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Technological Change and Social Organization among Small-Scale Fishermen

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INTRODUCTION Although much has been written concerning psychological, social, and cultural responses to techno-economic change in agrarian and industrial sectors of society, little systematic effort of comparable magnitude has been directed at small-scale fisheries. This is probably due to the fact that in comparison with agriculture and industry, small-scale fisheries have extremely small impacts on most national economies. Nevertheless, when viewed on a world-wide basis, the number of individuals involved in small-scale fisheries is quite impressive. The United Nations Food and Agricultural Organization has recently estimated that there are 9.2 million small-scale fishermen in developing countries (F.A.O. 1974). This figure does not include the approximately 4 million employed in associated activities such as fish processing, selling, equipment manufacture, etc.

As producers of high quality protein in a world suffering from food shortages, the importance of this occupational subculture should not be underestimated. Ongoing and future attempts to improve the technology and production of small-scale fishermen will meet and hopefully overcome many of the same social, cultural, and psychological dislocations that occurred and are occuring as a result of change in the agrarian and industrial sectors of society. The purpose of this paper is to briefly examine the interrelationship between technological change and several important aspects of man's social adaptation to the occupation of small-scale fishing. The relationships between certain social and techno-economic aspects of small-scale fisheries will be examined and a model of these relationships will be developed. Examples of how technological changes impact

on social relationships will be provided from actual small-scale fishery development programs, and suggestions will be provided concerning the utility of the model for development programs.

SOCIAL ADAPTATION TO TECHNO-ECONOMIC ASPECTS OF SMALL-SCALE FISHERIES Several aspects of small-scale fishery technology result in social relationships that differ somewhat from those found in agrarian social groups (cf. Pollnac 1976). This section of the paper examines the relationship between small-scale fishing technology and certain aspects of the ownership of productive equipment, workgroup and non-workgroup structure, and degree of social stratification.

Turning first to the relationship between small-scale fishing technology and the ownership of productive equipment we find that several scholars have made important observations concerning differences between ownership of the means of production in farming and fishing communities. 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 smaller social and economic distance between owners and laborers in fishing.

Kottak (1966) provides a good discussion of how the relatively simple technology of the small-scale fishermen of Arembepe, Brazil provides relatively equal opportunities for all fishermen to own capital equipment thus resulting in a relatively egalitarian community. He notes that the cost of the technology is approximately equal to the average annual earnings of fishermen in the community; thus the opportunity to buy a boat is theoretically open to all

fishermen. He points out, however, that other mechanisms operate to prevent the development of social stratification resulting from income variance between successful and non-successful fishermen. These mechanisms include reciprocal exchange networks as well as annual festivals which demand more resources from the more wealthy; thus, leveling out the distribution of wealth. He also notes that the relatively short lifespan of plank boats inhibits transgenera transfer of ownership differentials through inheritance.

Although the ownership pattern that Kottak (1966) described for Arembepe is quite common among small-scale fishermen, the literature indicates a wide range of possibilities. Ownership patterns include both individual fisherman owners (e.g. Firth 1966; Kottak 1966) and non-fisherman owners (e.g. Forman 1970). In some cases several members of a crew will cooperatively own a large boat (cf. Fraser 1960). In other cases large, sea-going canoes are owned by kinship lineage heads (cf. Firth 1965) or lineage members in common (cf. Lessa 1966). In general, the larger and more complex the technology, the more likely it will be owned by non-fishing entrepreneurs (e.g. middlemen, local elites, etc. cf. Forman 1970) or groups of individuals (e.g. kin groups; cf. Nason 1975). Epple (1977) provides a good example of how mechanization, because of increased price of capital equipment, altered patterns of fishing boat ownership on Grenada. Prior to mechanization 90 percent of the fishermen owned their own boats. Following mechanization this figure dropped to 25 percent. When the ownership pattern of relatively complex, expensive equipment is individual entrepreneurship rather than cooperative kinship or workgroups, there is great potential for increasing social stratification and inequality.

