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Sociocultural Aspects of Implementing Aquaculture Systems in Marine Fishing Communities

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INTRODUCTION The purpose of this paper is twofold: First, to apply a generalized model of sociocultural factors influencing the diffusion of innovations to the problem of aquaculture development; and Second, to examine sociocultural aspects of introducing aquaculture systems into communities adapted to small-scale marine capture fishing.

Literally thousands of studies have been conducted concerning sociocultural aspects of the diffusion of innovations. On the basis of these studies, a generalized model has been developed and applied to the study of change in marine fishing communities (Pollnac 1976) and the introduction of appropriate intermediate food technology (Pollnac 1978). In the first part of this paper the model is applied to developing a model to be used in conducting sociocultural studies related to the introduction of aquaculture systems. Drawing on aspects of the model, the paper then examines potential problems associated with a shift from marine capture fisheries to mariculture. Pillay (1977), in a recent guide on planning aquaculture development, suggests that aquaculture sites be planned close to present capture fisheries to take advantage of existing distribution and marketing systems. It thus seems important to examine the sociocultural compatibility of these two systems. The paper contrasts aspects of man's sociocultural adaptation (e.g. psychological adaptation, workgroup structure, community social and legal structure) to small-scale marine capture fishing with comparable aspects of society and culture associated with aquaculture systems and discusses how complementary and conflicting aspects of the two systems can

either impede or facilitate aquaculture development programs.

THE SOCIOCULTURAL CONTEXT OF AQUACULTURE DEVELOPMENT Most experienced field workers involved with development projects realize that sociocultural variables are among the important determinants of project success or failure (cf. Zaltman and Duncan 1977). The relative importance of these variables was recently made clear in a study of 36 rural development projects which indicated that sociocultural variables were strongly related to project success (Morss, et al 1976). Social scientists have been investigating the sociocultural antecedents and consequences of technological development and change for a number of years. Rogers and Agarwala-Rogers (1976) note that some 2,700 published studies deal with the subject. Some of these studies have succeeded in accounting for over eighty percent of the variance in innovative behavior (e.g., Moulik 1966; Mish 1967). Despite this apparent mountain of information numerous technological development programs are slowed down and sometimes fail due to sociocultural factors. This may be due to the fact that some development assistance agencies have reservations concerning the value of social research (Cochran 1974) and thus provide only token support. It is thus important to clearly outline the sociocultural context of aquaculture development as a means of emphasizing the importance of these variables by considering their role in project success or failure. Hence, the purpose of this section of the paper is to focus on sociocultural variables potentially related to success or failure of aquaculture development programs. Variables considered will be examined in a systematic manner which may help us anticipate and propose solutions for sociocultural impediments to specific aquaculture development programs.

Most social scientists agree that an effective program of technology transfer consists of several essential and interrelated ingredients (see Figure 1).

First is the development of a technology compatible with the target environment and economy. Second, the idea of the new technology must be communicated to the target population. Third, the target population must perceive, or recognize, that the new technology will fulfill a need and will be, or can be, made consonant with existing beliefs, values, attitudes, and status and role relationships. These preliminary stages are either followed by a trial period or ght rejection. After a trial, the innovation may be rejected, revised, or opted. The adoption stage is reached when substantial numbers of the target population begin to use the innovation. Following adoption, incompatibilities may become more salient, and the new technology may be rejected. If not, it finally reaches the institutionalization stage where its "innovation" status is removed and it becomes part of the sociocultural system (cf. Rogers and Agarwala-Rogers 1976).

Several key ideas will help us understand what happens to a newly developed aquaculture technology as it passes through the various stages of the technological development and transfer process. First, the technology itself exhibits a number of distinct but interrelated attributes which affect its success or failure. These attributes will be discussed below. Second, an aquaculture project does not stand on its own. It is dependent on supply of raw material (e.g., seed, feed, medicine), access to water supplies (cf. Bennett 1977), and consumer acceptance of fish and fish products which are also affected by sociocultural factors (see Figure 1). Finally, even where the aquaculture system is compatible with the sociocultural and physical environment there will be individual differences in adoption due to variance in individual socioeconomic and personality attributes. Rogers and Shoemaker (1971) have identified over 30 of these variables which have appeared in empirical studies in the literature. Included are variables like education, social status, attitudes toward credit,

