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SPATIAL IMPACT ANALYSIS FOR DEVELOPING COUNTRIES

A FRAMEWORK AND A CASE STUDY

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1. Introduction

Developing countries all over the world are coping with a wide variety of severe problems regarding demographic, socio-economic, spatial and political developments. In many of these countries, the lack of coordinated effective policy strategies, the lack of analytical insight into complex development problems and the absence of appropriate information systems have hindered the design of coherent development plans, not only at the national level, but also at the regional and urban level.

In recent years, urban and regional planning problems in developing countries have drawn much interest from the side of planners and regional scientists (cf. Chatterji, 1982, and Richardson, 1980). This increased attention for spatial dimensions of development planning was particularly induced by the strong sector orientation of prevailing policies (for instance, housing, industrial or infrastructure policy), which led to a neglect of important impacts on other components of society.

In this paper, a method is described that serves to provide a logical and coherent framework for assessing all relevant (and sometimes unintended or harmful) spatial consequences of public policies. This method named here spatial impact analysis, may be regarded as a specific application of more general effectiveness analyses. In general, effectiveness or impact analyses aim at assessing all relevant foreseeable and expected consequences of external changes in a system within a certain time period (cf. Nijkamp, 1983 a). Spatial impacts refer to the spatial dimensions of impacts of external changes (particularly government policies). By means of spatial impact analysis, the consequences of intended (or hypothetical) government actions for cities and regions can be assessed, so that planners can gain more coherent insight into the spatial aspects of designed plans.

In view of the specific problems of developing countries in the field of data and information availability, we propose a systems approach to spatial impact analysis, which can be applied in situations of limited information. Hence, a method is described for an effectiveness analysis in developing programming, in which cities and regions will receive a more prominent place in government policies, and which is based on a relatively simple methodology that does not presume only "hard" information regarding impacts.

After a discussion of a systems approach to spatial impact analysis, a case study will be described in the subsequent sections. The method has been applied in Bhubaneswar, India, in the framework of a research project in this city. Finally, given the experiences in methodological and empirical respect, some final conclusions will be drawn at the end of the paper.

2. Spatial Impact Analysis

Spatial units (cities, rural areas, regions) are influenced by a number of external forces, of which - in addition to exogenous factors (for instance, international developments like a rise in oil prices) - government policies have great significance. In this paper, particular attention will be paid to the impacts of policy measures.

Government actions that affect spatial units can broadly be divided into two categories: first, actions that directly aim at influencing the spatial units concerned, and secondly, actions that are not primarily directed towards these units, but may have unintended impacts on these units. The second group, which may consist *inter alia* of industrial, agricultural etc. measures, influences geographical patterns of cities and regions sometimes in a decisive way, sometimes even without the planner's prior knowledge. Thus, both types of policies may imply impacts on spatial units.

Spatial impact analysis may be defined as a systematic and coherent organization and application of established analytical techniques to assess the expected or foreseeable impacts (both intended and unintended, both direct and indirect) of various policy measures or programs at various administrative levels upon relevant welfare indicators of cities or regions (Nijkamp, 1983b). Examples of such impact analyses are: the impacts of a national energy programme for a specific region, or the impacts of a new infrastructural policy on a specific city.

Spatial impact analysis aims at providing an integrated (rather than a partial) picture of the consequences of a public policy plan (or of a set of such plans) for regions, rural areas or cities. Clearly, the spatial dimension of government actions gets more attention by applying this method. In this paper, we confine ourselves to two types of spatial impact analysis: *regional* and *urban* impact analysis. The first one aims at providing an assessment of the impacts of policies for a specific region, the second one for a specific city or system of cities in its regional context.

In recent years, especially *urban* impact analysis has drawn a lot of attention. In the United States, Glickman (1980) collected a number of applications of urban impact analysis, following the implementation of a new law, by which responsible public agencies are required to assess the expected urban impacts of federal policies. In these studies, the impacts for systems of cities were highlighted. Another approach has been put forward by Nijkamp (1981), who assessed the impacts of various government plans for one specific Dutch city. At a conference in Paris (OECD, 1981), a number of case studies were collected, where urban impacts of government policies in a number of countries (*inter alia*, Sweden, Canada, France) were the subject of study. These studies paid attention to a wide variety of impacts on cities or groups of cities caused by (mainly non-urban) public policy programmes.

Various studies in the field of *regional* impact analysis can be found in Pleeter (1980). A general framework for spatial impact analysis will now be presented in order to highlight the three major components of the method used in this paper.

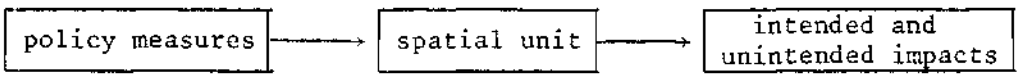


Fig. 1 Three main components of a spatial impact analysis

As mentioned before, spatial impact analysis aims at assessing the impacts of policy measures on relevant welfare indicators of a spatial unit. The three related components will successively be discussed.

The first component is related to *government policies*. In principle, it can be safely assumed, that measures of all policies will have impacts on cities or regions. These policies may relate to urban and non-urban fields, and may be pursued at various institutional levels (international, national, regional and urban). Hence, policies related to various fields and various institutional levels may have a relevance for spatial units.

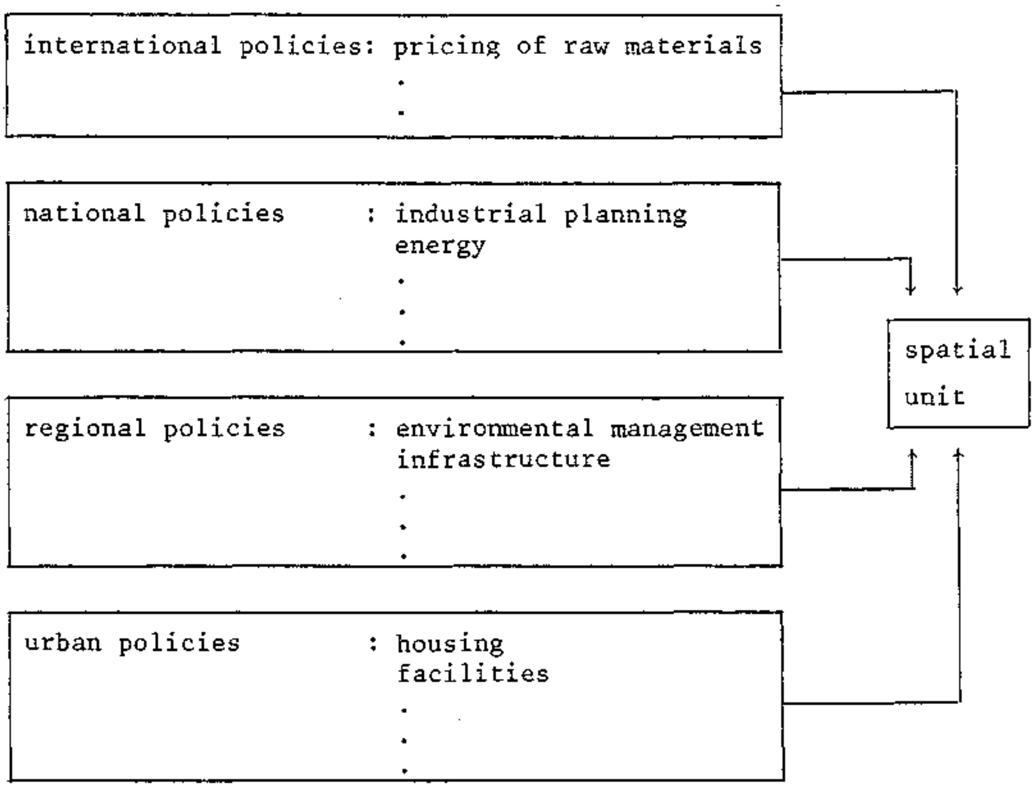


Fig. 2 Sectors and levels of spatial impact analysis

On the basis of Fig. 2, a multi-level, multidimensional vector of policies (a so-called policy profile) can be constructed (see Nijkamp, 1979).

