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Marian ZIĘCIK

Technology of
fishing ports

TECHNOLOGICAL – SPATIAL MODEL OF A FISHING HARBOUR SERVICING MEDIUM AND LONG-RANGE FISHING FLEETS, WITH A PARTICULAR CONSIDERATION PAID TO FISH PRODUCTS SERVICING TECHNOLOGY

MODEL TECHNICZNO-PRZESTRZENNY PORTU RYBACKIEGO PRZEZNACZONEGO DO OBSŁUGI FLOTY ŁOWCZEJ ŚREDNIEGO I DALEKIEGO ZASIĘGU ZE SZCZEGÓLNYM UWZGLĘDNIENIEM TECHNOLOGII USŁUG DLA TOWARÓW RYBNYCH

Departm. of Fishing Harbours and Vessels Exploatation
Acad. of Agriculture – Szczecin
and
Institute of Food Technology Acad. of Agriculture – Kraków

The paper presents a technological-spatial model of fishing harbour servicing simultaneously medium – and longrange fishing fleets; two alternate versions are considered: a single-basin and a two-basin approach. The main emphasis is placed to considerations on technological processes associated with services paid in connection with fish products, the concept covering all the operations devised to protect, preserve, and process fish raw materials from their discharge to dispatch. The paper may serve as a pattern on which to base the development of fishing ports, particularly in developing countries wishing to fully exploit their 200-mile economic zones.

INTRODUCTION

Against the background of changes that have occurred in the world fisheries as a result of creating the 200-mile economical zones by many countries of technological potential not advanced enough to take full advantage of it, there arises a need for working out new organisational and technological solutions of problems confronting fisheries and fishing harbours so as to make possible an optimal exploitation – in economical and technological terms – of fishing grounds owned.

The paper presented describes an attempt to solve the problems of fundamental technological processes and their spatial lay-out in a fishing harbour servicing medium- and long-range fisheries based on a 200-mile zone. The considerations presented concern basically technological processes associated with services paid in connection with fish products, the concept covering all the operations devised to protect, preserve, and process fish raw materials, from their discharge to dispatch. The operations discussed, based on appropriate refrigerating chains, are illustrated by Table 3.

METHOD

The type and size of model harbour and its particular services are based on the following assumptions: the fish landings are estimated at 130 000 t (based in part on the detailed models developed by the author for cutter (3) and longrange (2) fisheries). Also sizes and types of basic harbour facilities are derived from the above assumptions.

The spatial design of the harbour is presented as two alternatives: a single-basin (Alt. A) and a two-basin (Alt. B) harbour, both operating in a uniform technological way, be it a cutter fishery or a deep-sea one; the fish products servicing is concentrated in a single unit in each of the two alternatives.

The functional and implementation aspects of the two solutions of the spatial design presented are compared bellow.

EXPLOITATIONAL ASSUMPTIONS OF A MODEL HARBOUR

Quantity and type of catch and landings

In order to obtain a multi-purpose and representative model harbour, three most important types of fisheries that are most frequently employed within the 200-mile zone are taken into account. That does not, however, rule out a possibility of introducing other types of fishery depending on a fishing ground characteristics within the area in question.

The tentative composition of catches and landings is presented in Table 1.

The data applied are tentative mean results serving to calculate output and technological processes of the harbour.

Table 1

Type and size of fishery

Type of fishery	Catch (t)	Landings (t)		Total (t)
		Dressed fishes (t)	Fish meal and/or autolysates	
Cutter-based	50.000	44.000	6.000	50.000
Deep-sea,	80.000	56.000	4.800	60.800
of which:				
caught by trawlers	48.000	33.600	2.880	36.480
caught by seiners	32.000	22.400	1.920	24.320
Total	130.000	100.000	10.800	110.800

Fishing fleet

The fishing fleet designet to catch the assumed amount of fish consists of: 40 deep-sea cutters equipped in bottom and pelagic trawls 1,250 t annual catch each, 25 seiner-trawlers (1) of an individual annual capacity to catch 3,300 t, and 3 depot ships.

The auxiliary fleet consists of 5 vessels: 1 coast guard cutter, 1 research vessel, 1 tug-boat, 1 sanitary and 1 training ships. The two fleets employ altogether ca 1,260 persons, which – along with the reserve – makes up the total staffing of 1450.

