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FORECAST OF INDUSTRIAL WATER DEMAND IN THE CONTEXT OF REGIONAL PLANNING: EXPERIENCE IN ITALY

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SYNOPSIS

Regional planning has become a necessity because of the scarcity of available resources which have to satisfy the increasing demand. Only through planning is it possible to distribute the resources among the competing requirements. Not even industrial demand can be seen in isolation.

The present article describes two examples of planning in Italy in which the authors took part. The description concentrates on the study of the group of experts on industrial demand, which was used as an input of the regional planning mathematical model.

RESUMÉ

La faiblesse des ressources disponibles au regard des besoins sans cesse croissants rend désormais indispensable la planification régionale. Seule la planification permet de répartir les ressources entre les différentes demandes en lice. Les besoins industriels non plus ne sauraient être examinés isolément.

Le présent article illustre deux exemples de planification en Italie, auxquels les auteurs ont prêté leur concours. Il met l'accent sur l'étude que le groupe de travail a fait porter sur la demande industrielle et qui a servi d'input pour le modèle mathématique de la planification régionale.

RESUMEN

En vista de la escesez de los recursos disponibles para cubrir una siempre mayor demanda, la planificacion regional es actualmente indispensable. Solo mediante la planificacion ce logra distribuir los recursos entre las diversar exigencia. Ni siquiera la planificacion industrial puede ser vista aisladamente.

Este articulo ilustra los ejemplos de planificacion en Italia a los cuales han contribuido los autores. La ilustracion trata sobre el estudio hecho por el grupo de trabajo sobre la demanda industrial y que sirvio come input para el modelo matematico de la planificacion regional.

1. REGIONAL PLANNING

Today water is one of the primary resources which, in relation to the utilizations, are becoming scarcer and scarcer and, consequently, can no longer be considered as free public goods, inexhaustible and "without cost".

This is mainly due to the increasing and indiscriminate use of it by man, particularly in agricultural and industrial activities, which, in the absence of a scale of charges based on the equality between marginal social cost and price, leads to a misallocation of the resources and, as a result, to the progressive and rapid qualitative and quantitative impoverishment of both the surface and underground supply sources.

The foreseeable increase in industry's water requirement will therefore have to be met both by making available new supply sources, and by rationalizing its utilization through the use of more advanced recycling technologies, or by a different allocation of the available resources among alternative and competing uses.

Planning of the resources is possible only on the basis of a global view of the resources and of the demands. Systems analysis offers useful tools for regional planning by means of mathematical models.

Mathematical models express the physical and political constraints of the system and seek an optimal solution of the objective set. The planner can intervene in the model both with the constraints and with the objective, and, by means of the model, he can "measure" the effects of such interventions: cost of a constraint, effect on the solution of a modification of the objective.

The construction of a mathematical model requires the cooperation of experts in the various disciplines involved. This multi-disciplinary approach offers the guarantee of a complete examination of the situation from every point of view. In the present article the sector concerning industrial demand is dealt with. The work of this sector does not present a separate result, but one which forms part of the inputs of the mathematical model.

In what follows, a description is given of the study of the industrial demand of two regional plans in Italy: the pilot project of the Arno in Tuscany, and the water resources plan in Emilia Romagna.

The two plans present considerable differences. The first is concerned with a basin entirely contained in the Tuscan Region; the basin represents (in terms of industrial potential) 80 per cent of the Region. In this plan, flood protection (the disastrous flooding of Florence in 1966 must be remembered) has an important role. The other plan, that of the Emilia Romagna Region, is concerned with a series of artificially interconnected rivers that flow into the Po or into the Adriatic Sea. In this Region agriculture is highly developed. It already consumes over half the available water resources, and this consumption is tending to increase both in volume and in percentage of the total.

2. ARNO PILOT PROJECT

Evaluation of the industrial water requirement is one of the most delicate and also one of the most uncertain elements in the programming of the multi-purpose and multi-functional water uses of a basin. Moreover, it has a quite special importance in the case of the Arno basin. In fact:

- the objective of territorial re-equilibrium assumes the realization of systematically equipped industrial areas, for which the availability of water resources assumes a strategic and priority role;
- the high degree of scattering of the industrial settlements over the territory makes it necessary to have a quantitatively adequate collection/distribution water system, but one which can permit operating costs compatible with competitivity needs;
- the preponderance of small-medium size local units considerably reduces the possibility of having supply, recycling, treatment and discharge plants at the level of individual factories, so that larger-scale works have to be provided.

The available data are fragmentary and their reliability is doubtful because of the absence of systematic statistics (in particular time series) on the use of water in industry, the great variability of the industrial water consumptions in relation to the technologies employed, and the possible influence of water concession and price systems.

Because of these deficiencies and the impossibility of carrying out direct investigations (for example, by flow measurements, factory enquiries, expert interviews with plant officials or technicians, etc.), 'indirect" evaluation criteria were adopted, as regards both the present water utilizations and the foreseeable future uses.

The calculation method employed for evaluating the consumption amounts consists of the product of suitable specific consumption coefficients, determined for the various industrial sectors by a variable parameter.

