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**A FRAMEWORK FOR THE ANALYSIS OF
COMMON POOL NATURAL RESOURCES**

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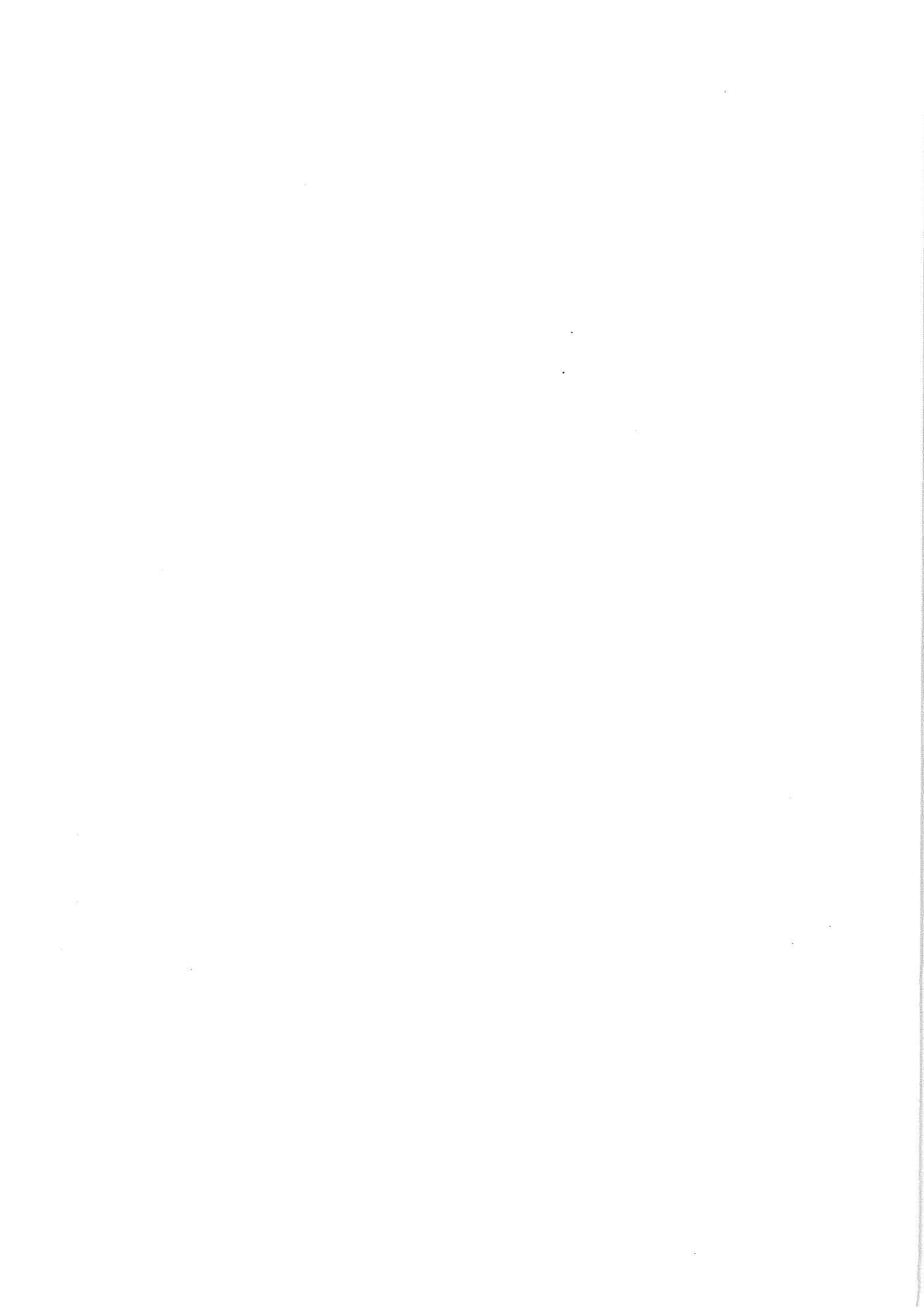


Table of Contents

Introduction	3
A Framework for Analysing Common Pool Situations	8
Definition Issues	
Technical and Physical Attributes	17
Decision Making Arrangements	20
Structuring Property Rights	
Structuring Coordinated Access Rules	
Operational Rules	
Boundary Rules	
Membership Rules	
Allocation Rules	
Input Rules	
Penalty Rules	
Rules on Rules	
Patterns of Interaction	33
Dimensions of Transactions	
Three-Party Interactions	
Theories of Collective Action	
Outcomes	47
Concluding Remarks	52
References	54
Appendix:	57
Theorizing about Social Choice and Social Organization	

INTRODUCTION

Interest in the management of natural resources has increased strongly in recent years. The activities of the Club of Rome in the early 1970s, called attention to the implications of geometrically increasing use of natural resources by mankind living in a finite world. The Stockholm Conference of 1972, which spearheaded the creation of the United Nations Environment Programme, generalized concerns about the state of the natural environment, especially air, water and land-based resources in the development process. The actions of OPEC in 1973-74 brought home to every country and individual the issues of how dependent the world had become on non-renewable fossil fuel resources which were geographically distributed in very unequal fashion. Those owning or controlling such scarce resources could and did wield immense power. Decisions to disrupt supplies in general or to specific countries could have major consequences for global development efforts and international security. National energy strategies had to be rethought.

Many of the world's natural resources are managed within the framework of property rights regimes. To promote more equitable benefits for larger numbers of people, the issues surrounding land reform --defined as desirable changes in property rights-- have received much attention, at least in theory though less in practice. The major ideological conflict of the last quarter of the 19th and much of the 20th century, between capitalism and socialism, was rooted in questions about who should exercise property rights: the individual or the state.

However, there are a number of extensive natural resources for which no clear property rights regimes exist or are not thought to exist. These are often called, somewhat misleadingly, as will be explained later, common property resources. They are seen as resources freely available to mankind. In addition to air and water, they can be land based resources. Important common property resources are grazing and range lands, forest areas and fishing grounds in many different parts of the globe. These three types of natural resources, especially in developing countries, are the major areas chosen within the current research project. The aim of the present paper is to develop a framework for analyzing interactions between humans and these types of natural resources. This complex will be labelled "common pool situations".

For the past 25 years the major paradigm for these common property resources has been based on Hardin's 'Tragedy of the Commons' (1968). It postulated the inevitability of the disappearance of the commons under the impact if decision making by rational man. Privatization, or external coercion and externally enforced regulation, were seen as means providing a possible way out of the threat of impending destruction of the

remaining commons.

More recently, however, people have begun to question Hardin's views on the future of the commons. In Bromley's (1989) words: this 'other land reform' (the transformation of the commons to bring them under property rights regimes) may be neither desirable, nor efficient to stimulate economic development.

It is undeniable that extensive areas of grazing and range land, many forest lands and fishing grounds in developing countries are important natural eco-systems which are now seen to be seriously threatened under the impact of developmental and social processes. Common pool characteristics of these resources have been very important historically, and continue to be important at the present time. These areas, increasingly, also form the last resort for large groups of the population which, under the impact of development trends in the property rights-based and managed natural resources, find themselves expelled from such areas. Such people have become landless, i.e. they are without access to "landesque" resources. Better management of these, often already deteriorating, common pool natural resources would thus seem to be imperative at the present time. How is that to be accomplished, what are the options, and what are suitable institutional arrangements for such resources?

The issue before us, therefore, is the following.

Is it "in the nature of things" that all natural resources will be brought under property regimes, or is it conceivable, or even desirable, that some types of natural resources, could remain under some other form of regime, without destroying the resource itself. If such regimes could be defined, what would be their characteristics, and what would determine their effective functioning and performance?

How to look at the place and function of property rights? Ciriacy-Wantrup and Bishop's (1975) formulation seems relevant and has been influential.

Property rights:

- i do not pertain directly to natural resources but are a form of social relations to settle competing claims between individuals and groups of individuals in respects of natural resources.
- ii can best be seen as a bundle of rights, varying from "thick" to "thin".
- iii may be seen as part of an institutional and legal layer in a three-tier structure of decision making: (a) policy and strategy; (b) legal and institutional

framework; (c) operational level decision making in respect of the resource.

The first point seems obvious. In a Robinson Crusoe economy one does not have to define property rights because there is nobody around to contest anything Crusoe decides to do.

The second point deserves attention. There can be many property rights in the "bundle", and these "threads" could be held or owned by different individuals or parties.

Property rights to natural resources are complex. They can be distinguished in many ways.

For instance:

- user rights with or without the right to dispose of or transform (through a new destination) the resource or proceeds from the resource; ownership without user rights (blote eigendom); ownership with or without the right to (sub)lease;

- rights to the land surface, but excluding mineral rights. This gives conflicts in open cast mining as the two types of rights cannot be independently exercised, unlike in deep mining.

- part-time rights, during the fallow and/or post harvest season, but not during the cropping season; rights may or may not be subject to inheritance.

- partial rights, to trees (but not the land/soil); to the lops and tops, but excluding stemwood; collecting rights for dead wood on the ground.

- immaterial rights, such as the right of trespassing over a neighbor's land to allow access to one's own land; this right limits the forms of transformation which the owner of the first land may want to implement for his land: build a fence, or a house or stable, etc.

Various property rights may be in conflict with each other, so that a hierarchy of rights should exist or may need to be established.

Establishing property rights regimes can be quite costly. Rights have to be defined, recorded and an inventory has to be made. These registers need to be carefully and accurately maintained. Mechanisms have to be established to interpret rights, enforce adherence to established, and thus sanctioned rights, and to adjudicate conflicts.

Thus, the establishment and maintenance of an effective property rights regime requires a whole superstructure of institutionalized supports. These costs of property rights regimes are rarely recognized.

The various elements distinguished in property rights may initially have been established to meet certain felt needs and situations. In modern society the establishment and maintenance of property right is a function of the state. In many developing countries the situation is very complex, because a whole range of indigenous law in different communities has been influenced by an overlay of imported colonial law. Conflicts between different legal systems are thus inevitable. With growing interdependence between communities within the state, standardization and rationalization of property rights takes place.

This process often leads to simplification of existing systems, doing sometimes grave injustice to historical rights which have been discarded. To increase the chances for effective maintenance of the property regime, once it is established, may also imply that the resulting legal system is rather inflexible, in the face of changing circumstances and needs.

The complexity of property rights regimes, especially in common law and in unwritten law, also presents major problems to outside analysts. They observe phenomena which they try to frame in concepts and language familiar to the readers of his subsequent writings. Sonius (1962), for instance, reviewed, as a trained lawyer, ethnological, anthropological and sociological writings, in which much information about rights to natural resources and land law can be found. He found many instances where observed phenomena were wrongly, or loosely, by way of association, "translated" in concepts familiar to the culture of the researcher, largely to suit the cultural background of his intended readership.

In Ciriacy-Wantrup and Bishop's (1975) hierarchy, the existence of a property rights regime appears to be a precondition, which needs to be fulfilled before the rights' holder can engage in his deliberations about what to do with the natural resource over which he holds sanctioned claims.

Within the limitations of his property rights, and within the broader context of laws and customs, the property rights holder has considerable latitude to do as he pleases, as long as he does not infringe the rights of others. Different goals and strategies can be pursued by different individuals: to preserve, exploit for himself or for the market, or destroy the resource. There would be considerable scope for individual choices because the main function of property rights, where existing, is that claimants are insulated from each other.

Those in society with authority to oversee the process of establishing property rights' regimes, obviously wield great power. They may be traditional community leaders, or organs of the modern state. Rights may be established by Executive Decree, or by parliamentary process, depending upon the nature of the state. They decide whether property rights are to be established,

how they are to be restricted (the "thickness" of the bundle), and who shall get the rights thus identified. Such rights may be granted as a privilege to individuals, or they may be sold off in the market to the highest bidder.

Increasingly, however, there may not be sufficient natural resources to entitle every aspiring claimant to a piece of the cake. This is unavoidable for a growing population in a finite world. Conflicts will arise and sharpen between the have's and the have-not's, but those with property rights will respect each other's claims.

The social function of a property rights regime is therefore to reduce conflicts by isolating claimants. It is an apparently useful, because wide-spread, device to regulate access to natural resources.

In contrast, what would the relationship between humans and natural resources in the absence of a property rights regime? Would it lead to chaos if such an important societal ordering device did not exist? What sort of issues would then still have to be resolved? By whom? How?

What are the likely outcomes of decision making processes. Such decision making has to be based on collective choices as there is no basis or incentive for individual action, in disregard of how other members in the community are reacting to such individual decisions.

To distinguish between property rights-based approaches and non-property rights-based approaches to define the relationships between humans and natural resources, Swallow (1989) introduced the term coordinated access regimes. Such regimes are not focused on property but emphasize joint-ness in use.

We would prefer this term over other classifications which retain various forms of property in their descriptions. We shall return to this issue below.

In this paper, as noted already, we develop a framework to enable study of problems and issues in, and conditions for, coordinated access regimes for certain types of natural resources. We use the short-hand notion of common pool situations, to denote interactions between people and natural resources under coordinated access institutional regimes. We would like to obtain a clearer idea of the range of issues that need to be taken up for subsequent analysis.

The issues and problems, as identified, are situated and grouped under different headings in different blocks within the proposed framework.

The paper does not analyze the issues themselves, nor does it prejudice the outcomes of a second round of analysis, of the relationships between the blocks, once the full range of issues within the blocks have been analyzed in isolation.

The paper does, however, indicate in a number of places the relevance and importance of the issue, and points at some of the aspects and ramifications, which may be fruitfully discussed at that particular place in the scheme when the model is applied to specific case studies, at a later stage.

This paper does not provide a worked-out theory of how common pool situations evolve over time, which theory can be tested in application. Rather, it tries to assist any student in identifying a range of pertinent questions with which to enter into an analysis of what are in reality very complex phenomena.

The complexity of the analysis is caused by, and required to

- (a) link collective choices of joint users of certain types of natural resources to the highly variable characteristics of the natural resource base.
- (b) identify the perspectives and interests of different parties involved in the collective choice process, either directly or indirectly. It is likely that the composition of groups which makes collective choice decisions, differs from issue to issue, thus pointing at the possibility that a number of partial collective choice decisions are in conflict with each other.
- (c) acknowledge that diverse disciplinary inputs play a critical role in common pool situations. The framework thus has to allow for incorporation of multi-disciplinary inputs.

There is a further practical aspect in designing a coherent and comprehensive analytical framework. The diversity of required inputs for a proper analysis of common pool situations implies that no single individual will be able to cover all relevant aspects. To make sure that different analysts contribute the required information, a coherent framework may function as an organizing device to structure a coherent ex ante effort at data collection and analysis.

A FRAMEWORK FOR ANALYZING COMMON POOL SITUATIONS.

Starting point for the framework for the analysis of common pool

situations is the model used in a trend-setting and path-breaking international conference on Common Property Resource Management, held in Annapolis in 1985. It was organized by a special panel of the Board on Science and Technology for International Development of the US National Research Council, (1986)]. The conference proceedings will be referred to as the BOSTID Conference (1986).

Participants in the BOSTID Conference were asked to apply a predefined common analytical framework to the presentation of case studies in five natural resource areas:

- (i) fish and wildlife;
- (ii) water (surface and ground water);
- (iii) range and pasture land;
- (iv) agriculture land; and,
- (v) forest and bush land.

This framework, by Oakerson (1986), was discussed in advance of the conference, in two workshops with the experts in charge of the case studies. Nevertheless, it turned out that many of the invited expert participants had difficulty to cover all elements of the model in the presentations, as the case studies in the published Conference proceedings indicate.

This is not surprising in view of the fact that Conference contributors work in different intellectual and professional traditions. Quite a few were anthropologists, others were specialists in forestry, livestock or fisheries. It included researchers and operational and policy staff. For many of them, the work and research experience was primarily geared to different issues, and not specifically to the full range of interactions between people, production and natural resource management. In most cases it was not possible for contributors to that conference to do supplementary research to fill information and data gaps, at least not in time for the conference itself.

Often, the position of the analyst has a major influence on how the purpose and scope of his research is defined. These starting points influence the selection of the variables to be studied, and in some cases, it may prejudice findings. Partial studies may lead to conclusions which are invalidated if the problems are placed in a wider context or in a different perspective.

It is also possible, however, that the framework, prescribed for organizing the data in case studies for the conference, itself has a number of shortcomings, which only become apparent when attempting to apply it to real life case studies. The guideline framework in its published form is rather brief and compactly written, which may present difficulties to prospective users.

Therefore, though the framework may have considerable initial appeal and analytical value to be applicable in a wide range of situations, it may still be desirable to attempt to expand on the

model and to elaborate on a number of issues as they appear to emerge from the frame work. This is attempted in this paper.