The tentative technical characteristics of the fishing fleet is presented in Table 2.

Table 2

Technical characteristics of fishing fleet

Technical data	Seiner–trawler (1)	Cutter	Depot ship
Total length, L_c(m)	60.80	25.30	115
Beam breadth, B (m)	11.50	7.20	19.50
Maximum draught, T (m)	4.95	3.20	6.15
Running speed (kn)	14.5	11	12
Main engine- horse-power (KM)	2,500	570	3,375
Number of holds, capacity (m^3), temperature ($^{\circ}$C)	I 360; (-30°) II 260;(-30° – -50°)	0– -1°	30°– -50°
Crew	21	7	15
Freezing room output (t/day)	50	–	–
Fish meal factory output (t/day)	50	–	–
Annual catch (t)	3,300	1,230	–

Organisational recommendations for foundamental technological processes designed to service fish products

Basically, an improvement in technological operations associated with preservation and processing of fish raw materials, from catching to marketing, calls for a uniform refrigerating chain, appropriate means of cargo packing, and improved cargo discharge, handling and transfer.

Type of refrigerating chain and methods of fish products conservation

In the cutter fisheries, the adopted method of fish processing on board is gutting with or without heading. The fish refuse are preserved as autolysates in barrels. The refrigerating chain involves near-zero or near-cryoscopic temperatures obtained by using ice and mechanical chilling.

Processing of large fish in the deep-sea fisheries includes production of gutted fish, fillets, and/or mince frozen to –30 or –50°C. Clupeids are frozen whole. The fish refuse are processed on board into fish meal, protein concentrates, and oils.

Cargo packing

Fresh fish and shellfish caught by the cutter fleet are transported iced in 20–40 kg boxes arranged on special 1–2 t pallets in chilled holds.

The deep-sea fleet's catch is to be transported as whole frozen fish, mince, and fillets in 10 kg blocks piled on 1 t single use pallets, or as frozen individual large gutted fishes.

General organisation of fishing operations

Fishing operations may be carried out individually or in teams, the latter system implying an increased efficiency and higher benefits. The system is possible to come into effect within the frames of designed organisation of technological processes and harbour facilities.

TECHNOLOGICAL AND SPATIAL ASSUMPTIONS FOR THE FISHING HARBOUR LAY-OUT, WITH A PARTICULAR EMPHASIS PLACED ON FISH PRODUCTS SERVICING

Type and scope of solutions offered by the model. The fundamental tasks of a fishing harbour, i.e., fish products servicing, services paid to boats and gear, harbour and sea-going staffs as well as to the transportation centre, are the major elements of the technological systems in the two spatial alternatives (A, B) presented (Figs. 1 and 2).

As it has been noted previously, the fish products servicing is treated in detail, the technical possibilities of the present paper permitting. The remaining services are given in a more general way so as to provide a background for a description of that harbour quarter dealing with fish raw materials and its links with other parts.