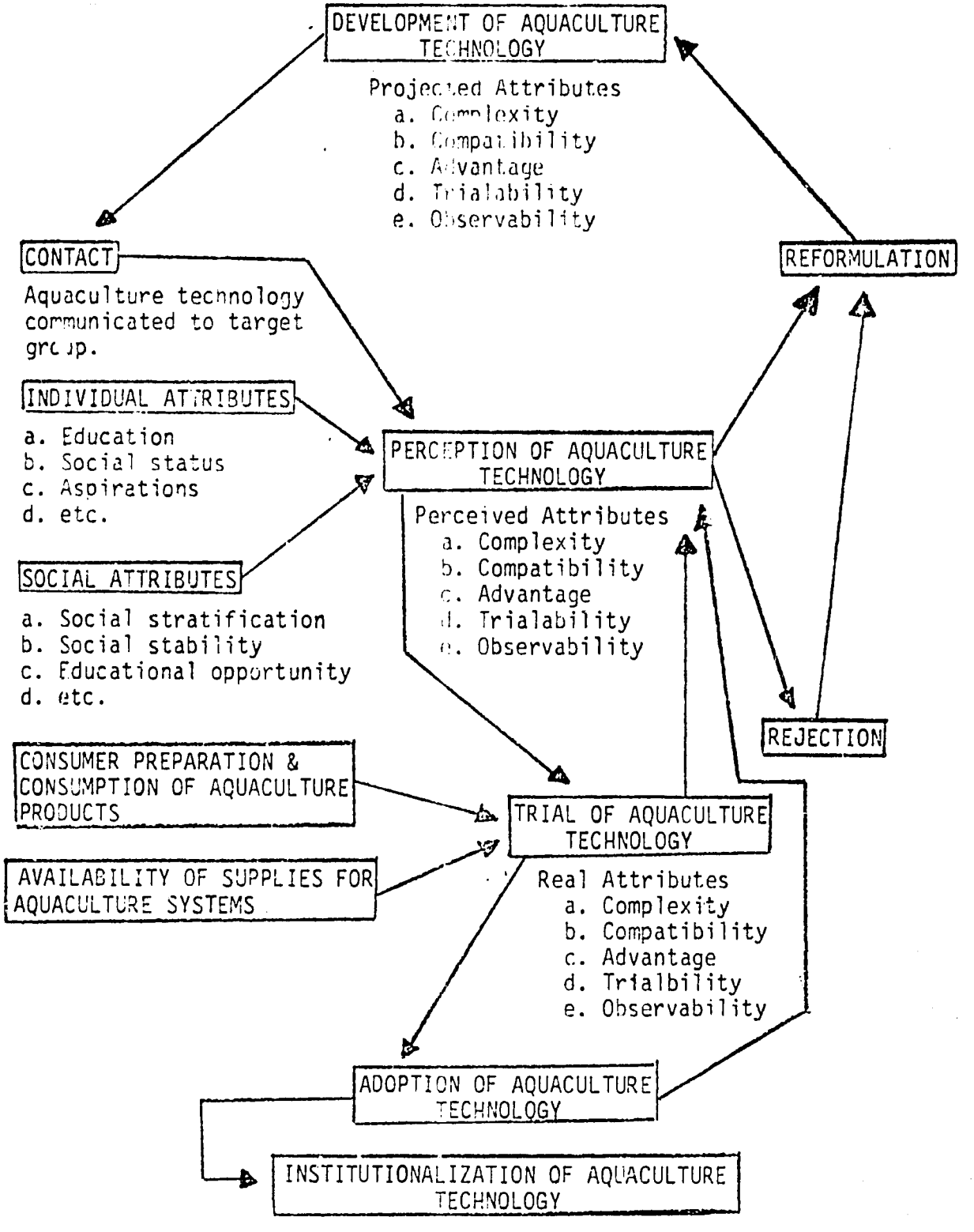

Figure 1. Sociocultural factors influencing adoption of aquaculture technology.

level of aspirations, change agent contact, mass media exposure, etc. These variables are further related to characteristics of the local society such as the social stratification system, educational opportunity structure, degree of sociocultural stability, extent of communication and transportation networks, and degree of market versus subsistence orientation (cf. Pollnac 1976). These variables must be considered as important sociocultural variables intervening between an otherwise appropriate aquaculture technology and its adoption.

Turning to the general attributes of an innovation we find that among others (cf. Zaltman and Duncan 1977) there are five major attributes of significance in the development context: (1) complexity, (2) compatibility, (3) advantage, (4) trialability, and (5) observability (cf. Rogers and Shoemaker 1971). The aquaculture scientist should anticipate these attributes when developing a new technology; the target population will perceive the technology in terms of these attributes; and these attributes, in large part, determine how the community will respond to the proposed changes.

Complexity The complexity attribute is relatively important with respect to aquaculture systems because the technology needed is often quite complex (cf. Pillay 1977). Complexity, however, is a relative judgement related to level of technological development. We must therefore determine if the aquaculture technology is too complex for the target group; e.g., what levels of training are necessary for its effective operation, and are there enough qualified individuals in the target group. Lack of skilled labor or management has been cited in many instances as a constraint to aquaculture development (cf. Shao-wen 1973; Cheng 1976; Jhingran and Tripathi 1976).

Compatibility With respect to the compatibility of a proposed aquaculture technology, we find that in some societies where social obligations are extremely time consuming, innovations perceived as conflicting with these temporal

demands will meet resistance (cf. Brown 1957). The temporal demands of the proposed aquaculture technology must therefore be congruent with time allocated for productive work in the target group. The role of the sexes in the social structure is also important with respect to the compatibility of food production techniques. In many societies around the world, men conduct capture fishing from boats while women are responsible for collecting shellfish and other fish in shallow waters along the shore (Pollnac 1976). If the proposed aquaculture technology involves activities similar to shellfish collecting, it will probably be viewed as women's work in many of these same societies, and attempts to introduce the new technology through men may fail. Attempts to introduce changes not compatible with the sexual division of labor have resulted in project failure in areas other than aquaculture (cf. Lowie 1954; Obibuaku 1967; Ritchie 1977), and there is no reason to believe that the transfer of aquaculture technology would be immune to this potential problem.

It is also important that the product of the aquaculture system be compatible with consumer preferences. Variance in food habits due to aesthetic, religious, status, and other cultural reasons is widely discussed in the literature (cf. Den Hartog and Bornstein-Johansson 1976; Levinson and Call 1975, Call and Levinson 1973; Foster 1973; Uchendu 1971). Further, and more directly related to aquaculture, Simoons (1974) has provided numerous examples of the rejection of fish as human food in both Africa and Asia.

The product of the aquaculture technology must also be made compatible with consumer food preparation techniques. In one country where the author worked, an international aid organization introduced a new shark meat drying and packaging technology. In attempts to stimulate use of the new product, television programs were developed to demonstrate cooking techniques. The demonstrators used electric ranges. Most people had access to televisions in

community centers and local stores, but they did not have access to electric ranges to prepare this dried shark product, and the cooking times, etc. were not valid for the small charcoal burning stoves prevalent in the target population.

Advantage Turning to the advantage attribute of a proposed aquaculture technology, we find that the advantage of a new technology is not usually perceived in a similar manner by both change agent and target group. We usually think of advantage in terms of financial return. This perception of advantage is not universal as evidenced by a study which indicates that Indian, in contrast to U.S. farmers, attach more importance to the social approval of an innovation than to its financial return (Fliegel, et al 1968). Further, with regard to the differential perception of advantage, the marginal utility of leisure time can be an important factor. Hewes (1974) discusses the interrelationship between dietary deficiencies, malnourishment, and lack of energy to do a full day's work. It seems reasonable that leisure time will be an important factor in perceptions of relative advantage of innovations within a malnourished group. Perhaps the sleeping peasant is not lazy but conserving energy to perform the daily tasks that keep him and his family alive.

Advantage is also relative--what is perceived as advantage by one may not be perceived so by another. For example, resistance often occurs when vested interests perceive an innovation as affecting their socioeconomic position. For example, MacNeil (1975) reports that while an oyster culturing project received praise from individuals not previously involved in oystering, those who harvested and sold oysters for years became outspoken critics of the project when they perceived the new entrants and alternative source as a threat to their livlihood.