This multidimensional profile approach is also a meaningful analytical method for dealing with various spatial units. Attention should be paid to the variety, coherence and institutional framework of the spatial unit at hand. This implies that normally economic, spatial, social and environmental aspects of the spatial unit should be included (Nijkamp, 1981). The multidimensional approach can be used to consider the wide variety of relevant aspects in a city or a region, as in such a case a certain phenomenon is characterized by a vector profile, with a set of different (multidimensional) components or attributes. For instance, urban quality of life is a multidimensional phenomenon which can only be represented in a useful way by means of a vector with such elements as the quality, size and rent of dwellings, the availability of recreation areas, congestion etc.

Finally, the impacts of all policy measures on the spatial unit at hand have to be assessed. Assuming alternative measures (P_1 .... P_J) it may be useful to employ an impact structure matrix which reflects the impacts of alternative policies on the elements (C_1 .... C_I) of the multidimensional profile of the spatial unit (cf. Nijkamp & Van Pelt, 1982).

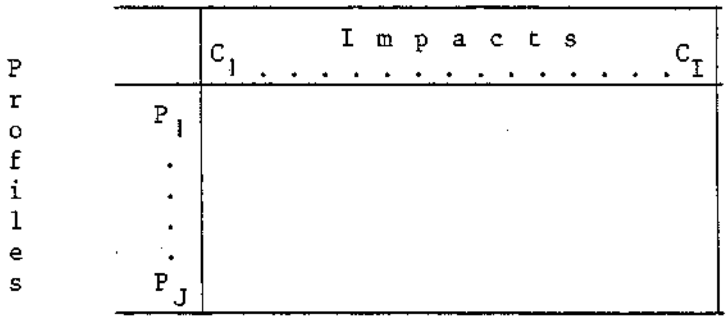


Fig. 3 An impact structure matrix

After this general exposition of the main features of spatial impact analysis, the following conditions that have to be fulfilled by an operational elaboration of the method may be mentioned (Nijkamp & Van Pelt, 1982):

- a focus on policy issues and instruments
- a complete picture of all relevant impacts
- a consistent treatment of all relevant data
- a multidimensional representation of the spatial unit at hand
- a possibility of a cross-regional or intertemporal comparison of effects
- a flexible adjustment to new circumstances
- an orientation towards the available data
- a comprehensive picture of spatial interactions
- a possibility for an effectiveness analysis of policy measures
- an orientation to prevailing institutional and political structures.

Given these methodological requirements, the question arises whether an operational and practical framework for spatial impact analysis can be designed, and more in particular for countries in the developing world. In the next section, we will first draw attention to specific characteristics of the Third World, that evoke the need of spatial impact analysis in these areas. Next, in section 4, a systems approach to spatial impact analysis, with a special view on developing countries, will be developed.

3. Spatial Impact Analysis in Developing Countries

In order to discuss the relevance of spatial impact analysis in developing countries, some attention will be paid to some specific characteristics of these countries. In many ways, the developing world shows different development paths from the western world. A different historical background, different political relationships and different internal factors contribute to some specific developments in the Third World. In regard to regions and cities, the developing world shows some tendencies that are worth mentioning.

As far as regional developments are concerned, there is a general trend in many developing countries that interregional welfare discrepancies are increasing, that infrastructure facilities are often insufficient to stimulate growth, that rural areas are becoming less able to reach their first take-off stage, that rising energy costs affect the welfare prospects of peripheral areas and that perpetuating interregional gaps in welfare reinforce the trend towards more regional autonomy (Rondinelli and Ruddle, 1978). In general, most of the developing countries are still agricultural in nature, while many rural people still face severe poverty (Friedmann & Douglas, 1975).

The cities in developing countries display also drastic developments. Whereas the share of population living in cities in developing countries is still comperatively low, the number of urban citizens is increasing very fast. The same holds true for the number of cities with more than one million inhabitants. In fact, the twelve fastest growing "million-cities" are all to be found in the Third World (Palen, 1976). Among the world's biggest cities many are also located in developing countries: Mexico City, Sao Paolo, Calcutta etc.

The large urban agglomerations face serious frictions in labour and housing markets, while also the level of public facilities appears to be far from satisfactory (cf. Chatterjee & Nijkamp, 1981). An increasing percentage of urban population is living in slums and squatters under extremely bad conditions: Mountjoy (1976) found that these percentages varied from 20 - 80%.

In regard to the labour market, Third World cities are showing increasing numbers of unemployed and underemployed people (Bairoch, 1973). A typical feature in these cities is the existence of a dual (or segmented) labour market, in which a formal sector exists next to an informal sector (Dholakia 1977, Sinclair 1978, Sethumaran 1981).

Finally, the decay in urban quality-of-life caused by pollution, overcrowding, congestion and social alienation has led to severe problems in large agglomerations in Third World countries. The absorptive capacity of cities is usually insufficient to accommodate a growing number of inhabitants.

The problems of the cities are partly a result of rural developments. The lack of facilities and job opportunities in the rural areas and the (supposed) attractive urban opportunities in big cities induce a movement of many rural people to the cities. Besides the natural growth of population in the cities, the immense immigration is substantially contributing to the overcrowding of urban areas. Todaro (1976) has developed a model in order to study the rural-urban migration processes. This analysis is an important step forward towards a more operational analysis of migration patterns in developing countries, although it could be extended in order to arrive to an even more comprehensive model (see, for instance, Rempel, 1981).

The spatial dynamics in developing countries have led to the need of appropriate policy programs, such as demographic and migration policies, rural development strategies, urban revitalization programs, industrialization programs etc. Unfortunately, many governments of developing countries are not sufficiently equipped to develop these plans or to implement them (Bhambri, 1973). The coordination and integration between different policies at various institutional levels are often lacking. Many policies are hindered by administrative frictions, mono-disciplinary approaches, lack of information, political discrepancies and shortage of trained government employees.

The problems in this field are clearly reflected in regional and urban planning. The emphasis on sector policies has led to a neglect of urban and regional dimensions in planning. Various policies have been developed without an explicit geographical connotation, although they apparently had strong spatial repercussions (like labour market policies, national energy savings programs, industrial development programs etc.) (Misra and Sundaram, 1978, Misra et al, 1974). The geographical aspects of public policies in developing countries have too long been neglected.

In view of the abovementioned shortcomings and frictions in planning, the relevance of spatial impact analysis for developing countries has to be emphasized. A systematic method, that aims at assessing the spatial dimensions of government policies, could shed more light on the coherence of policies and/or programs and could provide an integrated frame of reference for such policies and programs. For a healthy development of cities and regions a rigorous attempt has to be made to assess the relevant geographical repercussions of public policies. Spatial impact analysis offers such an integrated framework for studying the impacts of policies on cities and regions. The systematic assessment of all relevant regional, rural or urban consequences of public policies may lead to more harmonious and balanced regional and urban policy decisions. The city and the region, often neglected in the past, may hence obtain a more prominent place in the considerations of planners on various levels and in various fields.
However, the question arises whether an operational spatial impact analysis can be designed for developing countries, given the problems these countries face in the field of information and data availability. Severe shortcomings can be observed regarding information systems in developing countries. The data and information base is often very weak (see Nijkamp, 1983). Information regarding many factors (especially on a time series basis) is often lacking or otherwise unreliable. Therefore, it is generally impossible to build and employ complicated, mathematical models in order to arrive at the assessment of quantitative impacts. Therefore, a less ambitious form of spatial impact analysis, especially suited for application in situations with limited information, has to be developed. In the next two sections such a spatial impact analysis will be proposed. It will be demonstrated that - by means of a systems approach - it may be possible to use even qualitative information in the analysis.

4. A Systems Approach

In this section, a simple systems approach to spatial impact analysis is described that may be an operational tool in development planning.
This approach has the advantage of being fairly simple, while it does not necessarily require hard or cardinal information. Besides, given the need to obtain a comprehensive picture of relevant (intended and unintended) spatial effects of policy measures, a systems approach may offer a practical frame of reference for spatial impact studies.

In general, a systems approach aims at portraying the processes in a complex system that encompasses various components which are linked together by means of functional, technical, institutional or behavioural linkages and which can also be influenced by changes in parameters and controls from the environment outside the system itself (cf. Harvey, 1969, and Klir and Valach, 1967).

In this definition, three main concepts may be distinguished: controls, system and influences. In the scope of spatial impact analysis these concepts may be seen as government policies (measures), the spatial unit (city or region), and the impacts (of the measures on the city), respectively.