The paper also incorporates a number of important, recent and pertinent publications, which may have been partly inspired by the results of the BOSTID initiative. This is especially true for restatements of some frequently used collective choice decision making theories. Some of these publications have clarified sources of confusion, including confusion about language use by authors working in different disciplines.

It is hoped that the framework as set out in this paper, can be used (perhaps after additional improvements), in four ways:

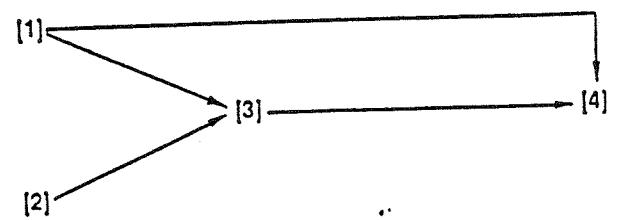
First, it could, and will be used to review the existing literature within the chosen common pool situations. In the case of our current research project at the Institute of Social Studies: on range lands, forestry lands and fish grounds. In the bibliographic work done so far, the "normal" annotation format was not found to be useful, because many of the specific data and issues relevant to the study of common pool natural resource management tend not to be captured. This is directly related to the different perspectives in which most articles and monographs are written. This diversity, in turn, inspired the search for a better, and more comprehensive framework.

It was, therefore, necessary to develop a special coding system intended to capture many of the specific elements relevant for the study of common pool management, which are only touched upon in much of the literature. We had to first define the analytical issues before approaching the literature. (see CPNRM Bibliographic Coding System, May 1989). This mode of operation implies that bibliographic work is proceeding rather slowly, because publications have to be scanned in much greater detail to glimpse bits of information which are thought useful within the research focus. Only the more useful publications are then included in the system.

Bibliographies of general publications on forestry, pastoralism and fishing are not, by themselves, very useful, though we collect such bibliographies as well: they form the gross list of references --which may, or may not, be available in the Netherlands-- to screen for useful, i.e. more specific items.

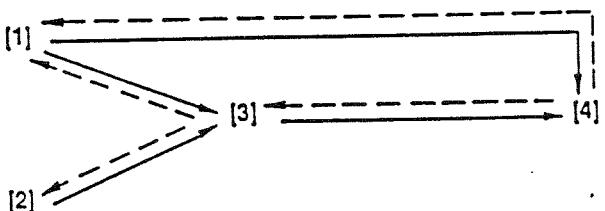
A second purpose for which the framework could be useful, is to "cut across" the numerous case studies of specific populations and livelihood in different common pool situations: what are the systematic differences in fisheries as compared to forestry areas or range management. Can something be learned from such a comparative perspective?

A third use of the framework is in the design of new research studies. By focusing on a number of analytical issues beforehand



[1] Technical/Physical Attributes
 [2] Decision-Making Arrangements
 [3] Patterns of Interaction
 [4] Outcomes or Consequences

FIGURE I Relationships among independent variables.



[1] Technical/Physical Attributes
 [2] Decision-Making Arrangements
 [3] Patterns of Interaction
 [4] Outcomes or Consequences

FIGURE II Long-term relationships among independent variables.

it may facilitate the identification of specific research questions, and this may lead to economies of research implementation.

Finally, the framework may prove useful in the identification and design of policy issues, in the screening of proposed development projects and programmes in areas where common pool natural resources play a role --often next to property rights- managed natural resources-- and thus in policy planning and implementation generally. It may also be useful in teaching programmes in rural development.

ELEMENTS OF THE MODEL

The general model for analyzing common pool situations [Oakerson (1986) is composed of four, mutually exclusive blocks, as follows:

- I Technical and physical attributes.
- II Decision making arrangements.
- III Patterns of interaction.
- IV Outcomes.

These blocks are linked in the following manner.

[see Figure I and II overleaf]

The first two components of the model can be thought of broadly as independent or exogenous variables in the short run, though not in the medium or long run. The third and fourth components are endogenous, the third intervening and the fourth the outcomes and effects. In block III individuals choose strategies against the situations, constraints and opportunities analyzed in Sections I and II. In block I, we find the hard constraints, that can only be ignored at one's own peril. Institutional constraints, of Section II, are soft constraints, made operative only through human knowledge, choice and action.

The dynamics of the model can be explored as well. In the first round, people will have limited information on the Technical and Physical Attributes of the natural resource. This will generally be the case (a) where new common pool resource areas are opened up in a moving land-frontier, (b) where people are resettled in different agro-economic zones as in transmigration areas, or (c) where separate home steaders are made to join in development villages or similar such constructs for promoting development.

In such conditions, initial collective decision-making arrangements may be unrealistic or naive in social and social-organizational terms. In combination with poor information about the natural resource, they lead to patterns of interaction which

yield rather unsatisfactory outcomes.

It is unlikely that adequate research about the state and the characteristics of the common pool natural resource will have been undertaken before settlement takes place, and, generally, no income maintenance schemes are in place to support resource users pending the development of the necessary resource data base. People thus have to make a living in the meantime, and they can only learn more about the resource by actually using that natural environment.

The observed outcomes of their actions can then lead to better information about the Attributes of the Resource and this forces the commoners to make better Decision-making Arrangements (institutions), and to develop experience-tempered modes of behavior in future Patterns of Interaction. There is much initial uncertainty about the characteristics of the resource and the behavior of individuals in collective choice situations.

This probably realistic state of affairs implies that Decision-making Arrangements must be flexible over time, the more so as the information base on the resource itself is less complete. Furthermore, it suggests the following important provisional conclusion: when decision-making arrangements are substantially shaped by actors other than those actually working and living in the common resource --such as the State Apparatus, or other outsiders-- chances increase that such arrangements are inappropriate and too inflexible to be of much use.

In sum, unsatisfactory outcomes are to be rescheduled (feed back) through the other blocks to see whether (a) different technical constraints and opportunities may exist upon closer inspection, or as a result of proposed research or action, (b) decision-making arrangements might be modified in some manner, and (c) whether different choice strategies are chosen or need to be chosen when the outcomes for the individual and the community become known, or after modifications in Sections I and II. In this manner, simultaneous adaptive processes in all three areas may lead to more appropriate forms of resource exploitation, resource management and social organization among the resource dependent population.

Commoners may, or may not, have the ability and the opportunity, to alter initial decision-making arrangements. This often requires that they be permitted by the State, through legal or bureaucratic action, to modify pre-existing and often externally imposed decision-making arrangements. This implies that the externally imposed decision making rules should leave enough leeway to the commoners to develop their internal rules. If sufficient scope exists, Figure II could be expanded to include a direct feed-back from (4) to (2). This would be a modification, and possibly an improvement on the original Oakerson Model.

The model as sketched above implies that simulation methodologies could in principle be useful, especially if a number of key variables could be quantified.

DEFINITION ISSUES

Before discussing these four blocks in detail, we should first define common pool resources relative to public goods and private goods. We borrow these concepts from textbooks on Public Finance. Their application to natural resources leads, however, to a somewhat different terminology.

It is not useful to distinguish goods by ownership, as identical goods may have different types of owners.

Rather, goods should be distinguished by intrinsic characteristics. The criteria used to distinguish goods (in our case: natural resources) are excludability, which refers to the property whether the goods can be partitioned, and subtractability, which looks at the issue whether goods are relatively scarce in use.

The following logical classification emerges [Goetze (1987)]:

	<u>excludable</u>	<u>subtractable</u>
public goods	no	no
private goods	yes	yes
common pool	no	yes

This classification of goods by these two criteria can be used to "fit" institutional arrangements to these categories of goods.

Private goods, by being excludable ('separable') and subtractable ('more or less scarce') lend themselves to be provided by market processes. These are the goods most often discussed in standard economic theory.

Public goods should then be provided by government because they cannot be provided by the operation of market processes. The individual producer cannot create value because the goods are not individually separable (national defense) and their use does not lead to lesser amounts being available to others (knowledge).

Common pool resources have mixed characteristics, their subtractability resembles private goods and their non-excludability gives them traits resembling public goods. Therefore, one could argue for a sui generis type of provision.

In much of the mainstream literature dealing with common pool

natural resources, in the Hardin (1968) tradition, the suggestion is made to (a) privatize the commons, or to (b) put them under the state, or to (c) make them subject to government regulation. The most appropriate 'fit' is, however, unclear and hotly debated.

Proponents of these commonly used management "solutions" to common pool resources confuse issues. They ignore the intrinsically mixed character of common pool resources, and disregard the technical criteria of subtractability and excludability. Instead, they assume that such goods can be subtracted and excluded. This needs empirical investigation. It is probable that many goods can only be partially partitioned.

For instance, a pasture could be fenced, though usually at high cost. This fencing does, however, not protect the cattle on the pasture from diseases, such as those transmitted by the tse-tse fly: a partial, technical element of fencing. Nor will the pasture be safe from cattle rustlers, due to the limited effectiveness and high cost of policing the fences: a social attribute linked to the expected benefits from fencing. This raises the question: is it worthwhile at all to privatize through fencing, in light of the associated costs and expected benefits of such actions for subsequent use of the pasture?

Single ownership, be it private or the state, would still have to contend with the problems of partial, but possibly substantial spill-overs or leakages at the boundaries of the resource.

If (external, state) regulation is proposed, the issues of what and how to regulate and of how to enforce regulations will have to be addressed explicitly. Merely 'passing the buck' from the commoners themselves, who are distrusted by Hardin followers, onto some one else, an impersonal and non defined 'authority', reeks of escapism.

These proposed 'solutions' for the commons are therefore no more than a partial agenda of the issues to be investigated. They are not yet workable solutions to the real problems to be faced.

The presentation of Ostrom (1986) illustrate the relationships between the type of the goods and the "best fit" in terms of their provision. Linking, in the most general terms, phenomena to organizational arrangements for public goods and private goods is straightforward.

[see Figures III and IV overleaf]

The mixed character of common pool resources stand out. We note that, in Figure IV the management regime "common property sector" is used. Following Swallow (1989), I would prefer to group the Open Access category and the Common Property Sector as the two variants of the non-property based institutional models, the coordinated access regimes, whereby coordination amongst joint users is weak or absent for Open Access and effective for the

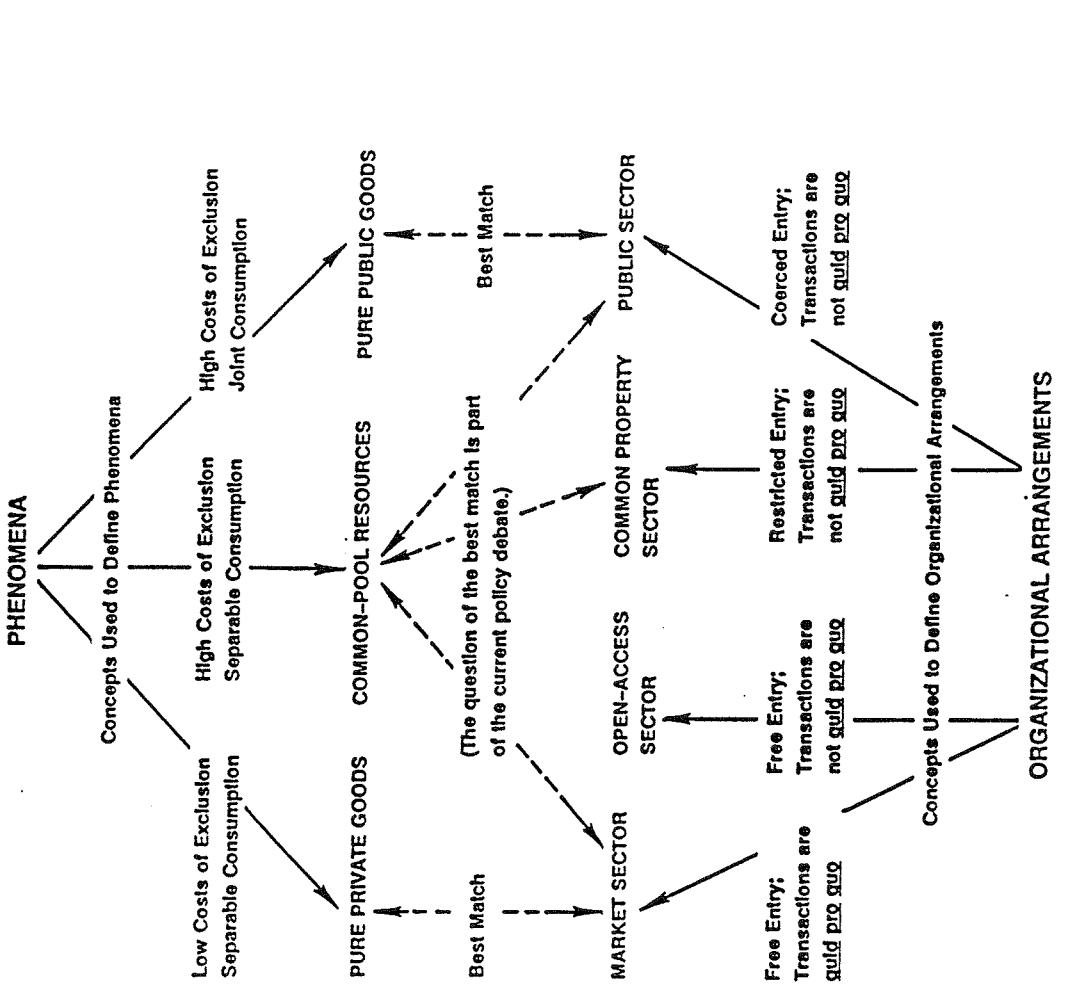
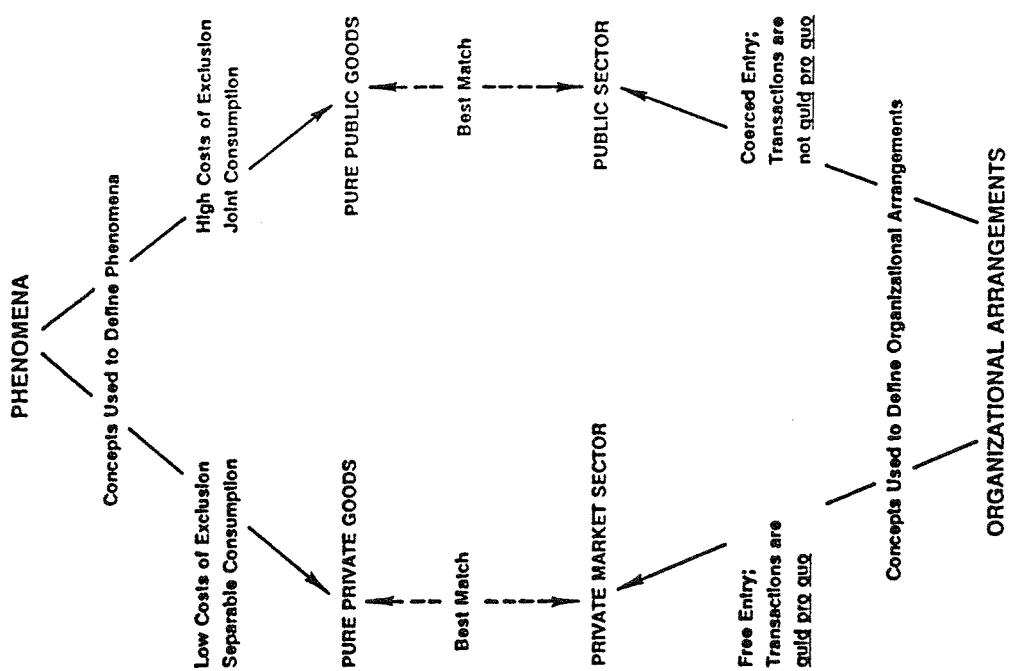


FIGURE III The dichotomous view of phenomena and organizational arrangements.

FIGURE IV A more complex view of phenomena and organizational arrangements.

Common Property Sector.

Rights can be assigned to single users or to multiple users. Single users can be private or public (the state). The choice is not only a question of a priori ideology: capitalism versus socialism or communism.

The study of actual performance under the two options could yield important information which might shape the choices which society wishes to make. Comparative practices are then to be fruitfully analyzed. In a number of concrete (historically inherited) situations private and public management exist side by side and can be studied comparatively in a fruitful and valid manner. Such an approach would avoid the additional complications of having to compare different countries or different historical periods. For instance, in many situations one could study the management of the State Forest Department and private forest owners side by side. Similarly, state owned and operated ranches vs private or group (communal) ranching schemes. Also in fisheries different management models might exist side by side for comparative study.