Traditional sharing systems and perceived danger from theft may also

influence the target population's perception of the relative advantage of an aquaculture program. For example, Collier (1978) notes that in East Java as many as 50 to 100 people may join in a pond harvest and request a share of the production. Fish farmers state that this behavior is traditional in the area, and if they did not comply, the people would take revenge. This, of course, reduces the fish farmer's income and the overall advantage of the system. Theft is also reported as a widespread problem with respect to aquaculture stock (cf. Malaysia Fisheries Division 1971; Malaysia Ministry of Agriculture 1977), and in affected areas potential aquaculturalists may see little advantage in investing in a system which is so susceptible to theft.

Finally, perceptions of relative advantage are influenced by past successes or failures. FAO (1975) reports that previous failure of ill-conceived aquaculture systems in Africa remain a major constraint in convincing potential aquaculturalists of its economic viability. An understanding of why earlier projects failed along with the target population's perceptions of these failures would be important for designing education programs to convince the target population of the viability of newly proposed systems.

Trialability The trialability of a proposed aquaculture technology will also influence its success. Many aquaculture systems are relatively expensive to establish (cf. Pillay 1977), and financing is often difficult to obtain (Jhingram and Tripathi 1976; Shao-wen 1973). Further, perceptions of cost are relative to the economic status of the target group. Subsistence level producers usually do not perceive innovations as trialable no matter what they cost because they frequently do not have slack funds for investment (cf. DeWalt 1975; Gartrell, et al 1973, Cancian 1967). If the cost of the innovation is such that few can afford it, and if it is perceived as giving more advantage to those few, the disadvantaged may actually campaign against it. Bernard and

Pelto (1972) note that individuals who are already in advantageous positions in a socioeconomic hierarchy can be expected to be the ones who take advantage of innovations--they have both the slack resources (free capital) and are in more favorable positions with respect to information sources. They suggest that in most cases the socioeconomic effects of technical change lead to increased socioeconomic stratification. Henderson's research in British Honduras (1972) and Alexander's in Sri Lanka (1975) support this generalization. Such increases in social stratification are often manifested by further concentration of control over productive resources (cf. Havens and Flinn 1975).

Irrespective of the basis for these deleterious changes in social structure, Erasmus (1961) notes that they will result in emotional distress among peasants who have lost their old prestige system and who lack the opportunity to take part in the new one. These increases in social stratification will lead to more relative deprivation among future generations and enhance chances for social upheaval with disasterous long-range effects (Hewes 1974). Viewed in light of these potentially disruptive consequences, great care must be taken concerning the introduction of relatively expensive aquaculture technologies. FAO (1976) suggests that large scale aquaculture operations might be organized through associations of producers or cooperatives. Such a procedure might eliminate the potential for the development of excessive social stratification as discussed above.

Observability Erasmus (1961) places a great deal of emphasis on the observability of the results of an innovation. He points out that innovations most likely to succeed are those for which a quantitative appraisal of advantages are possible with only casual observation. Rogers and Shoemaker (1971) cite several studies supporting the hypothesis that an innovation's rate of adoption is positively related to its observability. Aquaculture systems do not begin to

produce immediately, but once they do, their results are quite visible. Pilot aquaculture operations financed by international aid organizations could serve to increase observability of results as well as provide a data base for needed investment information (FAO 1976).

How then do we determine if the proposed aquaculture technology is socially and culturally appropriate with respect to the five attributes we have discussed above? Solutions that seem sound in a distant experimental station can turn out to be unworkable in the traditional sociocultural matrix of a developing region. This suggests that research concerned with the introduction of aquaculture technology must be conducted, at least in part, within the target area and involve a careful assessment of the sociocultural factors involved with food production and consumption. It is suggested that the aquaculture technologies can best be related to the characteristics of the target group by directly involving the affected community in their formulation and implementation. In support of this suggestion, Morss, et al (1970) find that development project success is most affected by local action taken by small farmers to complement outside aid. The success of this kind of early involvement is a good indication of the necessity for feedback during the development and communication stages of the transfer of a new technology. This feedback can result in project reformulation and ultimate success without intermediate rejection which could hurt future credibility (see Figure 1).

In sum, we have identified general sociocultural factors directly involved with the successful application of aquaculture development programs. The general attributes of an innovation were discussed and examples were provided to demonstrate how they influence project success. It was suggested that community involvement in development and implementation of aquaculture development programs is the most effective technique for insuring their local appropriateness.

INTRODUCING AQUACULTURE INTO FISHING COMMUNITIES Turning next to potential problems associated with a shift from marine capture fisheries to aquaculture we find that Pillay (1977) suggests that aquaculture sites be planned close to present capture fisheries to take advantage of the existing distribution and marketing system. Given the highly perishable nature and marketing difficulties associated with fish and shellfish this is undoubtedly sound advise, but we must be aware of potential problems associated with such locations. The remainder of this paper is devoted to a brief examination of such problems.

Perhaps the most salient observation made concerning the differences between ocean fishing and aquaculture was expressed to the author by a small scale fisherman in the Azores. Upon hearing a description of an aquaculture system, he said with scorn "thats not fishing, thats farming--I wouldn't like to do that." A good starting point for our discussion, then, would be to determine what aspects of aquaculture are like farming, in contrast to ocean fishing, and how these aspects could be perceived negatively by ocean fishermen.

The importance of making these evaluations is based on the assumption that planned development of any sector of an economy will be maximally effective if proposed changes are carried out with an understanding of the target population's attitudes, beliefs, and values concerning affected occupations. For example, if changes result in displacement of individuals who must shift to alternative occupations, knowledge of attitudes towards the alternative occupations are essential to arrive at an understanding of the potential for either acceptance or rejection of proposed changes. If such knowledge is obtained in advance of proposed changes, programs can be structured to enhance the desirability of alternative occupations by focusing on positive attributes and attempting to change negative perceptions (cf. Pollnac 1977; Pollnac & Ruiz-Stout 1977).

Let us now examine contrasting aspects of small-scale marine capture and aquaculture systems to anticipate potential areas of conflict. Perhaps the most effective way to do this will be to list contrasting aspects with potential consequences, and then examine them in detail, point by point.

Table 1. Contrasting aspects of small-scale ocean capture fisheries and aquaculture systems.

