SYSTEMS RESEARCH INSTITUTE
POLISH ACADEMY OF SCIENCES

INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS

CONTRACTED STUDY AGREEMENT REG / POL / 1

"CONCEPTS AND TOOLS FOR STRATEGIC REGIONAL SOCIO-ECONOMIC CHANGE POLICY"

STUDY REPORT

PART 2

POLISH CASE STUDY REPORT

COORDINATOR, IIASA: A. KOCHETKOV
COORDINATOR, SRI PAS: A. STRASZAK

ZTS/ZPZC/ZTSW 1-36/85

WARSAW 1986

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Consisting of 3 Parts

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I. CASE OUTLINE: STRUCTURE OF THE REGIONAL PROBLEMATIQUE

by Jan W. Owsiński

This chapter presents an outline of the regional development problem considered. First, general characteristics of the region in question are shown. Then, a short description of the new, large-scale development is given, followed by a description of previous main economic activities of the region. It is shown how a definite problem structure arises therefrom in the case considered, having clear strategical nature and calling for solutions to well defined subproblems. A review of possible approaches, taking into account the problems at hand, existing experience, both within the region and with the analysing team, and available methods, is presented. Therafter, the choice of actually applied methods, in view of circumstances, is justified, see Fig. I.1.

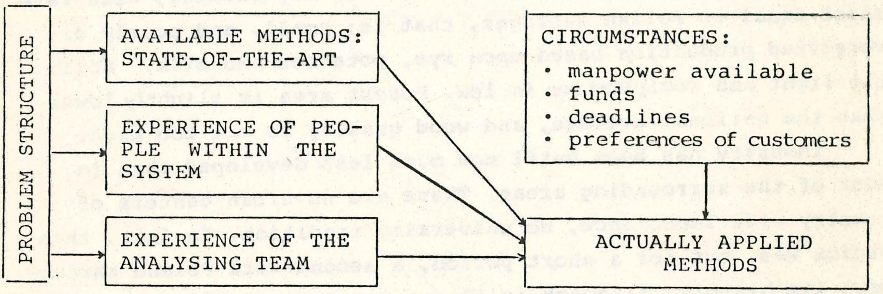

Fig.I.1. Factors influencing the actual choice of methods applied.

Note that this procedure, in which the methods actually applied to the study of strategic regional case were chosen is a simile of the real-life procedure, through which a certain subset of analysis, planning and design instruments is chosen and applied, the main difference being an abstraction from the particular institutional setting.

It should be emphasized that the regional development problem undertaken in this case study, though well defined and clear is by no means just a subject of economic planning and scientific inquiry. This region has, by and large, become a focus of a wider discussion spreading beyond the economic and scientific communities even into mass-media. The subject of this wider discussion is primarily environmental, i.e. direct consequences of digging the vary large opencast lignite mine, and mass burning of lignite in power stations. On the other hand, this discussion was not limited to the particular area, but rather - starting from this area it tried to higlight the problems related to other potential large scale lignite basins in Poland. This, of course, does not only regard Poland and therefrom the universal significance of the problem. On the other hand, it is both the substantial contents and the methods of resolving that one would like to look at.

I.1. <u>General information</u>

The area in question is located in central Poland. It is characterized primarily by traditional family farming, with farm sizes equal to Polish averages, that is: small, and poorly diversified production based upon rye, potatoes and milk. Soils are light and recipitation is low. Forest area is slightly lower than the national average, and wood quality is not too high.

Industry has been until now much less developed than in most of the surrounding areas. There are no urban centers of country-wide importance, no university tradition. In fact, this region was, but for a short period, a second-rate Poland throughout its history, although it always was in its geographical centre.

To illustrate this point let us note that in the list of 500 biggest Polish manufacturing enterprises (1985), that is, without mining and power generation, this particular area has only three enterprises, listed as number 167, 369 and 439. Taking a simple measure of

$$\sum_{i=1}^{I_k} \frac{500 - L_i^k}{250} \qquad (I.1)$$

where I_k is the number of enterprises located by an area k on the list of 500, and L^k are locations of these enterprises on inquiry. This region has, by and large, become a focus of a wider discussion spreading beyond the economic and scientific communities even into mass-media. The subject of this wider discussion is primarily environmental, i.e. direct consequences of digging the vary large opencast lignite mine, and mass burning of lignite in power stations. On the other hand, this discussion was not limited to the particular area, but rather - starting from this area it tried to higlight the problems related to other potential large scale lignite basins in Poland. This, of course, does not only regard Poland and therefrom the universal significance of the problem. On the other hand, it is both the substantial contents and the methods of resolving that one would like to look at.

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where I_k is the number of enterprises located by an area k on the list of 500, and L^k are locations of these enterprises on the list, one obtains the value of 2.1 for this particular area, while the expected value for an average voivodship in Poland is approximately 10.0. Even taking into account the fact that the area in question covers the surface of approximately half of an average voivodship, the indicator clearly shows lack of bigger industry on this territory.

