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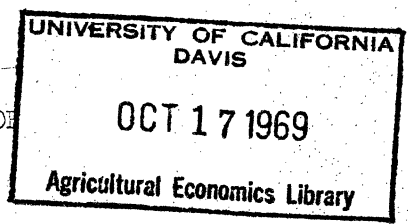
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NATURAL RESOURCES IN ECONOMIC GROWTH: THE ROLE OF  
INSTITUTIONS AND POLICIES\*



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I. Focus of this Paper

During the last 10 years, it has become the fashion among economists to emphasize the decreasing importance of natural resources in economic growth. This applies especially to the renewable resources used by agriculture [21, 23]. Use of these resources is strongly influenced by economic institutions, both in developed and undeveloped economies. It is not surprising, therefore, that there has been, in recent literature, a de-emphasis of the role of institutions paralleling that of natural resources. In the current mathematical models of economic growth, the role of institutions is not explicitly considered [11, 14, 20]. A well-known book on transforming traditional agriculture devotes the only two pages on the influence of economic institutions to land tenancy [24].<sup>1/</sup>

Emphasis has shifted from natural resources and economic institutions to technological change or, in production function terminology, to "new" or "modern" factors of production. If institutions are considered at all, they are treated

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as factors furnishing services like other factors of production. Changes in the kind and quantity of institutional services are regarded as determined by an economic demand-supply scheme [22].

In accordance with my assignment, I should like to focus on this doctrine of the decreasing importance of natural resources and the relatively insignificant and passive role of institutions in economic growth. I should like to analyze its validity, inquire into its relevancy, and show its implications for policy in developing countries.

## II. Decreasing Importance of Natural Resources in Economic Growth?

The doctrine of the decreasing importance of natural resources in economic growth is based on the observation, documented largely for the United States, that the shares of agriculture and of agricultural land in the national income have decreased in the course of economic growth. Two questions arise with respect to this observation.

First, does the fact that the income shares of agriculture and agricultural land have decreased in the United States since the last quarter of the 19th century mean that the income shares of all natural resources used by agriculture, including those also used by the rest of the economy, have decreased? Further, can the experience with the agricultural sector in the United States during a particular period of economic history be extrapolated to other sectors, other time periods, and other national economies?

Second, even if the first question can be answered in the affirmative, what is the meaning of a decreasing income share in terms of the "importance" of natural resources in economic growth? What are the implications for explaining, projecting, and influencing economic growth?

Let us turn to the first question. The natural resources used by agriculture are mainly land, water, and climate. All three are also used by industry, transportation, urban settlements, and recreation. For this reason referring to differences in demand elasticities for the products of agriculture on the one side and those of the industrial, transportation, urban, and recreational sectors on the other and then equating agriculture with natural resources is not permissible.

Shifts of these natural resources out of agriculture into other uses proceed at different rates and with different geographical impact. In California, for example, the shifts of agricultural land and water into industrial, transportation, urban, and recreational uses is a relatively recent phenomenon but has progressed further than in other parts of the country [7]. This shift involves price increases for natural resources which are frequently a multiple of prices prevailing in agriculture. Admittedly, the quantities of land and water used in agriculture are still large compared with those used in other sectors.<sup>2/</sup> But this relationship is changing in favor of nonagricultural uses.

Next, we may note that the decrease in the income share of agriculture in the United States took place in a period of history when the terms of trade moved against agriculture internationally for a number of specific historic reasons which are not likely to recur in the same combination. Terms of trade were affected by the expansion of agriculture into less-developed regions, the mechanization and intensification of agriculture in more developed regions, and, cyclically, by economic fluctuations--especially during the 50-year "cycle" connected with the name of Kondratieff [3]. Cyclical effects are distorting when income shares of sectors and factors are compared for periods, such as census years, falling into different phases of economic fluctuations.

