AGRICULTURE AND ENVIRONMENTAL QUALITY:

TOWARD A COHERENT POLICY*

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There are many programs in existence today which have the intent of influencing the supply and demand for agricultural products, and reducing price and income uncertainty. Price support programs originated in 1933 with the passage of the Agricultural Adjustment Act which at that time was aimed at restoring the purchasing power of agricultural commodities. This goal became known as parity, where the term parity comprehends an equality of exchange relationship between agriculture and industry or between persons living on farms and persons not living on farms (Rasmussen and Baker).

Price supports, supply control, soil conservation, export and trade restrictions are all designed with the farmer being the primary beneficiary. Price support policy has the most direct and obvious impact on the acreage and the type of crops grown. Lidman and Bawden found that agricultural programs had exerted a significant influence on the acreage of wheat planted since 1933. Their analysis showed that the area of wheat planted had been responsive to loan levels, to acreage allotments and to direct payments. Houck and Ryan found that 95% of the variation in U.S. corn acreage during 1948-70 was associated with selected policy variables, including price support rates and loan rates. Price support programs also influence expectations. In the absense of binding acreage allotments, Weaver _et_. _al_. showed that a 10% increase in the expected price for spring wheat would cause the planted spring wheat area to increase by 8-11% in the Dakotas.

The rate at which our soil, water and energy resources are being utilized in the production of food is influenced by agricultural policy. Policy affects the quantity and quality of these resources when viewed as inputs, it also influences the extent and the magnitude of externalities associated with agricultural production. Some residuals, such as phosphorus, accelerate the eutrophication process; others, such as pesticides, may accumulate in the ecosystem creating conditions that are toxic to biota.

The continued and increasing use of the environment's assimilative capacity as a sink for the discharge of residuals represents a real income transfer away from those members of society deriving consumption and production benefits associated with higher levels of environmental quality (EQ). This transfer is due to the failure of our institutions to produce the signals necessary for correcting the socioeconomic imbalance that exists between and among users of the environment. This state of affairs will persist until the problem is perceived as a social issue. EQ was not perceived as a social issue until the mid-1960s in the United States. People became aware that the assimilative capacity of the environment was not inexhaustible in supply and that increased industrialization, agricultural production and urbanization would further exacerbate the problem.

The passage of Public Law 92-500 (PL 92-500) in 1972 reflected societies disenchantment with the existing set of social control mechanisms. Since 1972 much has been achieved. Point sources, such as municipal waste treatment facilities and industrial plants, have made substantial reductions in their emissions; to the extent that nonpoint sources (NPS), especially agricultural NPS now enjoy a comparative advantage in terms of the demand placed on the nation's assimilative capacity. Concern that the national goals of water quality, as detailed in PL 92-500, would not be attained without more attention being given to NPS has led to the development of programs for NPS abatement. These programs are specifically designed to influence the behavior of agricultural producers that is consistent with higher levels of EQ.

An adequate supply of food is a fundamental objective for any nation. And policies are necessary to ensure this supply - for example, conservation policy is aimed at protecting and enhancing the quantity and quality of our soil and water resources, trade policy is designed to ensure access to foreign markets while at the same time offering some protection to producers, and so on. A clean environment is another objective. We are beginning to see policies and programs being designed to ensure an adequate supply of this "commodity." Are these objectives necessarily competitive? Can we invoke policy and design programs to enhance EQ while at the same time encourage food production? Are these programs mutually appreciative of the common goals of society? The objective of this paper is to raise issues, to question the conventional approach to policy analysis and to offer a framework for viewing policy as a coherent entity.

ECONOMIC THEORY AND ENVIRONMENTAL POLICY

The theory of economic policy, in its narrowest sense, is concerned with determining optimal policy. Tinbergen has suggested that the following steps are involved in policy analysis:

1. Determining a preference indicator (a welfare function G).
2. Deducing a set of feasible targets (mg/l DO, ..., bushels of wheat).
3. Selecting a set of instruments (taxes, subsidies, ...).
4. Determining numerical values for these instruments.
5. Formulating relationships between the targets, the quantitative values of the instruments and the structure of the economy.