The choice of future institutional regimes could be made dependent upon the relative ease with which various regimes can be established. This is a major problem in many countries, in view of what has been the mainstream approach to common pools, e.g. to bring them under private or state property based management regimes. Is this transformation worthwhile? Might there be an alternative approach, to strengthen viable and effective coordinated access regimes. Where, and under what conditions, is that possible?

Determinants of this transformation process are the cost of exclusion and the cost of coordination, including the ex ante and ex post costs of rule making (see Appendix).

These costs can be influenced by technical factors and by social factors. For instance, the invention of barbed wire made fencing of range lands possible: range lands could be privatized, so that they are no longer a common (a joint-use area). Socio-cultural and economic homogeneity of communities should make problems of coordination easier to solve by the community itself. These two concepts thus may be of some use in discussing the dynamics of organizational/institutional regimes either within themselves and in terms of the change-over of one system into another

The two attributes, -- cost of exclusion and cost of coordination -- are not dichotomous but in reality are scale variables. This makes it possible to analyze, at the margin, the impacts of various factors which influence either the cost of exclusion or the cost of coordination. It may well be that the cost of exclusion or of coordination are non-linear.

Cost of Coordination

	<u>low</u>	<u>high</u>
<u>high</u>	<u>effective</u> joint-use system possible (res communis)	<u>ineffective</u> joint-use (res nullius)

Cost of exclusion

<u>low</u>	Property based regime (private or public)
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In the older literature the distinction between common property (res communis) --with joint ownership regulations, common pools (subtractible goods) --with joint use regulations, and open access (res nullius) --un-owned resources, and therefore without management, were not clearly drawn, thus leading to confused and confusing discussions. The classic discussion on these concepts is to be found in Ciriacy-Wantrup and Bishop (1975). Hardin's famous parable on livestock in his 1968 article --which mainly dealt with the threat of overpopulation by humans on the small globe-- appears to assume "open access" resources. The reader should thus be forewarned. The whole Hardin paradigm seems inspired by and based on a mis-understanding! A number of contemporary authors maintain the word property in their classification for all categories. They then speak of Private, State, Common and Non-property Property Sectors. This I find confusing, and I prefer to use as major categories: Property rights-based and Coordinated Access regimes. A distinction, sometimes used, between single user and multiple user systems, is also helpful, because it stresses individualistic versus collective decision-making.

These observations does not pretend to discuss in full, and to resolve all issues involved, in all possible interpretations and uses of terms in the literature. The discussion should, however, be sufficient to situate the place of common pool resources, to note their mixed physical attributes, and to point at the conflicting views being held on how to treat these common pool resources in designing suitable institutional arrangements for managing them.

Let us now turn to the discussion of the Blocks in the Oakerson framework.

TECHNICAL AND PHYSICAL ATTRIBUTES.

All common pool problems are rooted in some set of constraints, either given in nature or inherent in available technology. The technical and physical constraints can be analyzed against three concepts from economics literature: (1) joint-ness of consumption or supply, (2) exclusion, and (3) indivisibility. Each concept can be interpreted as a variable: indicating that there are degrees of joint-ness, exclusion and divisibility.

These physical commodity characteristics have to be distinguished from the issues of joint-ness, exclusion and indivisibility by rule. The latter are only possible within the constraints in the physical characteristics of the resource.

Joint-ness.

For pure public goods no single beneficiary of some good subtracts from the ability of others to derive benefits. Examples are a light-house as a beacon for any number of ships passing, or knowledge available to anyone.

Common pool resources are by definition partially subtractible. Each individual user is potentially capable of subtracting from the welfare of other users; but, within limits, all users can derive benefits jointly. Relevant technical or natural conditions relate to maximum carrying capacity, for livestock, fish or trees/biomass. Within such limits all users can derive joint benefits from use as a public good.

The current state of the natural resource is determined by nature: rates of natural reproduction, and/or influenced by the outcome of technological decisions in the past which are still felt in the present. For instance, the fertility or carrying capacity may have been negatively affected by past technological interventions. An issue then arises in decision-making, whether to compensate for such interventions and past mistakes for the sake of the present and the future. Such considerations would have, possibly significant, ramifications for decisions about currently permissible overall use rates.

Exclusion.

Exclusion refers to the ability of individuals to exclude others from use unless they pay the stipulated price. For common pool resources the principle refers to whether access can be controlled. Access is related to technological variables: transportation, equipment to cope with climatic extremes, etc. For common pool resources there is usually some difficulty to effectively exclude others.

Indivisibility.

Could the common pool resources, held in common, feasibly be divided among private property owners? What would be the cost of doing so? If the commons is not divisible, what boundary conditions apply? In common pool situations the resource often may be divisible but at considerable cost, and often not very effectively.

The three concepts --joint-ness, exclusion and divisibility-- provide a way to summarize the physical and technical nature of the commons. Often though, knowledge about these conditions, especially on carrying capacities may be ambiguous. In many instances they would also be highly variable over time: fish resources may temporarily move out of traditional fish grounds (Peru), or the quality of pastures for livestock are variable due to variable rainfall patterns. Carrying capacity could then be fixed at the minimum long term level of resource availability, resulting in under-utilized resources for much of the time, or they could be fixed at higher levels, with a probability of shortfalls in bad periods. Trade-offs could be constructed between use-levels, natural carrying capacity and external input requirements in the lean periods. Insights in such trade-offs in terms of their feasibility and costs would be useful to develop. The costs refer not only to the costs of the physical supplementary feeds, but there will also be considerable institutional, organizational and managerial cost elements in such a strategy.

A commons, or common pool resource, can have a fixed location or it can occur as a fugitive resource (fish and wildlife). Some are renewable (grasslands) and some are not (oil pools, or closed aquifers).

What might be the type of natural constraints applicable to different commons?

- (i) Location factors, such as remoteness from people.
- (ii) Climatic factors, extreme cold or heat.
- (iii) Natural protection, such as prevailing diseases, insurmountable barriers such as wild rivers, gorges and mountain ranges.
- (iv) The knowledge about the functioning of some ecosystems may be rudimentary or incomplete, such as in a number of fish grounds. This lack of knowledge may preclude exploitation in any form. Conservative, low levels of exploitation and a sizable research component may be strategies for the future exploitation of the resource.

The question may be asked whether it is necessary or desirable to develop an institutional regime, before hand in such cases. Resources may have only limited economic value at present, because of them being inaccessible or inhospitable, and/or because there is lack of knowledge about their properties.

Dormant natural resources may remain dormant because they are inaccessible at current technological levels. However, in a dynamic perspective, such resources may become valuable under the impact of technological change. The new technology may make them economically exploitable in future. Moreover, the search for a new technology may itself be stimulated only after an institutional regime has been established.

One area where this type of problem plays a role is in respect of the Law of the Sea, for instance the exploitation of the rich manganese nodules on the deep sea bed. If no management regime is established, these resources remain "open access" resources. Without a suitable technology, they remain unexploited.

In this case, the developed industrialized countries were unwilling to establish an effective "coordinated access" regime. They preferred to let the Open Sea remain an "Open Access" area.

Once the technology to exploit the nodules is developed, the owner of that technology, inevitably the rich countries or large mining corporations, occupy, and thus own the resource on a first-come first-served basis. This is considered "normal" for open access (*res nullius*) resources.

Any institutional regime for the Open Sea, to be established after the development of a suitable exploitation technology for the deep sea nodules, is likely to be decisively shaped by the owner of the technology, both in an institutional or legal sense, and through his ability to control access to the resource through control over the technology needed for exploiting the resource.

This situation may be contrasted with the treatment of the oil and gas resources in the North Sea. A number of countries and corporations had developed, or could develop, the necessary exploitation technology. The countries bordering the North Sea felt an urgent need to define their mutual claims on the North Sea, and so they did. Subsequently, each country made its own arrangements to settle the mode of exploitation: by forming a new State Corporation, well-established private oil corporations, or joint ventures. Each country also made its own arrangements on the terms of exploitation: on production volumes and division of the financial proceeds. Despite these institutional arrangements, problems may still arise if oil and gas resources under the North Sea bed are physically interconnected. A resource conservation strategy by one country may then be ineffective, because the oil/gas resources are pumped away by someone operating under a different institutional and incentives regime.

For land-based mining resources an institutional regime is usually established by declaring them state property under a national mining law. Such a regime is then established often in advance of the knowledge whether a resource exists, and sometimes also in advance of the technology to exploit any available resources)

In a slightly different vein, consider the case of the Antarctic Treaty. It designated the area as a Common Heritage of Mankind, not to be exploited, but to be preserved for study of an 'unspoiled' natural environment. The Treaty could be concluded because the Antarctic was thought to have no economic value. The historically expressed territorial claims by the Treaty signatories were frozen. Treaty parties, however, attempted to restrict visits for scientific purposes by outsiders. Now that it has been discovered that the Antarctic may be rich in exploitable fossil fuel and metal mineral resources, pressures to keep outsiders out intensify as do pressures to open up the Antarctic area for economic exploitation, by modifying the Treaty or its reach.

What these examples indicate is that it may often be useful not only to analyze existing natural resources in terms of their natural limiting characteristics, but also to devote some effort to suspected or potential natural resources in the area under consideration.

DECISION MAKING ARRANGEMENTS

The second component of the model consists of rules that structure individual and collective choices with respect to the particular commons defined in Section I. In this Block we look at the institutional settings, and at a number of 'agenda items' on aspects of natural resource management, which require collective decision making to be resolved.

As already briefly noted in the Introduction, two approaches can be used to define the relationships between humans and the natural resource base. Such relationships may be based on property rights doctrines, or on non-property rights doctrines, which are called coordination access regimes [Swallow (1989)].

Property rights are quite common in cropland areas. The organizing principle defining who may use the resource is ownership of the resource. The owner may decide to use the resource himself, he may leave exploitation to tenants or he may decide not to exploit the resource, or favor extensive exploitation under a care taker. The choice is his, to do as he

pleases. His individual decision is respected by others by virtue of the protection provided by the property right itself. There are initially few, if any, externally imposed regulations which constrain the rights of the owner.

In modern times this situation is changing, as growing population density and increasing interdependencies of production and consumption imply that individual owner' decisions affect non-owners of the natural resource. Formerly absolute property rights are increasingly circumscribed by regulations which affect the manner in which the owner may exercise his decision making power in respect of the resource.

Ownership rights, in its Roman Law absolute sense, often include the right to destroy the resource itself. Resource destruction may be a rational strategy of land use, if the proceeds from the land rents invested in alternative directions gives a higher long term yield than reinvesting (part of) the proceeds in the maintenance or even restoration of the natural land-based resource.

Property rights can be vested in individuals, corporations or in the state itself. Property doctrines fit the tradition of legal centralism, whereby the government has to approve of arrangements. An independent judiciary, e.g. external to the contending parties in a conflict, is invoked in case of conflicts between the ownership holder and others. For most people in the Western world this tradition is so wide-spread that it is assumed to be the only system conceivable. It is often thought to be therefore universally applicable.

Coordination access regimes are not based on individual property of the resource but they are pre-occupied with defining who, and under what conditions, a number of parties may jointly use the resource. Where the resource may not be easily divisible in technical terms, it may not be feasible to establish a relatively low cost and effective property rights regime. Coordination access regimes may present a more fruitful approach to institutional arrangements for common pools, such as in livestock or fishing areas.

Depending upon the effectiveness of the coordination access rules and of the rule maintenance arrangements, we may have either well managed commons, or an 'open access' regime in practice.

Coordination access regimes may lend themselves to private ordering, or internal ordering in a context of legal pluralism. The characteristics of common pool resources often indicate that more flexible arrangements are to be preferred over rigid property rights regimes. It implies that private ordering may be more appropriate than arrangements in the legal centralism paradigm which, by its very nature, involves different and separate parties: the direct rights holders, the state which sanctions these rights, and the judiciary which interprets the

rights and adjudicates disputes between the rights holders or between them and the state where the state itself is a property rights holder. (See further Appendix 1).

In common pool situations the two principles of ordering relations between humans and the natural resource may occur side by side. This may be so in situations involving boundary situations, or they may occur simultaneously within a resource area. For instance, it is conceivable that the community (hereditary or traditional) leaders have the right of alienation of the total or part of the resource, akin to a property owner, but that within the group a range of arrangements on resource use exist which resemble more the coordination access approach. In irrigation schemes one usually finds property rights for land allocations, and coordinated access rules for the irrigation waters which largely determine the productive value of the land. Such water users associations, when they exist, may be restricted to land owners, but they may also include tenants.

For these reasons, we shall briefly discuss some aspects of property rights, especially the distinction between property rules and liability rules, before turning our main attention to the identification of the rules needed for coordination access regimes.

STRUCTURING PROPERTY RIGHTS.

Society has to make decisions about who is to own something, the nature of that ownership (a property rule or a liability rule), and what price is to be paid if it is used, taken or destroyed. But there is an additional role for society and that is prescribing the conditions for a sale -- including the prevention of some bargains.

The latter element, inalienability, could become relevant when significant third party effects arise. Inalienability means that certain types of transactions are expressly forbidden under any circumstance. They are null and void, and no claims arising from such transactions can be invoked by either party. Inalienability rules are akin to absolute prohibitions. They are imposed from outside, as an element of external ordering. For instance, even though an upstream and a down stream firm may agree on the value of the river for the dumping of waste, all those potentially affected by its use as a sewer are not represented in the transaction. To assure such representation would imply transaction costs so great that the reasonable solution may be an inalienability rule which simply precludes the two-party transaction.

As will be shown, the distinction between property rules and liability rules is important. Bromley (1978), following Calabresi and Melamed (1972), distinguishes the following entitlement rules:

Table 1. Alternative Rules of Entitlement.

Rule I consent; (property rule)	A <u>may not</u> interfere with B without B's B is protected by a property rule.
Rule II (liability rule)	A <u>may</u> interfere with B but must compensate; B is protected by a liability rule.
Rule III (property rule)	A <u>may</u> interfere with B and can only be stopped if B buys off A; A is protected by a property rule.
Rule IV (liability rule)	B <u>may</u> stop A from interfering but must compensate A; A is protected by a liability rule.
Rule V (inalienability rule)	A <u>may not</u> interfere with B under any circumstances, and the stopping does not imply compensation; B is protected by inalienability.

The incidence of transaction costs is central to natural resource management, and to the incentives which parties in a collective action situation face. The tendencies for interference differ between the two types of entitlement, and thus changing the entitlement structure can have a profound effect on the outcome of transactions. (See for details and examples Bromley (1978) and Coase (1960)).

Resource allocation effects may be analyzed in producer-producer conflict (Coase's cattle rancher versus the corn farmer). When moving to producer-consumer conflicts third-party effects may be more frequent and more widespread, and the need to take recourse to inalienability rules increases. In matters concerning the environment, harmful emissions from joint production, or the disposal of toxic residuals may pose such widespread and large harmful threats to society, especially in the longer term, that the need to impose strict environmental rules and regulations tends to sharply increase over time, or when the population of possibly affected persons, increases.

The distinction between property rules and liability rules has implications for litigation, because it shifts the burden of proof for any negative effects or injury. When parties are highly unequal in terms of own resources or in seeking legal, economic or political, assistance from outside, the outcome may be

systematically detrimental to the weaker party.

An implication of this type of analysis could be that one tries to change the structure of entitlement in such a way that the structurally weaker party faces reduced transaction cost. This could be done by attempting to change the entitlement rules, or by providing non-fee legal assistance to the economically weaker party.

Property rules, liability rules and inalienability rules thus are useful within the property rights sector, in conflicts between the property rights sector and the coordinated access sector, and liability and inalienability also within the coordination access sector.

STRUCTURING COORDINATED ACCESS RULES.

Let us now turn to the structure of coordination access regimes. Relevant decision making arrangements are of two types. First of all, the operational rules themselves, and, secondly 'rules about rules', which relate to the rules concerning the question of how operational rules are to be decided upon, amended and enforced.

It should be realized that the constraints from nature and technology, identified in Block I, may also constrain the ability of individuals and groups to set up appropriate institutions to regulate individual actions. If one does not know physical and technical carrying capacities, how can one then organize collective action on permissible use-rates?

On the other hand, institutions often more than individuals, have the ability to generate more and relevant information by their ability to pool existing knowledge, and by embarking upon specific information generating activities. Together with a well developed institutional memory, institutions may eventually be better placed in improving the range of options in respect of nature and technology and their consequences for different types of actors.

Institutionalized research activities can be important "merit goods" and as such obtain external, government support. But participants or commoners themselves, in learning by doing, will also acquire relevant information individually and by interaction from each other.