With respect to climate and the increasingly important group of amenity resources--such as scenic attractions, public parks, clean water and air, and wilderness areas--it is difficult or impossible to evaluate shares in national income and wealth because the market system furnishes prices only incompletely or not at all. Still, there is little doubt that the significance of these resources for the location of industry and nonagricultural residence--including second homes--and for the income shares going to transportation, communication, and other services has greatly increased in the United States during the same period for which a decrease in the importance of natural resources is being claimed. There is also little doubt that the price society must pay for safeguarding the quality of these resources is increasing greatly and will continue to do so in the future.

With respect to natural resources originating and mainly used outside of agriculture, such as minerals and energy resources, there is evidence that their income shares have increased in the United States in some periods and decreased in others [19]. Here, also, the effect of economic fluctuations is significant.

In summary, then, we should be cautious in extrapolating an observation that applies to agriculture and agricultural land in the United States during a particular period of its economic history to all natural resources, time periods, and economies. On the basis of the available evidence, the validity of such extrapolation appears at least questionable. The possibilities for such extrapolation depend on the type of natural resource considered, on the type of technological change that interacts with the resource, on factors affecting the terms of trade of the products of the resource, and last but not least on the degree to which the resource is integrated into the market system.

Let us now turn to our second question and disregard for a moment the cautionary remarks just made. What does the alleged decreasing "importance" of natural resources in economic growth mean for explaining and projecting economic growth and for public policy aimed at generating and influencing economic growth? The reply, I am afraid, must be that it is irrelevant.

A decreasing income share may be due to greater efficiencies in a sector favored by technological change, making its product cheaper--especially if demand elasticities are low--and/or releasing factors for other employment. Are we to argue that such a sector or the services employed in it have become less important for economic growth? The opposite would seem more plausible.

A decreasing income share of a sector, on the other hand, may be due to the growth of other sectors producing substitutes for particular uses. Historically, this has been the case in many minerals and energy resources (charcoal, bituminous coal, sperm oil, etc.). Still, this does not indicate that the individual natural resources replaced in particular uses and the larger groups of the natural resources to which they belong have become less important in economic growth.

The whole question of the importance or unimportance of natural resources in economic growth to which so much attention has been devoted in the last 10 years, generously financed by some research foundations, appears rather banal. In the relation which one may call the resources function, all relevant variables are important [5, Chap. 37]. Nobody has yet claimed that natural resources are irrelevant in economic growth. In the continuously changing interplay of challenge and response between natural environment and human culture, it is meaningless to say that the challenge is less important than the response. Both are a part of the same system--that of human ecology. If there were no challenge, there would be no response. And, I may add, challenges may yet appear that will prove overwhelming to the response.

### III. The Role of Economic Institutions in Economic Growth:

#### Factors or Decision Systems?

The remaining of my allotted time will be devoted to a more meaningful subject--the role of economic institutions in economic growth. In this connection the mathematical models of economic growth need not be considered because, as stated above, economic institutions are not a part of their input. The output from a mathematical-statistical formulation depends on its input. If one is interested in explaining economic growth as a historical phenomenon, and in development policy in the political reality of today, such models have little to offer. Good critiques by economists concerned with development policy are already available.<sup>3/</sup> Rather, I should like to focus on the treatment of economic institutions in the book on traditional agriculture mentioned earlier.

To avoid misunderstanding, the main theses of the book are not under discussion. Within the assumptions and terminology employed, traditional agriculture can be regarded as efficient; and its marginal productivity of labor is greater than zero. Neither is it my main criticism that technological change is segmented into "new" factors in order to speak of "shifts" of a global production function--although understanding is scarcely advanced by such terminology.<sup>4/</sup> Historically, technological change has proceeded through packages of interrelated changes of many factors. The nature of these interrelations over time, the Gestalt of technological change, if you like, is the phenomenon that needs understanding rather than the appearance as a deus ex machina of quantities of "new" individual factors. I mention this merely because institutions are subjected to the same segmentation as technological change. My main criticism is that the book presents a conceptually insufficient model of economic growth because the role of institutions is left out.

