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9. ABSTRACT
This paper discusses the benefits of fish culture development, and the potential impediments to such development. It notes that private international investment in aquacultural production will not contribute substantially to the war on hunger, although it may result in a useful contribution to the foreign exchange earnings of the less developed nations. It notes also that if aquaculture is to alleviate hunger problems, development efforts should focus on production of low-cost aquacultural projects by a low-wage indigenous labor force. Some suggested roles for the public sector in development of such an industry include funding of scientific research and the dissemination of results through the private sector, particularly results concerning improved methods of production. Public-sector efforts can also be directed toward improving the marketing process. Another role for the public sector involves identifying as early as possible the potential negative effects of technology--for example, the effects of weed and insect-control chemicals introduced to improve agricultural production.

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AQUACULTURE

IN LESS DEVELOPED NATIONS:

SOME ECONOMIC CONSIDERATIONS

by

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ABSTRACT

This paper focuses on the benefits of fish culture development and potential impediments to development. It is suggested that private international investment in aquacultural production will not contribute substantially to the war on hunger, although a useful contribution to foreign exchange earnings of the less developed nations may result. It is suggested that development of low cost aquacultural products by a low wage indigenous labor force will be necessary if aquaculture is to alleviate hunger problems.

Some problems which may arise in development of such an industry are noted and some roles for the public sector in solving them are suggested. Those include funding of scientific research and dissemination of results, possible through the private sector in forms which may be used to improve methods of production. A concomitant role exists in improving the marketing process. The possibility of serious extra market effects particularly from new technology is noted. It is suggested that the public has a role in identifying as early as possible the potential of technology for harm, and in reconciling these extra market effects wherever possible.

I. INTRODUCTION

Aquaculture has been defined as an operation "that subjects the organisms in question to...manipulation before their eventual harvest or capture." (Bardach and Ryther, 1968). This definition includes more than I wish for today's discussion. I am implicitly orienting my comments toward fish culture. I am assuming that the objective of fish culture is production of edible protein to augment domestic food supplies and/or to export for foreign exchange earnings. This excludes aquacultural production of pharmaceuticals, food additives (e.g. carrageen) and factory synthesis of food from unicellular organisms. Such production may be expected to take place, if at all, in a vertically integrated industrial structure. By contrast, much food fish production is dispersed geographically, production technology is traditional, and little integration of production and marketing phases is evident.

I am assuming that the objectives of aquacultural production are to be pursued via a viable private sector and that public assistance will be considered to establish and/or develop such a sector. Given the preceeding terms of reference I would like to discuss some economic and institutional considerations which are relevant to fish culture development

II. THE BENEFITS OF AQUACULTURAL DEVELOPMENT

A complete analysis of any proposed development program would consider both benefits and costs. I will not discuss costs in this section; only benefits. Benefits may be classified as market or extra-market and as primary or secondary. An extensive literature exists on the subject. I would hypothesize that for fish culture, by far the most important category of benefits would be primary market benefits. These benefits are measured by market price, hence the following discussion focuses on various aspects of market price.

The importance of price to the stated objectives is so obvious that one is tempted to leave price an implicit factor. No more serious mistake could be made since a casual reading of fish culture literature suggests it is all too often ignored or given mere lip service. Even where price is discussed it is assumed constant and used to compute gross revenue generated from a projected supply increase. The implicit assumption thereby made is that price is unaffected by quantity, i.e., zero price elasticity of demand is assumed.

The reduction of prices which can stem from supply increases has generated considerable controversy in the context of social benefit-cost analysis. This writer's inclination is to treat consumer and producer surpluses arising from such price decreases as equal but of opposite sign, in the absence of data to the contrary. Regardless of how one chooses to treat this question, the

ex post price must exceed costs if the projected benefits are to materialize in an unsubsidized industry.

If anticipated profit margins are sufficiently wide, a price decrease induced by projected supply increases would not jeopardize project viability. In many cases one may be able to suggest reduction in project scale by a comparison of ex-ante and ex-post supplies and the projected impact on project viability via price depressions. The funds thereby released might be allocated to development of storage and distribution infrastructure.