These steps are illustrated in figure 1, where A' represents the antecedent output mix of water quality (WQ) and food. By manipulating the price of WQ and/or food a set of alternative output configurations is generated. In this example the goal maxima, as indicated by G_{max}, is not feasible - we must be satisfied with G^*_{max}. Other complications may also arise when the policy instruments are bounded, constraining (Food, WQ) to remain in the region of OABC. These constraints may be due to any number of institutional, political, or legal considerations that we care to include in our model.

This conceptualization of economic policy parallels a standard application of welfare economics. The methodology developed by Baumol and Oates for determining environmental policy proceeded as follows: a preference function is maximized subject to a set of resource, emission and non-negativity constraints. From the conditions that characterize an equilibrium a tax scheme is deduced which, with the aid of duality theory, shows us that this instrument will achieve the emission standard at least cost to society. Aside from the usual problems of determining whose preference function to maximize and the possibilities of non-convexities there can be little argument - in theory - with this conclusion. However, in practice - in policy making, in program formulation, in organizational design, in program implementation, and so on - the theory is of limited use.

There can be no presumption in favor of a particular kind of policy instrument derived from normative analysis. Ten years ago Kneese and Bower advocated taxation as an incentive to alter polluting behavior, and it still is the predominant instrument recommended in the literature today. Yet, not one program in the United States has adopted a taxation scheme! This paradox is somewhat bewildering in a society that taxes almost everything else. It is of particular concern when one considers the unrelenting pressure from the general public for higher levels of environmental quality. Some of the ingredients, essential to policy formulation, have been omitted in our analyses - the hiatus that exists between theory and application has not been addressed.

I can think of no more serious a flaw in our analysis models than the assumed institutional vacuum. Social institutions, other than the market, are designed to induce a correspondence between the salus individualis and the salus rei publicae. Institutional factors co-determine the shape of economic policy and it is through these organizational structures that policy emerges. These considerations impact the action of policy, they may also prevent the realization of goals. The technology to control a substantial part of the agricultural pollution problem exists, yet we do not possess the institutional arrangements capable of leading us toward the targets set for EQ.

We must be prepared to accept the status quo and view policy adjustments as perturbations to this structure. In other words:

> "Policymaking proceeds through a sequence of approximations. A policy is directed at a given problem; it is tried, altered, ..., and so on. In short, incremental policies follow one upon the other in solution to a given problem (Lindblom)."

Incremental policymaking is a reality, it is an aspect that our theoretical underpinnings fail to capture, and it is a dimension of policy analysis that economists appear reticent to recognize. The usefulness of our results are extremely limited when viewed in isolation from the social matrix that co-determines the shape and the effect of policy.

Consider the trend in agricultural pollution abatement. What appeared to start out as a regulatory approach to abatement has emerged as a voluntary program based upon the availability of cost-sharing incentives to encourage participation. This is a modification of the existing soil and water conservation programs. Here, we have witnessed incrementalism in action, there were no quantum leaps or redirections; rather, just minor perturbations.

There are clearly many degrees of institutional change:

1. The same organizational structure can be maintained, with policy changing the "values" of the instruments.
2. The set of policy instruments can be altered, along with minor changes in organization.
3. And/or, a major change in the institutional-organizational complex can be made.

A change in the cost-share rate for conservation practices is an example of a modification made within an existing framework. The above represent an increasingly difficult sequence of considerations to include in policy analysis. As we move from minor modifications to major reorganizations the less concrete our knowledge of human behavior under alternative rule configurations becomes. Uncertainties about behavior increase while the ability of the theory to discern between the alternatives decreases. Moreover, the values that the variables assume may become too finely differentiated for our theory to distinguish.