Sometimes the author himself seems vaguely aware of this insufficiency. He is "puzzled" by economic decisions under a feudal land-tenure system and "baffled" by the economic behavior of plantation owners under a system of slavery.<sup>5/</sup> Still, none of the economic institutions which are significant for resource use--such as the systems of owning and using property, the systems of water rights, taxation, collective and cooperative organizations, and quasi-governmental agencies like public districts--are mentioned, much less systematically treated. Economic growth proceeds in an institutional vacuum as far as natural resources are concerned.

Is this vacuum filled by the belated admission of institutions as factors, the services of which are supplied in kind and quantity in accordance with the demand for them until a demand-supply equilibrium is reached [22, p. 1117]?<sup>6/</sup> This comforting notion is presented as a "theory" in a field in which it is claimed that "there are virtually no terms of reference, concepts with specification that can be identified, and no economic theory to guide the analysis" [22, p. 1114].

The facts are quite to the contrary. Institutions have been the central focus of the study of social organization for more than a century, both by adherents of the theory of economic determinism of institutions and by its opponents.

While Marx, Engels, and Kautsky emphasized the role of technological change in economic growth and the economic determinism of institutions, they, as well as non-Marxian adherents of economic determinism, were too aware of the relations between economics and social organization to press institutions into a simplistic demand-supply scheme.<sup>7/</sup> They recognized that the demand for changes of institutions is always opposed by demand for the status quo or demand for change in the opposite direction. They recognized also that a new equilibrium between conflicting demands on the one side and institutional change on the other is a long and hard struggle and is brought to conclusion by political rather than economic forces and tools.



The position of scholars who do not accept the theory of economic determinism of institutions--like Emile Durkheim in France; Max Weber, Werner Sombart, and Eduard Hahn in Germany; and W. I. Thomas and Talcott Parsons in the United States--is not affected by this recent oversimplified version of economic determinism [10, 13, 18, 25, 26, 27, 28].

What, then, is the essence of economic institutions? We may conceptualize an institution as a social decision system that provides decision rules for adjusting and accommodating, over time, conflicting demands (using the word in its more general sense) from different interest groups in a society. A change in the demand from one interest group, therefore, rarely effects a change in institutions. A feudal land-tenure system does not change merely because serfs or tenants demand it. A water-rights system based on the riparian doctrine does not change simply because nonriparians demand it. A system of taxation does not change because one or even the majority of taxpayers demand it. It all depends on the effectiveness of different demands, that is, on the relative weight of the interest groups from which demands originate. The locus where conflicting demands meet and where the relative weight of interest groups is determined is the political arena rather than the marketplace. For this reason, changes in economic institutions are usually slow and often require political changes and sometimes outright revolution. Changes in the feudal land-tenure system in Europe took centuries. In South America the change of similar land-tenure systems is still in progress. A hundred years after abolition, the economic effects of slavery in the United States are still present. It took half a century and required a constitutional amendment for the appropriation doctrine to obtain co-equal status with the riparian doctrine in the water-rights system of California. Tax reform in the United States is talked about for decades; but as every newspaper reader knows, accomplishments are slow.

Demand for institutional change may not even originate from those groups directly involved, such as the landlords and tenants in tenure systems. The demand may come from other groups because of what one might call the externalities of land tenure--that is, the benefits and costs incident on social groups other than landlords and tenants. This is frequently true for the collectivization of agriculture in order to promote industrial growth and the stability of a socialist political system. Other examples are tenure changes in fugitive resources--such as fisheries, range, oil, and gas--to further the social objectives of conservation. We are presently studying a case of this kind for a nomadic group of tribes in East Africa--the Masai. Here, tenure changes are demanded by the government in order to conserve the range resource and the game herds sharing use of the resource with the Masai livestock. The game herds, in turn, are important for economic growth as the basis for a flourishing tourist trade and large foreign-exchange earnings. If the demand for institutional change originates outside the groups directly involved, the changes required are even more clearly political and sociological and usually involve various degrees of "persuasion."