For institutions to fulfill these roles, however, it is necessary that they are specifically designed to undertake these tasks. It is one of the anomalies of many development oriented institutions, be they foreign aid agencies, national ministries or project organizations, that it took them such a long time to

start to systematically learn from their potential wealth of diverse experiences in development ventures, through systematic monitoring and evaluation activities.

Many such institutions, to this date, have a poorly developed institutional memory: their filing systems tend to be permanently in shambles and the staff in such institutions tends to be transferred to other duties every few years. These factors do allow for individual learning-by-doing through experience, but this is individual learning and not institutionalized learning: e.g.: in otherwise similar situations new staff makes the same mistakes which old staff working in that country or in similar project situations made in the past, but from which the previous staff has learned its lessons. For a discussion of how the institutional context shapes actual decision making, in the context of the World Bank, see Van de Laar (1980, Chapter VII).

OPERATIONAL RULES

Operational rules define who can participate in which situations, what the participants may, must, or must not do, and how they will be rewarded or punished. Operational rules facilitate coordination among participants if the participants share a common knowledge of these rules and are willing to follow them. In a world of rapidly expanding knowledge and changing circumstances, rules have to be able to create enough predictability among individuals, yet permit enough flexibility to deal with various contingencies.

Rule making can be undertaken by the commoners themselves, internal rule making, or they can be made or materially shaped and/or influenced by external agencies, notably the State (the formal legal system) and the Bureaucracy, which may have discretionary powers relevant to the design of coordination access regimes. For each sub-set of rules to be discussed below, one would therefore have to analyze the rules made by the commoners themselves as well as the range of relevant externally imposed rules.

Operational rules can be classified in different groups:

1. Boundary rules
2. Membership rules.
3. Allocation rules
4. Input rules
5. Penalty rules.

1. BOUNDARY RULES

These are intended to demarcate the boundaries of common pool natural resources. In settled areas with fully developed single

user (private or state) property regimes, land based resources are demarcated by the cadastre for measurements and a system of land titles to the owners. In common pool situations which are more fluid a similar system is not available, and the issue of demarcation is an open issue that needs to be investigated.

Boundary rules can have different characteristics; they can be paired as follows:

- (a) internal divisions within the resource, or external, to demarcate different resources.
- (b) fixed or variable.
- (c) permanent or temporary.
- (d) artificial or natural.
- (e) firm or permeable.

(a) Internal or external.

Internal divisions arise from attempts at partitioning the commons. Whether this would happen depends upon technical excludability considerations and the socio-economic situation. These can provide incentives to partition or to leave the resource as a common. The interaction among members is part of the processes of collective action to be discussed in the next section (Block III)

External boundaries can be used to differentiate resources: one common from another, or one common from a property resource. Examples of the former are the boundaries between a common forest and a common pasture. Both resources fulfill different community needs and it would be of interest to find out whether rules exist preserving these separate commons and/or to permit transformation of one common to another. In parts of Africa, there is a tendency for pastoralists to cut forests to reduce the incidence of the diseases caused by the tse tse fly. It might be useful to analyze such trans-resource, or over-arching issues, and to attempt to find out whether, and what kind of rules govern such situations.

Boundaries between individual agricultural land and common pastures or forests may also often be a source of conflict, such that arrangements need to be made to define boundaries between them. Such situations often also involve conflicts between property rights doctrines and coordinated access regimes, or between modern unitary law and common, traditional law. By virtue of the property rights regime external parties, the state and the judiciary, come into the picture automatically, because they are the guardians of the property rights system, as was noted before.

Fencing may separate livestock from agricultural lands. Conversions from forest lands to agricultural lands may be prohibited to conserve the hill slope above a village against land slides or avalanches (such as in the Alps). Zoning regulations may separate built up areas from agricultural lands,

whether single user or communal.

(b) Fixed or variable.

Fixed boundaries would not be alterable except by special arrangement. Very explicit and often extremely rigid boundaries apply to demarcate forest lands from village lands, such as in Indonesia.

Variable boundaries tend to occur in cases of fugitive or mobile resources: livestock grazing areas and fish grounds. In the case of livestock, land is not so important, but rainfall is, because it determines the amount of fodder resources. With good rainfall restricted wandering will suffice, while under low rainfall and deteriorating fodder resources a wider movement over the range will be needed to cater for fodder requirements. Clearly, arrangements would then be desirable to allow variable wanderings as a function of variable rainfall. Regular variations in rainfall will lead to regular patterns of trans-humance, while wide variations round these averages require 'contingencies' -- only applicable under special conditions -- to move over wider areas and to come to boundary arrangements with the occupants of those outlying or 'stand-by' -- from the perspective of the pastoralists -- resources. In many respects fishing communities resemble pastoralist communities in this regard.

In this light, pastoralists will never accept ranching schemes with fixed boundaries and thus give up 'contingency territorial rights', unless guarantees are provided to overcome the problems of variable fodder availabilities through substitute sources of supply such as concentrate feeds, within the ranch. This is often difficult to accomplish for technical and organizational reasons. In East Africa most projects pre-defined the external boundary conditions of the ranching area. In some projects in West Africa the focus was on inputs, leaving external boundaries untouched, so as not to unduly restrict nomads in their mobility, a necessary survival strategy in face of variable rainfall and thus of fodder availability.

Similar problems arise in respect of fish grounds [Pollnac (1985)]. The resource is not so much the water but the fish. Exclusive economic zones of the sea may be unhelpful where fish migrates in and outside the zones. To what extent, over what distances and with what frequencies would fishermen be allowed to follow the fish, in disregard of national jurisdictions?

There seems to be one case where boundaries can be both fixed and variable. The boundary can be defined as a river bed, where the river course changes from time to time, or even yearly, such as in some river delta's. This would affect the livelihood of the population: some get more land as a result of boundary changes, and others would become land-less. The economic importance of river delta's for large numbers of the world's population would

tend to make this a non-trivial possibility.

(c) Permanent or temporary.

Rules can relate to the time factor. Lands can be single user during the cropping season, and revert to common use thereafter. Pastoralists may be entitled to graze the stubble from a fixed point in time regardless whether the crop is fully harvested. Lack of alternative fodder may determine this timing. Sometimes pastoralists come in waves over the stubble: first the cattle, then the camels, as the latter can digest materials unsuitable for cattle [Cockrill (1984)]. Delays in harvesting the crop, due to machine breakdown or labor conflicts, arguing for postponing the cattle entry date, could lead to cattle starving.

This interaction between livestock and cotton is notorious in Gezira, Sudan: harvesting the last kantar of cotton would mean net profit to the cotton marketing board, after all the sunk costs have been recouped, but this would reduce fodder availability and may lead to cattle losses to either cattle owning tenants or visiting cattle owners [Van de Laar (1982)].

Changes in crop varieties, e.g. a switch to dwarf varieties, leads to reduced non-grain biomass, and this reduces cattle feed available to pastoralists: the latter may require compensation because their stubble grazing rights have been impaired. In cases where a transition is made from annual to perennial crops, livestock grazing rights may disappear forever. Current thinking about introducing agro-forestry systems may have such side-effects.

In irrigation schemes alterations in water management may affect fishing in the area, leading to conflicts between crop producers and fishermen, which are often different ethnic groups (West Africa, the Niger Inland Delta).

(d) Artificial or natural.

Boundaries can be either a mere line on a map or follow certain natural boundaries. Artificial boundaries may be a source of conflicts in different ways; politically and administratively -- between countries (the colonial imperialist heritage); socially and culturally -- within ethnic groups straddling both sides of the artificial boundaries; or in terms of natural resource management.

Natural boundaries often are to be preferred for purposes of integrated natural resource management. In many countries attempts are currently made to define 'natural' resource management areas, such as agro-economic zones, or watershed areas. Similarities in natural characteristics or nondivisible common resources such as groundwater resources, argue for such concepts. However, management of such areas often generate new

conflicts because most other political and administrative divisions have been made on a different basis. As these structures precede the new natural resource management areas, the imposition of the latter leads to numerous jurisdictional conflicts, which hamper and often postpone more effective resource management systems.

(e) Firm or permeable.

Boundaries are supposed to separate two resources, with the purpose to subsequently apply different natural resource management practices in the separated areas. Boundaries may be more or less effective in separating resources. Fencing may be effective in limiting livestock movements, but they do not inhibit poaching by humans. Boundaries may not contain the spreading of insect born diseases.

In the natural resources field, border-crossing phenomena are ubiquitous. Emissions in the air interact with sun and wind resulting in smog or acid rain over wide areas, disregarding 'ground level' boundary arrangements. Australia formally undertook legal action against France for damages from radioactive emission resulting from nuclear explosions undertaken by France on Pacific atolls under its domination. Residuals entering the soil may penetrate with destructive effects on ground water resources.

Effective surface boundaries are then impossible to establish and resource management policies and rules will have to be established over much wider geographical areas, and usually at higher levels of authority. In the contemporary world interdependencies increase rapidly: emissions and pollution have major impacts on the atmosphere and the biotope. Such wide-spread effects increases the need to impose inalienability rights.

One proximate boundary solution may be found through zoning regulations and concepts such as buffer zones. This concept plays an important role in protecting certain habitats of flora and fauna.

2. MEMBERSHIP RULES.

Membership rules are obviously important because they govern access to a group which makes decisions, or which plays a defined (co)role in resource use decisions. Often, membership groups also define relationships to non-group members and this has clear implications for the types and patterns of interaction and social dynamics which emerge. It is possible that different groups are involved in different aspects of resource use. This implies that the outcomes of decision-making processes within the groups may be in conflict with each other.

The commoners may decide amongst themselves on issues of resource use on the common. However, when the external boundaries are variable, the commoners will have to negotiate with outsiders, often crop producers of different ethnic/social origin. Such arrangements, for instance, are wide-spread in the Hausa-Fulani interface in West Africa. The results of the two decision-making rounds, involving differently composed groups, will be interdependent and could be contradictory.

Membership rules of such groups can be based on different criteria, many though not all of which may be mutually exclusive. For instance, the following criteria could be stated:

- ethnic group.
- gender.
- age or age group.
- marital status.
- economic status: self employed, tenant, employee.
- occupation: farmer, pastoralist, fisherman.
- residence, or birth.
- purpose or issue: those interested in or affected by issue.
- voluntary or compulsory memberships.
- automatic or optional memberships.

Most of these criteria are self evident. Equally evident is that many of these criteria are critical to define the stake which group members have in certain issues of resource management. However, stake holders may have different stakes and the question arises whether different stake holders should be in the same group or in different groups. For instance, should farmers and tenants be in the same group or in different groups; producers and consumers? Should people with different occupations be in the same group?

The residence or birth issue is often important. Long term residents may remain second rate citizens, and may be permanently excluded from critical decision making processes if they cannot join relevant groups.

If birth is used as a criterion for group membership, individuals who have left the area remain a member with or without voting or resource use rights. However, once such people have moved out, they acquire outside interests which may become dominant. Some may use such newly acquired resources to influence either the group of origin or the pattern of resource use on the commons. For instance, the Botswana political and economic leadership reinvesting in livestock, a case of intra-group effect, or Kikuyu political and economic leadership in Kenya investing in Masai cattle thereby transforming independent Masai pastoralists to hired labor.

If gender is used as a criterion for group formation, the outcome of what men decide may harm women.

It would seem that the groups that could be formed in response to a wide variety of resource use issues could well be many. The situation will then become rather complex and diverse so that any attempts to impose additional group formation from outside are most likely counterproductive.

People must be able to organize themselves for whatever issue which is important to them, and for as long as the purpose for which the group was formed remains an issue. Many groups will be formed and will fade away.

On vital issues of resource management more permanent groups are likely to emerge. They are most probably well structured with precisely circumscribed duties and practices which, furthermore, are likely to be firmly and effectively maintained.

At the practical level it will be necessary for each common pool situation to define the most important features of natural resources from a resource management point of view; to then study the institutions and the membership rules of these institutions.

Of special interest, and of increasing concern, are questions about new-entrants or arrivals. Newly land-less people may find themselves having to turn to, for instance, coastal fishing in order to survive. Important questions then arise. How will they be received by the members of traditional fishing communities? What are the patterns and channels for their integration? How are the problems inherent in competition from these new-comers for the available fish resources dealt with?

3. ALLOCATION RULES

Allocation rules prescribe the procedures to use the resource, in response to user demands. These could be of different types:

- automatic, by virtue of group membership;
- by permit or license;
- for members only or they may also be given to non-members;
- continuous or for specified periods (stinting);
- for limited or for unlimited amounts;
- general use or restrictions pertaining to certain species (such as in fishing).

Allocation rules may also relate to the technology to be used: fishing boats with specified capacity to affect range, choice of fishing gear, choice of fishing methods pole or net: yes,

detonations: no.

4. INPUT RULES.

Input rules are defined as the procedures related to the contributions which users are expected to make to the natural resource: what do users supply in exchange for their use of the resource? Such procedures may lead to the maintenance and possibly improvements in the quantity or quality of the natural resource.

Important are labor input requirements for maintenance of irrigation systems, tree replanting programmes, or supervision to guard new pastures or young plantations against livestock intrusions.

Two further points seem to be important here:

1. Resource users may not coincide, in part or at all, with actual or intended resource managers. This has important implications for the nature and structure of incentives for resource management. It may be difficult to find a basis for reciprocity, and thus for successful collective action in those commons.
2. Allocation (output) and input rules probably should be looked at simultaneously because they are interdependent. Many output rules also have important input effects. 'Stinting arrangements', -- through shifting cultivation, pastoralists' movements or closed fishing seasons -- as well as membership, technology and output restrictive allocation rules, are designed precisely to save the natural resource and to permit natural regeneration of the resource itself. The suggestion that many types of commoners do not apply resource management practices is obviously a misleading and wrong notion.

5. PENALTY RULES.

In most cases rules will be ineffective unless there are penalty rules to punish rule-breakers. It is thus necessary to study the nature, content and enforcement aspects of penalty rules. Especially the enforcement practices would seem to be important, because penalty rules will otherwise remain a dead letter. Another aspect which seems to be important is the time lag between offense and penalty. If legal arrangements of due process, with litigation and appeals requires much time, irreparable harm may have been done to the natural resource itself. The value of actual penalties as a deterrent of other possible offenders will then be much reduced.

RULES ON RULES

Rules about rules are important because they determine the manner in which operational (substantive) rules are brought about, amended and adapted under the impact of changing conditions.

Rules about rules refer to procedural rules and can be distinguished in different ways

- (a) by the number of decision makers involved: dictators, unanimity, or (qualified) majority. This approach looks at the democratic character of the decision making process, regardless of the substantive outcome
- (b) by those directly involved (stake holders) or by appointed or elected officials, not-direct stake holders in the joint use of the commons. Distant non-stake holders may be more remote and insufficiently aware of the intricacies of the resource and its problems. Alternatively, they may pursue different interests of their own choice -- rather than the purpose for which they were appointed or elected -- in their decision-making tasks.
- (c) ex ante or ex post. In the former all possible situations are anticipated and rules are provided, as is done in the legal centralism tradition (see Appendix). In the latter case rules are formalized only after they have become generally accepted. Practices evolve (private ordering) on a needs basis and, when found more or less satisfactory, are embedded in formal rules. Uncertainties may be created when the rules are still in flux. In particular, in common pool situations the possible or actual transformation of common management to a private property regime, may lead to uncertainties, and temporary 'lawlessness', normally associated with 'open access' situations, emerges. The consequence may be that the resource itself could be destroyed before a new regime takes hold. Ex ante decision-making runs the risk that unanticipated situations come to prevail or that application of existing rules lead to anomalies which are considered unsatisfactory ex post, so that revision of the ex ante rules is warranted.

PATTERNS OF INTERACTION.

So far, we have identified various types of rules, several but non-exhaustive, substantive issues about which negotiations can be conducted, the institutional settings where such issues can be taken up, and the rules of conduct within the groups concerned. Agenda's and forums as well as procedural rules, or the rules of the game.

Interaction patterns can take place about rules, their numbers and character, within fluid institutional settings. The latter may be taken as constant in the short run but could be changed in the longer run. New institutions can be formed for new issues, or institutions may split on the same issue, when factions decide not to work from 'within' but from 'outside'. Exit as against voice options.

The main reason for studying several collective choice theories, is to obtain insight in patterns of interaction and possible outcomes from decision-making processes.

In respect of patterns of interaction it is assumed that individuals weigh the costs and benefits of their actions on the basis of bounded rationality and opportunism. This does not preclude that a wide range of individual behavioral assumptions and motivations can be accommodated in the chosen framework of transaction economics (see Appendix).