The explanation for incremental policymaking is not too difficult to find. Personal preferences are continually changing and it is through experience that people assign values to the implications of action alternatives. This means that the feasible set of policy instruments is bounded, more or less, by experience or exposure to similar policies. Witness ✓ again the cost-share-voluntary approach to pollution abatement. People have experienced cost-sharing, albeit for a different purpose. An analysis that recommends another form of control, such as a tax on soil loss may be incorrect in assuming that people have the experiential data to evaluate this alternative. Moreover, the behavior of people under these rules will be uncertain and, therefore, so will the performance of the arrangement. The challenge is to address the issue of incremental adjustment, and to do this the antecedent conditions of policy must be recognized. The historical record, or the sequence of policy, is a useful starting point.

SOME POLICY CONSIDERATIONS FOR ENVIRONMENTAL POLICY ANALYSIS

In the previous section some of the problems associated with a conventional approach to policy analysis were discussed. In particular, it was argued that the hiatus that exists between the status quo and the policy recommendations that emerge from applying the conventional wisdom exceeds the institutional capacity so necessary for implementation. Storey and Walker have developed a taxonomy that is useful for comparing policy alternatives on the basis of effectiveness, efficiency and equity.

Effectiveness is defined in relation to the ability of the policy to attain the goals. Two policies are illustrated in figure 2. Both action alternatives can result in the target level of dissolved oxygen (DO*). However they differ in two respects which may turn out to be pertinent to program design. First, policy I reaches the target faster than policy II which may be important at lower levels of DO. Second, although policy II is slower to bring about the DO standard, it does result in more damped oscillations about DO* than the alternative. Policy II therefore minimizes disturbances to the ecosystem in the long run. Clearly, we are in the realms of multiobjective decision making, trade-offs are involved and a clear delineation of these is an important piece of a priori information. An agriculture-related application of this may be: would the imposition of standards to on-farm practices translate into a temporal sequence of water quality similar to policy I? Or, would a voluntary approach, using cost-sharing incentives, result in the profile depicted by policy II. A voluntary mechanism may take longer to reduce loadings, but the rate of standard violations under a regulatory alternative, during times of economic hardship, may result in greater oscillatory behavior in the long run.

An efficient policy is one that achieves the target at minimum cost to society. The standards-charges approach will do this for us in theory; however, in practice we must expand upon the notion of cost to include total system costs. That is, we must recognize not only abatement costs, but also the costs of monitoring, enforcement, administration, assistance and so on. That is, all instruments must be applied through an institutional arrangement - these costs need to be highlighted. Only after accounting for these costs can the total social costs be determined.

Equity is another aspect of policy that needs attention. Obviously, the distributional consequences of alternative policies will affect their performance. This is not too difficult a problem to address - it starts to become more difficult when deciding which policy is to be preferred.

The above taxonomy may be called the a priori phase of policy analysis. Policy relates to the future and because we lack perfect foresight it is always too late. The time lags involved in economic policy are illustrated in figure 3. First, there is a disturbance t_d to the system, the effects of which are fully registered later at t_e - in our case, excessive diffuse loadings are entering the nation's waterways at t_d where they bio-accumulate. Second, we begin to observe the effects of this disturbance at t_o when, for example, excessive algae blooms occur. Then, there is a time lag t_m involved in formulating and implementing policy that serves to counteract at t_c the initial disturbance. Our defective telescopic facility usually means that $t_c - t_e > 0$.

The a posteriori phase of policy involves a refining of the instruments. What can be done to shorten the time period between the initial disturbance and when the policy takes effect? What factors in our existing institutional set-up determine the observation-effect period $t_o - t_e$? Institutional inerita may be a prime candidate for further research that focuses on the effectiveness and responsiveness of organizations that implement policy.