More precise delimitation of the area considered is defined by the influences of the undertaking, which has triggered the problems presently looked at, i.e. the very large-scale lignite strip mining and power generation related to it. There is a number of such influences, environmental, economic and social. Some of them shall be commented upon further on. Each of them has a different geographical stretch.

Ideally, in delimiting the area of concern, one would take into accout all the geographical stretches of various influences exerted by the strip mining and related developments. Adaptation of such a strict approach, however, would require: quantification of all the influences over the geographical space, determination of appropriate thresholds of influence and spatial aggregation. This seems to be quite a formidable task.

It is, therefore, convenient to take certain proxies in order to represent the region. Thus, Fig. I.2 shows the maximum envisaged area of the groundwater table drop resulting from strip mining, this drop being of at least 1 meter depth, as located against the local (voivodship) administrative boundaries. This area shall be referred to as "groundwater crater". Since the rest of the Piotrków voivodship, in which approx. 85% of the crater is located does not differ substantially in its features from the crater area, therefore some of the characteristics given at the beginning of this section are illustrated with data for the Piotrków voivodship in Table I.1 (Piotrków voivodship may, for some purposes, be also taken as a proxy for the region in question).

It should be emphasized here that even taking the whole of the Piotrków voivodship together with the part of groundwater crater located outside of this voivodship one gets the value of indicator (I.1) of just 3.69, i.e. still far below the average for voivodships.

As can be seen, from Table I.1, this voivodship, and, similarly, the area in question, slightly lags, form the urbanization-

-industralization viewpoint, behind the Polish average. The data in this table, however, are as of 1983, and therefore their values have already been influenced by the growing mining-and-power generation undertaking. Thus, the actual background situation was even a bit more below the national average. There are, certainly in Poland areas with even lower values of appropriate indicators but they are not located in the center of the country.

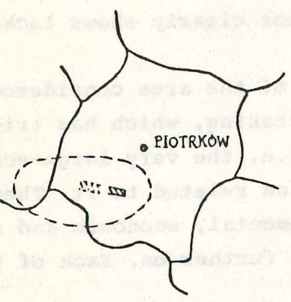

Fig. I.2. Schematic view of the maximum area of the envisaged groundwater level decrease of at least 1 meter ("groundwater crater")
———— voivodship boundaries
– – – boundary of the groundwater drop area
strip mine, actual and planned

To add to that: before 1975 Poland was administratively organized into a smaller number of bigger voivodships, which were composed of counties. The most important county in the area was Bełchatów, encompassing more than a half of the region considered. Out of 317 counties in Poland in 1986 this particular one occupied 277th rank as to its general economic position, 252nd rank as to industralization and urbanization, 247th as to agricultural potential and 247 as to population's living standard.

Table I.1. Some indicators relating Piotrków voivodship to Polish averages, 1982

Item	Polish average	Piotrków voivodship average	Piotrków voivodship as % of national average
1. Urban population share	59.1%	43.1%	73%
2. Population density, persons per sq. km	115.3	97.8	84.8%
3. Employment in state economy per 1000 inhabitants	333	301	90.3%
4. Values of capital assets per capita in 10^3 zlotys	214	207	96.7%
5. Global value of annual state-controlled production per capita, in 10^3 zlotys	66	57	86.4%

When assessing the data of Table 1 one should therefore remember that Poland is a flat central European country, relatively evenly developed, with the most industrialized and densely populated areas surrounding the Piotrków voivodship.

I.2. Features of the new development activities

Poland is virtually devoid of oil resources and has quite limited gas fields and therefore, to a large extent, Polish energy policy is oriented towards coal. Poland is, besides that, traditional exporter of anthracite, which is treated as a financially very important export item. In conditions of shrinking coal resources and increasing costs od exploitation it becomes expedient to find and put in operation new reserves. Luckily enough, the Central European Plain, stretching from the Rhine beyond the Vistula has in its upper part several rich lignite fields. These lignite fields are exploited as strip mines in FR of Germany, German DR and Poland.

The opencast mine in question in one of the biggest in Europe. Its depth reaches 300 metres while the total length will near 20 kms. Altogether it shall measure over 10 cubic kms. It is composed of two parts, of which only the first one is now in operation. The first part is supposed to contain more than 10^9 tons of lignite, while the second - a little more than $0.5 \cdot 10^9$ tons. It is anticipated that, under the presently assumed operation conditions and reserves, the lifetime of the whole mine will reach approximately 40 years from now. The maximum extraction and power generation potential shall be reached by 1995-2000 and last for about 20 years. Most probably, after the operation is finshed, some 60-80% of the mine surface shall be covered by lakes. Meanwhile, the "brown hole" draws water from the surrounding aquifers.

In the vicinity of the mine a lignite-fueled power plant is in operation. Its capacity is 4200 MW. Another power plant is planned to start generating when the second part of the mine starts producing coal. The capacity of the other power plant is envisaged at 1500-2100 MW.