Fishing technology is also related to workgroup composition and structure. In a comparison of Thai fishermen and farmers, Foster (1975) notes that in

contrast to farming groups the size of fishing groups is rigidly determined by technology. This is obviously related to the limited space on a vessel. Further, Norr and Norr (1974) note that ocean fishing demands much more reliance on reciprocal interdependence and coordination of crewmen than agriculture. Pulling a net, launching a boat through a heavy surf, and responding to the ever changing nature of the sea requires a high degree of skillful coordination among a compatible workgroup. Thus, technological constraints limit the size of the workgroup and environmental and technological constraints select for worker efficiency. It appears, therefore, that crew composition should be flexible and not based on prescribed social criteria. Nevertheless, we find that social groups play an important role in workgroup composition among small-scale fishermen.

Kinship plays an important and varied role in the structure of the occupation of fishing in many parts of the world. The importance of kinship in fishermen's workgroups has been extensively cited in the literature from regions as widely separated as Ghana (Quinn 1971), Peru (Sabella 1974), Micronesia (Knudson 1970), the Faroe Islands (Blehr 1963), Ulithi (Lessa 1966), Costa Rica (Pollnac 1977), and the West Indies (Aronoff 1967). The need for harmony on a vessel is essential for success at sea, and kinship ties may enhance cooperativeness within the workgroup. Other factors may also increase the tendency toward kin based crews. For example, Gladwin (1970) notes that among the Mfante of Ghana, boat crews with family cores are more stable than non-kin linked crews. On Moala kinship ties are related to the sharing and loaning of capital equipment such as boats (Sahlins 1962), while on Tikopia canoes are nominally owned by heads of kin groups, but actually by the kin group as a whole (Firth 1965). Sabella (1974) suggests that the use of kin in the crew among small scale fishermen from Peru is often related to keeping boat production within the family.

Among some fishing people, however, we find that kinship plays little or no role in crew composition. Glacken (1955) notes that family members fish from different vessels on Okinawa. This is done to minimize loss to individual families if a fatal accident occurs. Further, neither Taiwanese (Diamond 1969) nor Malay (Firth 1966) fishing crews are primarily based on kin ties. Norr (1972) reports a similar situation in South India and suggests that the skilled nature of the occupation of fishing results in worker recruitment on the basis of skill and interpersonal ability rather than social ties. There is thus a great deal of variability in the role that social groups play in small-scale fishermen's workgroups. It has been indicated, however, that in many societies, kinship plays an important rôle in boat crew composition.

Turning to the structure of relationships within small-scale fishermen's workgroups, Norr and Norr (1974) have suggested that the need for coordination within fishing crews and the physical risks associated with the marine environment increase both the need for interdependence and the importance of each worker. This, in combination with the rapid depreciation of equipment and the possibility of equipment loss, decreases the social and economic distance between owners and laborers. Hence, they argue that work relationships in fishing crews should be more egalitarian than among farmers. Their data and the ethnographic literature supports this proposition. For example, Norr (1972) reports that few distinctions are made within workgroups among fishermen of South India; that the owner does not direct work--he participates as an equal. Burrows and Spiro (1953) comment on the egalitarian nature of fishing workgroups in Ifaluk, and contrast this with the general rank consciousness of Ifaluk society. On Taiwan, Diamond (1969) notes that friendship characterizes the relationships between crew members. T. Gladwin (1970) reports that although the navigator is in command of the vessel on Puluwat, he is not aloof--he pays attention to the suggestions

of crew members and imparts a sense of egalitarianism. At Arembepe, Brazil, Kottak (1966) writes that the captain works like all the other crew members. When the fishing begins he is the same as the crew. Knudson (1970) stresses the fact that the exploitation of terrestrial resources is an individual act in Micronesia while marine resources are exploited by cooperative groups. The same general relationship hold in Nicaragua among Miskito turtle fishermen. There, land hunting partnerships are loose in contrast to the close cooperation demanded between turtle fishermen. Turtle men must have partners they can rely on; thus, partnerships form around each individual's skill, reliability, and temprament (Nietschmann 1973). The need for cooperation in trap fishing among the Matupit of New Britain is given structural expression in groups known as motoni which are associated with particular areas of beach used for fishing related activities (Epstein 1969). On Saint Kitts in the Caribbean, Aronoff (1967) notes that fishing crews are integrated and cooperative with little stratification in comparison to cane cutter groups. He notes that fishermen are likely to view their captain as helpful and nurturant in contrast to cane cutters who view the head cutter in a negative manner, suggesting that he takes advantage of the men. Firth (1966) reports that among Malay fishermen the crew leader shows a readiness to consult the crew on matters of policy. Mfantese fishermen of Ghana believe that harmony in the boat is essential to safety at sea (Quinn 1971). Sabella (1974) writes that cooperation is so necessary among the fishermen of Caleta San Pablo, Peru that arguments stop short of the beach. He further notes that crews are very egalitarian--even the captain performs the same work as the crew. Finally, Brandt (1971) comments on the egalitarian nature of interaction aboard fishing vessels in Korea.