MARINE CAPTURE	AQUACULTURE	POTENTIAL CONSEQUENCES
1. Unseen, elusive prey. Catch as much as possible.	Controlled harvest.	Thrill of chase missing. More predictibility.
2. Open resource.	Closed resource.	Less freedom of choice. Less independence. Loss of perception of unlimited catch based on luck and skill.
3. Primarily male workgroup.	Potential female workgroups.	Possible social structure changes.
4. Usually open tenure.	Closed tenure.	Use right conflicts. Property disputes.
5. Relatively low capital investment.	Relatively high capital investment.	Potential for increased social stratification.
6. Only harvest.	Must cultivate and harvest.	More complex manpower and training needs.

The first several rows in Table 1 are concerned with what we can consider the least tangible aspects of contrast between the two systems. They deal with psychological variables that may effect preference such as need for adventure and independence. Factors such as these are clearly less tangible than economic and technical aspects of productive systems; nevertheless, they are real, amenable to research, and can affect individual participation in the systems.

Particular aspects of the occupation and subsistence pattern of marine fishing allow one to make suggestions concerning psychological characteristics

of individuals following this pursuit. Perhaps the most important aspect is the challenge and danger associated with braving the sea. Man faces alone, or with small groups of men, the perils of an environment he is ill adapted for. He must rely on his man-made vessel for support and protection from the sea and the creatures therein. The necessity of facing up to this dangerous and challenging environment probably selects for a certain type of personality configuration. This configuration would serve to psychologically adapt the individual to the situational requirements of the marine environment. It is therefore expected that fishermen will be relatively more active, aggressive, and courageous than individuals gaining subsistence from land based pursuits. For example, Poggie & Gersuny (1974) report that fishermen from Southern New England are adventurous, outdoor types in comparison with millworkers from the same region. Support for the claim that fishermen are more aggressive is provided by Aronoff (1967) who notes that a Saint Kitts fisherman is more likely than a cane cutter to take active response when mistreated by a crew leader. He also notes that aggression between males and females is more frequent among fishermen than cane cutters. Glacken (1955) notes that on Okinawa fishing villages use more "rough language" than farming villages. Use of rough language may be interpreted as an expression of aggressiveness. Abrahams (1974) writes that the fishing captain in Tobago must be brave to encourage his men. T. Gladwin (1970) reports that on Puluwat there is an heroic quality to sailing--the risks taken result in a zest and occasion heroes. He writes that fishermen often troll simply for the excitement of it, although it is less productive than other methods. The emotional appeal of trolling was also noted on Ifaluk by Burrows and Spiro (1953). Panamanian small scale fishermen emphasize the sporting, pleasurable aspects of their occupation when asked what they like about fishing (Pollnac and Ruiz-Stout 1977). Salmon fishermen on the Northwest Coast of

America also tend to rank the challenge and personal enjoyment of fishing highly (Smith 1977). Forman (1970) points out that raft fishermen have become legendary heroes along the Brazilian coast with tales of their daring and courage told over the generations. Finally, Bernard (1972) comments on the folk heroic nature of successful sponge divers on Kalymnos, Greece. Overall, the literature supports the proposition that fishermen manifest the psychological characteristics of being active, aggressive, and courageous.

Fishermen meet the demands of their occupation alone or with small groups of men. The decisions they are forced to make in the face of uncertainty have immediate effects with respect to the safety of the vessel and its crew as well as the success of the hunt. These decisions must often be made with little hesitation because of the rapidly changing nature of the sea. It is thus expected that fishermen will exhibit tendencies toward independence and self control. This expectation is partially supported by Poggie and Gersuny (1974) and Leighton (1963) who find that fishermen are characterized as 'independent' types. Further, Pollnac and Ruiz-Stout (1977) note that fishermen often cite independence as an important characteristic of their work. Smith's (1977) research among the Northwest Coast salmon fishermen clearly shows that these fishermen rank personal freedom and being one's own boss highly. Further, Kottak (1966) reports that successful marine fishing at Arembepe, Brazil requires individualistic behavior. In South Thailand, the economic orientation of Malay fishermen stresses individualism (Fraser 1966). Harrison (1970) notes that among the Malay of South West Sarawak, fishing develops an independent discipline of mind. Finally, Caribbean fishermen from Saint Kitts emphasize independence and self reliance in statements concerning reasons why they chose to fish (Aronoff 1967). Overall, the literature appears to support our expectation that environmental and technical constraints of ocean fishing result in

independent, self reliant fishermen.

An additional, significant facet of marine adaptations is that fishing from boats is conducted almost solely by males. Thus the relatively rigorous situational demands are met in the company of other males and tend to reinforce an image of "ideal masculinity" characterized by bravery, independence, and a capacity to endure hardship. This is probably associated with an emphasis on the distinction between the sexes resulting in a machismo complex among males which most feel compelled to live up to. T. Gladwin (1970) reports that drinking on Puluwat is almost exclusively male activity and is viewed as an enhancement to masculinity. Bernard (1972:301) related bravery in sponge diving among Kalymnos divers to perceptions of the diver's virility. In general, the discussion provided above concerning the importance of bravery and courage among fishermen can be used to support our suggestion that in many instances the constraints of the marine environment result in a machismo complex among fishermen.

Another feature of the occupation or subsistence patterns of fishing which may influence psychological orientation is periodicity of income. Size of catch is both difficult to predict and highly periodic. In contrast to many salaried occupations, the fisherman cannot count on an even flow of earnings. This context of relatively high periodicity necessitates skillful management of production. Further, the need for continual preventative maintenance of fishing equipment to counteract the destructive nature of the sea also requires thinking ahead. Thus, the fisherman must have a future temporal perspective if he is to succeed. This hypothesis is supported by Pollnac, Gersuny, and Poggie (1975) and Pollnac and Poggie (1978) who report that fishermen from Southern New England and Puerto Rico defer economic gratification to a greater extent than millworkers and cane cutters from the same regions. Further, Poggie (1978) has demonstrated that a deferred orientation is a strong predictor of

success among Puerto Rican Fishermen. Additional support is provided by their finding that millworkers tend to perceive that they have less control over their future than fishermen.

In sum, aspects of the occupation and subsistence pattern of capture fishing are expected to influence the psychological orientations of fishermen. It is suggested that fishermen are active, courageous, aggressive, macho, independent yet cooperative, future oriented individuals who manifest a high degree of self control. This suggestion is supported in part by both the literature cited above and commonly held stereotypes of fishermen and does not appear to be a personality type that could be fulfilled by working at aquaculture. It is interesting to note that the raft fishermen of Brazil "...claim they would not be agriculturalists under any circumstances because their personalities simply will not allow it" (Forman 1970:23). Considering the perceived similarity between agriculture and aquaculture systems, this statement is quite important with respect to the goals of this paper.