Direct employment in power generation and mining is envisaged to grow in the next few years from the present 5 thousand to 8 thousand. Including all accompanying, but jointly managed operations, employment reaches 12 to 18 thousand, respectively, and is expected to shightly grow yet. This would account for approximately 10-15% of the overall voivodship's industrial employment and proportionately more for the direct influence area considered. The significance is, however, even greater if one accounts for incomes (wages) of this employee group, and the indirect influence (spouses, children, service etc.).

The one-meter depth "groundwater crater" surface is now approaching 450 sq kms. Its envisaged maximum is 1500 sq. kms. (Compare with 6250 sq. kms. of the whole Piotrków voivodship).

I.3. Background activities

As indicated, the region in question is rather poorly industrialized. There are some traditional activities, mainly in wood, textile and glass industries. As of present there are no signs of major changes in these activities due to new developments.

Lack of major urban centers did not allow growth of important service sector. Thus, agriculture, although not very intensive and effective, maintained its essential position in the regional economy, see Table I.2.

Table I.2. Role of particular sectors in the economy of Piotrków voivodship, as compared to Polish averages, 1984.

Item	Poland, average	Piotrków voivodship average	Piotrków voivodship as % of Polish average
1. Employment is socialized economy, per 1000 inhabitants, 1980/1984	341/320	311/295	91.2/92.2
2. As above, in industry, except constr.	134/120	142/139	106.0/115.8
3. As above, in construction	33/28	41/29	124.2/103.6
4. As above, other socialized sectors (mainly service)	174/172	128/127	73.6/73.8
5. Sold production value of socialized industry, per capita, 10^3 zlotys	271	213	78.6
6. Beds in general hospitals, per 10 000 inhabitants	56.3	42.5	75.5
7. Investment outlays per capita, 10^3zl.	35	71	202.9
8. Population in productive age, total	58.7%	56.8%	96.8
9. As above, in towns	61.0%	59.5%	97.5
10. As above, in rural areas	55.1%	54.6%	99.1

Note that this table does not provide directly the data on agricultural employment. This is due to the fact that it is quite difficult to assess actual employment in private farming. Quite a lot, however, can be inferred from the data at hand. First, if labour participation in socialized economy, item 1, were the same in Piotrków voivodship with regard to productive age population as it is on the average in Poland, then it would be 310 instead of 295 in 1984, which is quite an important difference, due primarily to higher than average employment in agriculture, a few percentage points above the national average.

Accelerated development in this area, and its character, is expressed through higher than average industrial employment (item 2), very high investment rate (item 7) and also in relatively low value of production sold. Similarly, there is a significant drop in construction employment (item 3), from very high to average values. Simultaneously, there is a lag in infrastructure and services (items 4 and 6, for instance). Agriculture preserves, to a large degree, a stable employment level.

As mentioned, regional agriculture is relatively little diversified and technologically traditional. Rye, potatoes and fodder crops make up for most of the cultivated area. Permanent grasslands occupy, typically for Poland, about 15% of the whole agricultural surface. In some parts of the region vegetable and fruit cultures become more important. Livestock breeding is not very intensive neither. It is less-feed-oriented, i.e., for instance, more towards milk (dairy cows) than quick meat (hogs, poultry). Soils are relatively poor, sandy and clayey for the most part. Average annual precipitation - approximately 55-58 cms, which is far too low, with the given types of soils, for a really intensive agriculture.

Some important indicators describing the position of local agriculture are given in Table I.3. To the picture thus formed one should add three important remarks. It should be emphasized first, that in spite of its lower than average intensity and traditional character this local agriculture is an important net food exporter to other regions due to geographical supply/demand distribution. Besides that, such a traditional agriculture is, with respect to many resources - excepting land and labour - very

I t e m	Polish average	Piotrków voivodship average	as % of national average
1. Cereal net yeld, in tons per hectare	2.6	2.2	85%
2. Potato net yield, in tons per hectare	17.7	16.5	93%
3. Cattle number, per 100 hectares*	67	60	90%
4. Milk production, in tons per hectare	0.87	1.03	118%
5. Meat production, in tons per hectare	1.6	1.4	87%
6. No. of tractors per 100 hectares	3.7	2.8	76%
7. Share of agricultural area in private farming	74.9%	92.5%	123%
8. Average surface of a private farm**, in hectares	5.0	4.7	94%
9. Surface share of private farms exceeding 15 hectares	5.7%	2.3%	40%
10. Share of population in post--productive age	11.8%	13.8%	117%

Table I.3. Some indicators relating the Piotrków voivodship agriculture to Polish averages, 1982.

* here and further on: hectares of the overall agricultural area

** this indicator erros on the lower side, since "farms" having surfaces 0.5 to 2 hectares are also accounted for.

efficient. This feature enables subsistence of the traditional agricultural sector in conditions of persisting heavy underinvestment. Third, it must be remembered that at present agriculture and related activities are still providing jobs and incomes for quite an important share of regional population, someplaces exceeding even 50%.