Before discussing various theoretical approaches to the modelling of individuals in collective action situations, and discussing the expected outcomes of collective action, I should like to briefly discuss two issues of strategic importance. These topics are the dimensions of transactions, or of the "deals" that need to be made, and the phenomenon of three party games.

DIMENSIONS OF TRANSACTIONS.

There are three principal dimensions of transactions that are related to different organizational problems. First, some transactions are characterized by asset specificity, which refers to 'durable investments that are undertaken in support of particular transactions, the opportunity cost of which investments is much lower in best alternative uses or by alternative users should the original transaction be prematurely terminated' [Williamson (1985): 55]. One is 'locked-in' by the transaction and there is no 'backing-out'. For better or worse, one has to live with the material consequences, and with the institutional setting which such an investment demands, in terms of management or control models.

Examples which come to mind are the implementation of a specific design of an irrigation system; a decision to invest in specialist deep-sea fish trawlers; decisions to sink bore holes

or build non-movable cattle dips in specific locations. Examples of different technical irrigation designs and their implications for the need for and scope of individual or collective action in irrigation systems is given in Figure V [after Van Ankum and Storsbergen (1985)].

[see Figure V overleaf]

Second, some transactions are subject to uncertainty caused by their environments and by their participants' opportunistic behavior. Situations in which such transactions occur have two different consequences: they may influence the choice of the transaction itself -- substitution of projects with a short term gestation period for those with long gestation periods, a preference for trading and thus self-liquidating transactions over investment transactions which tie specific resources for longer periods, and a preference for ready cash over commodity transactions. Economists would say that a high social discount rate is applied in decision making. In forestry: will trees be allowed to reach maturity or will they be coppiced more frequently?

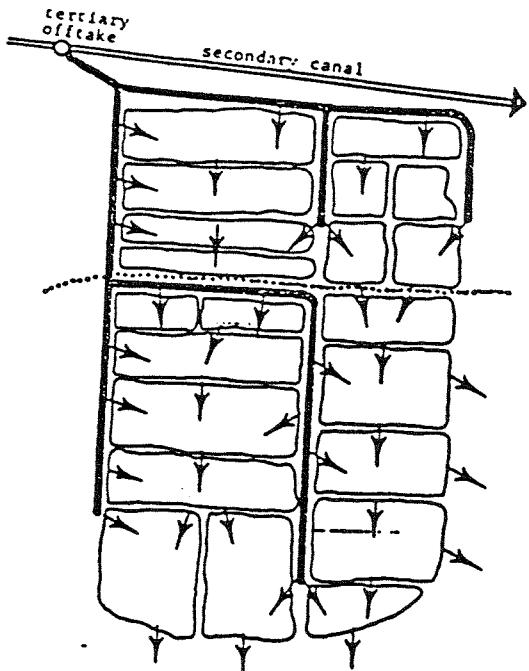
Institutionally, such situations tend to favor arrangements which are capable of sequential adaptation. 'Wait and see, be ready to act when conditions change'. Make sure that the institutions needed to cope with such situations can act quickly, e.g. can be mobilized at short notice, have sufficient decision making authority, and have the relevant information base on hand.

Third, transactions are undertaken with different frequencies. If transactions occur only incidentally, it may not be worth while to develop special and elaborate institutions for handling such cases. On the other hand, frequently occurring transactions will induce institutional arrangements to be set up such that they follow fixed and standard procedures: standard trading practices, custom or society and business culture. Such transactions can then be handled in routinized fashion. Often such routines will be formalized, to increase reliability and reduce uncertainty. Such routines can be set up within communities but also between different communities or individuals. [such as arrangements governing interactions between the Hausa and the Fulani, in Northern Nigeria and adjacent areas].

THREE-PARTY INTERACTION.

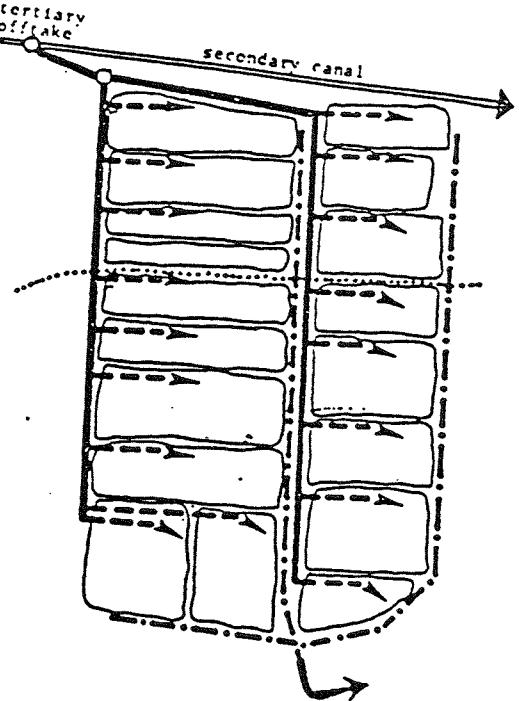
Any realistic analysis of collective action should be based on a three-party framework and not on the customary two-party framework.

A number of social choice theories are couched in the framework of two-person games, sometimes generalized to multi-person games. This is unsatisfactory for most decision-making processes on natural resources and in real world situations.



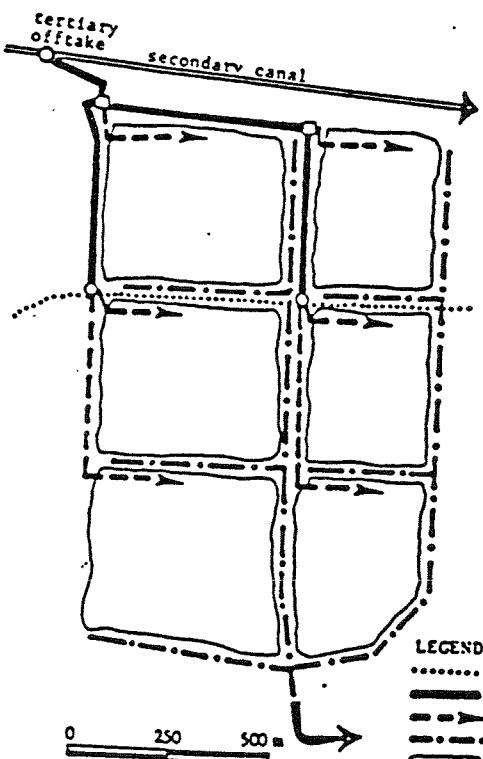
A. SIMPLE IRRIGATION

- irrigation mainly from higher quarternary units
- drainage to lower quarternary units
- water division between villages based on adat
- proportional flow only
- water management by farmers impossible



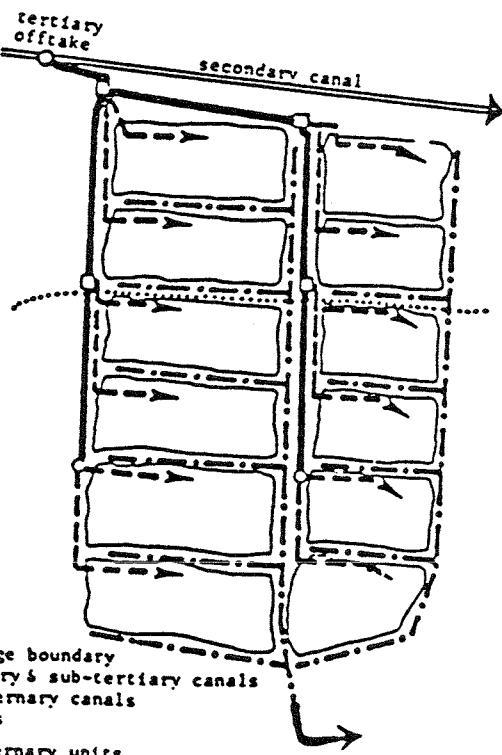
B. SEMI-TECHNICAL IRRIGATION

- irrigation from sub-tertiary canals
- drainage to drains
- water division between villages impossible
- proportional flow only
- water management by farmers impossible



C. TECHNICAL IRRIGATION

- irrigation from quarternary canals
- drainage to drains
- water division between villages possible
- only large-scale rotation possible
- water management by farmers difficult



D. PERFECT TECHNICAL IRRIGATION

- irrigation from quarternary canals
- drainage to drains
- water division between villages easy
- cropping calendering and water rotation possible
- water management by farmers easy

Figure V . Types of irrigation in tertiary unit
(source:Van Ankum and Storsbergen, 1985, p5)

The problems that require solution are not only between the commoners and property-rights-based claimants of other natural resources, at the same level. Parties in a conflict may seek external support to strengthen their hand in the negotiation process. Alternatively, outsiders may impose themselves on a conflict when it arises. They take the opportunity to get involved.

In this context it is critically important to incorporate the role of higher government, or rather, to explicitly analyze the different roles which government and government agencies can and do play in social conflict.

In much of the economics literature it is customary to see government in an idealized role, as guardian of the common good, as a neutral arbiter above contending parties or as the representative of often unidentified third party interests. These may be consumers in producer-producer transactions or, a role stressed by the environmental movement, the state as guardian of the natural environment and thus for sustenance of life for future generations.

In this conceptualization government is seen to be essentially benign, and in a corrective role. Government is seen as part of the solution of societal problems.

The government, or sections within the state bureaucracies may play such roles, but whether they do cannot be assumed but needs to be investigated. It is quite possible that governments' actual role is not essentially benign but malicious. Such judgments require the formulation of explicit norms against which human behavior can be assessed.

It may then be preferable to conceptualize the role of the government more realistically. In many cases it is as much part of (possibly more complex) problems than as part of the solution [Buchanan and Tullock (1962)].

In the last decade the limits to government and bureaucratic action are more clearly realized than a generation ago. Frontal attacks are made on government planning, the welfare state, and the virtues of a shrinking state are extolled in theory and in public policy practice. Recent policies in the USA and the UK come to mind, and the apparent collapse of the economic performance of the socialist block adds considerably to the power of the arguments advanced. Moreover, much of the policy advice of the IMF and the World Bank to developing countries, within the frame work of adjustment policies and as preconditions for external finance, seems directed towards a reduced government role in those countries, implying a preference for a smaller, or euphemistically, less-overextended state.

While thus not precluding that the state can play a neutral and even benign role, one should explicitly allow for the possibility

that one or both contending parties in a commons resource conflict may attempt to reduce its private transaction cost by shifting the incidence of its transaction costs, in part or in full, onto the government. Through this process these costs are diluted over the population at large and the successful party gains in the collective action situation. In other words, we should analyze the transactional cost-benefit framework in private terms as well as in social terms.

THEORIES OF COLLECTIVE ACTION.

A theoretical framework seemingly relevant to analyze issues of management involving common pools, is that of institutional analysis and of transaction costs economics. The premises of these bodies of literature, some of the main concepts used and a sketch, however brief, of how these frame works relate to other bodies of public choice theory, economic theory and theories of economic organization is given in the Appendix, so as not to distract from the main argument of this paper.

In brief, institutional analysis and transaction economics share individualistic behavioral assumptions. Both approaches study situations (institutional settings), decision making processes and outcomes, where individuals weigh costs and benefits of their actions in specific collective action situations.

Guiding principles for individuals in specific action situations are rationality and opportunism. Rationality is not perfect but bounded by two factors: limited information processing capability, and information cost. This states simply that the process of identifying, acquiring and processing information for decision making bears resource costs and time costs.

Another attribute of individuals in collective action situations is that they are guided by opportunism, defined as 'self-interest seeking with guile.'

Transaction costs economics focuses on the potential disputes that may arise when individuals, characterized by bounded rationality and opportunism, enter into contractual relationships within specific institutional settings (Kiser and Ostrom, 1982; Williamson, 1975; 1985).

The purpose of this section is to attempt to do three things. Much of the academic and theoretical (economics and political science) literature of collective action is, to put it mildly, rather negative about the possibilities for collective action.

When the possibility for collective action is theoretically admitted, the stability and the optimality of the outcome of collective action is often negatively assessed.

Resource management in common pool situations is precisely about forms of collective action relative to individual action. Joint management is seen as something worthwhile to investigate. It believes that the outcome of common pool focused joint management can be superior to individual and competitive action, and that joint management is thus to be actively promoted or otherwise at least admitted and recognized. The natural and physical characteristics of some type of commons make collective action imperative.

Historically, common pool situations have been quite common and such systems seem to have worked reasonably well for long periods of time without destroying the underlying natural resource base. But more recent historical evidence also shows that contemporary experiments to set up collective or communal organization quickly and frequently end up as utter failures, thus seemingly proving the skeptical theorists right.

A first objective of this section is, therefore, to identify and very briefly discuss major approaches to collective action theory, and to understand the theoretical basis for their generally negative conclusions.

It is not intended to discuss these theories in full, but to only identify their core. It will always be possible to include a somewhat fuller treatment of the literature concerned, should that be desirable. That literature is indicated below.

A second purpose of this section is to see whether the theoretical frameworks are appropriate conceptualizations for the reality in many common pool situations in developing countries. It is necessary to do so because the public choice literature is often rather general, but has situations in developed countries, and relations between the government and the collectivity of state subjects in mind. Other areas where collective action is much discussed is in respect of trade unions and negotiations with business. Often, the applicable context of theories is not specified in some detail. Hence, the double focus on developing countries (with their pervasive characteristics of weak institutions) and on natural resource management areas seems appropriate.

A third purpose of this section is to identify factors and mechanisms which may enable mutually beneficial bargains to be concluded among players in the collective action process. It may be that the factors and mechanisms differ for each type of natural resource management problem.

It is suggested here that a solid grasp of major social choice theories, in their logic and applicability, could shorten the search procedure in case studies: one can almost assume what type

of rules to find in certain situations, - which only limited factual research (rapid appraisal) may confirm. Different theories focus attention on different elements, and thus help to sort out where to look in specific situations: it reduces the sins of omission. Thus a grasp of the theories in general tends to reduce the information cost of possible intervention 'transactions' by reducing the data collection efforts.

Put in a different and more blunt way: it substitutes for experience. Too often researchers go into the field with a lot of enthusiasm and limited theory, to start collecting hopefully comprehensive data bases. When use for planning is contemplated later, many gaps show up, especially on the social and human side of populations depending upon the commons. Experienced policy oriented staff generally does not embark upon massive data collection efforts, but tends to be much more selective (economize time use) in the points he wants to probe for obtaining a meaningful information base for subsequent planning use. 'In der Beschraenkung zeigt sich der Meister'.

Finally, we should look at costs and benefits of private, competitive action, the alternative to failed collective action. After all we should not willing advocate that people should be jumping from the frying pan into the fire itself.

Prisoners' Dilemma.

This parable is well known. We follow the presentation of Wade (1987); Magrath (1989) and Runge (1986), to review its relevance for common pool situations. Two suspects are separately interrogated about a crime they jointly committed. They know that if they both stay silent they will receive a light sentence. If one stays silent while the other confesses the first will receive a long sentence while the other goes free. If both confess they will receive a medium term sentence. Each person can only choose once - which means that if one chooses to stay silent while the second confesses, the first cannot then confess upon learning of his sentence.

This is what creates the dilemma. Their joint interest is for both not to confess (that is, for them to 'co-operate' with each other). But the outcome is that both confess (both 'defect'). From the point of view of either one of them, staying silent while the other confesses would give the worst outcome, and confessing at least ensures that this worst outcome is avoided while it also opens the possibility that the confessor will go free if the other stays silent. In this single-period game the choice of best strategy is made regardless of the expected choice of the other player, and that is the important point for our purpose. Confessing (or non-co-operation) is, in other words, the 'dominant' strategy.

This parable extends to common pool resource use by regarding the choice as being either to co-operate with others in a rule of restrained access or not to co-operate. The argument is that each individual has a clear preference order of options:

- (i) everyone else abides by the rule while the individual enjoys unrestrained access (he 'free rides' or 'shirks');
- (ii) everyone, including himself, follows the rule ('co-operates');
- (iii) no one follows the rule;
- (iv) he follows the rule while no one else does (he is 'suckered').

Given this order of preference, the stable group outcome is the third-ranked alternative: unrestrained access to all in the group. The second-ranked alternative, with mutual rule-bound restraint, is more desirable. But this is not stable equilibrium because each individual has an incentive to cheat and go for his first-ranked preference. Even if it then turns out that no-one else follows the rule, his cheating at least insures that he avoids his worst alternative - following the rule while no one else does.

In this situation the only solutions are either coercion from outside the group to force people to reach and maintain the social optimum (second preference), or a change in the rules from outside the group to a private property regime.