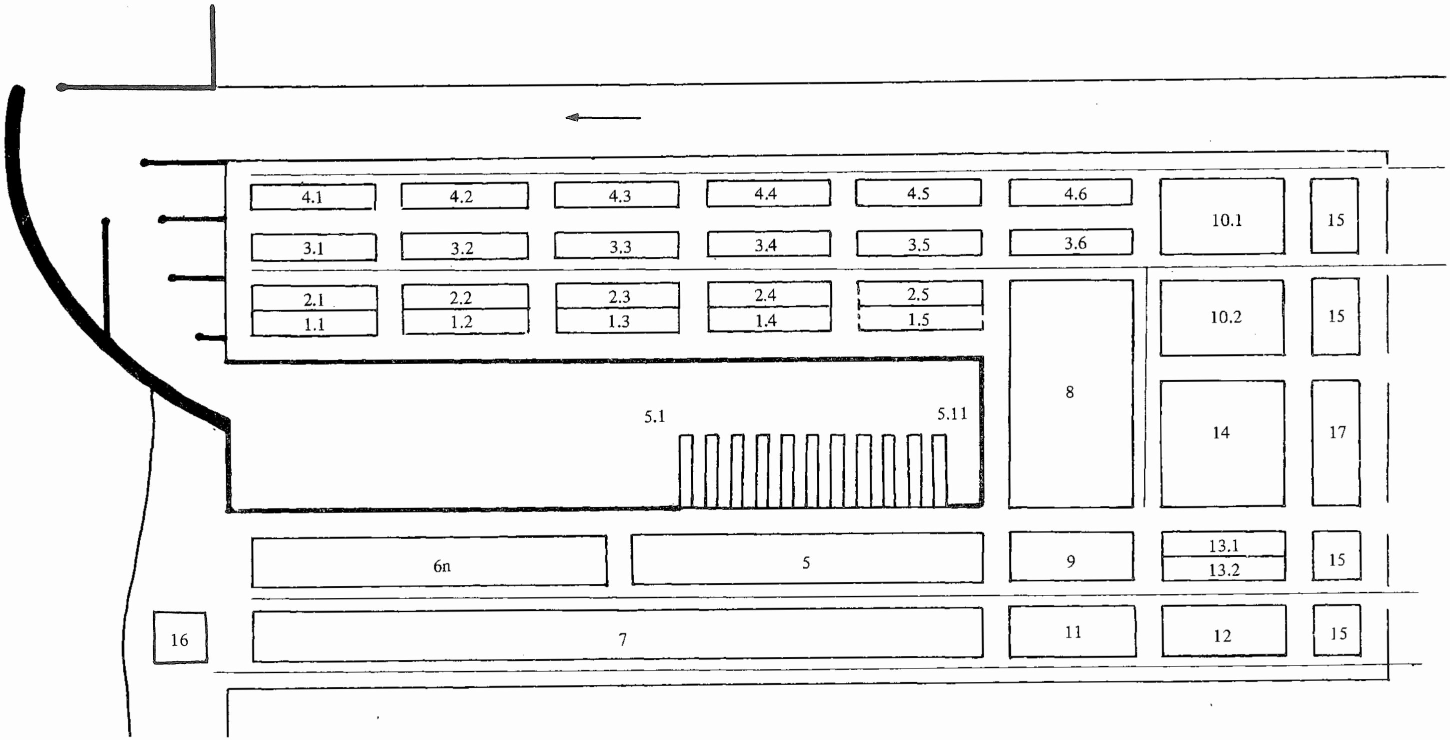

Fig. 1. Alternative A of technological and spatial model of fishing port

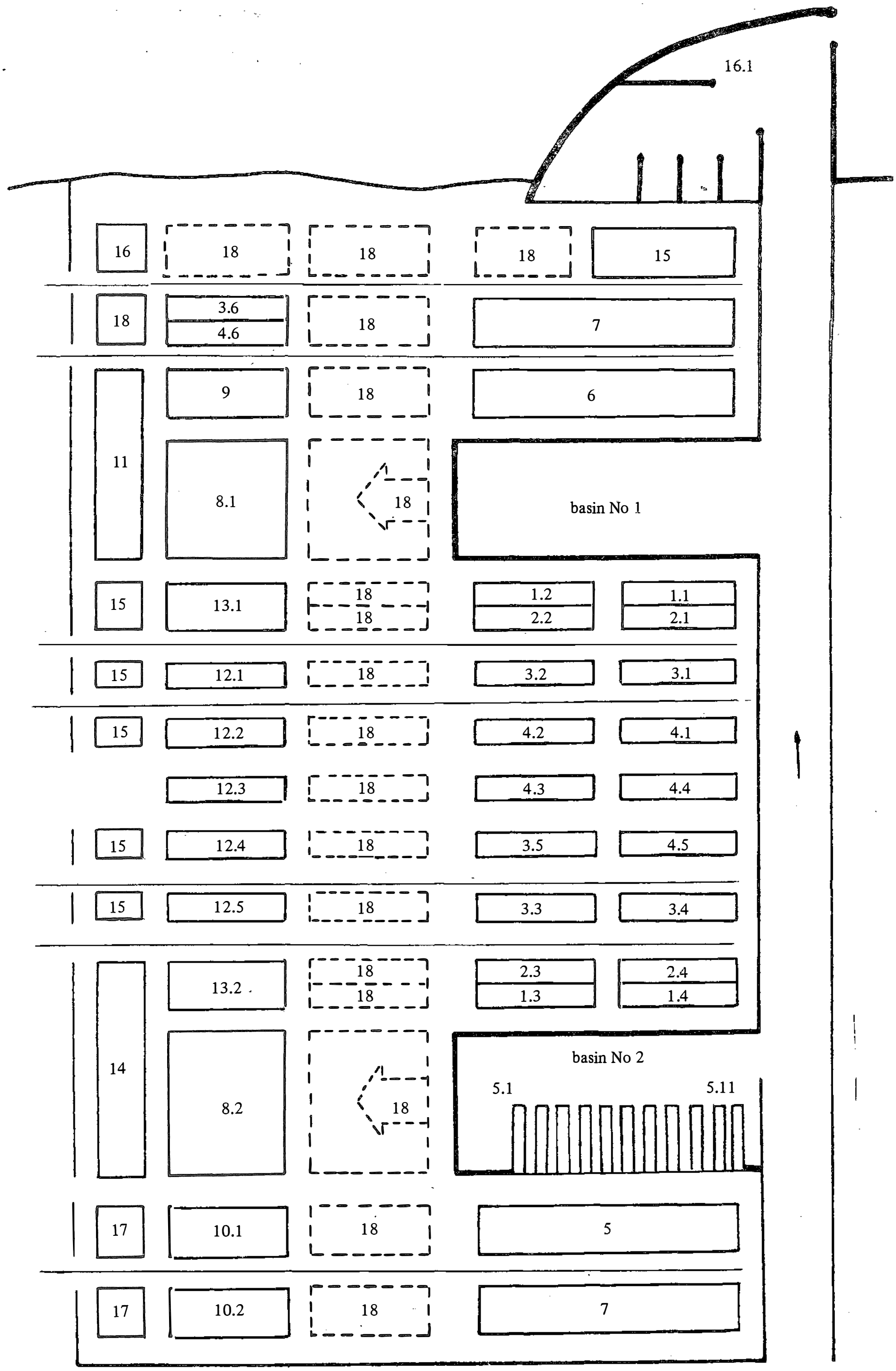

Fig. 2. Alternative B of technological and spatial model of fishing port

Allocation of grounds in a fishing harbour in the two alternatives (A, B)

1.1., 1.2	Refrigerated unloading halls for frozen raw materials
1.3., 1.4., 1.5	Fish raw materials unloading halls
2.1., 2.2	Frozen raw material stores
2.3., 2.4	Manipulation halls for fresh fish
3.1	Fish offals utilisation plants
3.3	Refrigerating plants
3.2., 3.4., 3.5., 4.1., 4.2., 4.5	Processing plants
3.6., 4.6	Auxiliary packaging-producing plants
4.3., 4.4	Auxiliary condiment – and pickle-producing plants
5.	Servicing yeards for cutters supply-mooring quay
5.1.–5.10	Cutters supply-mooring jetties
6.	Servicing yards for deep-seas fleets supply quay
7.	Areas for whole fleet supply plants
8.	Areas for whole fleet between-cruise repair quay
8.1., 8.2.	Repairing yards for cutters and deep-seas fleets
9.	Areas for land facilities repairing works
10.1., 10.2	Areas for vehicle and internal transportation servicing
11.	Cultural centre for harbour employees and fishermen
12.	Areas for health care facilities
13.1., 13.2	Welfare premises for female and male harbour employees
14.	Areas for office buildings for harbour companies
15.	General utilisation plants
16., 16.1	Depot and supply of liquid fuels
17.	Parking lots
18.	Spare grounds

The exemplified localisation of the harbour is a river mouth, a solution quite frequently encountered. The entrance is protected by wave breakers forming an outer harbour of a ca 8 m depth, which allows arrivals of vessels such as designed here.

When planning a harbour in the Alt. A (Fig. 1), a properly organised single-basin system has been adopted. The basin is provided for both the cutters and deep-sea vessels. The latter are to be serviced in the basin front part (I), i.e., that situated close to the road, whereas the part II houses the small or crafts. The basin is of a uniform depth all over (ca 8 m) in order to facilitate mooring; of deep-sea vessels and depot ships. The basin has an immediate connection with the road but can be entered from the river as well. A special servicing quay provided with berthing jetties for auxiliary fleet and designed to render general harbour services is included.

The Alt. B (Fig. 2) is based on two separate basins: No 1 and No 2, servicing the deep-sea and cutter fleets, respectively. The first basin is 8 m deep, the other has the depth of 4–8 m depending on whether its services are paid exclusively to the cutter fleet or to transporting vessels as well. The two basins are entered from the river mouth; however, depending on local conditions, other solutions are possible. The fish cargo is serviced on an area between the two discharge quays.