Two comments are due on the numbers given in Table I.3. They concern items 9. and 10. Farm size >15 hectares indicates the greatest private farm category in Polish statistics. On the other hand it is a widely accepted conviction in Poland that a farm can secure appropriate income and development capacities, in conditions of absence of other special opportunities (closeness to market, start up capital for installing highly specialized production, e.g. flowers or winter vegetables in greenhouses etc.), if it is at least 10 hectares large, with appropriate spatial organization. This, it seems, quite applies to the regional situation considered, for there is only a very limited farm subpopulation who can afford e.g. construction and maintenance of greenhouses in order to sell vegetables or flowers in agglomerations some 60 kilometers away. Thus, the margin shown in Table I.3, represents, provided all necessary resources are there and economic situation does not change sharply, the farms which can ensure jobs, adequate income and economic resilience. It can be estimated that the total of such farms in the region does not exceed, under the present economic situation, some 35-40% of all farms. Other farms secure incomes lower than national average and do not allow important investments to be made.

Finally, item 10. of Table I.3, although it applies to the whole of local population, has special bearing on agriculture. It is sufficient to compare Item 1 of Table I.1 (urban population share) with the datum to see the connection. Rural population there is an old one, at least in Polish terms, which does also inhibit quicker changes in the effectiveness of local agriculture.

I.4. Main problems and interrelations

The case study area is primarily defined by these problems--opportunities, challenges and threats - which have arisen as the consequences, present and/or future, of the new development activities.

There are a number of regional effects resulting form introduction of the large strip mining and power generation developments into the region in question. In the exploratory analysis, see Owsiński and Hołubowicz (1985), the essential questions were listed as follows:

1. Agricultural land appropriation and landscape changes,
2. Employment in industry,
3. Diversion of labour from agriculture,
4. Lack of water and "groundwater crater",
5. Increased personal income,
6. Crop decrease,
7. Ecological deterioration,
8. Crop quality decrease,
9. Changes in human environment.

In the course of further analysis a number of issues were added to this tentative list:

10. Attraction of new industries to the area,
11. Education and skills of labour force,
12. Power exports of the region.

Fig.I.3 shows schematically interrelations between various aspects of the regional system, including the above listed questions, as resulting from introduction of the new development activities.

The general remarks on Fig.I.3 are due. First, while the general outline of interrelations is as presented, the actual course of events depends as much on the specific strength of these relations and on the magnitudes of causing phenomena.

Thus, it becomes obvious that the effects listed have to be taken in the analysis in their dynamics over the whole cycle of development. For the sake of this presentation it should be mentioned that although some of the effects may have at least a partly reversible character, e.g. groundwater level in the vicinity of the mine, most of them are hardly, if at all, reversible.

Groundwater will approximately return to its previous level when the mine is abandoned and let to be filled with water. In fact, some areas may even become more humid than before. Soil quality, however, will in some places (e.g. peaty areas) deteriorate in an irreversible manner. For the best soils, which can thus

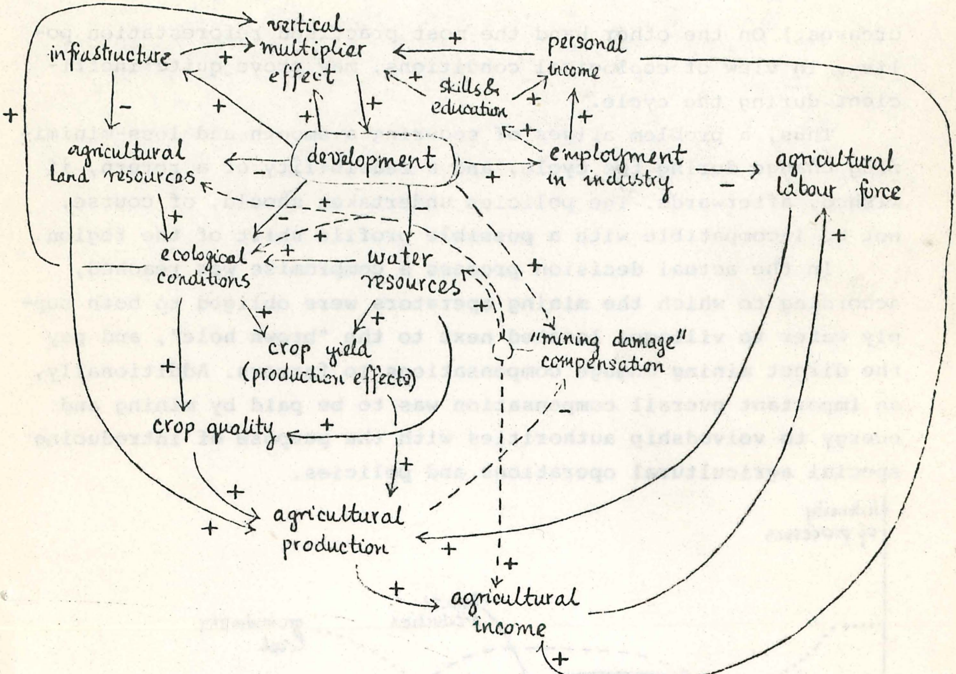

Fig. I.3. Interrelations among some aspects of the regional development/population/environment interface.