Now let us return to the comment of the Azorian fisherman who said with scorn that aquaculture is more like farming than fishing. If fishermen view aquaculture as being more like farming than fishing, then in lieu of any hard data on ocean fishermen's view of a real aquaculture system, I would like to present some results of a study concerning variance in perceptions of the occupations of fishing and farming among small scale fishermen in the Gulf of Nicoya, Costa Rica.

Data for the study are based on interviews with 80 small-scale fishermen from the Gulf of Nicoya. Part of the sample (50) was drawn from Barrio el Carmen, Puntarenas. Puntarenas, the major Pacific port of Costa Rica, is located on a thin finger of land jutting westward into the Gulf of Nicoya approximately 110 kilometers west of San Jose. Barrio el Carmen is at the extreme western end

of Puntarenas and is inhabited primarily by small-scale fishermen. A sample of 30 small-scale fishermen were interviewed at Costa de Pajaros, a concentration of fishermen in a rural region approximately 21 air-kilometers northwest of Puntarenas on the coast of the Gulf of Nicoya. In both areas most small-scale fishermen fish from motorized wooden plank or dugout vessels from 15 to 30 feet in length using handlines and/or nets. Some still use sail or oars.

The technique used to investigate variability in perceptions of the occupations farmer and fisherman is the semantic differential. The semantic differential is based on the assumption that an individual's life experiences affect the connotative meaning of concepts (Osgood, Suci, & Tannenbaum 1957). Here we compare the connotative meaning of the concepts "fisherman" and "farmer" by having individual fishermen rank each concept on a set of six bipolar attributes (see Table 2).

Table 2. Bipolar Attributes Used to Differentiate Farmers and Fishermen

1.	GOOD - BAD	BUENO - MALO
2.	HAPPY - SAD	FELIZ - TRISTE
3.	INTELLIGENT - STUPID	INTELIGENTE - ESTUPIDO
4.	STRONG - WEAK	FUERTE - DEBIL
5.	FAST - SLOW	RAPIDO - LENTO
6.	BRAVE - COWARDLY	VALIENTE - COBARDE

Three of the bipolar attributes (GOOD - BAD, HAPPY - SAD, INTELLIGENT - STUPID) form an evaluative dimension, and the other three (STRONG - WEAK, FAST- SLOW, BRAVE - COWARDLY) a dynamism (potency-activity) dimension (cf. Osgood, Suci, & Tannenbaum 1957; Osgood 1964). Each bipolar attribute was ranked on a seven-step scale with the emotively positive pole (e.g. GOOD) receiving a value of seven,

and the negative (e.g. BAD) a value of one. Four independent variables (age, education, years fishing, and rural/urban residence) were determined with the use of direct questions.

Mean values on each bipolar attribute and the dynamism and evaluative dimensions can be found in Table 3.

Table 3. Mean Values on Bipolar Attributes and Semantic Differential Dimensions for the Concepts Fisherman and Farmer.

Attribute of Dimension	Fisherman	Farmer
STRONG-WEAK	5.23	5.23
GOOD-BAD	5.39	5.40
HAPPY-SAD	4.93	4.44
INTELLIGENT-STUPID	5.36	5.04
FAST-SLOW	5.58	5.00
BRAVE-COWARD	6.20	6.00
EVALUATIVE DIMENSION	15.68	14.88
DYNAMISM DIMENSION	17.00	16.22

Overall, Table 3 indicates that small scale fishermen tend to characterize farmer more negatively than fisherman. In figure 2, the mean values for fisherman and farmer are plotted on the evaluative and dynamism connotative meaning dimensions.[1] This figure makes it clear that the vector leading from fisherman to farmer in connotative meaning space is almost equally emotively negative on both dimensions.

The next step in the analysis was to determine if differences in conceptualization of farmer and fisherman are related to other sociocultural variables. Distance between fisherman and farmer (FFD) was calculated for each connotative

[1] A one-sample t-test of significance was applied to determine if the mean differences between fisherman and farmer on the two dimensions are significantly different from zero. For the dynamism dimension $t=2.499$ ($p < .02$) and for the evaluative $t=2.697$ ($p < .01$).

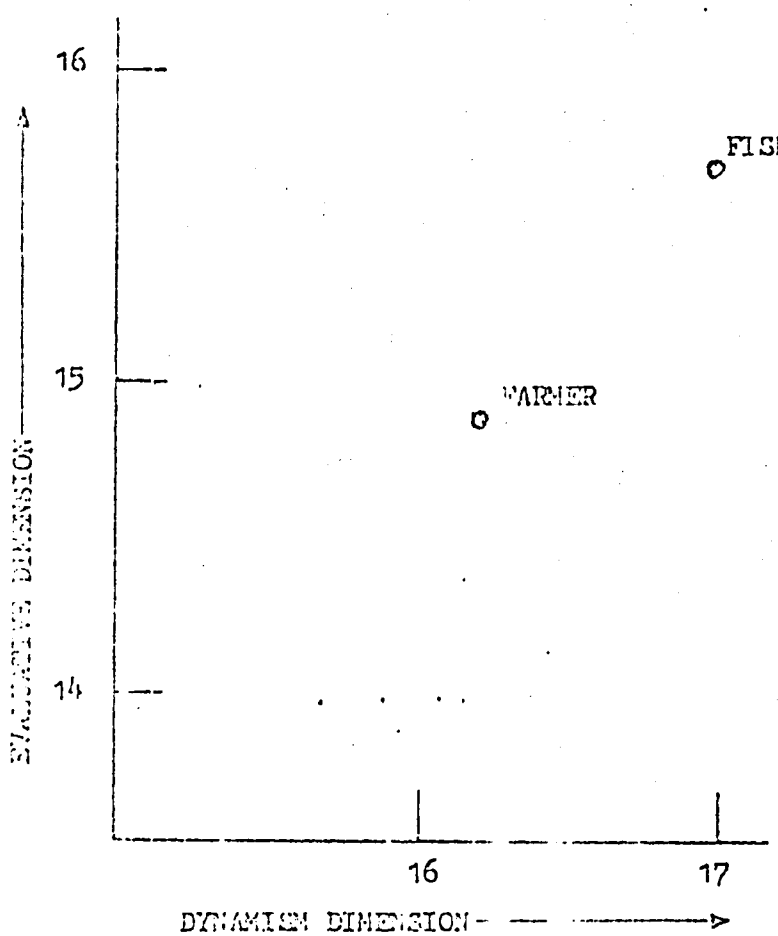

Figure 2. Location of FISHERMAN and FARMER in Connotative Meaning Space.

meaning dimension by summing the value for fisherman minus the value for farmer on each attribute within each dimension. This resulted in an FFD on both the dynamism and evaluative dimensions for each individual within the sample. Dynamism and evaluative FFD's were intercorrelated with age, education, years fishing experience, and area of residence (dummy variable; rural = 1, urban = 2). The results of this analysis can be found in Table 4.

