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Poverty, perceptions and planning: why socioeconomics matter in the management of Mexican reefs

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Abstract

This paper examines relationships between socioeconomic factors and perceptions of coastal resources in Mahahual, Mexico. Residents provided open-ended comments to questions regarding coral reefs and fisheries. Socioeconomic characteristics are examined to see if there are differences in perceptions between socioeconomic groups. We found that wealth is the most important socioeconomic variable influencing perceptions of coastal resources. The paper concludes that understanding how socioeconomic factors influence people's values of the environment can help in the development of efficacious conservation strategies that address the root causes of environmental degradation, but emphasizes that interventions must complement the complex livelihood strategies of stakeholders such as fishers.

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1. Introduction

This paper examines how socioeconomic factors influence perceptions of the local coastal environment among residents of the small fishing village of Mahahual in

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Fig. 1. Map of coastal Quintana Roo, Mexico.

Mexican State of Quintana Roo (Fig. 1). The coastal environment of Quintana Roo supports considerable tourism and fishing industries, upon which many residents depend for income and/or subsistence. Quintana Roo's diverse coastal environment is characterized by world famous tourist beaches such as Cancun and Cozumel, prolific mangroves in the Sian Ka'an biosphere reserve, and is part of the second largest coral reef system in the world, the Meso-American Barrier Reef. Although all of Quintana Roo's coastal ecosystems are of great economic and social importance, coral reefs, in particular, are crucial because they protect the coastline against hurricane damage and beach erosion, sustain subsistence and commercial fisheries, provide sand for beaches, and create recreational opportunities such as scuba diving. The social and economic base of many communities within Quintana Roo has evolved to depend, at least in part, upon the beauty and bounty of coral reef systems.

Throughout the southern Quintana Roo, coastal communities utilize a variety of methods to exploit their surrounding reef resources [1,2]. However, some activities, including fishing, development and tourism can alter the delicate balance of coral reefs [3–10]. The nature and intensity of some activities can compromise the very habitat that both animals and humans depend upon for their livelihood. Unfortunately, altering resource use practices that are harmful to coral reefs is often difficult because the various ways in which people utilize their natural resources are invariably related to a multitude of social, cultural, and economic factors [11–16].

Recent research concerning natural resource management highlights the importance of understanding and incorporating local perceptions into conservation initiatives [12,17–21]. In a study of perceptions of local resources in the Philippines, Nazarea et al. [12] note that individuals and communities utilize their surrounding resources based on a variety of social and cultural factors that shape their perceptions of the resource. Nazarea et al. [12] report that these factors can determine whether a potential resource is perceived as useful for extractive purposes or dismissed as useless.

Perceptions of environmental resources determine not only how a resource is utilized, but also its relative value to the community. In a similar study about perceptions of the coastal environment in Indonesia, Pollnac [21] discusses how the value that a community places on natural resources can have significant implications on how those resources are managed. According to Pollnac, the value that something has to an individual or community reflects the various satisfactions that can be gained from it. Pollnac provides evidence that these satisfactions can range from utilitarian (e.g., a source of income or food) to aesthetic (e.g., the beauty of the tangled roots of the mangrove tree). These culturally defined standards are often crucial in understanding local approaches to environmental management. For projects that aim to promote sustainable uses of coastal resources, it is important to understand which resources a community places values on and which they do not. It is essential to understand perceptions of factors influencing the status of coastal resources prior to attempts to involve local people in community-based or co-management efforts. Resource management projects may need to either direct outcomes at local values or somehow change these values. Gaining an understanding of how local communities perceive natural resources can allow resource managers to adapt and refine management strategies to reflect the needs and desires of the stakeholders.

However, it is also important to recognize that communities do not necessarily have a single perception regarding their natural environment. Social and economic factors can influence how individuals within a community perceive their resources. Both Nazarea et al. [12] and Pollnac [21] present a research which indicates that socioeconomic variables such education, age, occupation, area of residence, and gender are related to varying perspectives on the environment and its resources. These different perceptions may help account for variance in behavior related to resource management.