The approach is based on a stimulus-response method. The government policies (stimuli) create changes (responses) in the urban system. The following illustrative respresentation of the stimulus-response model may be given:

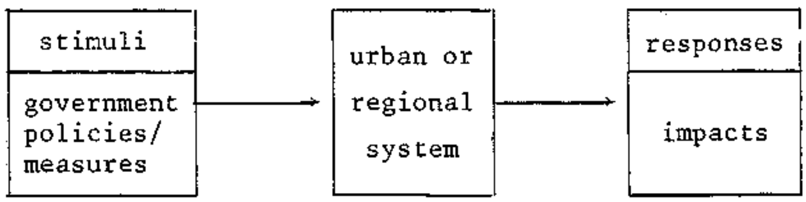


Fig. 3 A stimulus-response representation of a spatialsystems approach.

We will now draw more attention to the three abovementioned concepts, respectively.
The first topic is the government policies translated into policy programmes.

In section 2, several aspects of government policies have already been discussed. In this respect, a multidimensional profile of policy fields may be distinguished. Applications of spatial impact analysis may relate to various decision or policy problems. Firstly, it may be used for the assessment of one individual project (for instance, the construction of a large scale industrial project nearby a city) or of a set of policy measures, a programme, or a scenario (for instance, the implementation of a socio-economic plan in a region). Secondly, the application can be carried out for various alternative projects or scenario's. In the latter case, it will be interesting to make comparisons between the impacts of the alternative plans on the basis of plan evaluation techniques (see also section 5).

Next, we will turn to the relevant spatial unit (city or region), conceived of as a system. In section 2, the multidimensional profile of a system has already been mentioned. The profile contains the variables in a city or region that reflect the general position of welfare indicators in the spatial unit concerned. In a system these variables are linked together by means of causal, functional, behavioural, institutional or technical relationships. Thus, the city or region at hand is regarded as a system, characterized by the elements of the multidimensional profile. The relationships might be represented by means of a formal econometric model (see for instance Forrester, 1969 and Bertuglia et al, 1981), but in developing countries this approach is generally not applicable due to the weak information base. The other possibility, which will be explored and applied in this paper, is that the relationships are reflected by means of graphs or arrows. The latter approach is more modest, as it does not require the construction of a comprehensive spatial econometric model. In this case however, frequently only qualitative statements regarding the responses of the spatial system to policy stimuli can be made. In developing countries, with their poor information systems, the latter approach may be extremely relevant.

In general, it is useful to distinguish relevant subsystems in the spatial system, in order to examine its most important functional components.

A systems representation of a region or a city may include the following subsystems:

- an economic subsystem
- a facilities subsystem
- a demographic subsystem
- a social subsystem.

These subsystems can be distinguished for both urban and rural areas so as to encapsulate also the urban-rural duality. An example of such a comprehensive system for a region, consisting of a city and a surrounding rural area is given in figure 4.
The linkages between the urban system and the rural system are extremely important, as they draw attention to processes like migration and commuting.

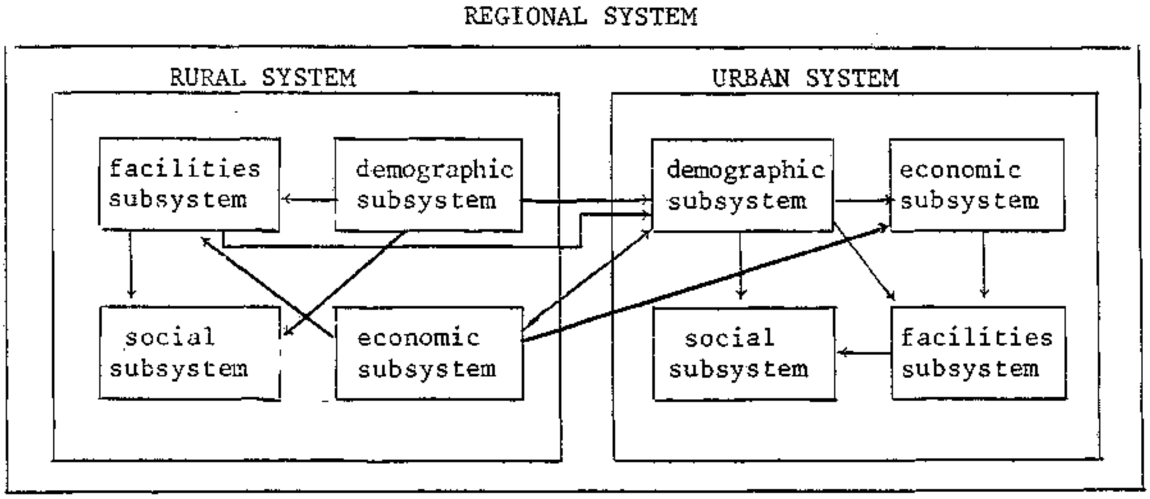


Fig. 4 An illustration of an urban-rural system

The various subsystems can be further analysed on the basis of interactions between the constituent elements. For instance, a demographic subsystem can be represented as in figure 5.

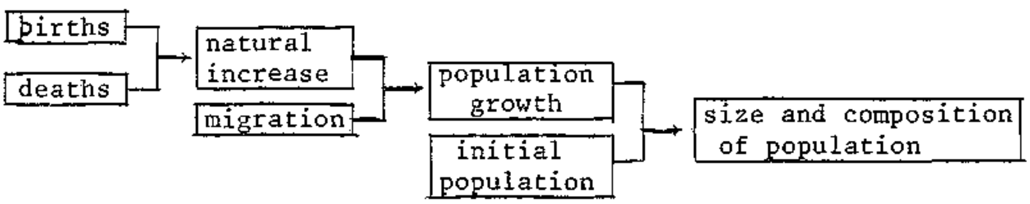


Fig. 5 An illustration of a demographic subsystem

In a similar way, all other subsystems can be depicted (Nijkamp, 1983b, Van Pelt, 1983). The degree of complexity of these subsystems usually depends on the policy objectives at hand and on the data availability. Each of these subsystems can be represented by a figure, like figure 5, so that ultimately a comprehensive, but comprehensible picture of the spatial unit concerned emerges.

It should be emphasized that the successive subsystems are not closed. There are strong mutual interactions between all subsystems.
Examples are:

- a rise in population (demographic subsystem) affects the situation on the labour market (economic subsystem)
- more medical facilities (facilities subsystem) influence the birth and death rates (demographic subsystem)
- increased migration from the rural areas to the city (demographic subsystem) may result in a decay of the social climate in the city (urban social system)
- high income differences (economic subsystem) cause more geographical mobility (demographic subsystem)

Thus these linkages have to be included as well. This may lead altogether to a fairly complex model. Clearly, in every application the question will arise as to how far the complexity of the model should be increased. In this respect, one has to trade off comprehensibility against practical suitability.

Finally, the impacts of the policies on the spatial system have to be assessed. Here, a step-by-step method may be useful. First the direct impacts are assessed, after which in the following steps the indirect impacts can be traced by following the arrows in the system. This approach can be illustrated by means of figure 6 (Nijkamp & Van Pelt, 1982).

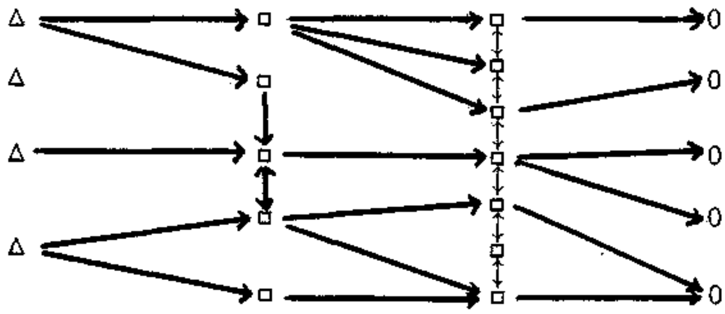


Fig. 6 A stepwise spatial impact system

By means of this figure, in which each step reflects the stimulus-response concept in a more detailed way, the step-by-step method can be clarified. In the first step it is indicated where (i.e. on which element(s) of the system) the policy measures will have their first, and usual major, impact. The relevant elements are the first-order intermediate variables; the relevant impacts can be labelled as the direct impacts. For instance, educational policy will have a first and major influence on the facilities subsystem.