Table 4. Correlations between Independent Variables and FFD on Evaluative and Dynamism Dimensions.

Independent Variable	Dynamism FFD	Evaluative FFD
1. Age	.06	.06
2. Education	-.06	-.06
3. Years Fishing	.22*	.22*
4. Area of Residence	.03	-.23*

N = 30 *$p < .05$

Table 4 indicates that both years fishing experience and area of residence are related to FFD. It appears that the longer one has been fishing, the greater the FFD on both dimensions. Area of residence is significantly related only to the evaluative dimension. Here the data suggest that evaluative dimension FFD is greater for the urban than the rural fishermen. Table 5 provides mean values for the rural and urban samples on both dimensions, and Table 6 provides these values for the sample dichotomized at modal years fishing experience (mode = 13 years). Figures 3 and 4 graphically display the relationship between these two independent variables and perceptions of farmer and fisherman.

Figures 3 and 4 clearly indicate the relationship between the independent variables and FFD on both dimensions. In Figure 3, the distance between farmer

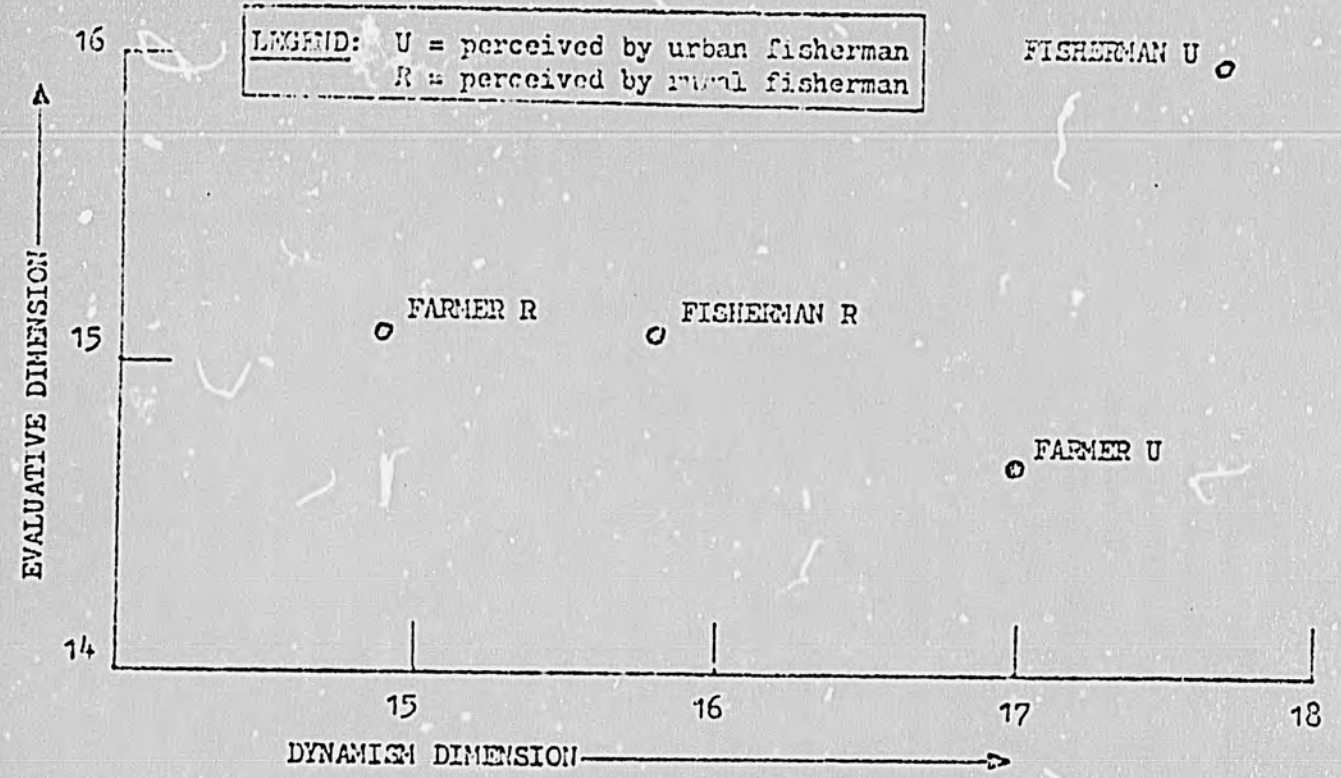

Figure 3. Rural-Urban Differences in Location of FARMER and FISHERMAN in Connotative Meaning Space.