This procedure therefore required:

(a) the definition of the parameter;

(b) the definition of the specific water consumption coefficients for the different industrial types.

All the considerations made about the two factors, available data and possible forecasting methodologies, made it necessary to adopt, for the present and future estimates of the water consumption, a parameter referred to number of employees.

The coefficients available as basic data refer to discharge values; it proved necessary to make both an aggretation of them according to the specific industrial structure of the activities present, and further conversion to consumption values.

For the future estimate of the industrial consumptions referred to the Arno basin, it was considered that the most reliable prospective estimate of these parameters could be based on the information criterion briefly described below.

Assuming that the techological evolution of the various industry sectors will proceed in Italy (and therefore in Tuscany/Arno Basin) according to a similar trend to that in the most industrialized countries, as a reference picture the dynamics of the water consumptions in the USA, broken down by activity classes, was chosen.

Linear approximation proved to be the "best" interpolation of the USA consumption coefficients at the various years, as it yielded more than satisfactory results in every case.

The methodology in no way implies the assumption of absolute data similar to those recorded in the USA. The only thing implicit in the procedure is the assumption that the direction of technological progress at sector level will be similar.

Putting therefore y_o = base coefficient 1971, the values corresponding to the different time targets, y_t (with t = 1981, 1991, 2001 respectively), are obtained by applying the equation
$y_t = y_o + b \cdot \Delta x$, where $\Delta x = t - 1971$, and b = a regression coefficient

The value given to water for industrial use in terms of "accounting" (shadow) price in computed in function of the planned re-equilibrium of industry within the Region. This price is used in the benefit analysis.

Therefore, favorable "accounting" prices are use in the areas where industrial activities are incentivated. This allows the "routing" of water resources in function of the planned re-equilibrium.

However, it must be said that water as a factor is rather marginal in respect of other factors that compose prices of industrial products. Therefore the said method can not be used to determine re-equilibrium policy.

3. EMILIA ROMAGNA WATER PLAN

The investigation of the industrial sector water consumptions was carried out by combining an examination of the principal existing bibliographical reference with a series of interviews in engineering offices and University Institures, and with experts in the sector, as well as a field investifation of a sample of over 150 factories.

The first problem of forming the "categories" picture was tackled by establishing a group of 26 categories which have the characteristic of being either very large water users, although with a presence on the territory that may be limited, or users with a smaller unit consumption but which occupy a very large area. A group formed in this way can be considered responsible for about 80 per cent of the industrial water consunmption.

(a) The bibliographical research was useful for obtaining a deeper general knowledge of the alternative technologies and of the cycles employed.
An examination of writings dealing with the use of water in industry reveals the limits of a treatment organized by large production classes and not by categories. This is an obstacle that makes it impossible to correlate the unit consumptions with the distributions of employees furnished by the National Statistical Institutes.
It may be affirmed that, at the design level, water is not always considered as a resource conditioning the solutions proposed, in the way that other consumptions (electricity, fuel, etc.) are.

(b) The field investigantion, apart from the necessary checks, provides the most important element of the picture when it reveals, within the same category, different utilization degrees of the resource depending not only on the cycles employed, but also on the size and often on the location of the factory.
The extraction of the significant sample highlighted considerable difficulties, not only because of the need to represent different factory sizes within the same category and significantly cover all the districts of the Region, but also because "activities" that are rather different as regards cycle, raw materials, and end product are put into the same "category".
Moreover, as the reference index with which to correlate the consumptions is number of employees, it is not possible today, for the purpose of a summary investigation, to go below the "category" level.
It follows that in general the standard reconstructed on the basis of a sample survey is greatly affected by the characteristics of the sample.
A comparison between the estimates of the sample and the few investigations available shows differences. The value of the research carried out is that it made it possible to define a credible order of magnitude by means of the consumptions.

The consumption standards are obtained as average values on the information collected for the category and are referred to the employees. They range form 140-150 m^3/employee x year to over 29,000 m^3/employee x year.

The total water consumption in stationary conditions amounts to about 560 million m^3/year, 130 of which come from the sea, while the rest come from ground-water (65-70 per cent) and surface water (30-35 per cent). The consumption forecast at 1986 are based on hypotheses formulated about the trend of three parameters: size of the industry in terms of employees, increase of productivity, and increase in water savings through the introduction of techniques requiring less water.

As regards the possible water saving, granting that technological progress may bring this value to 30-35 per cent at 1986, it is not possible to foresee decisive conditions involving a massive resort to such techniques in the near future.

In fact, as the cost of water is not such as to provide an incentive for increasing the profit margin through savings, the bulk of investment in the next few years will most likely continue to be devoted increasing productivity.

On the other hand, the wastes management costs borne by some categories today are such as to encourage the adoption of saving technologies. Indeed, the action of keeping down the volume of wastes seem to be the best way to induce the regional industry to reduce its consumptions.

To conclude, it is forecast that the water demand for industrial uses will be, at 1986, over 950 million m^3/year, 220 of which from the sea, with an increase of the remaining part of about 70 per cent compared with 1975.