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CHANGES OF THE SPATIAL STRUCTURE IN SELECTED TOWNS OF NORTH-EASTERN POLAND AGAINST THE BACKGROUND OF SOME ELEMENTS OF THE GEOGRAPHICAL ENVIRONMENT

The article deals with the problem of relations between the use of grounds in towns, particularly between new investments and natural conditions. Investigations were carried out in three towns: Suwałki, Elk and Augustów situated in north-eastern Poland and concerned changes that had occurred in 1970—1980¹. A comparative analysis of newly invested grounds in relations to selected elements of the geographical environment was based on the map of changes in the town-invested grounds (Fig. 1), the map of the first ground-water level (Fig. 2), the map of soils (Fig. 3) and the map of physiographic conditions (Fig. 4) which had been plotted for every town (the figures presented herewith concern the town of Elk but the other two towns have been similarly illustrated). The results of the investigations have been presented in Tables 1, 2 and 3. Only the interpretation of all the tables allowed to draw some general conclusions as to the relation between development of the town and the natural environment.

Water conditions or, in fact, underground water was the first element investigated. It is obvious that surface waters, as a topographic element, condition the course of the town development since they have an overwhelming effect on the formation of the spatial structure of a town. Lakes constitute a natural barrier to the expansion of settlements. Instead, rivers are obstacles that only partly hinder communication with areas annexed to the town. River valleys are often not utilized because of the occurrence of shallow underground water; their adaptation for building purposes is very expensive. Building enterprises avoid river-valley ground but if there are no topographically more suitable areas those grounds will be also occupied after a short time. However, it should be stated that precisely surface waters contribute highly, to the determination of the spatial

¹ Investigations of the spatial structure of towns in Northeastern Poland based on panchromatic air photos as well as the elaboration of maps of structural changes of town areas have been described in two successive volumes of *Miscellanea Geographica*, 1984, 1986.

Fig. 1. Grounds invested by the town in 1970—1980. 1. High apartment buildings, 2. Low houses, 3. Industrial and service grounds, 4. Industrial premises, 5. Grounds used by transport services, 6. Municipal greens

Fig. 2. Map of first ground-water level

Fig. 3. Map of soils. A — soil kinds, B — soil types. 1. light clays, 2. heavy clayey sands 3. slightly clayey sands on sands, 4. loose sand and gravel, 5. slightly clayey sands on sands, 6. heavy clayey sands on clays, 7. slightly clayey sands on sands, 8. light clays, 9. light clayey sands on sands and gravel, 10. loose sand and gravel, 11. light clays, 12. loose sand and gravel, I brown soils, II leached brown soils, III degraded black soil, IV areas of destroyed soil cover (buildings), V gleys, VI peat, VII muck, VIII silt and peat

Fig. 4. Map of physiographic conditions. A — Holocene, B — Pleistocene, I. lithology, II. origin, 1. gravel, sand brick, 2. clays, sand, silts, organic warp, 3. organic warp, peat, 4. sands, 5. silts, sands, clays, 6. sands, gravel, 7. clays, 8. sands, gravel, a. anthropogenic formations, b. deluvial and alluvial deposits, c. fluvial and lacustrine deposits, d. outwash, e. basal moraine, f. terminal moraine

structure characteristic of every town. The best grounds for building purposes are those in which the ground-water level occurs beneath 3 m. High buildings need a deeper level of ground water than the low ones.

In the investigated towns most of the multi-storeyed dwelling houses have been located on grounds where the water level occurs beneath 5 m underground. Low houses have spread where the first ground-water level occurs at the depth of 2 m. Industrial buildings have been located chiefly on drier land. No dependence of the ground-water level upon the location of new industrial or communication grounds has been observed. Municipal greens are generally located where the ground-water level is shallow.

Soil conditions were investigated as the second element of the geographical environment. Soil in towns undergo continual transformation losing their primary properties and becoming "soil wrecks". On built-over grounds, occupied by industry and transport services the previously occurring soils have been destroyed and the soil-forming process interrupted, while on municipal greens poor soils have become the so-called vegetable mould humus owing to intensive agrotechnical intervention. It is rather difficult to confirm the hypothesis that the soil quality depends on changes in land utilization since most changes took place on soils which had already been changed by urban economy. Those grounds have been determined as areas with a destroyed soil cover. Besides, it can be generally stated that building develops on poor soils formed of sands poor in clay and light clayey sand. The interdependence of the soil quality and the location of industrial grounds is still stronger. Good yards, stores and small food-processing factories are built on organic soils. Loose sands, gravel and peat are exploited in areas of their occurrence. Transport services grounds are located on soils of all types since

