S2803

UNITED NATIONS
ECONOMIC
AND
SOCIAL COUNCIL

Distr.
LIMITED

E/CN.14/CAP/22
29 August 1967

Original: ENGLISH

ECONOMIC COMMISSION FOR AFRICA
Conference of African Planners
Second session
Addis Ababa, 4-15 December 1967

CARTOGRAPHICAL METHODS FOR ASSISTING IN PROJECT IDENTIFICATION

M67-1044

TABLE OF CONTENTS

I. Planning and location policy

Location policy is one whose aim is the rational distribution of economic activity over a given country or territory; it is thus an integral part of general economic policy. Every development plan and each project must answer not only the question of "what to build" but also its corollary "where to build". Anyone who has worked with development plans and their implementation is aware of the vital importance of both questions. It should be added that errors in location policy have one outstanding characteristic: once implemented, they are almost irreversible. Fiscal policy or the pattern of management may be altered swiftly but a plant that has been already built cannot be dismantled without incurring heavy losses.

Location policy aims:

- to achieve the most rational (most economical) territorial distribution of economic resources and thus facilitate the solution of general economic problems;

- secondly, to provide rational development of a country's regions (provinces, municipalities) on the basis of their specialization, thus assisting in the solution of their social problems (housing, employment, etc.)

In all African countries, irrespective of their stage and level of economic development, territorial distribution of activities is of vital importance because the prevailing pattern of their distribution is extremely unequal. One of the features of most African countries is the concentration of industrial and infrastructural activities in capitals or ports while other areas are neglected, and which hampers the harmonized expansion of the entire country and its resources.

That is why each comprehensive development plan includes, as a rule, a special part dealing with regional development and project location.

Location policy is explicitly evidenced in the process of project identification. Each area has different conditions according to its

natural resources (water, soils, minerals, etc.), transport facilities, energy supply, manpower resources and other so-called locational factors. Locational factors of an area expressed in quantitative terms represent its locational characteristic. It is not sufficient to know, for example, that a given area has "much" or "limited" water resources, but it is vital to know exactly how much cubic metres per second (per day, per year) may be extracted for the project being identified; what are the costs of a cubic metre of water supplied, what are the seasonal differences, etc.

A schematic chart of locational characteristics is given below:

		Location characteristics of areas		
		Area A	Area B	Area C
Man-power	skilled	250	50	not available
	unskilled	1,500	2,000	2,500
Mineral resources		Coal, 500 mn. tons deposits, output 2,500 tons a year at a cost $100 per ton	not available	Salt, 50 mn. tons deposits, not exploted
Water resources		1.5 cubic metre per second at a cost of 0.2 cent per cubic metre	2.5 cubic metres per second at a cost of 0.1 cent per cubic metre	3 cubic metres per second at a cost of 0.2 cent per cubic metre (rain season) 0.5 cubic metre per second at a cost of 0.3 cent per cubic metre (dry season)
Energy		25 MW, 120 mn. kWh a year, 1.5 cent per 100 kWh.	not available	12.5 MW, 50 mn. kWh a year 2.5 cents per 100 kWh

It should be emphasized that knowledge of locational characteristics is mandatory for the implementation of a coherent location policy and regional development.

II. Collection of statistical data for analytical maps

The main methods for the analysis of statistical data are their tabulation and graphic representation. As for locational characteristics, they may be analysed very effectively by means of mapping, and the proper economic map may be an excellent devise for improving and even determining location policy.

Statistical data devoted to cartographical analysis should be:

(1) "geographical", i.e. related to a given area, city, village, etc.;

(2) "simultaneous", i.e. collected for a given year, and not for different years for different areas;

(3) presented on the same basis; for example, it would be wrong to show the power plants on the energy map partly in MW, partly in kWh.

III. Cartographical methods for analysis of statistical data

There are many special methods for coding on the maps and for cartographical analysis of economic phenomena, among which may be mentioned:1/

(a) Symbol method

In economic mapping, the symbol method is widely used because of its simplicity and geographical precision: each object in reality has its own symbol (sign) on the map, and similar objects are shown by the similar symbols in proper scale. This method is used mostly for coding of cities, towns, villages, plants and mills, power plants, mineral deposits and mines, transport routes, etc.

It is important, while mapping, to secure the proper scale of symbols. Two types of scales are used: absolute scale and class interval scale.