Time also plays a pivotal role at the farm community level. If we use a higher cost-share rate to induce a higher level of abatement activity, how long will these practices take to filter through the community? What impact will an accelerated assistance program, in the form of education and technical expertise, have on this rate of diffusion? What will the response of the ecosystem be? Some of these questions can only be answered after we implement policy. However, the developing institutional arrangements for agricultural nonpoint source abatement must have the analytic capacity to generate information with respect to performance, they must have the capacity to adapt to changing socioeconomic conditions and they must be able to reconcile the conflicting incentives that emerge from within the program.

So far, we have only addressed a single policy - the coordination of other policies is necessary for a coherent system of policy. This is a more complex issue; first we must set the stage for discussion.

AGRICULTURAL AND ENVIRONMENTAL POLICIES

Many agriculture-related policies exist and each have the potential to impact supply, resource allocation, resource quality, price equilibria, and price stability. As O'Rourke has noted, there is not a single integrated farm policy; instead a series of policies exists which are often inconsistent in intent and effect. For the sake of expediency and specificity, we will restrict our discussion of agricultural policy vis-a-vis environmental policy, or more specifically WQ policy, to the Food and Agriculture Act of 1977 and the Clean Water Act (PL 92-500) and its subsequent ammendments. While the programs initiated by these Acts differ with respect to the degree in which they impinge on farming they do have one thing in common: they are funded by taxpayers for the benefit of individuals, including the recipients of federal dollars. A brief over view of each bill is presented below.

The Food and Agriculture Act of 1977 is a 4-year bill directed at the 1978-81 cropping years. It contains the dual target price and loan rate system established in 1973 with the aim of providing farmers with price and income protection. Deficiency payments are made if the national weighted average market price received during the first five months of the marketing year falls below the established target price for that crop. The payment rate is the difference between the target price and the higher of the national weighted average price or loan level.

Before these deficiency payments are made an allocation factor is computed which is the ratio of the final national average program acreage (announced by the Secretary of Agriculture prior to the cropping year) to an estimate of the harvested acreage for that year. If producers voluntarily reduce their acreages in line with the Secretary's recommendations they will receive deficiency payments on all their harvested acres; provided set-aside requirements are met for each crop. If the set-aside is violated for one crop the entire farm is ineligible.

Farm land eligible for set-aside must have been tilled in the previous three years for crop production and it can not be grazed during the normal six month cropping period. Previous residues may satisfy the cover requirements for these areas and volunteer grains may also meet stipulations.

The notions of normal crop acreage and proven yields were introduced by the 1977 Act; these figures are determined by local committees of the

Agricultural Stabilization and Conservation Service (ASCS) according to national guidelines. If the set-aside provision is utilized in any one program year the eligible acreage for deficiency payments cannot exceed the normal crop acreage. Formulae for target price adjustments are also included in the Act and they are designed to reflect changes in a moving two-year average cost of production estimate.

The following example may assist in clarifying these provisions. Assume the following:

Area planted in corn	100 acres
Target price for corn	$2.20 per bushel
Loan rate for corn	$2.00 per bushel
National market price	$1.95 per bushel
Deficiency payment rate	$0.10 per bushel
Proven yields	100 bushels
Allocation factor	0.95

In this example the farmer would receive a total deficiency payment of:

$0.10 per bushel * 100 bushels per acre * 100 acres * 0.95 = $950.00

There are many variants to this example, especially when the set-aside provisions come into consideration for determining the total payment.

The Federal Water Pollution Control Act of 1972 (PL 92-500) established a set of national water quality goals. The discharge of pollutants into navigable waters was to be eliminated by 1985 with an interim goal of "fishable and swimmable" water to be achieved by July 1983. Diffuse agricultural sources were addressed in section 208 of the Act and a process was initiated to identify and investigate methods of controlling this source of pollutants.