Next, one has to follow the arrows in the spatial system for assessing the indirect impacts. When first-order intermediate impacts are changing, directly related other second-order intermediate elements will change as well. These impacts are assessed in the second step. In the third step, the resulting changes in other elements are assessed, and so forth.

This procedure can be repeated for higher-order impacts, until indirect impacts have become negligibly small, the information content is very unreliable, or the number of steps is fairly high (Nijkamp, 1983b). Finally, the impact matrix can be constructed (see fig. 3).

In an ideal situation, a dynamic model could enable us to relate the various impacts to time periods. This, however, will usually not be possible in developing countries. Therefore, this step-by-step method is a useful tool to assess the impacts of policy measures on a spatial system in a comparative static way.

So far, we have disregarded the dimensions of the assessed impacts. As no formal economic model could be designed to reflect the relations in the spatial system, only arrows were used. Consequently, not all of the impacts can be assessed in a quantitative cardinal way; often only qualitative statements were possible. The next section is devoted to the nature of these impacts and to a technique that may enable us to draw cardinal inferences from ordinal data. Then, the theoretical and methodological framework for an operational spatial impact analysis suited for application in Third World countries, is completed.

5. Qualitative Assessment of Impacts

Due to the nature of the spatial system at hand (in which the relationships are not reflected by a formal mathematical model, but simply by graphs or arrows), but also due to lack of data, uncertainties regarding policy measures or even lack of insight into the structure of complex urban or regional systems, the impacts can not always be gauged in quantitative terms. Often, only qualitative statements will be possible. In this case qualitative assessment methods can be useful. Such methods attempt to develop an operational framework for gauging regional and urban impacts of public policies that is oriented towards the needs and possibilities of developing countries (Nijkamp, 1983b). A qualitative assessment implies that effects are not necessarily measured on a cardinal scale.

Thus, if we turn back to the step-by-step method described in the previous section, the question of quantitative versus qualitative impacts arises primarily in the assessment of the direct impacts. During this first stage many impacts may be gauged in fairly reliable quantitative terms. For instance, the first-order impact of a housing policy may be an increase in the stock of dwellings by x units.

The next step is the assessment of the second - and higher - order indirect impacts. Although it might again be possible to gauge these impacts in quantitative terms, this will often not be the case. Then, qualitative inferences may be drawn. In order to do so, a number of options are available. When only one policy or plan is considered, ordinal, verbal, nominal or binary statements may be made, for instance, ++, +, 0, -, --, ?. These symbols mean respectively: relative large positive impact, relative small positive impact, negligible impact, relatively small negative impact, relatively large negative impact, unknown impact. Other possibilities are <u>inter alia</u> "high" or "low", or even "yes" or "no".

Ordinal rankings (1, 2, 3) may be used when comparing the impacts of a plan on the various elements of the system, or - in the case of a scenario - when comparing the impacts of the various measures on these elements.

In case of multiple projects or scenario's, ordinal statements may be very useful, as then comparisons can be made between the alternative plans. Especially in case of a comparison of the final impacts, this may be an interesting approach. The impact matrix, discussed in section 2 (see figure 3), can then be filled with ordinal rankings of the various plans.
At this point it may be worthwile to compare this impact matrix with a reference profile (Nijkamp, 1979), in which the desired targets referring to the elements are listed. The best plan may then be identified by comparing the ordinal rankings from the actual and the reference profile.

Even in such analyses, interesting conclusions may be drawn. Many practical experiences have demonstrated that the availability of qualitative information and the degree of sophistication in building complex economic models are less relevant for planning problems in developing countries. However, new developments in the area of qualitative data techniques make it even more appealing to concentrate on qualitative information. One of these techniques viz. multidimensional scaling analysis, will now briefly be discussed.

Multidimensional scaling (MDS) analysis has become a popular tool in social science problems characterized by qualitative (ordinal) data. In recent years, several applications in the area of geography, regional science and economics have been made (see for a survey Nijkamp, 1979). Scaling methods are multivariate methods aiming at reducing an ordinal data matrix to a cardinal matrix of a lower dimensionality. In a sense, scaling methods may be regarded as a qualitative factor analysis.

All scaling methods are based on ordinal (or qualitative) rankings of (dis)similarities among alternatives (e.g., items, attributes, objects or individuals). The aim of MDS methods is to identify a geometric representation of the positions of these alternatives in a Euclidean (metric) space. Then a scaling algorithm is used in order to find a consistent representation of these alternatives, so that ultimately metric conclusions can be inferred regarding the Euclidean distances between the points in this configuration.

The basic idea of MDS analysis is to reduce the ordinal information to a geometric configuration with fewer dimensions. This implies that more ordinal conditions are available than geometric coordinates are necessary. Hence, this abundant information involves many degrees of freedom that can be used by scaling algorithms to transfer ordinal inputs into metric outputs.

The geometric position of alternatives can be represented by means of Euclidean coordinates. These are determined such that the inter-point (metric) distances between the geometric positions in a Euclidean space do not contradict the original conditions implied by the ordinal input data. Thus this monotonicity condition should guarantee a maximum correspondence between the initial ordinal rankings (in terms of similarities or dissimilarities) and the Euclidean distances in a geometric space with a lower dimensionality. The technique itself of MDS analysis will not be exposed here in greater detail, but an elaborate exposition can be found in Nijkamp (1979). In the context of the present paper only an illustrative explanation will be given.

Assume the existence of N alternative plans which have to be judged on the basis of I evaluation criteria. Thus, altogether there are IxN ordinal conditions. If we want to represent the N alternatives in a two-dimensional Euclidean space, then we would need 2xN geometric coordinates (or N(N-1)/2 geometric distances). Thus, the initial IxN ordinal conditions have to be transformed into N(N-1)/2 cardinal conditions, such that there is no contradiction between the cardinal statements and the initial ordinal conditions. If I > (N-1)/2, there are degrees of freedom which may be used to arrive at an optimal fit (based on a goodness-of-fit or 'stress'-function). Once the cardinal configuration has been found, one may draw metric conclusions regarding the positions of the alternatives.

In conclusion, scaling methods aim at inferring quantitative statements from initial ordinal information. This will be further illustrated in section 8.

6. A Case Study of Urban Impact Analysis in Bhubaneswar (India)

During the year 1982, a case study of spatial impact analysis has been carried out in a country of the developing world, viz. India (Van Pelt, 1983). The case study concerned a special form of spatial impact analysis, namely urban impact analysis. The research work aimed at assessing the impact of various scenario's for government policy for one city, Bhubaneswar.

Bhubaneswar is the capital city of Orissa, a state on the eastern part of the Indian subcontinent. The city consists of two, more or less separated sections: Old and New Bhubaneswar. Old Bhubaneswar is fairly small, but it plays an important role in India due to the presence of many temples, among which the Lingeraj-Temple is the most famous. New Bhubaneswar was only constructed after 1954, after the decision to shift the capital form nearby Cuttack to Bhubaneswar.