Economic institutions conceptualized as social decision systems provide decision rules both for the use of resources and for the distribution of the income stream derived from such use. This distribution has strong effects on the demand for institutional change. But such income effects are frequently just the opposite of those claimed by the doctrine under discussion. In other words, the demand for institutional change is increased if the income stream of a social group is decreased absolutely or relatively. The demand for changes in the feudal system in Central Europe was increased through dispossession of the peasants in the course of enclosures, and the demand for labor legislation in England was sparked by the misery of the working class during the first stages of the industrial revolution.

Our conceptual framework is not complete by designating economic institutions as social decision systems. I have tried to show elsewhere that economic institutions operate on the second level of a three-level hierarchy of decision systems [9]. Understanding of the relations between the three levels is necessary for devising public policies. On each level, the structure, the functioning, and the performance of the decision system can be studied both conceptually and observationally. For economic institutions affecting private conservation decisions, that is, decisions on the first level, such a study has long proved its usefulness [5]. Water institutions likewise have been analyzed within this framework [4, 8].

To bring this framework closer to the realities of development policy, I should like to illustrate it by some observations regarding the role of water institutions in northern India under the impact of the green revolution--the rapid spread of a new cereal technology based on varieties with greater capacity to combine with complementary inputs, such as labor, fertilizer, and especially water. Because of time limits and because our study is not completed, I can only sketch the main issues.

#### IV. The Role of Water Institutions in Northern India Under the Impact of the Green Revolution

The results of the green revolution expressed in yields per acre, increase in acreage of high yielding varieties, and total production need not be recounted here. This revolution has spread so rapidly in northern India, Mexico, and several other countries because it requires the least institutional change of any new technology that I know of--at least in the initial stages. In subsequent stages, however, institutional changes will become necessary. Of these, changes

in water institutions will be the most essential and the most difficult to bring about.

My concern is that the doctrine discussed in the preceding sections will lead to complacency regarding the institutional difficulties which lie ahead in realizing the full benefits of the green revolution and avoiding serious setbacks. According to this doctrine, there are no such difficulties because farmers themselves will accomplish those changes of water institutions which will become necessary.<sup>8/</sup> Let us take a closer look at this projection.

In northern India, irrigation has been based for centuries on groundwater lifted from open wells by the Persian wheel, a simple but ingenious device to develop groundwater resources where they are available in large quantities not more than some 40 feet below the surface. This is the situation in large parts of the extensive Indo-Gangetic Plain.

Groundwater use is usually possible on a more individualistic basis than surface water use. This is especially true for the relatively small, low-capacity development of groundwater based on the Persian wheel. The farmer can build, maintain, and operate the water facility himself or with the help of a small number of villagers. Water is available to the individual farmer where he wants it, when he wants it, and in quantities and over time periods which are under his own control.

An irrigation economy dominated by the Persian wheel differs greatly from one which is based on diversion from large rivers, such as in ancient Egypt and Mesopotamia, or, in modern times, from large multipurpose reservoirs. Here, the individual farmer is dependent on other farmers for building, maintaining, and operating the diversion facilities and the canal system which distributes the water. He must take his water at certain points on the canal. He must

take his turn as to when the water is available to him. Quantities of water are rationed to him, and these rations may vary over time for reasons which are outside his own control. What is the effect of these fundamental differences in the irrigation economy on the development of water institutions?

In a diversion economy, water institutions--such as water rights, water districts, a water master, and public agencies engaged in building, maintaining, and operating facilities--are a necessary condition from the beginning. In a water economy based on the Persian wheel, such institutions are not needed and do not develop. Groundwater institutions become a necessity only when water use by one farmer affects his neighbor. This happens when the Persian wheel is replaced by modern deep-well pumps. Here the neighbor is affected by the pumping cone and by the seasonal and often secular depletion of the resource because of high-capacity pumps.