Major ammendments to section 208 were made with the passage of the Rural Clean Water Program (PL 95-217) in 1977. Here, the Secretary of Agriculture, in cooperation with the SCS and other USDA agencies, was authorized to enter into contracts with landowners to install and maintain best management practices (BMPs) to control pollution. The bill authorized $200 million for the nonpoint program in fiscal year 1979, and twice that sum for fiscal year 1980 (no funds were appropriated in 1979). These funds were intended to be in addition to the regular SCS and ASCS programs which received $45 million and $497 million respectively in 1979.

BMPs are at the center of the agricultural pollution abatement effort with cost-sharing being a major policy instrument, along with technical assistance, for inducing the installation and maintenance of these practices. A BMP is a conservation practice or management technique that will result in the opportunity for a reasonable economic return within acceptable environmental standards.

The Soil and Water Resource Conservation Act of 1977 (PL 95-192) established a framework for appraising the state of the nation's water and soil resources every five years. During this appraisal new and alternative methods of control were to be reported along with their costs and benefits.

The above legislation is only a sample of the involvement that government has in decision making at the farm level. We could add the food stamp program, trade restrictions and many others. There can be no presumption that the tax system, or any other instrument of policy, will work according to the rules deduced from theory. Conceptually we are dealing with a <u>system</u> of policy as depicted in figure 4, where many policies and actors are shown to codetermine the effect of policy on the behavior of economic agents.

TOWARD A COHERENT POLICY

In principle, we cannot separate environmental policy from agricultural policy or, for that matter, trade policy and nutrition policy. Conceptually, policy is a system - a set of interrelated subsystems. Each policy has a goal (or a set of goals) no matter how imperfectly defined. The interdependencies that exist between these targets and the associated instruments require more detailed and comprehensive study if progress is to be made toward the realization of these objectives. A policy designed to manipulate production incentives may be inconsistent with, and therefore dampen or even nullify, the effects of policy instruments aimed at reducing agricultural pollution.

Take, for example, the price and income support program described above. Four aspects of this legislation appear to have the potential of being inconsistent with the goals of PL 92-500 and its ammendments. First, the use of normal crop acreages may act as incentive to farmers to increase their cropped area in order to maintain a high eligible acreage for deficiency payments. Second, normal (established) yields may encourage more intensive use of fertilizers, herbicides, and pesticides on land that is marginally suited to intensive cropping. Third, the set-aside program does not contain any conservation provisions. And finally, the existence of price supports, established yields, normal acreages collectively tend to mask what is happening to the resources used in production. Yields will tend to become more variable as the limits of production are approached - the feedback mechanism becomes blurred when a return is "partly guaranteed." Will farmers be aware that their soil is being utilized so intensively that the organic matter is being continuously depleted? Can they get locked into a vicious circle involving inorganic fertilizers, support prices, and higher debt commitments that eventually leads to severe soil depletion?

In 1977 payments made to producers under the price support programs for feed grains and wheat amounted to $974.5 million. On the other hand, the total funds appropriated to State and Local units of government for conservation programs in 1978 was $127.5 million (USDA). Therefore, we have $974.5 million of the taxpayers money being spent on two price support programs that, according to empirical research, do influence crop acreage while a further $127.5 million is being spent to conserve the resources used in food production. With the emerging concern over agricultur's contribution to water pollution more money is to be spent. What are the social costs of agricultural production? What gains in EQ could be obtained if we made active conservation necessary for receiving the benefits of price supports? What fraction of the costs of agricultural pollution abatement are created as a direct result of programs designed to support production?

Clearly, we are dealing with a system of policy. One always treads a slippery path when discussing systems: everyone has a notion of what constitutes a system. Ciriacy-Wantrup defines a public policy as a set of interrelated actions by organized publics. Policymaking that proceeds without an appreciation of these interrelations is merely a congeries of public actions. The challenge facing policy anaysts lies in the coordination of objectives, instruments, and institutions to form a coherent policy.

