems proved to be more beneficial than traditional drainage.

Special work is done to protect the seashore around polder systems: breakwaters, piers, parapets, artificial reefs and other protective facilities are installed in order to avoid destroying the shoreline, and to give added protection from floods, storms, high waves and tsunami.

The most important condition for creating successful polders is the suitability of the soil for cultivation of agricultural crops as well as protection of the land from adverse ecological consequences. The use of reclaimed coastal lands is chiefly determined by natural bioclimatic, edaphic, geomorphological and social conditions of the shoreline area.

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Biographical Sketches

Ye.I. Pankova was born in 1932. In 1955, she graduated from the Geographical Department, Moscow State University with a diploma in soil geography and environmental geochemistry. Starting from that time, her scientific career has been connected with the Dokuchaev Soil Science Institute. At present, she is the leading researcher of the Department of the Genesis and Amelioration of Salt-Affected Soils, Doctor of Agricultural Sciences, corresponding member of the Russian Ecological Academy. She is the author of more than 200 works, including five monographs, devoted to the genesis, mapping, and monitoring of salt-affected soils.

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