The egalitarian nature of artisanal fishermen workgroups was commented on in detail because of the important role that workgroup organization plays

as an element of social organization. Workgroup organization is so important that when fishing people form part of a society that has a strong system of social stratification, ocean fishing is sometimes organized as the occupation of a low status, caste-like group (e.g. as in Japan and India). Norr and Norr (1974) suggest that this caste-like separation of fishermen functions to insulate the larger society from these potentially threatening egalitarian relationships.

Additionally, workgroup organization is often related to shore-side social organization. In many societies crew leaders (e.g. navigators in Polynesia, captains, etc.) also enjoy a leadership role ashore (cf. Davenport 1956; T. Gladwin 1970). Further, the friendships which often develop between crew members can form the basis for non-fishing groups. Fraser (1960) reports that among Malay fishermen of South Thailand, boat groups are very durable and frequently serve as the foundation for other social and economic groups.

Summing up the discussion of the relationship between small-scale fishing technology and aspects of the ownership of productive equipment, workgroup and non-workgroup composition and structure, and degree of social stratification, it has been noted that the generally low cost of small-scale fishing technology, the impermanent nature of the equipment, and the close cooperation required usually result in little social distinction between owner and laborer within small-scale fishing groups. Nevertheless, it was noted that as equipment costs increase due to increases size or complexity, the liklihood of individual fisherman ownership decreases; thus promoting the development of social stratification and inequality. Concerning workgroups, it was noted that vessel size and complexity affect both crew size and recruitment of crew on the basis of skill. Nevertheless, we have found that crews are often selected on the basis of social criteria such as kin group membership. Small-scale fishermen workgroups, however, tend to be egalitarian in structure due to the fact that

many shipboard tasks require close cooperation between fishermen. Finally, these close interdependent ties between crewmembers often result in the formation of male groups ashore based on the maritime workgroup. The structure of these interrelationships between small scale fishing technology and social organization can be found in Figure 1.

TECHNOLOGICAL CHANGE AND SOCIAL ORGANIZATION In this section of the paper examples will be provided which will demonstrate the interrelationships between technological change and aspects of social organization contained within the model developed in the previous section. A study conducted by Fraser (1966) among Malay fishermen of South Thailand provides a good example of the impact technological change can have on workgroups and other aspects of a sociocultural system.

Traditionally, the Malay fishermen of Rusembilan relied on oars and sail to take them to their fishing grounds. In 1956 groups of boat owners and steerers (traditionally a high status position in the boat crew) dominated deliberations concerning the best way to motorize the fleet. They decided to introduce tow boats to take fishing vessels to fishing areas and bring them back. Groups of boats would form tow-groups associated with a particular tow boat. This new technology immediately placed considerable strain on the traditional social system.

First, membership in tow-groups meant that individual boat crews and steerers lost their previous independence with regard to locating fish and timing return to market. Second, after a period of poor fishing, wives of members of the more skillful boat crews realized that they were subsidizing less successful crews since shares were based on the tow-group's total catch. Fraser (1966) notes that this situation had broad repercussions in other areas of community