A criterion for judging a system of policy may be found in the coherency of its parts. The components, such as: agricultural policy, environmental policy, and so on, should be in harmony. That is, the interrelations between these policies should be consistent and mutually appreciative of the overall objectives of the system. If this is not the case then all we have is a mere collection of policy, not mutually appreciative and not necessarily in harmony with the goals of society.

Only when these subsystems are coordinated for the purpose of achieving a vector of targets can we refer to it as a coherent entity - a system of policy. When analyzing the effects of support programs on price and income stability we should also be inquiring into the likely effects on the condition of the resource, the expected change in erosion rates and the concomitant change in externalities. Turn the propositions around: what degree of income stability can be achieved through soil conservation? Expand our inquiry to: farmland preservation, wetland protection, and so on. We too must venture beyond our current research methods if we are to contribute to a coherent policy concerning agriculture and the environment.

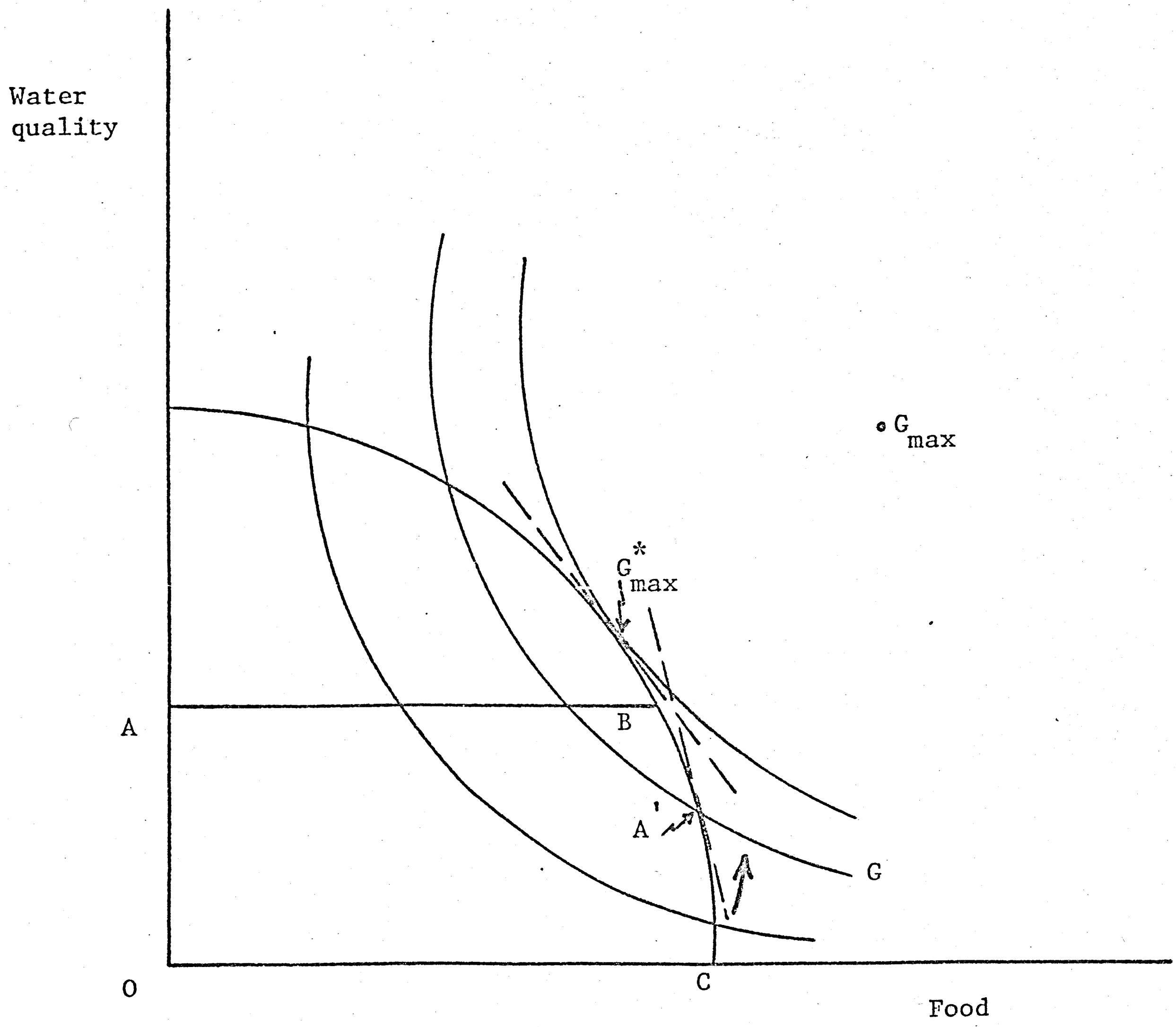

Figure 1: The Effect of Policy Instruments and Boundary Conditions on Goal Attainment