This research investigates the influence of socioeconomic factors on the ways in which people in Mahahual perceive their coastal environment by exploring whether specific socioeconomic sectors (e.g. a group of people characterized by a common socioeconomic variable) of the community are significantly more likely to have perceptions about coral reefs and fisheries that are complimentary or contradictory to goals of sustainable resource use. Determining how socioeconomic factors relate to perceptions about the natural environment can help resource managers ascertain and address root causes of resource degradation. Information about how people in Mahahual utilize and perceive their coastal environment is used to make suggestions concerning

how resource managers can tailor development projects and conservation initiatives to the needs and concerns of select stakeholder groups.

2. Methods

Research was conducted in Mahahual, Quintana Roo, Mexico from May to July, 1999. The boundaries in this study range approximately 12 km north and 11 km south of the village. Data on socioeconomic characteristics, including wealth, age, migration status, education, and perceptions of coastal resources were collected by participant observation, key informant interviews (such as governmental officials, participants in various coastal activities, and village officials), surveys of the heads of households, and collection of secondary data (such as village statistics). Before the survey instrument was developed, one month was spent in the community observing, listening, asking questions, and engaging in a variety of coastal activities (commonly called participant observation). Throughout the research, time was spent at sea with local fishermen partaking in a variety of fishing and tourism practices.

Thirty-seven of 65 households in the community were systematically surveyed (e.g. a map of the village was developed and every other household was selected to be interviewed) to elicit information on socioeconomic well being and perceptions about fisheries and coral reefs. The household surveys also examined the respondent's socioeconomic information such as age, years of formal education, length of time in Mahahual (referred to as "migration"), and wealth. Wealth was evaluated by using a material style of life scale based on the presence or absence of household possessions [22].

The survey also examined how respondents perceive coastal resources. Information regarding perceptions of coastal resources was elicited by asking open-ended questions regarding fisheries and coral reefs. Respondents were asked three open-ended questions about coral reefs: (1) What is the condition of the coral reefs? (2) How will the reef be in five years? and (3) What activities affect the reef? and three open-ended questions about fisheries: (1) What is the condition of the fishery? (2) How will it be in five years? and (3) What activities affect the fishery? Responses to the questions were grouped into categories based on their content. A response could have been included in more than one category, thus the number of responses varied with each question (e.g., a respondent could have mentioned that both tourism and natural events affect coral reefs). For each response category, respondents were formed into two groups based on whether or not they mentioned that specific response category. For example, the two groups formed for the response category "tourism affects coral reefs" were (1) the respondents that mentioned tourism affects coral reefs and (2) the respondents that did not mention this. Mean values of the socioeconomic variables were then obtained for each response group. The *t*-test was used to test the statistical significance (at the $p < 0.05$ level) of differences between mean socioeconomic characteristics across groupings formed by response categories. *Q-Q* plots

were used to assess the normality of the independent variables, which were all deemed suitable for the *t*-test.

3. Results

3.1. Dependence on coastal resources

Most households in Mahahual engage in multiple activities to meet economic and subsistence needs. Diversification of productive activities allows residents to receive income when fluctuations such as seasonal variations and weather-related phenomena affect their primary activities. The sample of 37 households reported 40 distinct productive activities. Respondents ranked the activities by order of importance. Sixty five percent of the households in Mahahual engage in fishing, making it the most important activity (Table 1). Other important activities include agriculture and operating boat tours.

3.2. Independent variables

Education is widely used as an indicator of wealth and social status. Respondents were questioned about their years of formal education. Respondents have an average of 6 years of formal education. Since 97% of respondents were immigrants, analyses regarding migration were based on how long residents have been living in Mahahual rather than simply whether they had migrated. The mean time respondents lived in Mahahual is 10 years. The average age of the respondents was 45.