⟶ causal links – –→ links subject to decisions

degenerate, located either within the mine or close to it, it may turn out cost effective to transport them to other locations or use it for greenhouses. Pollution will certainly diminish at the end of the cycle, but its consequences shall linger quite some time afterwards.

Within the domain of socio-economic effects, if abandonment of agriculture occurs on a greater scale, so that neither labour force, nor productive infrastructure can any longer be found afterwards, a return, if wished, may be difficult. (Note that abandonment itself inflicts large social costs of income and job provision, as well as production substitution and transportation increases.) On the other hand the most practised reforestation policy, in view of ecological conditions, may prove quite inefficient during the cycle.

Thus, a problem arises of securing a smooth and loss-minimizing change during the cycle, and a feasibility of a return, if wished, afterwards. The policies undertaken should, of course, not be incompatible with a possible profile shift of the region.

In the actual decision process a compromise was reached, according to which the mining operators were obliged to both supply water to villages located next to the "brown hole", and pay the direct mining damage compensations to farmers. Additionally, an important overall compensation was to be paid by mining and energy to voivodship authorities with the purpose of introducing special agricultural operations and policies.

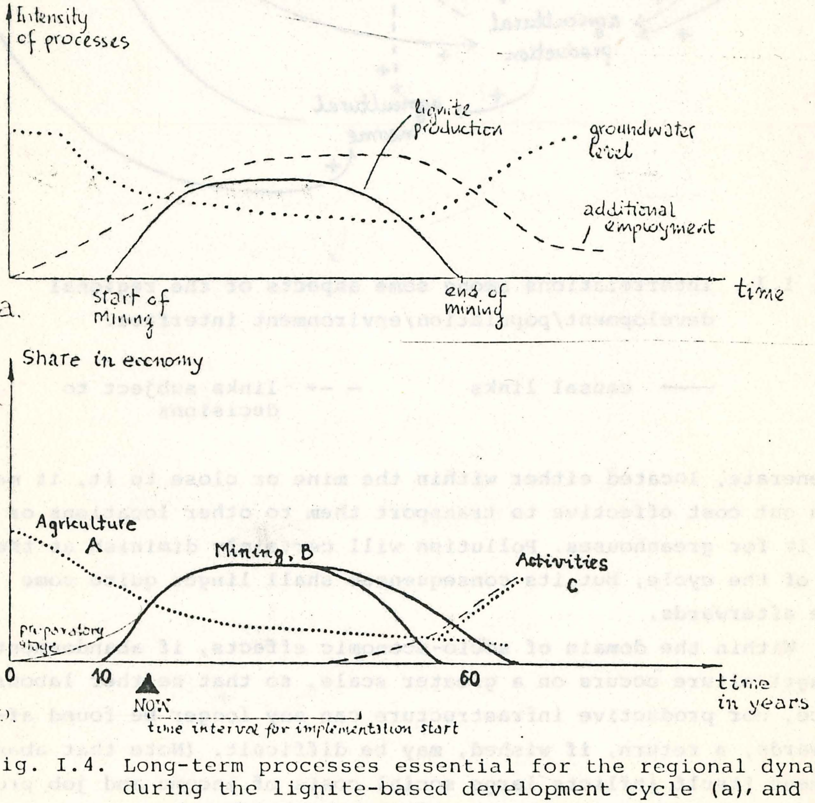

Fig. I.4. Long-term processes essential for the regional dynamics during the lignite-based development cycle (a), and time -scale of activities (b).

Such a compromise, however, does not guarantee a long-term, i.e. end of cycle (see Fig. I.4.) solution to the mentioned problem of smooth and loss-minimizing, or even better, opportunity--riding transition.

Thus, it turns out necessary to consider in more detail the other possible courses of policy and their consequences.

I.5. Choices available

When a leading and region-feeding industry declines, as in this case shall happen to the lignite-based development, there are three possible, broadly conceived courses of actions:

1. Wait and see, i.e. business as usual. This attitude in a majority of cases results from lack of adequate intelligence, and hence recognition of the situation. Another cause may be the belief that routine managerial and other activities will take care of the changing situation (which should have, anyway, been true, but virtually never is, since changes faced are far too deep for most of the usual mechanisms).

2. Choose another activity, possibly out of those already existing in the region. It is along this line of reasoning that the idea od "diversification" appears. Diversification is usually understood as a way of risk minimization. It should, though, be remembered that a region is virtually never capable of investing enough into each activity out of a broader "diversification" portfolio, having in mind that each of these activities may become a leading force of regional economy. Thus, the problem boils down to a choice of a small number of candidate activities.