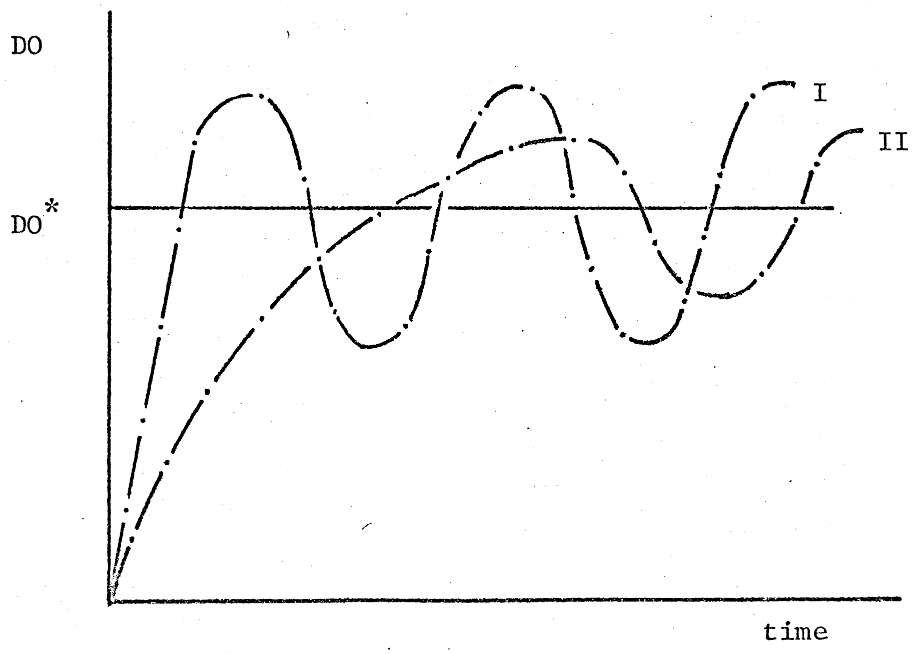

Figure 2: Temporal Implications of Policy Alternatives

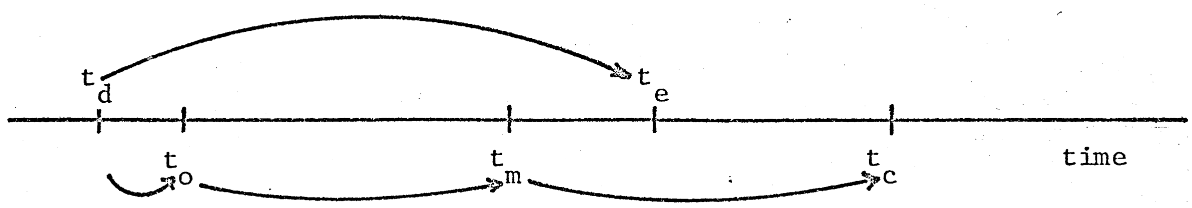

Figure 3: The Lags in Economic Policy