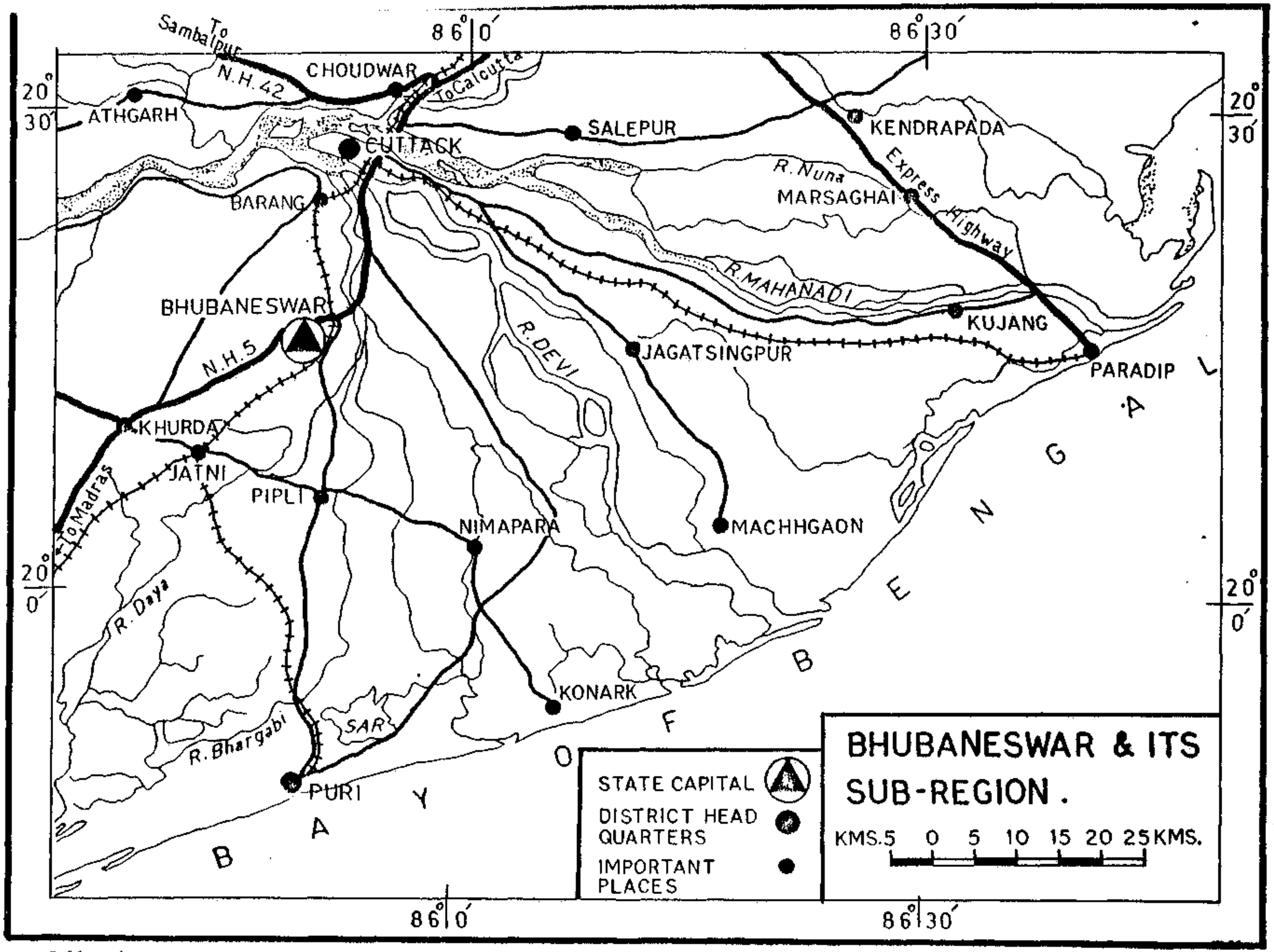
Bhubaneswar, a to a large extent planned city, was designed to accommodate 40,000 people by 1986. The latest census-figures for 1981 however, reveal that the number of inhabitants has already exceeded the level of 200,000 in the late seventies. The population has grown very fast, and it had its highest growth rates in the decade 1961-1971: 176,1%, even for Indian standards extremely high.

Bhubaneswar can be characterized as an administrative-cum-service centre. Due to its capital function, nearly half of the working population is working in government or semi-government offices, Industries have not yet come up in a significant way, though it is expected that in the near future the industrial sector will grow fast. Other sectors (commerce, trade, construction, etc.) mainly serve local demands.

The immense growth of the population, due to an influx of people from rural as well as urban areas - besides the natural growth - has caused many problems in the city. The most severe problems are concentrated in the field of housing: the housing gap could be estimated as 15.000 units in 1977, whereas there are only signs of a widening gap. Besides, the fast growing number of "slum-units" (about 15 to 20% of the population lives in these shelters) illustrate the impossibility of supplying enough shelter to the citizens. But other facilities show inadequacies as well;

especially health and education centres pose many problems for the inhabitants.
Bhubaneswar is a planned city that is facing many problems representative for other Third World cities. As many government policies (central state and local) have strong regional dimensions, an application of urban impact analysis is a potentially interesting approach. Hence, the methodology described in the previous sections has been applied. Thus, first the attention has been focussed on the selection of policy plans relevant for the city; secondly, on the construction of the integrated impact system for Bhubaneswar, and thirdly, on the assessment of the impacts of the successive policy plans for the Bhubaneswar system[1].

In regard to the policy plans, after many discussions, it was decided to choose three scenario's for regional economic policy. The region under study is essentially a greater metropolitan and rural area of Bhubaneswar: it concerns an area of which Bhubaneswar is more or less the geographical centre, and which includes cities like Cuttack (± 300,000 inhabitants) and Puri, Konark and Choudwar (all less than 100,000 inhabitants), as well as many rural villages and rural areas (see Map).



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7. A Scenario Analysis for Urban Impact Analysis

Three scenarios have been designed for the abovementioned case study. The three scenario's consisted of packages of government measures aiming at alternative desirable and feasible future developments in the economic pattern of the region up to the year 2001.

The first scenario was the Master Plan scenario, derived from the Master Plan of 1978. This scenario is more or less a conservative one, that is to say: no major changes in the economic structure of the region are envisaged. The main objectives and proposed measures are listed below.

1. Bhubaneswar will remain the principal administrative centre of the state. All government and semi-government offices still located in Cuttack should be shifted to Bhubaneswar.
   measures: The construction of government buildings in Bhubaneswar. Shifting of the offices to Bhubaneswar as soon as possible.

2. The capital function should continue to attract related administrative and "liaison" offices to Bhubaneswar.
   measures: Encouragement of this objective in various ways (premiums, provision of buildings etc.).

3. Bhubaneswar should get a limited number of small and medium sized industries, located in the northern part of the city. Choudwar, Jagatpur and Paradeep should function as the industrial centres.
   measures: Encouragement of the rise of a limited number of industries in Bhubaneswar by land allotments, tax concessions, etc. The other industrial centres should be encouraged by same measures to grow further.

4. Cuttack should remain the commercial centre. Bhubaneswar's commercial sector should only serve local demands.
   measures: Land allotments.

The second scenario is more progressive. It is envisaged that the construction of a bridge over a big river near Cuttack will favour the growth of an urban-industrial complex between Cuttack and Bhubaneswar.

This scenario includes the following objectives and measures.

1. A bridge over the Kuakhai River should be constructed.
   measures: Construction of the bridge, and improvement of the road system.

2. Between Cuttack and Bhubaneswar an industrial area should be planned. In this area, a large number of small-, medium- and large-scale industries should be created.
   measures: Land allotments.
   Stimulation of new industries by means of the varied Incentive Package offered by the Industrial Promotion & Investment Corporation of Orissa.

3. Between Cuttack and Bhubaneswar, an urban area should be constructed.
   measures: Land allotments.
   Construction of houses.

4. Government offices should only be shifted to Bhubaneswar, provided sufficient accomodation is available.
   measures: Restrictive public attitude regarding shifting these offices.

The third scenario aims at a fast development of the tourist potential of the region at hand.

1. A significant number of hotels in all classes for foreign and Indian tourists should be made available.
   measures: The construction of various hotels by the government.
   Promotion of private construction by land allotments.
   Less bureaucratic handling of building requests, etc.

2. The accessibility of tourist centres should be improved.
   measures: Construction of a road between Puri and Konark.
   Improvement of transport facilities.
   More sightseeing tours by the Orissa Tourist Development Corporation.

3. Tourist centres should be made more attractive.
   measures: The temples in Puri, Konark and Bhubaneswar should be better maintained and protected, of which a special government body should take care.
   In the cities swimming pools, golf courses, cultural facilities etc. should be developed.

4. Industries should mainly be located in the existing sites, avoiding the tourist centres.
   measures: Land allotments

In the second step of the impact analysis, a specific impact system for the city of Bhubaneswar itself has been designed. The Bhubaneswar system was extended with various regional variables in order to be able to take account of various linkages (migration, employment, etc.) that exist between the city and its rural-urban surroundings. The system itself is presented in figure 7.

For each of these three scenarios, the impacts on Bhubaneswar have been gauged in a step-by-step approach, based on the systematics of the above-mentioned spatial impact analysis, leading to the assessment of final impacts in the impact structure matrix. As the scenarios were related to a fairly long time period (1981-2001), the measures belonging to these scenarios were distributed over four five-year periods. Hence, for each of these periods the impacts of the relevant measures had to be assessed. Clearly, the reliability of the assessed impacts in the last five-year periods is less high than in previous years. The impacts were gauged mainly on a basis of qualitative, uncertain and verbal information, so that only qualitative statements could be made.