Fish cargo services

A number of operations, listed in Table 3, constitute the fish cargo services.

In accordance with the organisational and sanitary requirements as well as with international agreements, the operations listed proceed at a separate discharge quay and areas adjacent to it.

Fish cargo servicing in the harbour's cutter quarters takes place in the No 2 basin part (Fig. 1) or in the No 2 basin (Fig. 2) depending on the alternative chosen. After the clearance has been completed, fish raw materials iced in cases are discharged on pallets to landing stores (1.3–1.4) where the fishes are subject to the sanitary and quality control and sold on an auction or are otherwise distributed. Thereafter, fish raw materials – depending on their destination – are passed to processing halls (2.3–2.4) for processing and further refining. Those halls form, along with the previously-mentioned stores, the first line of the quay. Then, depending on their typy and destiny, fish raw materials are passed either to cold stores (3.3) to be re-chilled or frozen and stored, or to processing plants (3.2., 3.4., 3.5., 4.1., 4.2., 4.5.). Those plants constitute the second and third lines of the quay. Fish offal and organic effluents are processed in utilisation plants (3.1) to which they are delivered via hydraulic or partly mechanised systems from all processing plants.

A railroad network in the form of triple tracks coming down to the first, second, and third lines of the quay, roads and the transport centre (1●) assist mainly at the fish products dispatch. The internal transportation, storage, and transfer of fish goods are effected by a pallet system.

Fish goods brought from high seas (Alt. A: basin part No 1; Alt. B: No 1 basin) are handled at separate discharge quay adapted to service deep-sea vessels bringing frozen

Table 3

Fish cargo services at discharge quay

1. Ship's arrival and clearance of commodities brought

2. Discharge of fish raw materials and products in to the first line unloading halls

3. Veterinary and quality control of fish goods in halls; distribution of fish (wholesale marketing or other wise)

4. Fish processing in packing halls, preparation to dispatch and or further processing of fish

5. Short–, medium– or long-term storage of raw materials in cold stores

6. Dispatch of fresh or frozen fish to domestic and foreign markets

7. Auxiliary production for processing industry needs:
   a) production of packages
   b) production of pickles and other materials

8. Processing industry:
   a) production of durable fish products
   b) production of short-lived fish products
   c) production of frozen goods
   d) production of medicines and concentrates
   e) production of fish chemical products
   f) production of animal foods

9. Dispatch of fish products to domestic and foreign markets

(–30 to –50°C depending on a species) fish as well as fish meal and oils obtained from fish offal. After the vessel has been cleared, frozen fish piled on single-use pallets are carried to one of the refrigerated (–30 or –50°C) landing stores (1.1–1.2). Fish meal and oils are transported by pneumatic and hydraulic, respectively, devices to stores beneath the refrigerated halls and stores (1.1., 1.2., 2.1., 2.2.).

After the controlling operations are over, the frozen goods are taken over by the receiver and transferred to refrigerated warehouses for a short, medium, or long-term storage, to processing plants, and to domestic hinterland. Refrigerated warehouses (2.1.–2.2.) are one-storey refrigerated plants with temperatures ranging from –30 to –50°C depending on the type of product to be stored; they are directly connected with the refrigerated landing stores (1.1., 1.2.) and jointly form the first line of the quay.

The processing (3.2., 3.4., 3.5., 4.1., 4.2., 4.5.) and auxiliary (3.6., 4.3., 4.4., 4.6.,) industry plants of the second and third lines constitute a receiving-processing base for frozen and fresh raw materials brought in by the two kinds of fleets.

The model discussed assumes a high degree of raw materials processing in the harbour facilities into high-quality products for individual and collective consumption. Raw materials utilised to a possibly largest extent not only meet the modern feeding standards but also render the fishing harbour, when treated as an economical exploitation-fishing unit, fully remunerative. It should be borne in mind that a fishing-dispatch type of a harbour does not warrant its appropriate economic profitability.

Harbour's utilisation plants (3.1.), railway and transport centres as well as lorry and internal transport depots (10.1., 10.2.) service the whole dispatching part of the harbour.