The model is not realistic in many common pool situations, because (1) commoners live in a group, are thus not isolated and can learn about each others actions or plans; (2) commoners have to make repeated decisions, and not one-off decisions. Thus in reality commoners have the possibility to negotiate to obtain more favorable outcomes of their individual actions. Chances that they will do so increase when they know each other better: group size and homogeneity of individual interests are important attributes to foster collective action.

With these assumptions of the classic prisoners' dilemma dropped, the dominant strategy changes from non-cooperation to one of conditional co-operation: 'Co-operate first, defect if the other defects', or 'no first cheat'. Once group members are in a position to negotiate about rules of restraints they may also be able to negotiate penalty rules for cheaters, to reinforce the tendency to co-operate. Hence no outside coercion will be necessary, and there is no need to change to a private property regime.

Hardin's Tragedy of the Commons.

The article by Hardin (1968) has, in Bromley's words, dominated thinking about the future of the commons over the past 25 years.

It posits a finite pasture, open to all. Each herdsman is assumed to be a rational individual who obtains full benefit from each animal but faces costs of decreasing land productivity, due to overgrazing. Because the individual's contribution to total decline in land productivity is small (because spread over all other animals) compared to the full benefit of having an animal for use or sale, each rational herdsman will expand his herd till the resource is destroyed. In Hardin's view the only viable solution is 'mutual coercion, mutually agreed upon', by which restrained access can be enforced. He takes for granted - but does not discuss or analyze methods and consequences - that this must be done through the state apparatus - by an authority external to those on the commons.

There are three points which are important in this parable. It assumes that commoners have no knowledge about the state of the natural resource. In general this is unlikely because proximity and long use would lead to considerable knowledge about the characteristics of the resource amongst the commoners. However, in livestock, groups of herders may use only scattered parts of the total range pasture and may not possess detailed information over the whole of the pasture.

A second point is that groups of herders may well be able to organize themselves, but that coordination amongst different groups roaming the common pasture will be much more difficult to establish. The same applies to many fishing communities exploiting common fish resources. In general, it applies to fugitive resources.

A third point is that of a variable and permeable boundary, shifting with rainfall patterns, and the open access assumption of Hardin. Free entry means that the notion of groups themselves breaks down. Newcomers may not have the knowledge of the resource as yet, and they may not arrive in groups but as individuals and there may not be many possibility for them to be initiated in appropriate -- from a resource management point of view -- 'commons' behavior, especially when new comers are ethnically different. On top of this, open boundaries and moving people may make the establishment and enforcement of any group property rules difficult if not impossible.

The realization of the combined characteristics of fugitive resources, variable boundaries and open access, e.g. low barriers to entry, make it difficult also for any external authority to enforce access and use rules and to administer penalty clauses to reinforce good behavior. Whether a change-over to private ownership is any solution is then questionable, in view of high transaction cost of establishing (fencing) and policing effective external boundaries, which can anyway only be partially effective against insect-borne diseases. Hardin's solutions to his tragedy may only be pseudo-solutions, and that may be the real tragedy of some types of commons.

'The battle of the Sexes.'

This two-person game (Luce and Raiffa (1957) and Runge (1981) has the following structure. The man wishes that they go together to the dog races; the woman wishes that they go to the ballet. But each of them prefers to go together to either of these activities rather than to separate entertainments.

The game is not one of conflict, as in the Prisoners' Dilemma, but it is a co-operative game, because there is no dominant strategy for either individual. Hence, agreements, once made, contain no incentive to defect; both parties gain from adhering to the rules.

The solution is to undertake the two activities consecutively. Each player has a strong and a weaker preference. But the benefit of companionship outweighs the weak preference (the displeasure) to attend the other's preferred activity. Conditions for success are that each individual is assured that favors are returned at the appropriate times. Efforts to stress reciprocity could strengthen the assurance of future co-operation; instruments could be inter marriage, organizing parties or festivities in turn, mutual borrowing of tools, etc.

In common pool situations the equivalence of companionship may be the common interest in the state of the natural common pool, which provides the livelihood to all members. The activities may relate to different forms of exploitation of this resource. If individuals have different interests they can resolve the issue by doing each other a favor in turn. If both individuals have a preference for the same activity that activity may receive relatively more attention than the second activity which both individuals still value. For instance, food needs may be valued higher by both individuals than energy needs (forestry activities). The latter will be relatively neglected, but not abandoned because both individuals have needs for energy.

Two aspects warrant attention for the co-operative strategy to work: land use competition and time competition. When both have a preference for food, the area in trees will gradually decline to satisfy the relative preferences for food and energy. A second problem is potential time competition. When activities in different areas are both dependent upon, say, the timing of rainfall, with serious losses if activities are delayed, the consecutive strategy is not possible. One cannot work together simultaneously on the crop land and on the forest land. This situation is analogous to the near automatic failure of model farms or demonstration plots in (highly variable) rain-fed agriculture, which depend upon local community labor for implementation under the advice of the extension worker.

A possible solution to the dual problem of land use and of time

competition may be found in thinking along the lines of joint production, rather than separate production on different plots. One does then not distinguish two different types of land and time use, aggravated by the multiple conflicts between the attending bureaucracies of the agricultural departments and the forest service; instead, one has one type of land use but cropping patterns are such as to include higher woody biomass on the agricultural fields. This brings us to the ago-pastoral and agro-silvicultural combinations in land-use.

In this co-operative game neither the privatization alternative nor the coercion alternative would have to provide a solution to the problems encountered.

Olson's Logic of Collective Action.

The basic proposition is that public goods will not be provided because rational and self-interested individuals will not act to achieve their common or group interest (Olson, 1971). Once a public good is supplied nobody can be excluded from its use; hence nobody has an interest to contribute to the provision of the public good. Without either selective punishments or inducements, individuals will free ride. Olson leaves open the question whether the source of selective punishment or inducements should be internal or external to the group, but most other writers on this subject assume that the sanctions must be organized from outside by the state. Apparently, the theory holds for 'large' groups. Olson admits that the likelihood of voluntary action increases when the group size reduces, because 'noticeability' of free riding will be greater. (Wade, 1987).

Attention should not only be on selective benefits to free riders, but, one should also look at the size of the collective benefits of collective action to supply public goods. A cost-benefit framework would provide an answer: total benefits can be so large that the fraction of the non-exclusive benefits that can be appropriated by the contributing person, will suffice to induce the investment to be undertaken. Voluntary action also requires sanctions, however, to insure that nobody will be 'suckered'.

Free riders are often portrayed as obstacles to collective action, but one can also see them in a different light. In many common pool situations in the rural economy 'labor' is often the major, if not the only factor of production, which determines the size of potential contributions to a common cause, or the use-rate of the resource. Free riders, such as the elderly or the sick may be exempted from contributing by the relevant resource management institution. This decision-making puts some member categories in a more favorable welfare policy framework, and free riding then loses its negative connotation. It could be acceptable, though within specified limits (see below).

Transaction economics and collective action.

Olson's analysis at least admits that voluntary action may be possible within smaller groups. But the question of how many group members should agree to arrive at collective rules and how to approach free riders could be approached by way of a transaction economic framework [Ostrom and Ostrom, (1977), 157-72].

When people must agree to a decision before action can be taken, time, money and effort which could be used for other purposes must be devoted to gaining agreement. The opportunity to take other actions may pass by and other opportunities to invest for joint benefit may be lost. The process of collective decision making has opportunity costs which can be conceptualized as decision making costs.

If only one person were required to make legitimate decisions for a resource use decision, decision-making costs would be minimal. As the number of persons required to agree increases, so do the time, money and effort cost that must be invested. As unanimous consent is approached decision-making costs become very high.

On the other hand, a decision by only one individual maximizes the probability that the decision is at variance with the interests of other group members: their deprivation cost are high. As more group members are involved in decision making, compromises are made and more people will find the collective decision acceptable; total deprivation costs decline.

Decision-making cost and deprivation cost can be combined in the following diagrams:

[see Figure VI-IX overleaf]

Depending upon the shapes of the underlying curves, the cost minimizing solution -- obtained by aggregation of the two cost curves -- can be achieved with a variable voting rule. It illustrates that the 'perfect' (unanimity) can be the enemy of the 'good' (a possibly qualified majority). It also indicates that the group can live with a certain number of free riders because the decision and enforcement cost of total vigilance may be excessively high.

In this context it may be less interesting to try to determine the actual shapes of the two cost curves, but to look for developments which may influence them. One issue, which seems to be important, is to look more closely at the composition of the community which is engaging itself in forms of collective action. Simple voting rules assume equality among members. Weighted voting makes voting dependent upon asset distributions within the community, such as land ownership or controlled, size of herd or number of fishing boats. A third possibility is that voting rights, - one man, one vote - conflicts with the distribution of

Costs or benefits

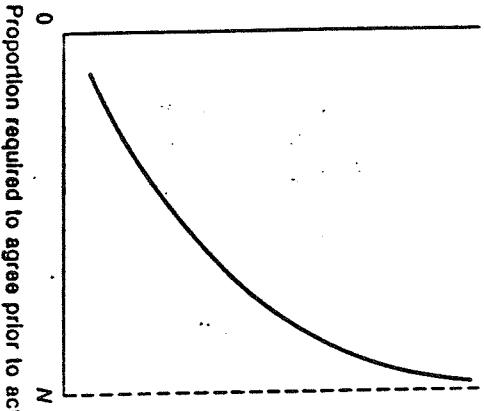


FIGURE VI
Potential deprivation costs.

Costs or benefits

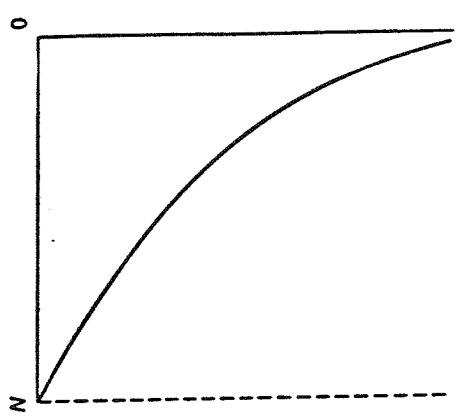


FIGURE VI
Potential deprivation costs.

Costs or benefits

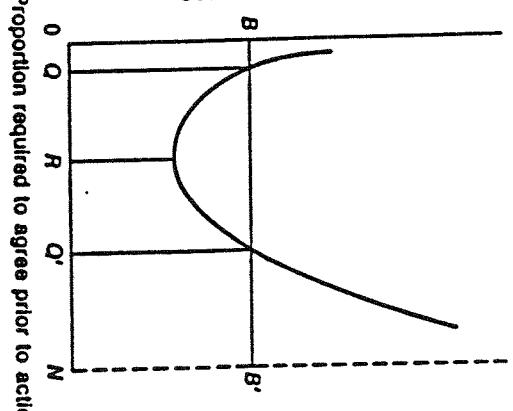


FIGURE VII
Potential decision-making costs.

Costs or benefits

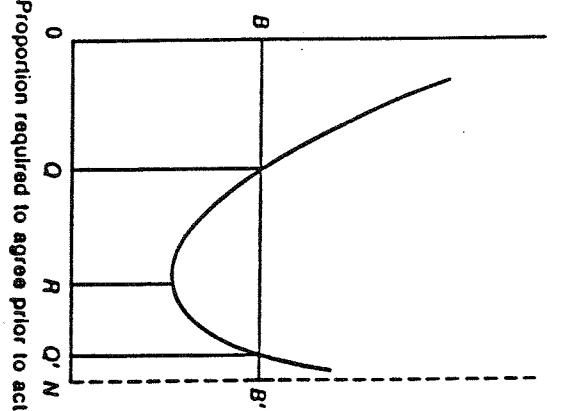


FIGURE VIII
Total costs of collective choice, when decision-making costs are low.

Costs or benefits

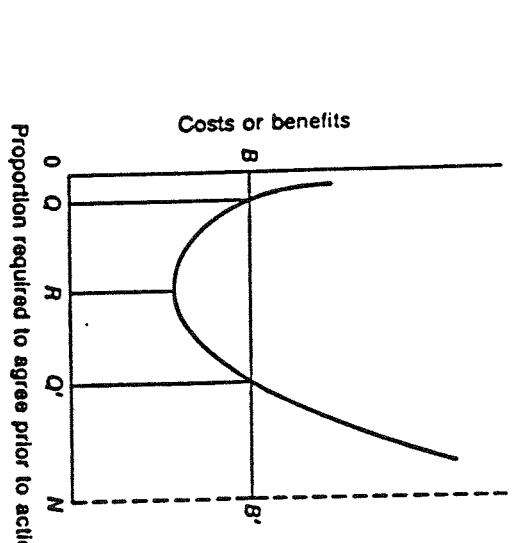


FIGURE IX
Total costs of collective choice, when decision-making costs are high.

economic power. If so, the democratic majority may always overrule the economically powerful minority, and this would provide strong inducements to the latter to sabotage collective decision making.

Two situations in local communities may be distinguished. Homogenous communities with little socio-economic differentiation and heterogenous communities where inequality in assets prevail. In homogenous societies, with little asset and income differentiation, it might be assumed (hypothetically), that people would be more ready to cooperate. A few individuals (elders, leaders) decide on the issues which would nevertheless be seen as to the benefit of all. The deprivation cost curve would be flat. As the decision-making costs would be assumed proportional to the numbers in the community, the optimal result would be towards the left end of the graph (Figure IX).

In heterogenous societies, with sharp economic and/or social cleavages, the deprivation cost curve will be very steep and may not intersect the right hand axis at all. The village elite quickly agrees among themselves, and the decision-making cost of reaching agreement with the rest would be sharply exponential. The elite may then not bother to attempt collective community action: they use their superior economic power without restraint, to implement decisions to their own benefit without even consultation with the majority of the community membership.

It does not follow, however, that in all such cases the outcome of elite action would be detrimental to the community at large. So far it has been assumed that collective action is confined to either entry or input side, or to the use (output) side. It is, however, possible that both types of transactions are interdependent. For instance, in a hillside community, or spate-irrigation schemes, most of the land may belong to the leader. He will, therefore, be tempted to use all water, and leave nothing to the rest of the community members.

If, however, the leader is dependent upon the labor of the mass of the community members for the annual maintenance of the long and vulnerable (to rock fall or land slides) water channel from the source, he will be forced to use restraint in the amount of water he intercepts. When the rest of the community pauperizes, they might migrate in the off-season to obtain supplementary income elsewhere, and not assist in the repair of the water channel, which is the indispensable input for realizing the leader's wealth.

Thus, even in undemocratic communities, bargaining opportunities may exist which lead to restrained and more optimal collective action. The search for bargaining opportunities within the community and between different sections of the community may have a temporizing influence even if individual transaction conditions would argue against co-operation. In such cases, the

worst thing that could happen is when government steps in and takes over the responsibility for supplying water to the community, including system maintenance. Restraints on water use by the leaders then disappear and the rest of the community membership marginalizes to the point of having to leave.

Dangers of the bureaucratic (state) solution.

The above theories in their more general and possibly not directly relevant form, tend to suggest state intervention to resolve the various dilemma's of collective action. However, this intervention is not cost-less. Transaction costs for state intervention may be very substantial, and the bureaucrats may have goals of their own which need not coincide with either party in the conflict [Buchanan and Tullock (1962)].

Government and bureaucrats' goals may be to extract resources for itself, to undermine the political or economic power of local elites, or to assist the elite to obtain and consolidate the power of the state apparatus, and/or the legitimization of the regime. A desire to optimize the welfare of the common pool dependent community may have the lowest priority in state intervention.

State intervention and state regulation may create more problems than it resolves, and many rural community members have a deep and often well founded distrust of government intentions and actions. The them versus us dichotomy has been well developed in the living memory of community members.

The assumption of the 'guardian' state -- so dominant in much of the economics literature and so universally decried in most other disciplines -- must not be maintained. Transaction costs economics can incorporate the motivations of bureaucrats in governments in their theoretical designs, and this is a major improvement over most conventional public sector economics theorizing.

Arguments for collective action in common pool situations.

There are several arguments to prefer collective action above either privatization and state intervention, despite the real problems of collective action which were indicated above.

First, the relative poverty of subsistence agriculture eliminates the possibility for the population to devote much time and effort to other things than to obtain a livelihood: the struggle for life itself. These limitations can make joint use rights a necessity, as the transactions costs of establishing a well

defined, demarcated and enforced private property regime may well be beyond the means of the subsistence economy.

The private property system is administratively costly. It needs a cadastre to investigate and measure clearly defined land rights, and a standing machinery to adjudicate and record changes in land holdings. Its material costs may also be high. Fencing of pastures, or a technical redesign of irrigation systems, is often needed to separate rights holders and to enable to differentiate different types of uses and users (see Figure X above).