3. Develop and/or apply new technology. This option is closely related to the previous one in that the choices are oriented at effective and efficient technoactivities. Introduction of a new technology into a previously dominating activity may be justified by existing capital assets, skills, social structure etc. It should also be remembered, though, that even with preservation of the dominating activity the change of technology shall upset many of the existing structures. Hence, additional approaches may become necessary.

In developing a regional strategy a mixture of these three courses of action, with regard to various activities, can be applied. In implementation, however, the temporal scales of preparation and build-up indicated e.g. in Owsiński (1985) must be carefully observed.

The mining-and power generation activity considered has a predetermined life span, which does not exceed 50-60 years. With higher intensity of lignite extraction, however, it may even get lower that 40 years. The bounds on extraction rates are defined by existing capital assets and their repayment conditions, by plans as to the national energy sector and by actual geological and technical conditions of extraction. Thus, although there exists NOW a certain margin for controlling the length of the mining period, as shown in Fig.I.4.b, it is not a significant one. Moreover, this margin shall diminish as time progresses from NOW on.

Simultaneously, having in mind considerations related to the time scales involved in technological change, Owsiński (1985), one can easily conclude that <u>the time for making decisions as to the future technoactivities is running out quickly</u>.

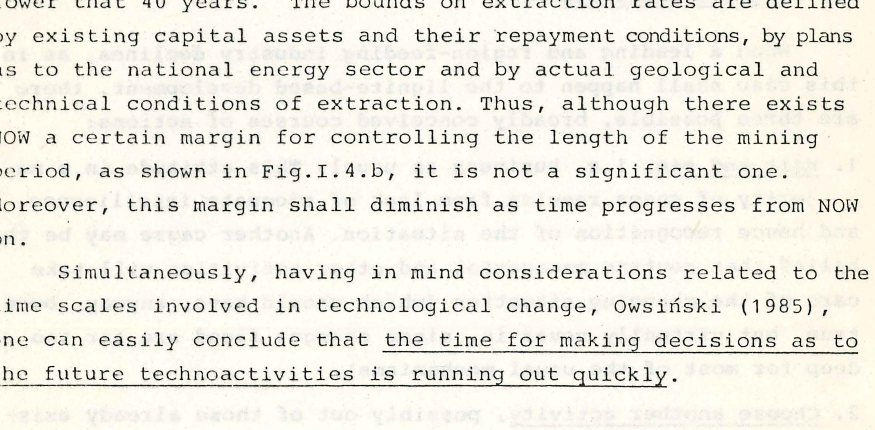

Fig. I.5. Profile of technology adoption, from Yao-Chi Lu (1979).

This conclusion follows directly from the analysis of the penetration course, with regard to the build-up time period. It should be noted that this applies not only to the entirely new technologies, but also to introduction of otherwise known and tested technologies, provided appropriate conditions hold. Suffice here to indicate that the ratio of the speed-up (rapid growth) to build-up (stabilization or slow growth) time, as can be seen from Fig. I.5 cannot be taken as more than approx. 0.3, and more plausibly as approx. 0.2. Taking into account that the stabilized growth should be ensured just after the mining would have been finished, and that the speed-up period would last 5-10 years, hypothetically, one obtains the interval for the starting point of implementation: 30 years from NOW (Fig. I.4) at the latest, as its far end, and already NOW, as its near end. When one adds the time necessary for research and planning it becomes obvious that it may already be too late for considering some of the potential future technoactivities.

Certainly, the actual latest starting point for implementation shall depend on such factors as:

x regional adoption capacities,

x technoactivities chosen,

x policies followed.

Some of the above shall be considered in a bit more detail further on.

This chapter is not meant to describe an actual model, but rather to provide a framework in which such a "model" or a set of approaches, not necessarily fully formalized, could be placed. The key issue in this framework is the time factor, and the main objective is the choice of proper technoactivities and their introduction policies. Thus, one of the most important classes of items appearing in the framework are:

Potential technoactivities

A fundamental set of such technoactivities will now be shortly characterized, with special attention as to positive ("for") and negative ("against") features.

A. Agriculture. For: Agriculture used to be the dominating regional activity. A large portion of regional population is still engaged in agriculture. There is still a significant capital, This conclusion follows directly from the analysis of the penetration course, with regard to the build-up time period. It should be noted that this applies not only to the entirely new technologies, but also to introduction of otherwise known and tested technologies, provided appropriate conditions hold. Suffice here to indicate that the ratio of the speed-up (rapid growth) to build-up (stabilization or slow growth) time, as can be seen from Fig. I.5 cannot be taken as more than approx. 0.3, and more plausibly as approx. 0.2. Taking into account mining would have been finished, and that the speed-up period would last 5-10 years, hypothetically, one obtains the interval for the starting point of implementation: 30 years from NOW (Fig. I.4) at the latest, as its far end, and already NOW, as its near end. When one adds the time necessary for research and planning it becomes obvious that it may already be too late for considering some of the potential future technoactivities.