Related to the issue of price level and project viability is market size. Over a period of time it may be possible to increase market size by lowering production and marketing costs and by production promotion. It is most unwise to project an industry scale which would effect substantial supply increases in a short time period, unless current market prices are far in excess of projected production costs. A balanced approach would extend the development efforts to marketing stages as well as production. In terms of public investment strategies this suggests priorities in allocation of funds for increasing production should be given to species with large current market volume. Allocations to untried species should be modest until a market potential has been established.

In addition to current price and market volume, some idea of anticipated time rate of change of demand is desirable. Here, income elasticity of demand is important as the factor of proportionality which links growth rates of per capita demand and income. There may be some differences between production for domes-

tic consumption versus export in this connection. The latter may be expected frequently to involve export of relatively high priced items to satisfy demands in higher income, developed nations. Different species, product forms and income levels are involved and, as the following comparisons illustrate, it is difficult to make any general statements about income elasticities of domestic versus export markets. Income elasticity of demand for all food products combined is probably higher in low income countries, but individual food products may not follow this pattern.

An income elasticity of about 1.0 for food at the wholesale level in underdeveloped countries has been estimated by Stevens (1965). Some of the most active fishery products in international trade flows toward developed nations include shrimp, lobster, and oysters. An examination of the results reported by Bell et al (1970) indicates the following: Income elasticities for shirmp are most reliably known for the U. S. (1.7), Pakistan (2.0), and Japan (0.14). Income elasticities for lobsters are reported for five countries all of them developed, and all with elasticities in excess of 1.5. Income elasticities for oysters are reported for several developed and underdeveloped countries. Except for the U. S. estimate, elasticities appear to be about 1.4 or higher.

These results indicate clearly the existence of a segment of consumers, in both developed and less developed countries, for whom a discretionary income exists. Several important candidates for fish culture are, for this segment, superior goods in high demand. They also suggest the hypothesis that, for the forseeable

future, international investments in fish culture are likely to contribute little to the war against hunger in the less developed nations of the world. Investments in fish culture, private or public, may, however, contribute to foreign exchange earnings. If aquaculture is to alleviate hunger problems in the less developed nations, we must expect it to do so via indigenous production of relatively low cost species. This leads one to a consideration of possible problems which may be anticipated; to the problems of developing an indigenous aquaculture or of transforming traditional aquaculture. We may in general identify aquacultural production for export to developed nations with marine species and production of low cost species for domestic markets in the less developed nations with fresh water culture.

III. TRANSFORMING TRADITIONAL AQUACULTURE: SOME ANALOGIES WITH AGRICULTURE.

Aquacultural production will probably require an indigenous low wage labor force. It was for a time fashionable to assert the ineffectiveness of market incentives with such a labor force. More recently it has been persuasively argued by Schultz and others that market incentives do work in most cases, and in many cases of alleged failure, the failure was due to obstruction of market incentives. The obstructions can be simple or complex, and may reflect local custom or national policy.

The existence of adequate use rights is a prerequisite for effective focusing of market forces. Effective use rights require either property rights formalized in law or infcrmal rights institionalized as custom or tradition. I include in this rubric not only the common property issue but also imbalances in property rights which permit extra market costs caused by one industry or firm to be incident on another. The common property issue is probably of significance primarily for mariculture. It may also be significant for development of fresh water culture where none currently exists, and favorable use rights have not yet developed. Extra market costs arising from imbalances in property rights are probably of minor importance in traditional agricultural communities where the level of technology is low. As the level of technology advances, I would hypothesize that imbalances of property rights will lead to increasing problems.

Various types of tenancy are common in agriculture of less developed nations. Temporal stability, incidence between lessor and lessee of benefits and costs of technical progress, and capital improvements are relevant aspects of tenancy because they can cause

behavior which is superficially "irrational."

A closely related institution is credit. In many instances large landholders hold a degree of monopoly power over local credit by virtue of their location. Similarly, fish buyers are frequently suppliers of inputs and are able to exert some monopsony power through pricing practices and control of credit. The supply depressing potential of these types of obstructions tend to increase with the degree of risk incident upon producers and decrease with their income margin over subsistence.