Table 1
Distribution of occupations, highlighting the percentage that ranked the occupational category as a primary occupation

Occupation	Primary occupation	Total involvement in occupation
Fishing	41%	65%
Tourism	14%	41%
Agricultural (ranching and farming)	11%	32%
Commercial (not including restaurants)	8%	22%
Skilled/trained employment	8%	19%
Building (construction, carpentry, and thatched roof-making)	5%	19%
Domestic work (laundry, house cleaning)	0%	19%
Hunting/gathering	0%	16%
Children's activities	0%	15%
Restaurant	5%	13%
Selling fish	11%	11%
Pension/unemployed	8%	8%
Artisan craft-making	3%	8%
Transportation	0%	5%

Material style of life, a method of measuring wealth based on the presence or absence of household possessions, can be an indicator of relative wealth or social status in a community [22]. To determine culturally appropriate indicators of wealth, key informants were asked to describe the house of a rich person and the house of a poor person. A list of 24 items was developed including items such as a television, VCR, satellite antenna, gas stove, wood stove, electrical generator, vehicle, type of bathroom (septic system or pit latrine) and the type of walls, roof, and floor. Table 2 shows a distribution of these items within the community.

To provide a clear picture of the distribution of material wealth within the community, scales can be constructed based on the interrelationship between these items [22]. The items were factor analyzed using the principal component method and varimax rotation, resulting in two material styles of wealth factors that explained 45% of the variance (Table 3). Nine items did not have significant loading on either factor and were discarded from the analysis.

Table 2
Distribution of material wealth

Material possessions	Distribution
<i>Walls</i>	
Wood	51%
Carton	19%
Cement	13%
Wood & cement	11%
Other	6%
<i>Floors</i>	
Cement	54%
Sand	35%
Cement/sand	8%
<i>Roofs</i>	
Tar paper	76%
Thatch	16%
Zinc	5%
Cement	3%
<i>Sanitary facilities</i>	
Septic system	48%
Pit latrine	34%
No sewage	17%
<i>Miscellaneous</i>	
Gas stove	73%
Second house	43%
Wood stove	29%
TV	19%
Generator	14%
Antenna	8%
Stereo	8%
VCR	8%

Table 3
Principal component analysis of material style of life

Item	Factor 1	Factor 2
TV	.823	.097
VCR	.764	.215
Antenna	.743	–.023
Cement floor	.677	.411
Sand floor	– .617	–.225
Generator	.521	.395
Cement walls	.467	.350
No sewage	–.371	–.162
Septic system	.355	.702
Gas stove	.223	.688
Second house	.188	.639
Latrine	–.079	– .611
Wood stove	–.102	– .572
Vehicle	–.202	.494
Carton walls	–.328	– .442

Bold denotes high factor loading (>0.4).

As indicated in Table 3, the items that have the highest positive loading on the first component are TVs, VCRs, satellite antennas, cement floors, generators, and cement walls. Items with high negative loading on the first factor include sand floors, and the lack of sewage facilities. Thus, factor one (subsequently called “wealth factor one”) is comprised of accessories and floor structure. Items with high positive loading on the second factor include septic systems, gas stoves, possession of a second house, and a vehicle. Items with high negative loading on the second factor include latrines, wood stoves, and carton walls. The second factor (subsequently called “wealth factor two”) is comprised of household structure, amenities, and luxury items.

A score for each of the components was calculated for each household based on the presence or absence of items in their household. These scores are the sum of the component coefficient times the sample standardized value. Thus, each item contributes to the component score based on a proportional transformation of its loading in Table 3. Items with high positive loading have a stronger contribution than those with low or negative values. Wealth factor one scores in the community range from –1.049 to 3.053. Wealth factor two scores range from –1.848 to 1.638. Scores are standardized, having a mean of zero and a standard deviation of one.

3.3. Perceptions of coastal resources

The majority of respondents indicated that they believe the reef and fishery are in bad condition (Table 4). Only 24% and 13% had a positive outlook on the condition of the coral and fishery resources, respectively. Thirty-five percent of the responses concerning the future of the reef reflected a belief that the condition of the reef will be worse in 5 years. However, from a conservation perspective, the fact that 48% of the responses suggested that the future condition of the reef will be determined by

Table 4

Responses to open-ended questions about past, present, and future conditions of coral and fishery resources