Table 1
Distribution of grounds invested in the town of Elk in 1970—1979 as compared with hydrographic conditions

No	Utilization	Hydroizohypses								Total utilized area	
		0—2 m		2—5 m		5—10 m		10—20 m		ha	%
		ha	%	ha	%	ha	%	ha	%		
1.	High apartment buildings	—	—	3.5	8.1	16.0	37.2	23.5	54.7	43.0	100.0
2.	Low houses	2.5	3.6	34.0	47.9	30.0	42.2	4.5	6.3	71.0	100.0
3.	Industrial and service grounds	4.0	5.2	36.5	47.7	26.0	34.0	10.0	13.1	76.5	100.0
4.	Industrial premises	6.0	6.9	54.5	63.0	25.0	28.9	1.0	1.2	86.5	100.0
5.	Transport services grounds	7.0	12.3	21.5	37.7	17.0	29.8	11.5	20.2	57.0	100.0
6.	Municipal greens	17.5	31.6	15.0	27.0	12.5	22.5	10.5	18.9	55.5	100.0
		37.0	×	165.0	×	126.5	×	61.0	×	389.5	×

Table 2

Distribution of grounds invested in the town of Elk in 1970—1979 as compared with soil conditions

No	Utilization	Built-up grounds						Brown soils										Black soils hec,cl			Peat, silts			Loose sand, gravel			Total surface							
								proper						leached																				
		cl		ls, g		lcs, scs/ls		cl		hcs, lcs/ls		secs, lcs/ls		ls, g		secs, lcs/ls		ha		%		ha		%		ha		%		ha		%		
		ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha		%	ha	%	ha	%		
1.	High apartment buildings	35.5	82.6	—	—	—	—	6.0	14.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	43.0			
2.	Low houses	21.0	29.6	—	—	24.0	33.8	1.5	2.1	2.0	2.8	16.0	22.6	—	5.0	7.0	—	—	—	—	—	—	—	—	1.0	1.4	0.5	0.7	71.0					
3.	Industrial and service grounds	22.5	29.4	3.0	3.9	12.0	15.7	5.0	6.5	5.0	6.5	27.5	36.0	—	—	—	—	—	—	—	—	—	—	—	1.5	2.0	—	—	—	76.5				
4.	Industrial premises	6A6	9.8	1.0	1.1	10.0	11.5	3.0	3.5	5.0	5.8	53.0	61.3	5.0	5.8	—	—	—	—	—	—	—	—	—	0.5	0.6	0.5	0.6	86.5					
5.	Transport services grounds	16.5	28.9	0.5	0.9	2.5	1.4	6.5	11.4	—	—	15.0	26.3	13.5	23.6	0.5	0.9	1.0	1.8	—	—	—	—	—	—	—	1.0	1.8	57.0					
6.	Municipal greens	17.0	30.7	4.0	7.2	5.5	9.9	6.0	10.8	6.0	10.8	3.5	6.3	—	—	—	—	—	—	—	—	—	—	—	1.0	1.8	7.0	12.6	—	55.5				
		121.0	×	8.5	×	54.0	×	28.0	×	18.0	×	115.0	×	18.5	×	5.5	×	3.5	×	10.0	×	2.0	×	389.5										

Symbols: cl — clays, hcs — heavy clayey sands, les — light clayey sands, secs — slightly clayey sands, ls — loose sands, g — gravel

Table 3

Distribution of grounds invested in the town of Elk in 1970—1979 as compared with physiographic conditions

No	Utilization	Holocene						Pleistocene										Total surface		
		anthropogenic formations		deluvial and alluvial deposits		fluvial deposits				outwash				moraine basal					moraine terminated	
		ha	%	ha	%	warp. peat		sand		silt, clay		sand		ha		%			ha	%
						ha	%	ha	%	ha	%	ha	%	ha	%	ha	%			
1.	High apartment buildings	—	—	2.0	4.7	—	—	—	1.0	2.3	14.5	33.7	—	—	25.5	59.3	—	—	—	43.0
2.	Low houses	—	—	1.0	1.4	2.0	2.8	—	—	—	14.0	19.7	18.0	25.4	7.5	10.6	28.5	40.1	—	71.0
3.	Industrial and service grounds	1.0	1.3	2.0	2.6	0.5	0.7	0.5	0.7	0.5	0.7	15.0	19.6	29.5	38.6	11.5	15.0	16.5	21.5	76.5
4.	Industrial premises	—	—	1.5	1.7	2.0	2.5	1.0	1.2	6.5	7.5	51.0	60.0	4.0	4.6	20.5	23.7	—	86.5	
5.	Transport service grounds	—	—	1.0	1.8	3.0	5.3	—	—	—	8.5	14.9	12.0	21.0	14.5	25.4	18.0	31.6	—	57.0
6.	Municipal greens	0.5	0.9	1.0	1.8	6.0	10.8	17.5	31.6	4.0	7.2	8.0	14.4	15.5	27.9	3.0	5.4	—	55.5	
		1.5	×	8.5	×	13.5	×	20.2	×	62.5	×	118.5	×	78.5	×	86.5	×	—	—	389.5