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A. Agriculture. For: Agriculture used to be the dominating regional activity. A large portion of regional population is still engaged in agriculture. There is still a significant capital, productive and not, serving agriculture, which may be lost if not renewed. After the development cycle is over agriculture may absorb a portion of surplus labour force.

Against: Regional agriculture, although resource efficient, is not effective and technologically old. Due to rather poor resource situation, it cannot be regarded as very promising sector. In view of current regional socio-economic trends investments into agriculture would be made against them. Because of increased pollution the value of agricultural products shall decrease.

Additional remarks: General national agricultural policy must be taken into consideration. In view of decreasing labour force and of effectiveness requirements there must be a technological change in agriculture. Possibilities of technological change depend heavily upon its economic conditions and results. Effects of pollution can be avoided, at least to some extent by shifting agricultural production profile, e.g. to industrial crops and products.

B. Nuclear power generation: For: Certain amount of appropriately skilled labour shall exist in the region by the end of the mining cycle. It would be good to have a continuation of power generation in this location, especially because of resulting downstream industrial development and various infrastructure. It may be possible to create a relatively smooth transition from the fossil-fueled to nuclear generation as parts of mine are abandoned. Resulting from filling of the abandoned mine with water there may be enough water resources on place. It may be expected that less environmental and social disruption would result than if the station were to be located in any of the neighbouring regions.

Against: The investments necessary would be far greater than the region could secure itself and therefore almost whole planning and decision process would have to go outside of the region, the region running all the resulting risks. The activity shall absorb a larger amount of labour force only during the (re)construction phase. It may be disruptive for other activities.

C. Fossil power generation (with fuels other than lignite).
Comment: This variant may serve either to prolong the present

cycle or to substitute it. Its futures can easily be deducted from the ones already presented.

D. Energy intensive industries (chemical, e.g.). For: Possibility of absorbing the surples labour force. Use of local energy sources. Availability of water.

Against: Risks related to the overall strategy implementation. Environmental problems.

E. Labour and skill intensive industries and services, requiring less energy, based upon those already existing. Comment: The idea behind is to provide infrastructure etc. during the period of abundant local energy, and to use these assets afterwards for absorbing the labour force released and for creating efficient and competitive regional economic base.

F. Recreation: For: Availability of water resources at the end of the cycle. Possibility of economically efficient use of land diverted from agriculture and forested, especially for the period of ecological transition. Distance from larger agglomerations: approx. 75 kms to the center of an agglomeration of more than 1 million inhabitants (55 kms to its outskirts) and approx. 60 kms to a town of 250 thousand inhabitants.

Against: Low labour absorption capacity. Potentiality of conflict with other activities.

These activities can be introduced, amplified or reintroduced into the region owing to implementation of defined policies, whether directed from local, regional or national levels. In this particular case local decision centers are able of carrying out a very limited scope of policies, related primarily to techno-activities A. and F. In general, one may distinguish the following:

<u>Policy controls</u>

1. Direct intervention, i.e. nationally or regionally managed, financed and supplied investments, either directly productive or infrastructural.
2. Indirect intervention, i.e. financing of definite undertakings, special allowances, zoning.

3. Motivation: credit schemes, taxation,

The framework provided by potential technoactivities and policy controls, as deployed here, is sufficient for constructing a structural model of future regional development. Because, however, of qualitative nature of such an exercise, it is necessary, in constructing such a model for purposes of regional development strategy, to have in mind a set of envisaged strategic paths.

It is obvious that the choice of individually most promising technoactivities may far be from the optimal or even satisfactory one. Their interactions have to be taken into account. In view of previous considerations it would be necessary to assess the interactions among the following issues:

a. Mining production intensity.

b. Energy and fuel exports relative to regional consumption.

c. Employment changes in mining and manufacturing.

d. Employment changes in agriculture.

e. Changes in the average personal income of regional population.

f. Skill improvement.

g. Changes of productive infrastructure value.

h. Changes of social infrastructure value.

i. Changes in landscape and in traditional habitat

j. Changes in crop yields.

k. Changes in water resources.

l. Changes in value of agricultural products.

m. Water demand changes.

n. Technological shift in agriculture.

o. Productivity horizon of the leading productive capital.

Besides that, the main conditioning issues have to be elicitated:

A. Full utilization of lignite and electric power generation capacities;

B. Continuation of the existing system of mining compensations vis à vis the region and its agriculture;

C. Maintenance of the existing agricultural policy at the national level;

D. Maintenance of the existing dynamics of regional agricultural investments;

E. Continuation of the observed trends in the price structure of energy, industrial goods and agricultural produce;

F. Overcoming of the country's economic crisis to the extent allowing carrying out of normal investment activities.

In accordance with previous considerations the time horizon taken for the analysis should be approximately 50 years.