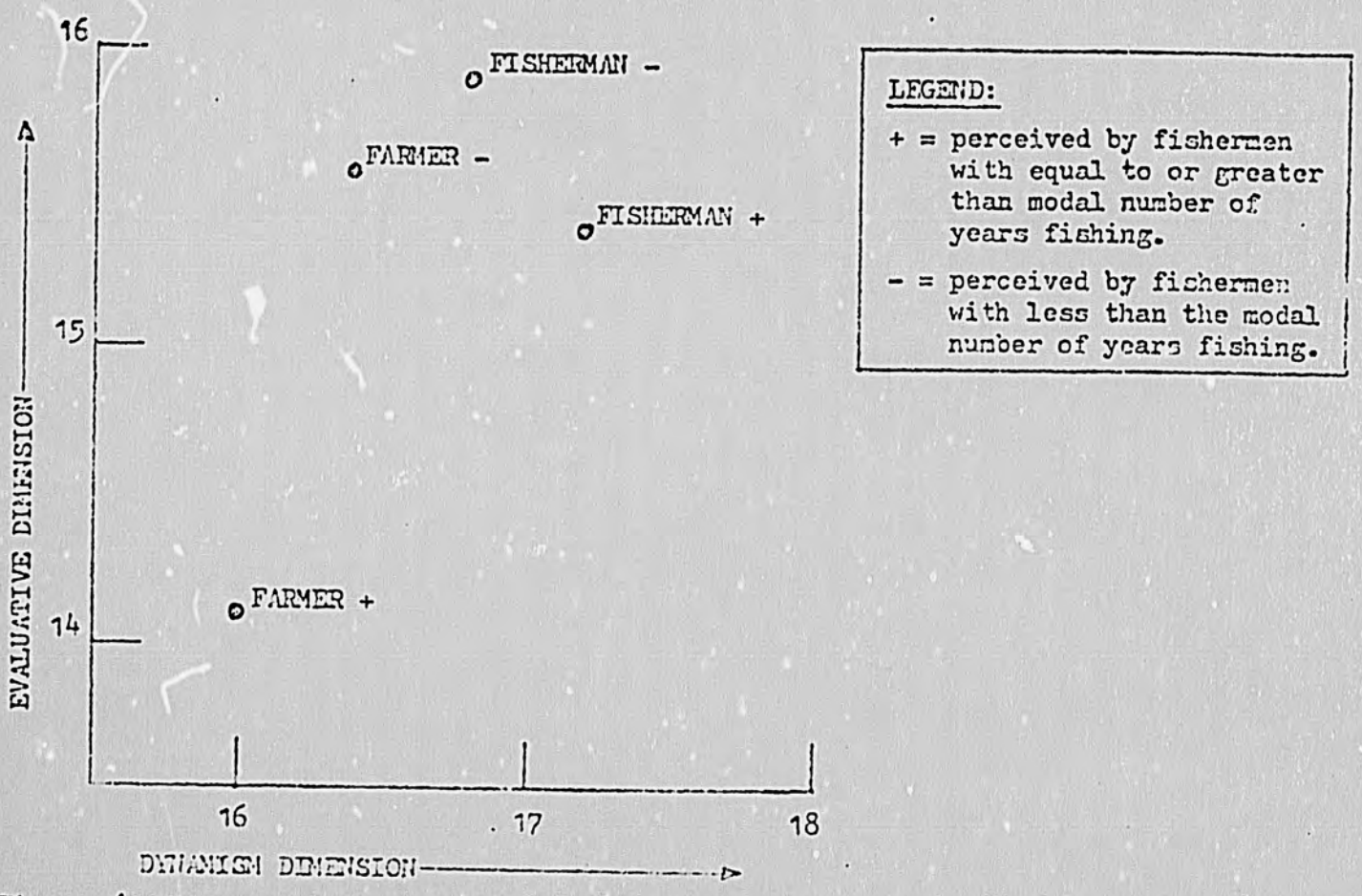

Figure 4. Effects of Years Fishing on Location of Fisherman and Farmer in Connotative Meaning Space.

Table 5. Rural/Urban Differences in Mean Values on Semantic Differential Dimensions for Farmer and Fisherman.

Concept/Dimension	Urban	Rural	F. Ratio	p
Fisherman/Dynamism	17.7	15.8	17.68	$<.001$
Fisherman/Evaluative	16.0	15.1	4.05	$<.05$
Farmer/Dynamism	17.0	14.9	10.88	$<.01$
Farmer/Evaluative	14.7	15.1	0.33	$>.05$
N	50	30		

Table 6. The Effects of Years Fishing on Evaluation of Fisherman and Farmer on Semantic Differential Dimensions.

	Years Fishing*			
Concept/Dimension	≤ 13	≥ 13	F Ratio	p
Fisherman/Dynamism	16.8	17.2	0.67	$>.05$
Fisherman/Evaluative	15.9	15.4	1.58	$>.05$
Farmer/Dynamism	16.4	16.0	0.34	$>.05$
Farmer/Evaluative	15.6	14.1	6.43	$<.05$
N	42	38	*Mode = 13	

and fisherman on the evaluative dimension is clearly greater for the urban fishermen than the rural fishermen. Differences between the concepts on the dynamism dimension are approximately the same for both samples. Nevertheless, we can see that the urban sample, in contrast to the rural sample, consistently ranks both farmer and fisherman higher on the dynamism dimension while ranking farmer lower and fisherman higher on the evaluative dimension. In Figure 4 we find that individuals who fished less than the modal number of years (13 years) tend to characterize fisherman and farmer closer together on both

dimensions than those who have fished 13 years or more. Further, Figure 4 indicates that those who have fished longest have the most negative perception of farmers.

Finally, since both years fishing and area of residence were significantly related to evaluative FFD, the combined effects of these two variables were examined. The multiple correlation between these two variables and evaluative FFD is 0.30, ($p < .05$) indicating that together they explain nine percent of the variance in the dependent variable, a modest but respectable sum.

Part of a person's self-identity is obtained from membership and roles in groups. Some is ascribed (e.g. sexual identity), and some is achieved. According to some authors, occupation forms a significant aspect of achieved identity (McKee 1974), and participation in low-status occupations can result in discesteemed self-identities. The findings reported here indicate that small-scale fishermen in the Gulf of Nicoya perceive farmers more negatively than fishermen. If, as has been suggested above, fishermen perceive aquaculture to be more like farming than fishing, then our findings suggest that they will perceive a shift from fishing to aquaculture as possibly resulting in a loss of self-esteem and resist such a shift. We must keep in mind, however, that the study presented here is based on perceptions of farming, not aquaculture, and that the findings may not be applicable beyond the region where the data was gathered. Further, the variance within the sample (e.g., the rural-urban differences) suggest that some members of a fishing population may be more receptive to aquaculture systems than others. It is clear, however, that differential perceptions of ocean fishing and aquaculture may effect willingness to switch from one to the other.

Turning next to workgroup composition, our attention here will be focussed primarily on the predominance of male workgroups in ocean fishing endeavors.

An examination of the ethnographic sample indicates that males conduct most of the fishing activity. Of the 330 societies for which data concerning the division of labor in fishing is available, both sexes participate equally in only 10 percent, and female participation predominates in only five percent. The familiar pattern is one in which males do the major fishing and/or marine hunting while females conduct minor shore or reef fishing and/or shellfish collecting (Pollnac 1976). In societies where shore fishing and shellfish collecting is done primarily by females, aquaculture may be perceived as woman's work and be resisted by men. If the aquaculture technology is accepted and conducted by females in these societies, it could result in changes in female roles which if unanticipated could be disruptive.