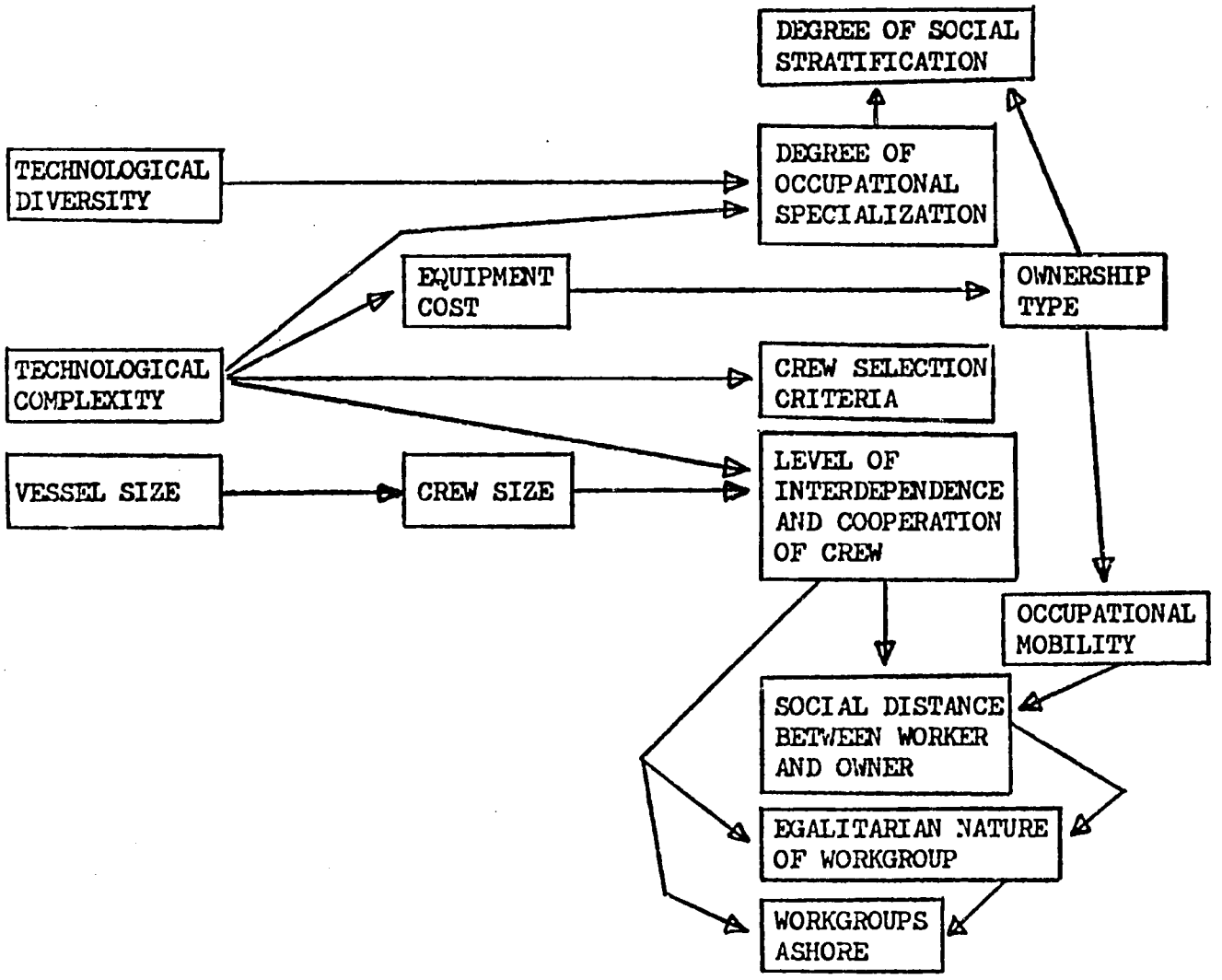

Figure 1. Relationships between technology and social organization (adapted from Pollnac 1976).

life. It resulted in overt hostility between women, and relations between men became strained. The coffee shops, which were the focus for community decision making groups and associated with boat crews, manifested a marked drop in attendance, reflecting the social strains. Attendance at coffee shops never fully recovered. Further, traditional village authority figures, the orang baik (morally good man), were involved in ownership of tows and their operation, thus, the chief source of authority and means of maintaining village control were undermined. Finally, because the religious leaders of the village remained aloof from the changes, their status increased.

Before long, the strains became too great, and the tow boats were eliminated. The reindividualization of fishing did much to restore good relations, but the degree of community organization which was originally based on boat crew membership and the traditional authority of the orang baik (whose traditional status depended on boat group affiliation) was never regained. Further, the introduction of nylon nets and individual motorized vessels reduced the need for a large crew; nevertheless, the crews were kept larger than necessary in keeping with traditional crew structure. Fraser (1966) argues that this featherbedding plus decreasing catches undermined the sense of pride that traditionally characterized crews. This reduction of group solidarity negatively affected the relatively high status of the steerer and, hence, his status in the community at large.