I.6. Possible approaches

The analysis to be conducted for the case considered should account for the following features of this case:

a. long time horizon, and, closely connected with that:

b. high uncertainty,

c. dependence upon the actual national-level policy actions,

d. dependence upon the views and opinions of those involved on the local level, these views and opinions being presently shaped.

Thus, for instance, it is not feasible, for the whole system and the whole period, to employ a mathematical programming formulation of the model, since it presupposes quite an accurate specification of both model structure and data. No "randomization" of such a model (e.g. chance-constrained programming) can help here, for the problem concerns the whole structure of the system and its transformations.

It would be quite feasible to construct a simulation model for the case, assuming relatively simple single linkages (interactions). Such an approach, however, entails one significant danger: as can be seen from the lists of issues and the like elements of the system envisaged (see e.g. Fig. I.3) the model obtained would be quite a complicated one, and therefore results produced with such a model would be intuitively hard, if at all, to follow. Furthermore, in view of points c. and d. above, such a model would have to integrate the possibility of representing various views and controls of the decision making process actors, which may not be very easy.

That is why it was deemed advisable, prior to attempting the construction of a simulation model, to analyze the system via a looser structure, in which interaction with the decision process actors would play an important role. (Thus, strict structural modelling, as too stiff, was also ruled out.) Information gained this way was to be eventually used in a simulatory or other modelling exercise.

Cross-impact analysis, see Jakubowski (1985), Turoff (1972), was chosen. In this technique the system analysed is described by the state of the issues e.g., as listed here, i.e. by "events". It evolves through their interaction, see Owsiński and Hołubowicz (1985), which is also shaped by the choices made, within the scope outlined before. In order to assess the not-too-well justified "scenarios" obtained from such methods as the cross-impact technique (see also e.g. Manne and Schrattenholzer (1985)) it is advisable to put forward the reference scenarios based upon certain intuitively obvious and numerically simple hypotheses. For the case at hand three such reference scenarios can be adopted with regard to choices made, each having two alternative courses of consequences. These are:

I. <u>Baseline, business as usual</u>

Ia. Everything goes right. Environmental consequences of mining and energy development are small, local and/or containable and reversible using routine countermeasures. Outflow of labour from agriculture serves it right by taking away labour force surplus and motivating necessary structural and technological changes. During the period of the mining boom sufficient skill pool and infrastructure are created in order to ensure smooth transition to some other, yet undefined, technoactivities, afterwards.

Ib. Everything goes wrong. In particular, too little investment is "by itself" created to ensure sufficiently smooth and prompt technological transition and/or technoactivity building in agriculture and in the post-mining non-agricultural activities.

II. <u>High energy</u>

IIa. Everything goes right. Agriculture is deemed to abandonment. Following lignite-fueled power station a nuclear-fueled one is built. Energy, and therefore water-intensive industries are developed, all that with important inputs (see Policy controls) from the central government.

IIb. Everything goes wrong. In particular, central government does not ensure adequate, or at all, investments for some, or all, of the technoactivities envisaged to build up, while ecological consequences turn out to be significant and hardly, if at all, reversible.

III. Low energy

IIIa. Everything goes right. Adequate investment and energy for timely technological transition in agriculture is ensured. Agriculture focusses on industrial crops. Post-mining technoactivities are skill- and knowledge-oriented and low-energy-intensive. Recreation and related activities are installed.

IIIb. Everything goes wrong. In particular, there is too much competition from other regions in the technoactivities envisaged, either due to time delay or to efficiency differences.

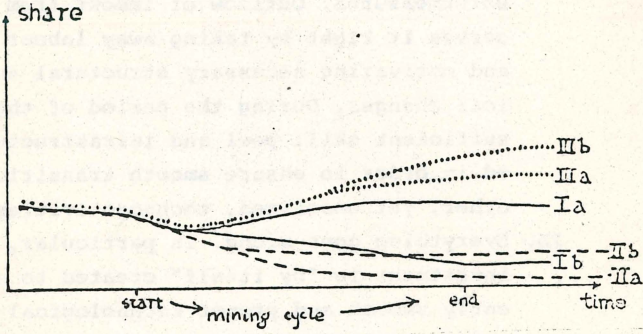

Fig. I.6. Possible shares of agriculture in regional economy for the three reference scenarios and their extreme alternatives.

When assessing from Fig. I.6. dependence of agricultural share in regional economy one should bear in mind that, e.g. in case IIIb position of agriculture is higher than in case IIIa owing mainly to more obvious failures in other activities.

Thus, a frame was set for the analysis. Chapter II shall describe in more detail the technique used, and Chapter III will be devoted to actual course of analysis and its results.

References to this Chapter can be found at the end of the volume, together with the references to Chapters III and V.

V.7. References to chapters I, III and V:

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STUDY REPORT

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