Existing land tenure (cf. Williams 1975; FAO 1976; Cheng 1976; Jhingran and Tripathi 1976) or sea tenure (cf. Smith and Marshall 1974) systems, which are also a part of the social system, are areas of potential conflict when shifting from a marine capture system to aquaculture. In some cases existing laws actually operate against developing aquaculture systems.

A review of the literature reveals several types of sea tenure operating in fishing communities. Least frequent was individual ownership. Suttles (1974) reports that among the Straits Salish of Western Washington, some shellfish beds and fishing areas were formally owned by important men in the community. Rights to this property were claimed through inheritance. Perhaps the most frequent form of sea tenure is communal ownership. For example, in Ulithi, Micronesia, a canoe fishing in grounds belonging to another district was traditionally subject to seizure (Lessa 1966). Knudson (1970) suggests that in Micronesian coral islands, level of production influenced population growth, which, in turn, increased the societal level of territorial integration; finally, higher levels of territorial integration are related to degree of leader

control over marine resources. In Polynesia, areas of ocean are corporate estates of groups of people, but title to the areas is associated with the group leader. Although all group members have use rights, the leader has the prerogative of administering use (Sahlins 1958). In South India, villages as a whole have rights to specific fishing grounds (Norr 1972). Norbeck (1954) notes that Japanese fishing waters are defined by prefectural law which usually conforms with traditional assignment of fishing waters. Among the Yoruk Indians of Northwest California, beach and seacoast rights were traditionally communal property (Beals and Hester 1974). Even in present day U.S. society where the sea is legally defined as an open access resource, Maine lobstermen claim fishing rights to particular areas. The lobstering territories are associated with harbor gangs, and violation of territory has resulted in equipment destruction and other forms of violence (Acheson 1975).

In some areas where there is no formal recognition of sea tenure rights, fishing spots are kept secret. For example at Arembepe, Brazil the fishermen view the sea as an open access resource, but good fishing spots are kept secret (Kottak 1966). Forman (1970) reports a complex system of named fishing grounds and landmarks among the raft fishermen of Brazil. Location of the fishing grounds is made by visual triangulation and knowledge of fish within them is transmitted from father to son over the generations. Forman suggests that secrecy regarding spots acts as a spacing mechanism.

Finally, some societies claim that there is true open access to marine resources. Fishermen of Isla de Margarita, Venezuela report that any man fishes where he wishes (Orona 1968). Davenport (1956) suggests that although fishermen usually set their pots in the same area off Jamaica, there is no permanent tenure over sea areas. Finally, Firth (1965) notes that on Tikopia no fish resources are owned.

In sum, despite the difficulty of boundary maintenance in the sea, some societies do recognize rights over fishing grounds. Most commonly these rights seem to be communal. Although one might argue that the preexistence of cooperative or communal ownership of fishing grounds would transfer readily to an aquaculture system, this is not necessarily so. Aquaculture presupposes an investment of resources such as time, labor, and supplies in contrast to the lack of such investment in naturally occuring marine organisms. Once such investments are made, individuals begin comparing their investment with that of others and arguments concerning relative rights begin to develope. An analogous situation existed among cattle raisers in a region where the author recently conducted research. Unimproved pasture was grazed collectively, but there were specific rights associated with improved pasture. Although it would be more efficient if all pasture were improved and grazed collectively, the cattlemen strongly resisted such a move, saying that lazy individuals would profit from the work of others. Improvement of shellfish beds or brackish fish ponds could result in similar resistance against cooperative ventures.

Needless to say, improvement of an area originally exploited as an open resource will result in conflicts when it is perceived as interfering with fishermen who normally exploited the natural region. For example, Kamara, et al (1976) report that racks and floating structures associated with oyster culture have been difficult to maintain if they are located in areas where local fishermen normally operated and their cooperation and involvement was not obtained early in the project. In some areas fishermen claim that poisons used by pond operators hurt their fishing operations (International Center for Aquaculture 1976). Further, some fishermen are against fish culture based on fry collected from the sea because they believe this will cause depletion of stocks (Ceylon Department of Fisheries 1972).

Problems such as these can lead to resistance that could severely disrupt developing aquaculture systems.

In cases where areas for aquaculture systems must be bought, leased, or rented they become part of the costs which are the topic of row 5 in Table 1. Several scholars have made important observations concerning differences between ownership of the means of production in farming and fishing communities. Shifts to aquaculture involve changes which result in a system quite similar to farming--parcels of land or sea are improved and some type of ownership is usually involved. Firth (1966) notes that land ownership has a permanency not associated with fishing equipment. The constant motion and fluidity of the marine environment in combination with sudden, violent storms at sea make fishing equipment especially liable to sudden damage and loss. Norr and Norr (1974) argue that the rapid depreciation of fishing equipment in combination with occasional losses result in higher rates of occupational mobility in fishing than in farming. They suggest that this results in small social and economic distance between owners and laborers in fishing. Hence, a shift to aquaculture, because of its structural similarity with agriculture, might increase the social and economic distance between owners and laborers, thus, increasing social stratification and its concomitant problems as discussed above. Additionally, the relatively high costs of aquaculture technology would probably increase social stratification as discussed in section one.

In addition to increased costs, the relative complexity of aquaculture in contrast to small scale marine capture systems (line 6, Table 1) also results in the need for the development of manpower training programs (Pillay 1977). The problems associated with the development of training programs are beyond the scope of this paper and are well documented elsewhere (cf. Leagans and Loomis 1971; Jones 1974). Nevertheless, it is important to note that

training programs must be established if the aquaculture development is to succeed--participation in an ocean capture fishery does not automatically prepare one to culture fish.

SUMMARY AND CONCLUSIONS In sum, we have applied a generalized model of sociocultural factors influencing the diffusion of innovations to the problem of aquaculture development and examined sociocultural aspects of introducing aquaculture systems into small-scale marine capture fishing communities. The model presented here can be used as a guide for developing research programs directed at determining the sociocultural impacts of proposed aquaculture systems. The examination of specific aspects of implementing aquaculture systems in marine fishing communities illustrates a potential application of the model as well as indicating potential problems associated with such programs. Although the paper has focussed on potential problems, there is no doubt that aquaculture technology can be successfully applied as a partial solution to the problem of protein production in the developing world. Nevertheless, it is through the recognition of potential sociocultural problems and taking steps toward their solution that we can facilitate the successful introduction of aquaculture technology wherever and whenever it is needed.

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