In countries where an irrigation economy based on diversion preceded the need for modern groundwater institutions, these institutions could be built on the experience and mental attitudes already formed. These relations between groundwater institutions and surface water institutions I have traced elsewhere /6/. But such experience and such attitudes are not available in northern India. There water institutions must be created from scratch.

The green revolution has created a need for more water. Groundwater tables are beginning to fall and will force the replacement of the Persian wheel by deep-well pumps. Increasing size of farms, related to the green revolution, will operate in the same direction because of the Persian wheel's relatively low capacity and high labor requirements. Increased irrigation will increase the need for drainage. Water allocation problems between users, between uses, between states and regions, between areas of origin and areas of destination, and between state and federal jurisdictions loom on the horizon.

To solve these problems, groundwater laws are needed to regulate the number and spacing of wells, the quantities pumped per well, the periods of pumping, and the provision and operation of recharge facilities. This will require adjudication of water rights and integration of groundwater and surface water development and, thus, an integrated water-rights and management system.

As a key element of such a management system, the water district has proved its usefulness in the United States and elsewhere. It is flexible with respect to its role as a part of local and regional government. It is also flexible with respect to the participation of social groups outside of agriculture that need additional water supplies. Water districts, possibly with greater governmental participation and supervision than in this country, are needed.

Water institutions of this kind will develop over time. But the individualism of the farmer, the local community, and the region, shaped over centuries in an irrigation economy dominated by the Persian wheel, requires a special effort by researchers and policy-makers to create and to make acceptable the water institutions that are needed. Complacency based on a simplistic doctrine of the role of institutions in economic growth is not at all warranted and will become dangerous if effort in research and in public policy is thereby deflected from this important area. What India's agriculture needs most at the present juncture are competent economists, fully aware of the intricacies and the difficulties in the development of water institutions. Otherwise, the cornucopia of the green revolution may indeed prove Pandora's box, to paraphrase the title of a perceptive recent paper [29]. A laissez-faire attitude toward institutions is no less inappropriate than regarding them as constraints.

## FOOTNOTES

- 1/ According to the author, this influence operates solely through profitability of tenant farming. Profitability is regarded throughout as a "strong explanatory variable" [24, pp. 167 and 168]. Edmundo Flores' emphasis on land reform as the basic issue in increasing Mexico's agricultural productivity is explicitly rejected [24, p. 19].
- 2/ Because of these weights, the study by Goldsmith, Brady, and Mendershausen [12] shows a decreasing share of all land in the wealth of the United States, but this study applies only to the period 1896-1956 and is subject to a number of statistical difficulties with respect to comprehensiveness and valuation.
- 3/ See the discussion of the Ranis and Fei and Jorgenson models by John W. Mellor [17]. Also, see the discussion of institutional influences by John M. Brewster [2].
- 4/ Since multidimensional relations are involved, one must, strictly, speak of movements to production hypersurfaces.
- 5/ "Why many of the farmers who own and are responsible for the operation of very large farms, especially in some parts of South America, do not successfully engage in the search for modern agricultural factors is a puzzle" [24, p. 174]. "Why better health and longer life were not realized [for slaves in the antebellum South] is baffling" [24, p. 180].
- 6/ The author must be aware that the economic definitions of "demand," "supply," and "equilibrium" do not apply in the cases he discusses. Clarity is not served by interchanging the more general sense of a word with its precise scientific connotation.

7/ Compared with Marx and Engels, Kautsky has not gained a wide reputation in this country. He was, however, an economic theorist of some stature who was especially interested in the role of agriculture in economic growth [15, 16]. Besides Marx, Engels, and Kautsky, a long list of non-Marxian works could be mentioned. The best known in the United States is probably Charles A. Beard [1].

8/ As Professor Schultz puts it, farmers "will join with neighbors to acquire tube wells and to undertake minor investments to improve the supply of water. Both tenants and landowners will also use whatever political influence they have to induce the government to provide more and better large-scale irrigation facilities" [22, p. 1118].



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