The results of the three successive scenarios are included in Tables 1-3. The assessment of the various qualitative impacts has been based on tracing the chains of successive effects from figure 7. These results provide the necessary information on long-term effects of public policies on the area at hand. The next section will be devoted to a further analysis of the successive plans.

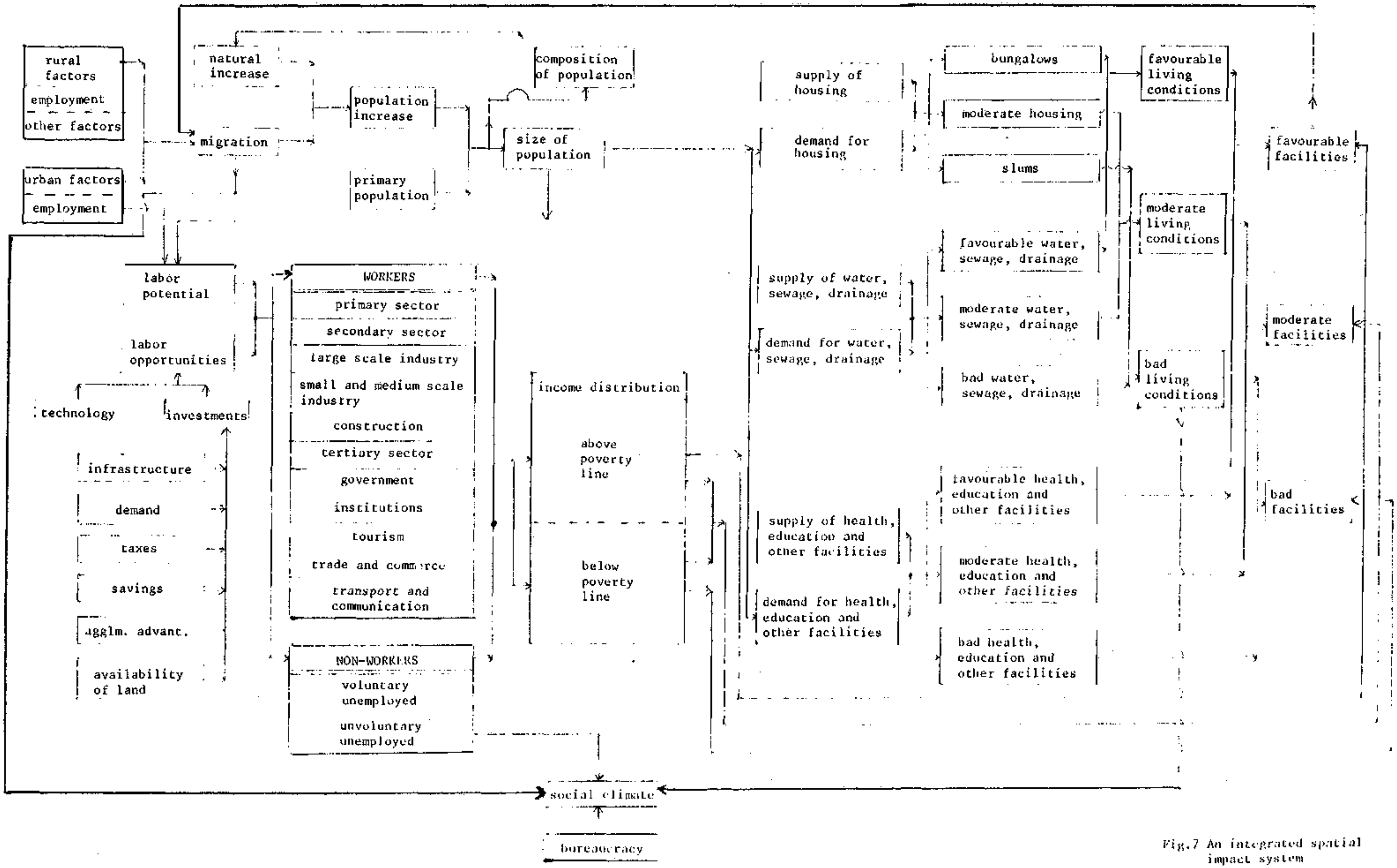

Fig.7 An integrated spatial impact system for Bhubaneswar

SCENARIO I : MASTER PLAN

	1981-1986										1986-1991									
	I	II	III	IV	V	VI	VII	VIII	IX	X	I	II	III	IV	V	VI	VII	VIII	IX	X
REGIONAL SUBSYSTEM																				
Cuttack gov. employment	-1500										-1500									
inv. bridge Cuttack																				
inv. B-C region																				
inv. road Puri-Konark																				
inv. tourism/transport																				
DEMOGRAPHIC SUBSYSTEM																				
migration/population		>6000					+++					>6000					+++			
ECONOMIC SUBSYSTEM																				
inv. industry Chandaka	++										++									
inv. industry Bhub.			++										++							
inv. construction																				
industry Chandaka		++										+								
industry Bhub.				+										+						
houses	C										0									
government		0										0								
institutions		+										+								
tourism		+										0								
commerce			+										0/+							
bridge																				
B-C region																				
road																				
inv. government	+++										+++									
inv. institutions	++										++									
inv. tourism	+										0/+									
inv. transport		++										+								
inv. commerce		++										+								
empl. industry Chand.					+4000										+3000					
empl. industry Bhub.							++										++			
empl. industry B-C reg.																				
empl. construction																				
ind. Chand.			++										+							
ind. Bhub.						+										+				
houses		0										0								
government			0										0							
institutions			+										0/+							
tourism			+										0							
commerce					+										0/+					
bridge																				
B-C region																				
road																				
empl. government					+1500	++									+1500	++				
empl. institutions					++										++					
empl. tourism					+										0/+					
empl. transport			++										0/+							
empl. commerce						++	+									+	0/+			
labor potential			++						+++				++						+++	
% involuntary unempl.										0/+										+
% underemployed										++										++
% below poverty line										+										+
FACILITIES SUBSYSTEM																				
demand for housing			++										++							
demand for facilities			++										++							
supply of housing			+7500										+7500							
supply of facilities			+										+							
housing gap										+++										+++
% slums										++										++
facilities inadequacy										+++										+++
SOCIAL SUBSYSTEM																				
social climate										--										--

Table 1. Impacts of the Master Plan Scenario[1].

1) B-C region means : Bhubaneswar-Cuttack region.

	1991-1996 I	II	III	IV	V	VI	VII	VIII	IX	X	1996-2001 I	II	III	IV	V	VI	VII	VIII	IX	X
REGIONAL SUBSYSTEM																				
Cuttack gov. empl.																				
inv. bridge Cuttack																				
inv. B-C region																				
inv. road P-K																				
inv. tour./transp.																				
DEMOGRAPHIC SUBSYSTEM																				
migr./population							++										++			
ECONOMIC SUBSYSTEM																				
inv. ind. Chand.	+										+									
inv. ind. Bhub.			+										0/+							
inv. construction																				
industry Chand.		0/+										0								
industry Bhub.				0/+										0						
houses	0										0									
government		0										0								
institutions		0/+										0/+								
tourism		0										0								
commerce			0/+										0							
bridge																				
B-C region																				
road																				
inv. government	+										+									
inv. institutions	+										+									
inv. tourism	0/+										0/+									
inv. transport		0/+										0								
inv. commerce		+										0/+								
empl. ind. Chand.				+2000										+1000						
empl. ind. Bhub.						+										+				
empl. ind. B-C reg.																				
empl. construction																				
industry Chand.			0/+										0							
industry Bhub.					0/+										0					
houses		0										0								
government			0										0							
institutions			0/+										0/+							
tourism			0										0							
commerce				0/+		0/+								0						
bridge																				
B-C region																				
road																				
empl. government				+										+						
empl. institutions				+										+						
empl. tourism				0/+										0						
empl. transport			0/+										0							
empl. commerce					+										0/+					
labor potential								++										++		
% involunt. unempl.									+										++	
% underemployed									+										+	
% below poverty line									+										++	
FACILITIES SUBSYSTEM																				
demand for housing								++										++		
demand for facilities			+7500					++					+7500					++		
supply of housing			+										+							
supply of facilities																				
housing gap									++										++	
% slums									+										+	
fac. inadequacy									++										++	
SOCIAL SUBSYSTEM																				
social climate										-										-

Table 1 (continued). Impacts of Master Plan Scenario.