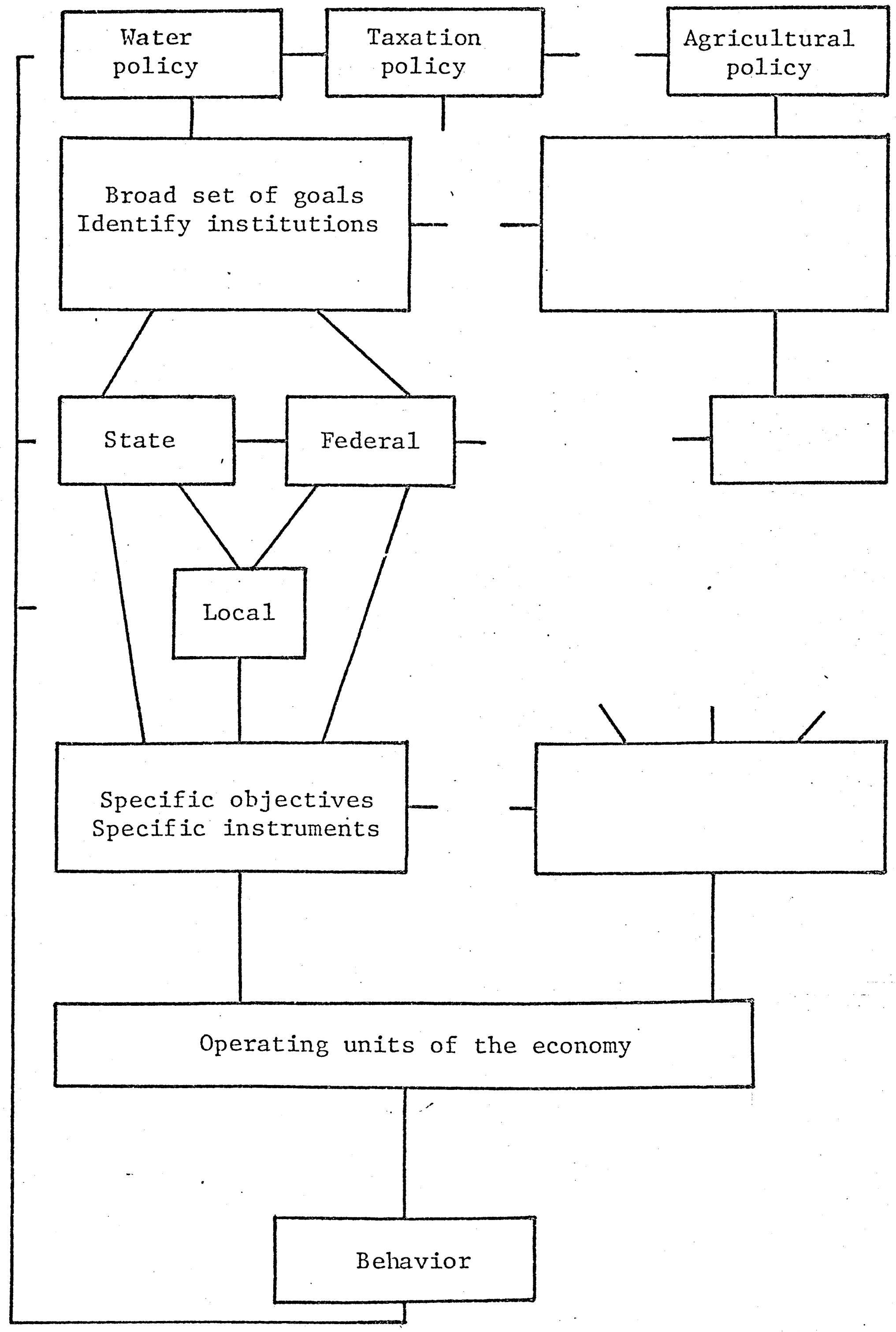

Figure 4: Public Policy as a Coherent Entity

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