Some of the less developed nations of the world are in South East Asia and include nations with a long history of aquacultural production. It seems a plausible hypothesis that Schultz' requirements for transforming traditional agricutlure would have applicability to transforming traditional aquaculture (Schultz, 1964). In their simplest form these may be stated as 1) an efficient set of prices 2) inputs which are profitable to producers and 3) the discovery and development of such inputs through organized research. The latter requirement is not likely to be met if left entirely to the private sector.

One may extend these requirements to include alleviation of some severe marketing problems. The problems of marketing food products are exacerbated in less developed nations by inadequate processing, storage, and transportation systems. As development proceeds urbanization of the labor force tends to increase the proportion of food entering formal marketing systems. Thus the potential benefits from improved marketing efficiency tend to increase as development proceeds. It has been reported, for example, that retail food comprises about 25 percent of total food at a $50 per capita income level. This percentage rises to 85 percent at a $100 per

IV. TRANSFORMING TRADITIONAL AQUACULTURE: SOME ROLES FOR THE PUBLIC SECTOR.

One important role of the public sector should be that of reconciling the disparities between private and social cost which arise from imbalances in property rights. This problem may be exemplified by water law which grants unconditional rights to the user without regard to qualitative requirements of subsequent users. If chemical herbicides and insecticides are profitable to an upstream farmer or aquaculturist, the question arises, should use of such chemical be permitted or encouraged irrespective of damage to downstream aquaculturists.

If a proposed agricultural development project dimihishes aquacultural production or reduces its potential for expansion an extramarket cost is created. Since it is not incident on a farmer this social cost will not be considered by him. This extra market cost is potentially a very important type of problem in some nations. In the present context, potential importance is obviously affected by the relative importance of fish vs. other protein sources in the diet of the people. In Thailand, for example, combined per capita consumption of hogs, cattle, buffalo, chicken, duck, eggs and milk is only about one half the per capita consumption of fish (Smith, 1963). Where these inter-firm or inter-industry impacts exist, benefit cost analyses should not consider either in isolation from the other. In particular, alternative technologies should be sought which minimize deleterious effects inflicted by one industry or producer or another.

This type of externality may have a counterpart in research bias. There is some danger that an agricultural research center which searches for weed and insect control mechanisms may not be concerned about their compatibility with fish culture. Such extra market effects of new technology should be identified very early, specifically from the very inception of research to avoid a biased search process. The task of constructing a research establishment capable of reflecting this need may require impositions on some researchers who prefer to keep their work free of such complexities.

The role of the public sector in funding research in an industry characterized by atomistic competition has long been recognized. In such an industry structure, individual producers find it difficult to capture the benefits of private research. Recognition of this public role in no way detracts from the role which the private sector can play in developing and disseminating research knowledge in the form of new, profitable inputs to the production process. The responsiveness of producers to market incentives was noted earlier to be influenced by the extent to which the incentives are in fact incident upon him. Sensitive cultural and political factors are involved, but it is desirable that policies be designed to reflect the facts of the case and to ensure that incentives are incident where they are most likely to be effective.

The increase in relative importance of food marketing which accompanies economic development may be expected to apply to fish. However, a brief survey of food marketing publications suggests hypothesis that fish are included as an after thought upon dis-

covery that the topic could not be avoided. In several studies dealing with food production and marketing in South East Asia, I found about three percent of the pages devoted to fish despite the fact that fish are the major source of protein in the countries discussed. This suggests some bias in approaches to food problems.

REFERENCES CITED:

1. Bardach, J.E. and Ryther, J.E. 1968. The Status and Potential of Aquaculture. Clearinghouse for Scientific Information, Springfield, Virginia.

2. Schultz, Theodore W. 1964. Transforming Traditional Agriculture (New Haven: Yale University Press).

3. Smith, Harold D. July, 1963 Agricultural Production and Consumption Patterns Market Potential in Thailand Misc. Publication No. 490. Department of Agricultural Economics University of Maryland

4. Stevens, Robert D. March 1965. Elasticity of Food Consumption Associated with Changes in Income in Developing Countries. U. S. Department of Agriculture, Foreign Agricultural Economic Report No. 23.