SCENARIO II : URBAN COMPLEX

	1981-1986										1986-1991									
	I	II	III	IV	V	VI	VII	VIII	IX	X	I	II	III	IV	V	VI	VII	VIII	IX	X
REGIONAL SUBSYSTEM																				
Cuttack gov. employment	-500										-500									
inv. bridge Cuttack	+++																			
inv. B-C region											+++									
inv. road Puri-Konark																				
inv. tourism/transport																				
DEMOGRAPHIC SUBSYSTEM																				
migration/population		>2000					+++					>2000						+++		
ECONOMIC SUBSYSTEM																				
inv. industry Chandaka	+++										+++									
inv. industry Bhub.			+++										+++							
inv. construction																				
industry Chandaka		+++										++								
industry Bhut.				+										+						
houses	0										0									
government		0										0								
institutions		0/+										0/+								
tourism																				
commerce			+										0/+							
bridge	+																			
B-C region												++								
road																				
inv. government	++										++									
inv. institutions	+										+									
inv. tourism												0/+								
inv. transport		+++										++								
inv. commerce		++										+								
empl. industry Chand.				+6000										+5000						
empl. industry Bhub.						+++										+++				
empl. industry B-C reg.														++						
empl. construction																				
ind. Chand.			+++										++							
ind. Bhub.					+										+					
houses		0										0								
government			0										0							
institutions			0/+										0/+							
tourism																				
commerce														0/+						
bridge		+																		
B-C region													++							
road																				
empl. government				+500	+									+500	+					
empl. institutions					+										+					
empl. tourism													0/+							
empl. transport			+++																	
empl. commerce					++		+						++		+	0/+				
labor potential			+					+++					+					+++		
% involuntary unempl.									0											0/+
% underemployed									+											+
% below poverty line									0/+											0/+
FACILITIES SUBSYSTEM																				
demand for housing			+					+++					+					+++		
demand for facilities			+					+++					+					+++		
supply of housing			+7500										+7500							
supply of facilities													+							
housing gap									+++											++
% slums									++											++
facilities inadequacy									+++											++
SOCIAL SUBSYSTEM																				
social climate																				

Table 2. Impacts of Urban Complex Scenario.

	1991-1996										1996-2001									
	I	II	III	IV	V	VI	VII	VIII	IX	X	I	II	III	IV	V	VI	VII	VIII	IX	X
REGIONAL SUBSYSTEM																				
Cuttack gov. empl.	-500										+500									
inv. bridge Cuttack																				
inv. B-C region	+++										+++									
inv. road P-K																				
inv. tour./transp.																				
DEMOGRAPHIC SUBSYSTEM																				
migr./population		>2000					+					>2000					0			
ECONOMIC SUBSYSTEM																				
inv. ind. Chand.	++										++			+						
inv. ind. Bhub.			++	+									++							
inv. construction																				
industry Chand.		+										0/+								
industry Bhub.																				
houses	0										0									
government		0										0								
institutions		0										0								
tourism																				
commerce			0/+										0							
bridge																				
B-C region		++										+								
road																				
inv. government	++										++									
inv. institutions	0/+										0/+									
inv. tourism																				
inv. transport		+										0/+								
inv. commerce		+										0/+								
empl. ind. Chand.				+4000										+3000						
empl. ind. Bhub.					+											++				
empl. ind. B-C reg.																				
empl. construction																				
industry Chand.			+										0/+							
industry Bhub.						++									+					
houses		0										0								
government			0										0							
institutions			0										0							
tourism																				
commerce				0/+										0						
bridge																				
B-C region			++										+							
road																				
empl. government				+500	0/+									+500	0/+					
empl. institutions				0/+										0/+						
empl. tourism																				
empl. transport			+										0/+							
empl. commerce					+	0/+									0/+	0/+				
labor potential			+					+					+					0		
% involunt. unempl.																				
% underemployed																				
% below poverty line																				
FACILITIES SUBSYSTEM																				
demand for housing			+					+					+					0		
demand for facilities			+					+					+					0		
supply of housing			+7500										+7500							
supply of facilities			+										+							
housing gap									+										0/+	
% slums									0										0	
fac. inadequacy									+										0/+	
SOCIAL SUBSYSTEM																				
social climate										0/+										+

Table 2 (continued). Impacts of Urban Complex Scenario.

SCENARIO III : TOURISM

	1981-1986										1986-1991									
	I	II	III	IV	V	VI	VII	VIII	IX	X	I	II	III	IV	V	VI	VII	VIII	IX	X
REGIONAL SUBSYSTEM																				
Cuttack gov. employment	-500										-500									
inv. bridge Cuttack																				
inv. B-C region																				
inv. road Puri-Konark	+++																			
inv. tourism/transport	+++										+++									
DEMOGRAPHIC SUBSYSTEM																				
migration/population		>2000					+++					>2000					++			
ECONOMIC SUBSYSTEM																				
inv. industry Chandaka	+										+									
inv. industry Bhub.			+										+							
inv. construction																				
industry Chandaka		+										+								
industry Bhub.				0/+										0/+						
houses	0										0									
government		0										0								
institutions		0/+										0/+								
tourism		++										+								
commerce			+										+							
bridge																				
B-C region																				
road	0/+																			
inv. government	++										++									
inv. institutions	+										+									
inv. tourism	+++										++									
inv. transport		+									++	+								
inv. commerce		++										+								
empl. industry Chand.				+2000										+1500						
empl. industry Bhub.						+										+				
empl. industry B-C reg.																				
empl. construction																				
ind. Chand.			+										+							
ind. Bhub.					0/+										0/+					
houses		0										0								
government			0										0							
institutions			0/+										0/+							
tourism			++										+							
commerce				+										0/+						
bridge																				
B-C region																				
road		0/+																		
empl. government				+500	+									+500	+					
empl. institutions				+										+						
empl. tourism				+++										++						
empl. transport													+	+						
empl. commerce					++	+									+	0/+				
labor potential			+						+++				+						++	
% involuntary unempl.										+										+
% underemployed										+++										++
% below poverty line										++										++
FACILITIES SUBSYSTEM																				
demand for housing			+						+++				+						++	
demand for facilities			+						+++				+						++	
supply of housing			+7500										+7500							
supply of facilities			+										+							
housing gap										+++										++
% slums										+++										+++
facilities inadequacy										+++										++
SOCIAL SUBSYSTEM																				
social climate										---										---

Table 3. Impacts of Tourism Scenario.

1991-1996										1996-2001										
I	II	III	IV	V	VI	VII	VIII	IX	X	I	II	III	IV	V	VI	VII	VIII	IX	X	
																				REGIONAL SUBSYSTEM
-500										-500										Cuttack gov. empl.
																				inv. bridge Cuttack
																				inv. B-C region
																				inv. road P-K
++										++										inv. tour./transp.
																				DEMOGRAPHIC SUBSYSTEM
	>2000					++					>2000					+				migr./population
																				ECONOMIC SUBSYSTEM
+		0/+								0/+		0/+								inv. ind. Chand.
																				inv. ind. Bhub.
																				inv. construction
	+										0/+									industry Chand.
			0										0							industry Bhub.
0										0										houses
	0										0									government
	0										0									institutions
	+										0/+									tourism
		0/+										0								commerce
																				bridge
																				B-C region
																				road
++										++										inv. government
0/+										0/+										inv. institutions
++										++										inv. tourism
+	0/+									+	0									inv. transport
	+										+									inv. commerce
			+1000										+500							empl. ind. Chand.
					0/+										0/+					empl. ind. Bhub.
																				empl. ind. B-C reg.
																				empl. construction
		0/+										0/+								industry Chand.
				0										0						industry Bhub.
	0										0									houses
		0										0								government
		0										0								institutions
		0/+										0/+								tourism
			0/+										0							commerce
																				bridge
																				B-C region
																				road
			+500	+									+500	+						empl. government
			0/+										0/+							empl. institutions
			++										+							empl. tourism
	0/+										0	0								empl. transport
				+	0/+									+	0/+					empl. commerce
		+						++					+					+		labor potential
									++										++	% involunt. unempl.
									++										+	% underemployed
									++										++	% below poverty line
																				FACILITIES SUBSYSTEM
		+						++				+						+		demand for housing
		+						++				+						+		demand for facilities
		+7500										+7500								supply of housing
		+										+								supply of facilities
									++										+	housing gap
									++										++	% slums
									++										+	fac. inadequacy
																				SOCIAL SUBSYSTEM
									--										-	social climate

Table 3 (continued). Impacts of Tourism Scenario.