Services rendered to remaining technological elements of the harbour (vessels, equipment, people, transportation centre

This group of services, particularly of those concerning fishing vessels, is presented in each alternative in a different way.

The between-cruise repairs take place, in the single-basin system (Alt. A), at a common repair wharf (8), whereas separate quays (8.1.–8.2.) are included in the two-basin system (Alt. B). Similar is the situation with ship's supplies; however, in the Alt. A those services rendered to the two fleets (5–6) are restricted to the first line, their various departments and central warehauses being placed in the second line (7).

Amenities connected with the crews' and harbour employees' well-being (13.1–13.2.), seamen's home etc., (11) officies (14), more important harbour objects such as a central boiler house, transforming power station, sewers and organic sewage-treatment plant, harbour guard etc., (15) as well as road and internal transport depots (10.1., 10.2.) are common for the two fleets and are located in farther lines of harbour premises due to safety reasons, the outer harbour having a connection with the station (16.1).

DISCUSSION

The two variants are being analysed here with regard to their technological and spatial characteristics. A strictly economical analysis calls for more detailed planning studies. Basical indices given in Table 5 visualise in part the magnitude of investment cost predicted.

Advantages and drawbacks inherent in the two alternatives

The following are the advantages of the Alt. A:

– concentration of services for the two fleets in a single basin supported by the joint organisation of basic technological departments; therefore a more advantageous technical indices and investments in hydrotechnic facilities and their maintenance emerge here.

Table 4

Fundamental spatial indices of a fishing harbour (Alt. A, B)

	Type	Alt. A	Alt. B
1	Total area of harbour (m^2)	877,800	1.277,000
2	Land area of harbour (m^2)	715,800	1.147,460
3	Area of basins (m^2)	162,000	254,700
4	Total water area of harbour (m^2)	162,840	255,540
5	Total length of quays (m)		
6	Length of quays in basins (m)	2,070	1,890
7	Length of railroad track (m)	5,700	6,570
8	Length of roads (m)	12,240	13,560
9	Area of fish products servicing quarter of harbour (m^2)	90,000	90,000
10	Area of ship's supply quarter of harbour (m^2)	100,800	79,200
11	Area of ship's repair quarter of harbour (m^2)	40,500	49,500
12	Areas for administration, social, etc. premises (m^2)	54,000	54,000
13	Remaining areas of harbour (m^2)	48,600	57,600
14	Harbour facilities repair yeards (m^2)	9,000	9,000
15	Areas for further development (m^2)		128,700

– combined (for the two fleets) organisation of the raw-material quay as a basis of the harbour and fishing industry effectiveness;
– joint centre of servicing, differently organised for each type of fleet;
– a convenient transport (road and railway) centre;

- a direct and short – therefore cheaper ın operation – connection between the basin and the outher harbour.

Among disadvantages of the alternative discussed are:

- a lack of possibilities for a further linear development;
- a necessity to apply a uniform (8 m) depth all over the basin.

The advantages of the Alt. B:

- the design fully satisfies the principles of spatial modeling. The harbour can be constructed stage by stage, all the technological systems adopted being maintained. The harbour can still undergo further development past the designed period of time;
- similarly to the Alt. A, all the fish product services are concentrated and optimally solved;
- the two basins can differ with respect to their depth, the cutter one may be 4 or 8 m deep depending on its servicing the individually – or team-working boats.

The drawbacks of the Alt. B are:

- separated supplying taking place at two quays, which increases investment costs;
- a need to maintain a suitable depth at the cutter basin entrance (from the river mouth);
- a general increase in harbour investment costs resulting from an increased land and water area occupied, number of quays, roads, and repair centres.

To sum up: it should be stated that the two alternatives presented implement optimal solutions, in functional and spatial terms, of fish products servicing. The choice of one alternative or another depends on the desired development of the two fleets and on an area available. The Alternative A is cheaper in its investment costs, whereas the Alternative B represents better perspectives of further temporal-spatial development, the exploitation of such harbour being more profitable.