Thus, a change in technology that was ill adapted to the traditional social structure of work was rejected, and the negative changes that occurred in the traditional social structure were never totally corrected. Further, traditional social organization dictated a crew size that resulted in inefficient application of other technological innovations. A prior understanding of the relationships between social organization and technology could have resulted in

development plans that would have prevented this undesirable situation.

The model also indicates that there is a relationship between technological change, equipment cost, equipment ownership patterns, and social stratification. Among Malay fishermen, increased costs of productive equipment associated with modernization has resulted in a class of equipment owners. Firth (1966) has noted that although equipment modernization has resulted in greater overall returns, increasing capital costs have led to a marked drop in the percentage of earnings going to the labor force. Despite the fact that the fisherman has become, in effect, an employed laborer in the new system, he is treated as a participant in a common enterprise and thus not put on a regular wage basis. His income is still based on a share of the catch. Firth (1966) notes that among the Malay fishermen, costs are removed from the catch before shares are calculated; thus, given the periodic nature of production in the marine environment, fishermen often receive next to nothing. He therefore reports that in 1963, the fishermen were in a less advantageous position than when he first studied them in 1939-1940.

Even when governments are aware of new technologies' potential effect on social stratification because of initial costs, problems occur and increased disparity in wealth result. For example, Alexander (1975) reports that in Sri Lanka the government was aware of financing problems associated with costly new fishing technology, so they introduced a hire, purchase scheme. Individuals who took part were selected by ballot from qualified applicants. The individual fisherman had to provide a deposit and received a government loan, repayable over five years, to purchase a hull boat with an engine. Unforseen problems developed, however. First, the deposit in combination with the fact that the loan covered vessel and engine, but not gear, meant that the fisherman had to go to private money lenders. Second, the new equipment deteriorated faster than

the old, and there was no provision of maintenance funds. Third, loan repayment was not related to the value of the catch--it was a fixed monthly payment; thus, during off-periods the payment could exceed income. Nevertheless, production increased, so the government viewed the project as a success and invested more funds in it. The total income to the fishing village increased, but other, less visible problems also increased. Since the number of fishermen increased little over the years since the innovation was first introduced, and the population increased, there was increased unemployment. New boats were introduced, but they rightfully went only to experienced deep sea fishermen. Important for our discussion, however, is the fact that inexperienced recruits were only drawn from relatives; therefore, few opportunities existed for those not related to the boat owning elite to acquire the experience necessary for allocation of a boat. The elite in the community is larger than it was in the past, but the large group of middle-class free peasants are finding life much more difficult, and there is now a substantial elite with the bulk of the population being reduced to the poverty level. Alexander (1975) suggests that since the elite have political power and control recruitment to the most favorable occupations, the degree of social stratification will become even more marked in the future. Increases in social stratification have been attributed to similar factors in other communities where costly innovations were introduced (cf. Sabella 1974; Norr 1972).

Ironically, in some communities attempts by change agencies to introduce costly fishing technology in a manner which would possibly reduce the potential for increased social stratification by going around traditional equipment owners and money lenders have failed due to the fact that fishermen viewed the traditional patron-client relationship as legitimate and the government's planned intervention as illegitimate (cf. Emmerson 1975). Once again, however, a thorough

understanding of the relationships between technological change, equipment costs and ownership patterns, and traditional social organizations dealing with these techno-economic variables might result in reduction of social strains and more readily acceptable development programs.

DISCUSSION AND CONCLUSION A model illustrating the relationship between small-scale fisheries technology and aspects of social organization was developed and examined in relationship to problems reported to be associated with fisheries development programs in the past. Although the examples examined had negative effects, this is not to be interpreted as meaning that given certain social facts, fisheries development cannot occur. In fact, an understanding of the social organization associated with the small-scale fishermen within a region targeted for development can aid in developing realistic programs which will enhance the probability of sustained development. It is only by understanding the existing social organization and working within it that changes can effectively take place--changes not only in technology, but in aspects of social organization that inhibit change. Additionally, an understanding of local social organization facilitates involvement of fishermen in early stages of the development program; thus, further increasing potential for project success (cf. Morss, et al 1976).

In conclusion, it must be noted that social organization is not necessarily the key variable associated with technological change among small-scale fishermen (cf. Pollnac 1976), but it can affect project success just as severely as other factors associated with technological change (e.g. funding, natural resources, infrastructure, etc.).

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