Widespread literacy would seem a necessary prerequisite for private property regimes, to avoid that the administrative systems are perverted and abused. Common use regulations are often quite complex as they pertain to 'thick bundles' of partial rights. Where land titling is applied in the simplified form of freehold land, it is implicitly unfair as many claim holders to partial rights (erfdienstbaarheden) will be excluded. All this is required to uphold a system of enforceable claims, with litigation procedures, in the legal centralism approach to contract.

When this task of land titling is carried out by the state which is only dimly aware of local conditions, and which may have objectives of its own, the result of such action may well be worse than existing common usage arrangements.

Second, where common property regimes are still widespread, natural resource positions are not only poor but also highly variable. This environmental uncertainty creates pervasive uncertainties about income streams from such resources. The benefits of a private property regime are then not obvious. On the contrary, wide spread private property arrangements make it then much more difficult for those affected by the outcome of environmental uncertainty to collaborate in overcoming such effects. The flexibility of common use arrangements in the face of resource uncertainties will be largely lost once a private property regime is instituted.

It may be pointed out that the Famine Codes in India have a long history. They were designed to enforce collective action in emergencies, whereby existing private property rights were and are overruled. In natural environments with high incidence of risk and uncertainties, it is not obvious that common use arrangements are to be broken up first towards a private property regime, only to be subsequently disregarded and overruled in the statistically frequently occurring cases of emergencies.

OUTCOMES

Patterns of social interaction produce outcomes. One has to stipulate evaluation criteria and to search for the consequences

that affect users and decision makers. Evaluation criteria which are often used are: efficiency, equity and stability.

Efficiency gives an indication of productivity of resource use. Equity investigations should shed some light on distribution aspects of resource use, while stability should give some clues about the dynamics of the situation. It could help explain why resource users may forego short run gains - are satisficing instead of optimizing - and pursue risk avoiding behavior, especially in environmentally vulnerable situations.

It is considered that a possible fourth criterion: environmental sustainability, should not be considered at par with the first three criteria. Not because environmental sustainability is not important, but simply because it puts a requirement on common pool users which is not generally demanded of users of natural resources in other forms of property regimes. Environmental sustainability should be a requirement of all resource users, if at all. It should not be imposed selectively, especially not if the environmental (non)sustainability is used as a main argument for advocating changes in property regimes.

This having been said, it may still be worthwhile to study how different coordinated access regimes, in their outcomes have different implications for the sustainability of resource use, e.g. for the survival of the resource itself.

Efficiency.

Efficiency, or the productivity of resource use, should be seen in two different dimensions. Physical productivity and economic efficiency. Physical efficiency looks at overall or aggregate physical input and output relations. Technical and physical considerations dictate some optimal use rate, between over exploitation and resource degeneration and under-utilization. A plan for regulation should be evaluated in terms of the value of uses foregone in addition to the uses retained.

Economic efficiency involves also relative prices. Where prices are often objectives of policy, to either stimulate productive resource use or to extract economic surplus by the state for its own use, a separate discussion of financial incentives or des-incentives often will be illuminating. For instance, it has often been found that government suppressed beef prices and thus provided des-incentives to the livestock industry. Similarly, much of the deforestation in the Amazon area can be explained not by energy requirements but by the existing set of investment incentives.

Equity.

In equity discussions the key question is: who gets what. The primary income distribution is of greatest interest: direct income from resource use. Difficult issues will arise when distinguishing auto-consumption and marketable output and income streams. Sometimes income and wealth, and thus income and savings aspects are difficult to identify and separate, for instance in cattle ownership.

It is often useful to pay explicit attention to the role of government, and to compare resource tax revenues with government provided services to the resource users. Such an analysis is not only useful in establishing the net position of government interventions, but also to look at the incidence of government revenue measures relative to the incidence of expenditure measures by socio-economic classes depending upon a commons.

Stability.

A number of resource interventions may directly affect the stability of the resource base. It would be useful to identify the major elements of the resource system and to investigate how the major use practices affect the stability of those elements. Factors affecting natural regenerative capacity are especially important and need to be identified. Often, the rules for resource use are stretched to accommodate a larger number of resource users or to permit higher income levels by the same number of resource users. Safety margins may disappear and the total resource system becomes unstable.

This analysis is not only relevant from the point of view of the stability conditions of eco-systems, but also from the point of view whether the actual resource users are aware of such margins, and of the precise risks they run in shifting limits to current resource use.

A third aspect of stability analysis relates to the tension between the knowledge about the limits of resource utilization and the poverty of users, which forces them to take risks even though they are aware of the possibly disastrous effects of their actions. When sheer survival is at stake the time horizon of actions inevitably shortens, to the detriment of the longer term viability of the resource base. A discussion of survival strategies of the poor in common pool situations may need separate discussion.

It has already been noted that in common pool situations efficiency, equity and stability elements are often interwoven

because the various rules are interdependent. Thus, it is often useful not to treat them consecutively but simultaneously, to optimize over the three dimensions.

Sustainability.

The results of the analysis in the preceding sections, on the productivity, equity and stability of resource use in common pool situations, inevitably brings up the question of the sustainability of these developments. In fact, the dominant paradigm of the Tragedy of the Commons [Hardin (1968)] assumes the inevitable destruction of the Commons. A discussion of sustainability is thus inevitable in treating the commons and that discussion should not be eschewed. Preservation of resources is often seen as a goal in itself.

There are, however, conflicting notions of what is meant by sustainable development. At least three different concepts are used by different disciplines.

(a) Biologists study sustainable development by looking at equilibrium conditions in the natural cycles. Which are the main natural cycles, what are the mechanisms in these cycles, and what are the equilibrium conditions for the natural cycles as identified?

Mankind tends to be considered a particular species in the natural cycles and subject to similar cycles, of birth, growth, decline and death, as in flora and fauna. Ecology is often defined as a branch of biology, and sometimes ecologists go so far as to claim veto power on behalf of the ecological viewpoint in matters of development. Mankind is thought to be subsumed under nature. Many biologists tend to look upon human intervention in nature with extreme skepticism or even hostility, claiming that nature eventually will take revenge on mankind.

(b) Economists and development scientists look at the natural environment as resources to exploit in the service of mankind. How can these resources be exploited in a manner such as not to destroy the resource base of life itself. Some resource analysts have no qualms in advocating the eventual destruction of a particular resource, if resource rents invested in alternative ways gives higher long term yields in the service of the contemporary generation of mankind, which is to take a decision.

One problem in this approach is that the actual and potential use value of many natural resources have not yet been defined or investigated and are thus unknown. Conservation is then advocated as a prudent strategy to ensure that a store of researchable and exploitation oriented topics remains for the future. The level of exploitation of those natural resources of which the development or use potential has not yet been identified, is of course not fixed, but it is a function of the patterns of

exploitation, technological levels and technological change. The notion of carrying capacities, and the problems associated with this concept would seem relevant starting points to discuss sustainability aspects of resource use, however difficult these concepts are to define and apply in specific situations.

(c) A third group goes further towards the primacy of mankind over nature, and asks questions about the number of people that can live, and at what income levels, within the limits set by maximum sustainable yields of known natural resources and current levels of technology. Here we find room for questions of the distribution of resources over the dependent population within and between population groups in a development perspective.

However, particular natural resources are not closed systems. In a partial analysis the possibility of external supplements to the resource to sustain the resource dependent population remains a possibility. For instance, one may look at the phenomenon of 'ghost acres' in agriculture, by which is meant the claims on land by countries outside national boundaries to, for instance, grow fodder for livestock to be exported from a developing country to, say, the Netherlands. The increasing international division of labor permits such resource use patterns. At the global level, however, it may be a zero-sum game, unless there is a continuing flow of resource use saving technological change.

These three perspectives on sustainable development do not normally lead to similar outcomes. More likely is it that serious conflicts arise between adherents of these different views. Conflicts will become more pronounced as and when one enters into more detailed levels of analysis, needed for workable compromises in specific development situations to be reached. Only at the level of sentiments and beliefs are calls for sustainable development widely supported. When it comes to specifics of actions needed unanimity quickly dissipates.

If one, in an interdisciplinary context, arrives at a consensus about permissible resource use, which is in excess of population 'needs', one would have to address specifically the means to reduce population pressure on the resource.

There are three principal mechanisms by which pressures can be relieved:

- (i) inter-generational selection: many children try their luck elsewhere;
- (ii) neglect, leading probably to pauperization of the population and destruction of the resource; and
- (iii) positive selection, the criteria and implications of which should then be carefully analyzed in turn.

CONCLUDING REMARKS

In this paper we attempted to expand on an analytical model which has been recently proposed and applied in the analysis of common pool situation. At the same time, we have made a provisional effort to indicate by way of examples where and in what respects the inevitably somewhat abstract language of the model, and some of its concepts, could be used to tackle issues which present themselves in real life situations, to professionals in different disciplines who work in different common pool resource areas.

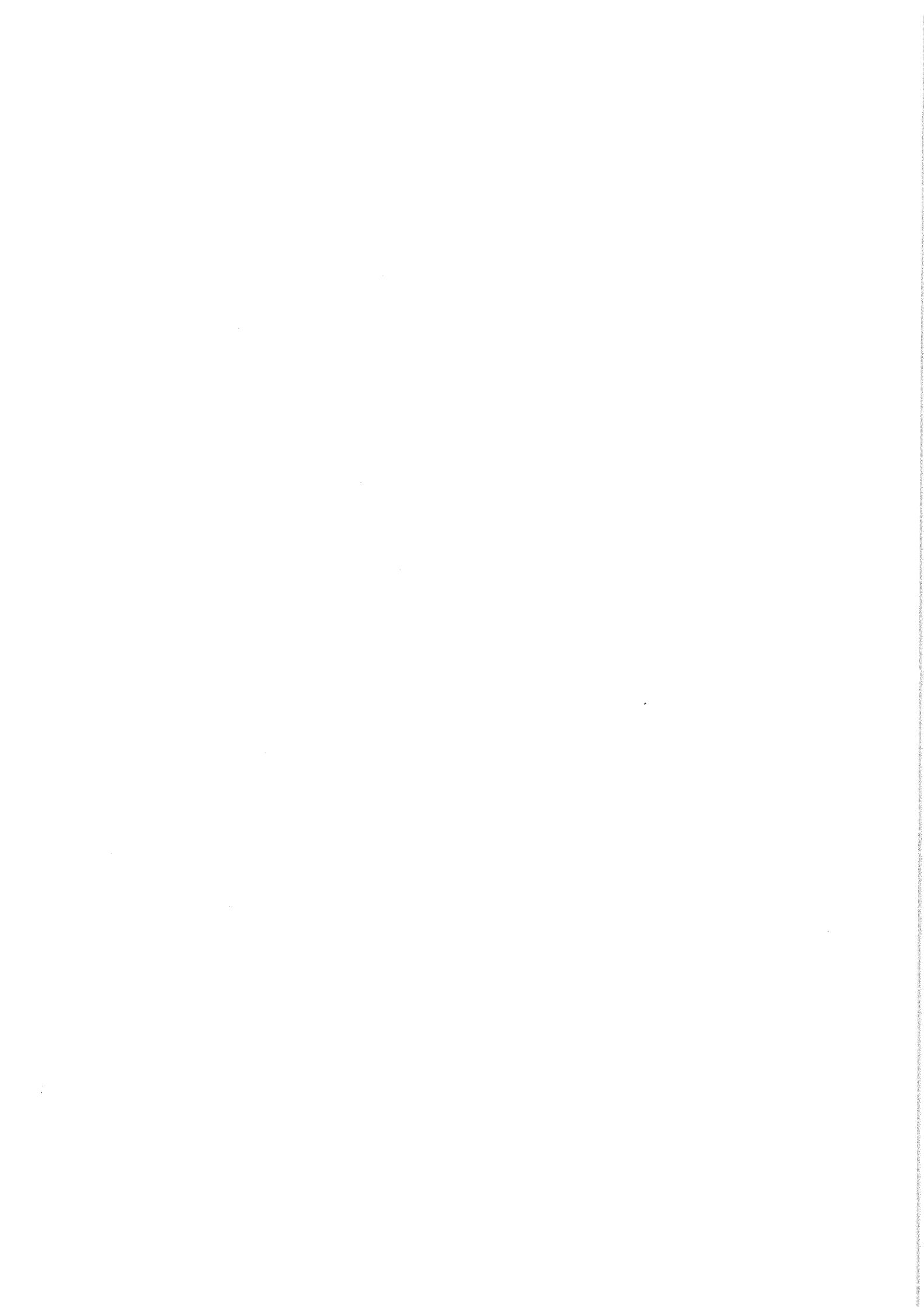
To some the taxonomy itself and the number of classifications given may seem bewildering in their numbers. Do we not defeat the purpose of the exercise: to develop an operationally useful model for approaching practical problem? It would seem however, that in specific and concrete situations a number of the analytical distinctions are not relevant. By going through the list, as if it were a checklist, one could then fairly quickly arrive at a much shorter list of issues which will have to be looked into in the case at hand. Using the list might reduce the risks that one leaves out of explicit consideration some issues which in reality are of strategic importance for policy formulation.

Nevertheless, reactions pertaining to the analytic and practical usefulness of the framework as given, will be much appreciated, as will be comments on where and how the model could be expanded and improved upon, and where the taxonomy and the research questions thrown up by them could be refined, articulated or sharpened. After all, the present paper reports on work in progress.

The fact that the model in its original form has been applied by a large number of recognized specialists working in different common pool natural resource areas, gives the model some credibility. Perhaps a number of them will be induced to expand their original research to fill the gaps which became obvious when they started to fit their data from previous research to the new framework.

We also find that new theoretical and applied work is appearing which explicitly builds upon the concepts and models used in this paper. Some of the theoretical literature has already been incorporated in the present paper. On the applied side, I may refer to the unpublished Ph.D. dissertation of Shui Yan Tang (September 1989) which applied the framework to irrigation systems. In community forestry, we have the work by Thomson (1989) on Niger. He explicitly used the present framework, based on Oakerson, Ostrom, and Ostrom and Kiser, to analyze problems in the forestry sector in Niger. Perhaps more interesting, from the point of view of the model, he had to, and actually did return to Niger for supplementary research, even though he already was very familiar with the studied forestry projects in Niger, and had worked there for nearly ten years.

Moreover, a number of key writers in this new field of public policy are currently producing papers which introduce the main concepts within the World Bank, and which assist the Bank in its efforts to develop a policy posture on these matters (Bromley and Cernea (1989), Wade (1987), Magrath (1989). Compared to the 1970s, when the Bank occasionally saw fit to hire a sociologist to study sociological aspects of development projects, current efforts testify to the widening and deepening of the Bank's efforts to grapple with the human and human organizational dimensions of development interventions. I interpret these trends as hopeful signs, rather than as negative signs.



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Appendix.

THEORIZING ABOUT SOCIAL CHOICE AND SOCIAL ORGANIZATION.

A theoretical framework seemingly relevant and helpful to analyze issues of institutional regimes for common pool resources, is that of institutional analysis and of transaction costs economics. This framework plays a major role in the contemporary debate, to enable communication between people working in different disciplinary traditions. In this note highlights and major concerns of these theoretical frameworks are briefly sketched.

Institutional analysis [Kiser and Ostrom (1982), Oakerson (1986), Ostrom (1986)] identifies the key working parts of typical situations facing participants in various social circumstances. It draws upon literature in political science, economics, anthropology, game theory and law. The focal point of institutional analysis is the action situation in which individuals adopt actions or strategies. Depending upon such factors as the number of participants involved, the types of choices available to participants, and the incentives faced by participants, different outcomes may result from interactions among participants. Institutional analysis thus defines the setting in which transactions take place.

Transaction costs economics [Williamson (1975); (1985); (1986)] adopts the transactions themselves -- which resembles the concept of an action situation -- as the fundamental unit of analysis. Transaction costs economics analyses how the individual weighs the benefits and costs of various alternatives and their likely outcomes.

Transaction costs economics and institutional analysis are concerned with identifying appropriate institutions that can counteract perverse incentives inherent in various transaction situations. While transaction costs economics approaches the problem by examining the characteristics of different transactions, the institutional analysis framework explicitly identifies a higher level of analysis by delineating the contextual attributes that shape various action situations. At the contextual, and very general level of analysis, one examines how rules, physical attributes, and attributes of community produce various action situations.

Implicit or explicit in the theories explaining individual behavior within institutional structures are five working parts, including (i) the decision maker, (2) the community affected by interdependent decision-making, (3) events (or goods and services) that interacting individuals seek to produce and

consume, (4) institutional arrangements guiding individual decisions, and (5) the decision situation in which individuals make choices.