Absolute scale indicates differences between the objects proportionally: the symbol of a 250 MW power plant is shown five times as large as that of 50 MW and ten times as large as that of 25 MW. When class interval

---

1/ All methods will be demonstrated by special maps.

scale is employed, one determines the classes of the objects (for power plants such classes may be: less than 10 MW; from 10 to 25 MW; from 25 to 50 MW, etc.) and codes each of them according to the class to which it belongs. This method observes only the order when the larger symbol corresponds to the larger object, if not proportionally. The choice of type of scale depends on the character of phenomenon to be coded on the map.

The symbols may be developed by supplementary features, i.e. dimensions of symbols may reflect the capacity of power plants, and the colour (shading) of symbols, the type of the primary energy source (hydro, coal, oil, etc.).

(b) Non-quantitative areal distribution

This method is applicable for demonstration of the areal distribution of so-called "space phenomena", i.e. areas under crop, dispersed mineral deposits, etc. The areas where a given phenomenon is observed are shaded or coloured on the map. The map shows the approximate distribution of the phenonmena without taking into account the density of distribution. This method may be used in a negative way, marking the areas where a given phenomenon does not exist or where its location is impossible for any reason.

This method is widely used for agricultural mapping.

(c) Dot method

The areal distribution method shows the selected space phenomenon only qualitatively, and separates the areas where this phenomenon exists from those where it does not. The dot method which is used also for space phenomena gives a quantitative picture of its distribution, since each dot is adequate to a selected scale quantity. For example, each point may represent 100 ha of crops (agricultural map), 1,000 persons of population (population map), etc. It is obvious that the areas where the phenomenon is observed more densely will be reflected on the map by the increased density of points.

(d) Choropleth maps

If an analyst desires to observe the change of any economic phenomenon from one area (province, municipality) to another, he may colour or shade these areas and which will correspond to its intensiveness. It may be population density, per capita income, capital/output ratios and other relative data. This method is never used for absolute data.

The question is, which cells of a country should be taken for choropleth mapping. Statistical data are usually available by certain administrative divisions (provinces, townships and others). That is why the simplest way to make a choropleth map is to code the phenomenon according to the existing administrative divisions. If other divisions are taken (for example, square cells in Resources Allocation Method), special work for data collection should be undertaken.

(e) Diagrammic maps

If the analyst desires to investigate some structural or temporal phenomena in their regional aspect, the diagrammic maps can be used for this purpose. In this method, each cell of the country (province, municipality, area) receives its own diagram (for example, the circle which corresponds to total output, divided by the sectors which correspond to different branches of industry). This method is applicable by demonstration of two or more features, describing the phenomenon form different facets (for example, one column may correspond to the total yield of cotton, other to the yield per hectare), or in different years (the first column for the base year of the plan period, the second for the end year).

(f) Isogram method

Isograms[1] are lines on a map which connect places of equal density or value of distribution of a given phenomenon. Isograms are used often for population maps where each isogram connects the points with the same density of population. Isograms are used also for equal-cost distance maps which show how far goods can be transported from a given point for

1/ Some authors use other terms: isopleths, isarithms, isolines.

the same money in which case the isograms are called "isophods" or "isovalents".

(g) Epures

This is a specific method for coding of dynamic phenomena (migration, transportation, etc.). On the transport map, for example, epures are those stripes which follow the transport routes and show the direction of traffic, the quantity, and, if necessary, the structure of commodity flows, as well as pinpoint the capacity of transport routes and its utilization.

These are the main cartographical methods for analysis of statistical data which can be used not only in isolation but in different combinations. The main task however is:

- to choose the proper method (or methods) for mapping the given phenomena;

- to choose the proper cartographical scale in order to prevent visual distortion;

- to eliminate secondary phenomena so as to prevent overcrowding of the map which diminishes its utility;

- to choose the proper class of territorial division of the country (provinces; municipalities or other sub-divisions; square cells, etc.).

IV. Several cartographical methods for project identification

It should be recalled that cartographical methods are not absolute for project identification, and it would be erroneous to expect that they could answer all questions for the planners. What they can do, however, is to answer certain types of questions:

1. The choice of the most rational, (from the social and economic view points) place of project location;

2. Several side-effects of the project (for example, the zone of flood after the construction of the dam, zone of economic activity after construction of the railway);

3. In several cases, the scale of enterprises (combining with other methods of calculation, the cartographical methods may show, for example, that instead of a single worshop of £3 million it will be more economical to construct three for £1 million in three different places);

4. The most rational or the most probable directions of regional development if only qualitatively.

For project identification by means of cartographical methods one should have not only locational characteristics of the area, but also locational determinants of a given project. Each project has its own locational specifications (its requirements to the quantity and quality of manpower, to energy, to raw materials, to water, etc.) which are its locational determinants. As an example, locational determinants of the nitrogen fertilizer plant (on the natural gas basis) are given:

Locational factors		Locational determinants
Manpowor:	skilled unskilled total	98 85 183
Production (i.e. transport requirements)	Ammonia nitric acid ammonium nitrato	150,000 tons a year 280,000 tons a year 345,000 tons a year
Gas requirements		240,000,000 cubic metres a year
Energy		344,000,000 kWh a year
Water		113,850,000 cubic motros a year (0.4 cubic metre per second)
Building site		8-10 ha

Each project has many determinants, but it is unnecessary to take into account all of them, since for each project the so-called "critical determinants" may be selected. For example, for the above-mentioned nitrogen fertilizer plant such critical determinants are availability of gas and water. Selection of critical determinants depends, of course, on the general conditions of a given country: for some countries even skilled manpower may be a critical determinant particularly so in the developing world where the manpower constraint has attained such gigantic proportions. The location determinants of the project may be compared to a key; and the locational characteristics of the areas - to the locks, and hence to choose the best location for any project is to find the lock which corresponds to the key.

The following methods are suggested for project identification.

(a) The method of elimination. This method corresponds to the initial stage of analysis. It consists of elimination of the areas where the project cannot be located under any conditions. It is very convenient to implement it, by using only the critical determinants. For the nitrogen fertilizer plant, for example, all the areas lacking sufficient water resources (0.4 cubic metres per second) may be eliminated, as well as the areas lacking gas or those which cannot be reached by gas pipeline. It is known, further, that the areas with a rainfall of less than 110 mm (40 inches) are generally alien to agriculture except through irrigation facilities. The more critical determinants are taken, the less will be the territory of probable location, and which will serve to simplify the analysis for the subsequent stage.

(b) The feasibility study method. This is the most widespread method when the choice of location for a single project is to be achieved. All the locational characteristics corresponding to the locational determinants of a given project are coded on a map. Attention should be focused on each type of locational factor: centripetal and centrifugal. The first set of factors embraces those which ensure the technical life of the enterprise (input factors: raw materials, water, energy spare parts, manpower, etc.); the second set takes into account marketing arragements and all the side-effects of the project, e.g. waste and pollution.

It is not rare to discern that the "best place" for a given project based on "centripetal" factors do not harmonize with "centrifugal" considerations. The final decision will take into account both types of factors.

The feasibility study map permits the planner to choose the most probable places for location of the project being identified. One may be sure that after the processes of elimination and feasibility study, the number of such places will be very limited, and that exact calculations for ultimate decisions will be facilitated.

(c) The complex method. This method may be used for obtaining some general decisions on location policy and regional development. For this method are necessary:

- a basic map of the country showing general geographic elements both natural and human (shore, rivers, lakes, mountains; frontiers, cities, transport routes; civil divisions);

- a set of auxiliary maps on transparent paper, each of them devoted to a single locational factor.

This method permits the aggregation of different maps in the combination desired and accelerates the pace of analysis for any given project. A proper combination of sectoral maps assists in the selection of poles of industrialization, determination of the pattern of development of the economic region and determination of general trunk routes to be built in a period envisaged.

It is evident that the divisions (cells) of the basic map and auxiliary ones must be identical.

V. Approximate expenditure for cartographic unit

The cartographic team (unit) attached to the planning body may consist of:

- a professional cartographer with university or post-graduate degree (chief of the unit);

- 1-2 technicians (university or technical school);

- 3-4 draughtsmen (technical school).

The cost of the cartographical unit may differ from country to country depending on the size of the planning commission, the character of planning and, of course, on attention given to mapping. It is foreseen that printing and reproduction of maps will be done by standard printing houses which exist in the country.

For the first year, the expenditure may be (in $)1/

- equipment and materials	10,000
- printing	5,000
- adviser from abroad	20,000
- salary	15,000
Total	50,000

It is foreseen also that the cartographic unit initiates work with a limited staff (say, a chief of unit, a technician and two draughtsmen).

For the next years:

- printing	5,000
- renovation equipment and materials	2,000
- salary	25,000
Total	32,000

It should be added that in a country which has already established a mapping service the incurred costs of special cartographic work for planning will be less than estimates given above.

It is difficult, of course, to determine exactly the efficiency of the work and the above-mentioned expenditure. The main result of the work may be reflected in improved planning and in raising the scientific level of planning. Besides, the cartographical unit may have its own publishing facilities which would ensure a partial return by the sale of its maps to its original expenditure.

1/ Based on some experiences in African countries.