8. A Comparison of the Impacts of the Scenarios

On the basis of Tables 1-3 some interesting conclusions relating to the various impacts of the scenarios can be drawn. It appears that a choice in favour of a specific regional plan is of great significance for Bhubaneswar. Different choices would imply different developments of the area concerned.

For instance, an adoption of the Tourism-scenario would imply a perturbation of the general climate in the city, whereas the implementation of the Urban-complex scenario would result in a relatively stable development, at least in the last two five-year periods.

Comparisons between the three scenarios may be made for all elements of the system for each of the four five-year periods. In the context of the present paper, however, only a final comparison based on the final impacts over all five-year periods, will be made.

For a number of selected elements, the ordinal ranking of the scenarios according to their final impacts has been assessed. It has to be emphasized that due to the qualitative and sometimes not fully reliable nature of the impacts assessed in the various time periods, the ranking of the final impacts may only be regarded as a tentative operation. However, the available data base does not allow more precise statements.

The rankings of the final impacts are presented in the following impact matrix (see Table 4).

Impacts	Master Plan Scenario (I)	Urban Complex Scenario (II)	Tourism Scenario (III)
1. migration/population	3	1	2
2. empl. industry	2	1	3
3. empl. construction	2	1	3
4. empl. government	1	2	2
5. empl. institutions	1	2	2
6. empl. tourism	2	3	1
7. empl. commerce	2	2	2
8. empl. transport	2	1	2
9. % invol. unemployment	2	1	3
10. % below poverty line	2	1	3
11. supply of housing/facilities	2	2	2
12. demand for housing/facilities	3	1	2
13. housing gap	3	1	2
14. % slums	2	1	3
15. adequate facilities	3	1	2
16. social climate	2	1	3

Table 4. Ordinal impact matrix [1)]

1) The ordinal rankings have the following meaning:

1. highest positive impact
2. moderate positive impact
3. lowest positive impact

On the basis of this impact matrix, the multidimensional scaling method discussed in section 5,has been applied. The results are presented below in figure 8.

The results indicate clearly that the three qualitative scenarios have significant metric differences. Their scattered pattern indicates that the impacts of these scenarios are very dissimilar. The Master Plan Scenario (I) is very much oriented to the fulfilment of objectives regarding employment in government (4) and in institutions (5), and to a lesser extent in employment and industry (2) and construction (3), involuntary employment (9), urban poverty (10), slums (14) and social climate (16). The Urban Complex Scenario (II) appears to address especially targets regarding employment in transport (8), and to a lesser extent targets regarding employment in industry (2) and in construction (3), involuntary employment (9), urban poverty (10), slums (14) and social climate (16). Finally, the Tourism Scenario (III) places much emphasis on objectives concerning employment in tourism (6), and addresses also targets regarding commercial employment (7) and supply of housing and facilities (11).

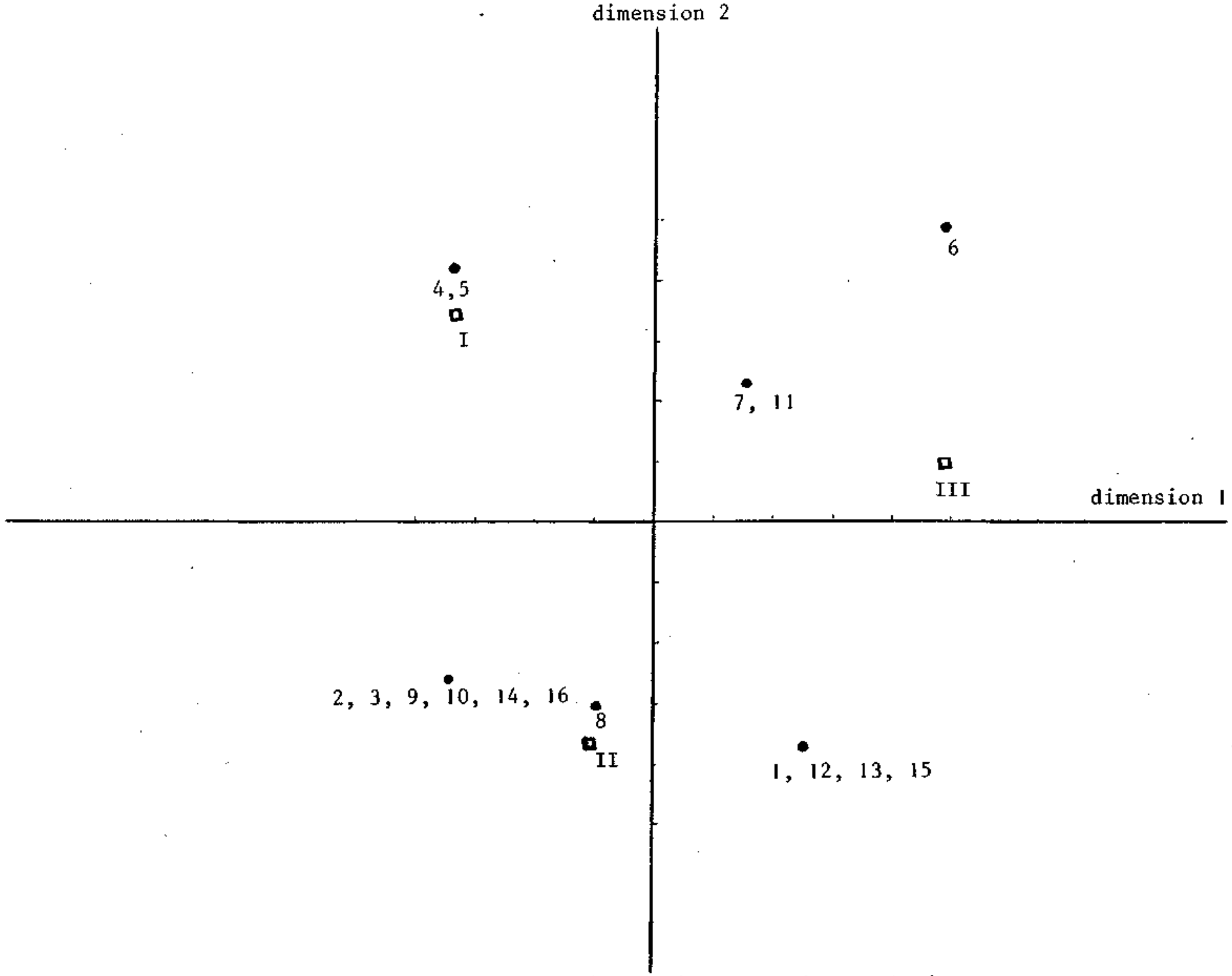

Figure 8. Results of a multidimensional scaling analysis (impacts: 1, ..., 16; scenarios: I, II, III)

9. Conclusion

In the foregoing sections, a methodological framework for spatial impact analysis was described, as well as a case study of urban impact analysis in India. It appears, that spatial impact analysis, on the basis of a systems approach, may be a very useful tool for policy analysis in developing countries. First, it draws attention to direct and indirect, intended and unintended impacts of government policies which makes it a potential instrument for urban and regional planning. In this respect, the neglect of the spatial dimensions of cities and regions may to a certain extent be avoided. Secondly, spatial impact analysis need not necessarily be an expensive, long-lasting research effort that will only increase the costs of regional and urban policies. The case-study proved that even an relative outsider in relation to the local situation can carry out a spatial impact analysis in a reasonable time period at very low costs. Thirdly, the possibility of including in this method both quantitative and qualitative information gives it an advantage over many other methods which (partially) failed during applications in the Third World because of its quantitatively-oriented methodology. However, it should be noted that a minimum quantity of information and knowledge is necessary in any case.

In conclusion, spatial impact analysis may be helpful in urban and regional planning in developing countries with a weak information and data basis. It may favour the coordination of national, regional, rural and urban policies. The general form of the method may be extended with various qualitative assessment methods, making the results more useful in practical planning. In this regard, spatial impact analysis may provide a useful contribution to an operational policy analysis in developing countries.

1) Data sources for Bhubaneswar case-study

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