These elements are depicted in Figure A.1 and A.2 [from Kiser and Ostrom (1982)].

[see Figures A.1 and A.2 overleaf]

The approach rests on a methodological individualist perspective. Attributes of the individual decision maker constitute the core of the analysis. Assumptions about the individual animate all particular models based on this micro-institutional frame, but different assumptions can be made about the behavior of the individual.

This approach is distinct from macro-institutional perspectives which animate theoretical models with social forces beyond the influence of individuals. Individuals in macro-institutional political economy have little choice but to obey these overriding social forces.

The working parts, other than the decision maker, establish the environment in which individuals make choices. Combining assumptions about all five working parts enables predictions of two types of results. One addresses individual decision makers' strategies or actions, and the second addresses the aggregation of individual actions into outcomes for the community. Depending upon the problem under study one can distinguish strategies and outcomes at different levels of the community, and their analysis might provide indications about the most appropriate level of decision making. What issues can be resolved by the individual, what issues by lower level (small group) organizations and which issues require state level or even global action for them to be satisfactorily dealt with.

Transaction costs economics has its roots in law, economics and organization theory. It is interdisciplinary by design, and fits the research tradition of the New Institutional Economics [Langlois (1986)]. Whereas the economic institutions of a society are usually explained by reference to class interests, technology, and/or monopoly power, the transaction costs approach maintains that these institutions have the main purpose and effect of economizing on transaction costs.

Transaction costs economics also adopts a micro-analytic approach to the study of economic organization. The focus is on transactions and the economizing efforts that attend the organization thereof. Transaction costs are the economic counterpart of friction. Transaction costs economics examines the comparative costs of planning, adapting and monitoring task completion under alternative forms of governance. Transaction costs economics poses the problem of economic organization as a problem of contracting. A particular task is to be accomplished.

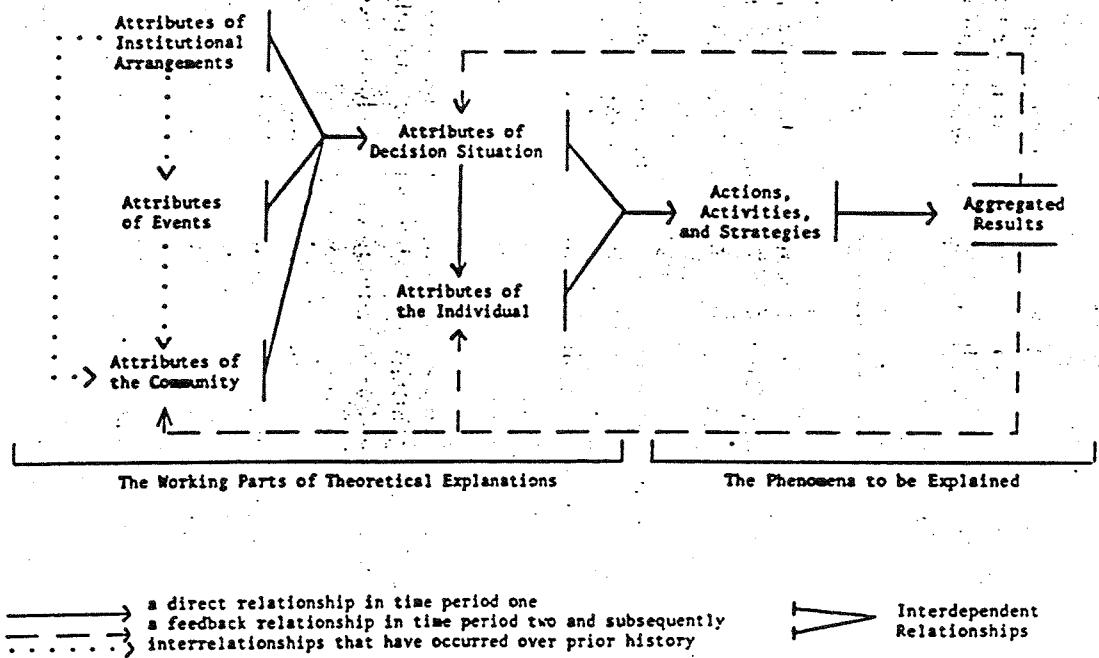


Figure A1 The Working Parts of Institutional Analysis

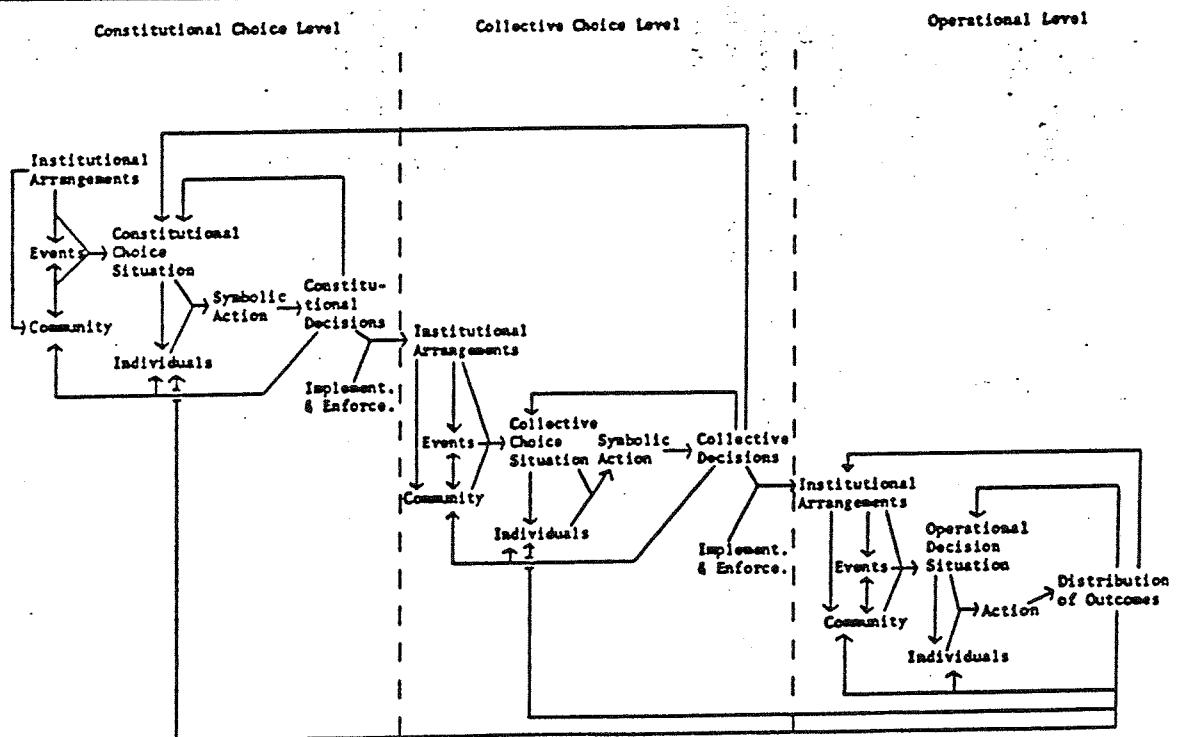


Figure A2 Three Levels of Institutional Analysis

It can be organized in any of several alternative ways. Explicit or implicit contract and support apparatuses are associated with each.

Most studies of exchange assume that efficacious rules of law regarding contract disputes are in place and are applied by the courts in an informed, sophisticated and low-cost way. These assumptions are convenient, in that economists and lawyers are relieved of the need to examine the variety of ways by which individual parties to an exchange 'contract out of or away from' the governance structures of the state by devising private orderings [Galanter (1981)].

Thus arises a division of effort whereby economists are preoccupied with the economic benefits that accrue to specialization and exchange, while legal specialists focus on the technicalities of contract law. The legal centralism tradition maintains that disputes require access to a forum external to the original social setting of the dispute, and that remedies will be provided as prescribed in some body of authoritative learning (formal law and jurisprudence) and dispensed by experts who operate under the auspices of the state. However, in reality, most disputes, including many that under current rules could be brought to a court, are resolved by avoidance, self-help, and the like. In Hirschman's (1970) formulation: the 'Exit' or 'Voice' options.

In many instances the participants themselves can devise more satisfactory solutions to their disputes than can professionals constrained to apply general rules on the basis of limited knowledge of the dispute.

Compared with other approaches to the study of economic organization, transaction economics (1) is more micro-analytic, (2) is more self-conscious about its behavioral assumptions, (3) introduces and develops the economic importance of asset specificity, (4) relies more on comparative institutional analysis, (5) regards the business firm (or any other organizational format where goods and services are produced for exchange) as a governance structure rather than a production function, and (6) places greater weight on the ex post institutions of contract, with special emphasis on private ordering (as compared with court ordering).

The field of transaction costs economics and the property rights paradigm [Alchian and Demsetz (1973); Furobotn and Pejovich (1972)] are to be put in the context of the organization of the economic institutions of society (the economic order). Both approaches contend that ownership matters, and that different incentive structures and ownership patterns have important implications for the economic outcomes of the economic process in terms of (a) the right to use, (b) the right to appropriate return to the asset, and (3) the right to change the form and/or substance of an asset.

To students of rural development, especially in developing

countries, these concerns are all too obvious. Among the most important aspects of the introduction of so-called 'Green Revolution' technologies (other than its production effects emphasized by agronomists and agricultural economists), one finds the decline of tenancy arrangements in favor of owner-occupied farming, and a tendency to change the size-distribution of land-holdings [Griffin (1974)].

But whereas the property rights theorists work within the tradition of legal centralism, transaction costs economics disputes that court ordering is efficacious. Attention is shifted instead to private ordering. What institutions are created with what adaptive, sequential decision-making and dispute settlement properties?

To ownership and incentive alignment, therefore, transaction cost economics adds the proposition that the ex post support institutions of contract matter. These ex post costs of contracting include mal-adaption costs, haggling costs, set up and bonding costs and running costs. The ex ante costs of contract are those of drafting, negotiating and safeguarding an agreement. The ex ante and ex post costs are interdependent and thus are to be studied simultaneously.

Questions may be asked: what purposes are served by supplanting classical market exchange -- whereby product is sold at a uniform price to all comers without restriction -- by more complex forms of contracting? Similarly, transaction economics asks questions relating to the forces determining conglomerate and vertical integration, the limits to firms and the functioning of hierarchical bureaucracies, the organization of labor etc.

There are two types of approaches to these questions. The monopoly approaches ascribe departures from the classical norm to monopoly purpose. The efficiency approaches hold that the departures serve economizing purposes instead.

The following cognitive map of contract emerges as in Figure 3 [Williamson (1985), 24].

[see Figure A.3 overleaf]

In monopoly approaches to non-standard contracting leverage and price discrimination study the firm's relations with consumers, whereas in the barriers to entry approaches the implications of such actions on rival firms, to enhance monopoly power.

Much of the New Institutional Economics work is located on the efficiency branch of contract: One branch stresses incentive alignments relevant for the ex ante side of contract. New forms of property rights and complex contracting are thus interpreted as efforts to overcome the incentive deficiencies of simpler property rights and contracting traditions. The agency literature [Baiman (1982) and Jensen (1983)], on separation of ownership and control, emphasizes that principals contract in full awareness of the hazards that contract execution by agents

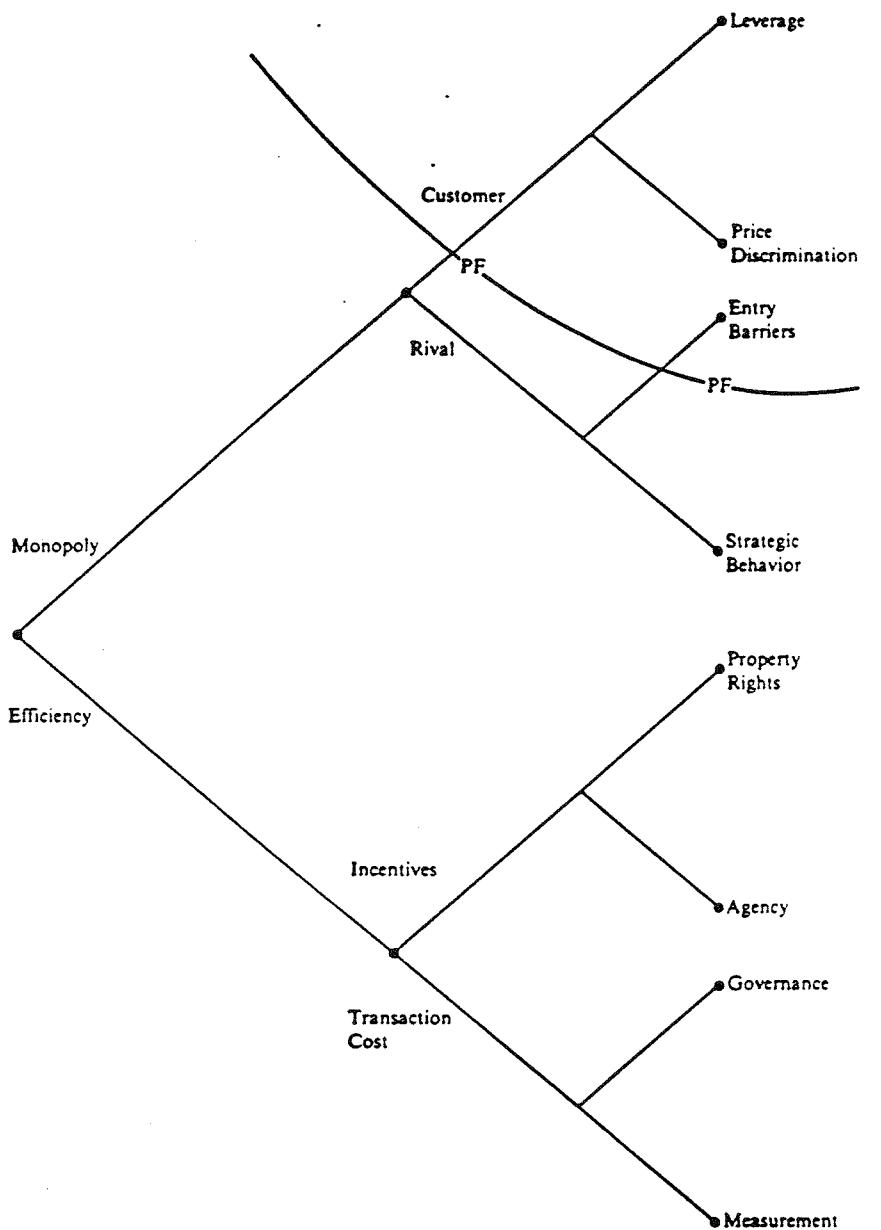


FIGURE A.3 Cognitive Map of Contract

poses.

The transaction costs literature also maintains that non-standard forms of contracting have efficiency purposes, but greater attention is given to the contract execution stage. Different governance structures shape contract outcomes; a cost-benefit framework determines the desirability of alternative contracts.

In sum, institutional analysis and transaction economics share individualistic behavior assumptions. Both approaches study situations, whereby individuals weigh costs and benefits of actions in specific action situations. Guiding principles for individuals are rationality and opportunism.

Though rationality of behavior is assumed, this rationality is not perfect but bounded by two factors:

- (i) limited information processing capability. In economics, it is often assumed that the individual is capable to instantly and without cost perform all the necessary permutations and calculations necessary for him to arrive at an optimal result. This is unrealistic. Optimality has been modified, or undermined, in economics by recognizing that actors are not 'optimizing' but 'satisficing', by allowing for short term and long term optimization, strategic decision-making, etc.
- (ii) information cost. This states simply that the process of identifying and acquiring information bears resource costs and time costs. Information collection activities may be very costly. For instance, some types of planning contend that full and comprehensive information is necessary for planning decisions to be taken properly. This is very costly to implement both in terms of data collection and in terms of data manipulation: to optimize over many processes, degrees of uncertainties, different levels of decision-making, different time frames and different regional interests. Similarly, in many situations an immediate action is to be taken, without the benefit of having first developed the relevant data sets. Comprehensive planning approaches versus the art of 'muddling through' [see for instance Dror (1968) versus Faludi (1973)]. Alternative data requirements also have implications for the time frame within which planning is attempted. Some professionals, for instance foresters, customarily work with planning horizons so long as to be often irrelevant for medium term planning (3-10 years) within which many social sciences work. This greatly hinders fruitful interdisciplinary co-operation.

Another attribute of individuals in collective action situations and in transaction economics is that they are guided by opportunism, defined as 'self-interest seeking with guile.

Transaction costs economics, then, focuses on the potential disputes that may arise when individuals, which are characterized by bounded rationality and opportunism, enter into contractual relationships in collective action situations (Williamson, 1975; 1985).