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Translated: mgr Teresa Radziejewska

MODEL TECHNICZNO-PRZESTRZENNY PORTU RYBACKIEGO PRZEZNACZONEGO DO OBSŁUGI FLOTY ŁOWCZEJ ŚREDNIEGO I DALEKIEGO ZASIĘGU ZE SZCZEGÓLNYM UWZGLĘDNIENIEM TECHNOLOGII USŁUG DLA TOWARÓW RYBNYCH

Streszczenie

W pracy tej przedstawiono model technologiczno-przestrzenny portu rybackiego obsługującego jednocześnie flotę łowczą średniego i dalekiego zasięgu w dwóch alternatywach to jest w ujęciu jedno- i dwubasenowym.

Głównym przedmiotem rozważań są procesy technologiczne związane z usługami świadczonymi na rzecz towarów rybnych, którym to pojęciem objęto wszystkie procesy związane z zabezpieczeniem, przetwarzaniem surowców rybnych oparte na odpowiednim łańcuchu chłodniczym, począwszy od wyładunku aż do wysyłki z portu. Obie alternatywy stanowią optymalne rozwiązanie usług towarowych pod względem funkcyjnym, przestrzennym i eksploatacyjnym. Alternatywa jednobasenowa (A) jest tańsza pod względem kosztów inwestycyjnych. Alternatywa dwubasenowa (B) ma lepsze możliwości rozbudowy czasowo przestrzenne oraz tańsza jest w eksploatacji. Praca może służyć jako wzorzec dla właściwych rozwiązań portów rybackich, zwłaszcza dla krajów rozwijających się, które przejęły w eksploatację 200-milowe strefy przybrzeżne.

VASTE MODÉLE TECHNOLOGIQUE D'UN PORT DE PECHE DESTINÉ AU SERVICE D'UNE FLOTTE DE PÊCHE HAUTURIÉRE ET A LONG COURS AYANT EN ÉGARD PARTICULIÉREMENT UNE TECHNOLOGIE D'ÉCOULEMENT DES PRODUITS DE LA PÊCHE

Résumé

Dans cet ouvrage on a présenté un vaste modèle technologique d'un port de pêche d'activité simultanée pour une flotte de pêche hauturière et à long cours, en deux alternatives, c'est à dire par conception d'un ou de deux bassins.

Le sujet fondamental des examens attentifs sont les procédés technologiques en rapport aux services en charge pour les produits de la pêche, dans lequel comme notion on a déterminé tous les procédés livés avec la protection et la transformation des produits bruts des apports, entreprise bien équipée sur le plan frigorifique, à partir du déchargement jusqu'à l'expédition du port. L'ouvrage peut servir comme modèle pour résoudre les solutions spécifiques des ports de pêche, notamment dans les pays en voie de développement, lesquels ont élargis leurs limites de pêche sur 200 mille du rivage.

Марьян Зенчик

ТЕХНОЛОГИЧЕСКО-ПРОСТРАНСТВЕННАЯ МОДЕЛЬ РЫБНОГО ПОРТА, ПРЕДНАЗНАЧЕННОГО ДЛЯ ОБСЛУЖИВАНИЯ ПРОМЫСЛОВОГО ФЛОТА СРЕДНЕГО И ДАЛЬНЕГО РАДИУСОВ ДЕЙСТВИЯ С УЧЁТОМ ТЕХНОЛОГИИ ОБСЛУЖИВАНИЯ РЫБНЫХ ТОВАРОВ

Резюме

В этой работе представлена технологическо-пространственная модель рыбного порта, обслуживающего одновременно промысловый флот среднего и дальнего радиусов действия альтернативно, т.е. в вариантах одного или двух бассейнов.

Главной проблемой работы являются технологические процессы, связанные с обслуживанием рыбных товаров. Под этим понимают все процессы, связанные с замораживанием, переработкой рыбного сырья, основанные на соответствующей холодильной цепи, начиная от выгрузки, кончая высылкой из порта.

Оба варианта являются оптимальным решением обслуживания рыбных товаров в свете функциональных, пространственных и эксплуатационных аспектов. Однобассейный вариант (А) является более выгодным в отношении капиталовложений. Двухбассейный вариант (В) имеет лучшие возможности расширения в пространстве и времени и является более дешёвым в эксплуатации.

Работа может служить как образец для соответсвующих решений рыбных портов, особенно, в развивающихся странах, которые приступают к эксплуатации 200-мильных прибрежных зон.

Перевод: др Юзеф Домагала

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Address:
Doc. mgr Marian Zięcik
Academy of Agriculture – Kraków
Institute of Food Technology
Kraków, 29 Listopada str. No 48