they are connected both with built-up areas and with lines of communication have been simply carried through grounds where they were necessary. One third of the municipal greens are situated on built-up areas not because of the soil quality but according to the assumptions of town-planners. In other cases they occupy grounds with prevailing brown soils or with a cover of organic soil. Vegetable gardens, orchards and plantations are chiefly located on brown soils while workers' allotments occupy organic soils. The lowest percentage of municipal greens occurs on very poor, sandy soils.

The third problem considered is that of relations that may occur between physiographic conditions and new-invested urban grounds. Physiographic conditions create predispositions to a differentiated, characteristic and individual spatial structure. In the investigated towns the greatest transformations of the towns structure have occurred on outwash plains. Outwash fields built of sand and gravel are advantageous areas for building location since here small gradients do not exceed 5%, the bearing capacity of the ground is good, the soil is poor and sandy, ground waters occur deeper and the microclimate is mild. There are less transformed grounds on areas of the basal moraine. It may be the results of a more differentiated relief with higher gradients, a varying bearing capacity and relatively richer soils. Most transformed grounds lying on the basal moraine are municipal greens, communication lines, while fewer are occupied by buildings. River and denudation valleys occur within the municipal limits of all the three towns and in Augustów there are also numerous cave-in lakes. Most of the valleys were formed in conditions of periglacial climate and they still undergo processes of erosion and accumulation. The intensity of those processes depends on local climatic conditions, on the vegetable cover and on the way in which the ground is utilized. The layer of ill-bearing ground varies, the ground-water level also undergoes fluctuations, the local climate conditions display dynamic changes, mainly diurnal variations.

Summing up, it may be stated that the bottoms of valleys present unfavourable conditions for building. Those forms are predisposed to act as ventilation in towns. It is advisable to leave those areas as open green grounds. The utilization of dry valleys partly confirms the advice of physiographers, as those grounds are also used for house and industry building. The possibilities of utilization of flood terraces, abandoned channels, depressions with periodically or permanently wet bottom are the same as within dry valleys. They have a low bearing capacity, the ground-water level is shallow, frequently it hardly exceeds one metre. Some of the terraces are periodically flooded so that they cannot be used for town investments. River valleys and systems of depression should perform the function of ventilation systems. It is advisable to leave those grounds as meadows, pastures and parks. It is also recommended to maintain there a high

level of ground water. In the towns under investigation the conformability of the utilization of those areas with the advice of physiographers depends on the distance from the centre. The lack of more convenient grounds for municipal investments in the centre of towns causes the occupation of valleys for building purposes.

Summing up, the investigations presented above, the hypothesis that natural conditions determine the development of town may be partly confirmed. The most important dependence, exemplified in the three selected towns, is that of house building on hydrographic, soil and physiographic conditions. This dependence is greater in the case of high apartment buildings. Water conditions and the kind of basement are decisive for their location; soil conditions are less important. A similar dependence occurs in the case of industrial and service building. As for industrial investments, hydrographic conditions are taken into account in the location of new works and there occurs a visible dependence between the kind of basement and that of soils. Grounds used in transport are the most independent of the environment which results from its service function in relation to other sections of the economy and its indispensable elasticity. The greatest conformity occurs on grounds occupied by municipal green since here the necessary hydrographic, soil and climate conditions are strictly determined.

The general conclusion of the above-presented investigations is that newly invested urban areas depend mainly on hydrographic conditions and the kind of basement, i.e. its mechanical composition and bearing capacity, while soil conditions exert but little influence on the development of urban grounds. On the other hand, high apartment buildings are most strongly dependent on the environment; low buildings and municipal greens are less conditioned. Grounds used for communication are the most independent ones.