Coral reefs		Fishery	
<i>Current condition</i>			
Bad	54%	Bad	56%
Good	25%	Declining	24%
Average	14%	Good	13%
Depends on conservation	7%	Average	7%
<i>Future</i>			
Depends on intervention	48%	Less fish	68%
Worse	35%	Depends on economics & regulations	12%
Depends on natural events	9%	Depends on fishers	14%
Same	9%	Equal	5%
<i>Affected by</i>			
Natural events	34%	Fishing	45%
Fishing	19%	Natural events	20%
Other activities	15%	Legal issues	20%
Ships (groundings & pollution)	13%	Other (noise, oil pollution, etc.)	8%
Nothing	7%	Land-based practices	8%
Tourism	6%		

anthropogenic interventions such as development and conservation initiatives is of particular interest. Recognition that these factors can influence the condition of natural resources indicates that many community members would be amenable to conservation initiatives. The general outlook concerning the future of the fishery is somewhat grim. Sixty-eight percent of the responses suggested that the fishery will be worse in 5 years. Fourteen percent of responses indicated that the future of the fishery is dependent on the actions of the fishermen, while 12% suggested that it is dependent on economic situations and regulations. Only 5% indicated that the fishery will be the same, and there were no responses indicating that it will be better.

Harmful fishing practices (which include responses such as the use of destructive gear types, increased fishing pressure, spears hitting the reef, and gill nets damaging coral when they are tangled in the reef and pulled free) and natural events such as hurricanes were cited as the most frequent factors affecting fish and coral. Anchoring, grounding, oil spills, and noise from outboard engines were recognized as ways that boats can affect coastal resources. Other activities mentioned that affect coral reefs include building piers, improper solid-waste disposal, and deforesting mangroves. Twenty percent of the responses indicated that legal issues such as stringent regulations affect the fishery.

3.4. Analysis of socioeconomic factors affecting perceptions of coastal resources

We first examined the correlations among the socioeconomic variables to ensure that each was a relatively independent social indicator. As can be seen in Table 5, the

Table 5
Correlation matrix of socioeconomic variables

	Education	Age	Wealth factor 1	Wealth factor 2	Migration
Education	1	—	—	—	—
Age	−0.274	1	—	—	—
Wealth factor 1	0.141	0.178	1	—	—
Wealth factor 2	0.200	−0.149	0.000	1	—
Migration	−0.329	0.387*	−0.195	0.074	1

* = $p < 0.05$.

socioeconomic variables do not manifest high levels of intercorrelation. Table 5 indicates that migration (length of time a resident has lived in Mahahual) is moderately, but significantly correlated with age ($R = 0.387, p = 0.018$), which makes sense. Other variables are not significantly correlated and can be considered to represent independent socioeconomic indicators.

Table 6 presents the relationship between responses to the six open-ended questions and the socioeconomic characteristics. Direction and magnitude of the difference are presented only where the differences are statistically significant ($p < 0.05$). For example, respondents who mentioned “the future of the fishery depends on interventions” have a mean wealth factor 2 score 0.98 higher than those who do not mention this category. Overall, it can be seen that relative wealth is the most influential factor in people’s responses to open-ended questions about natural resources. The two wealth variables accounted for 75% of the statistically significant relationships, while education accounted for only 16% and migration just 8%.

4. Discussion

4.1. Poverty and perceptions of coastal resources

Within Mahahual, the juxtaposition of wealth and poverty is quite evident. Poor households often lack basic amenities such as sanitary facilities. The poorest families struggle to obtain adequate shelter, clothing, and nutrition. Nearby, wealthy families have new vehicles and satellite dishes. However, the dichotomy between wealth and poverty in Mahahual is not only reflected in people’s houses, clothes, and diet, it is also evident in the way they perceive the coastal environment. Perceptions of natural resources are highly differentiated among community members based on their socioeconomic status.

Several patterns were evident in the responses provided by wealthier and poorer respondents. Poorer respondents clearly viewed a crisis in the fishery, but generally attributed it directly to fishery-related issues. Alternatively, wealthier respondents associated resource conditions with a wide range of terrestrial and marine practices such as tourism, shipping activity, conservation interventions, and land-based

Table 6
Relationships between perceptions regarding coastal resources and socioeconomic variables

Response	Education (years)	Age (years)	Wealth factor 1	Wealth factor 2	Migration (years)
<i>State of the reef</i>					
Bad	NS	NS	NS	^b 0.78*	NS
Good	NS	NS	NS	NS	NS
Average	^b 6.4*	NS	NS	NS	NS
Depends on conservation	NS	NS	NS	NS	NS
<i>Future of the reef</i>					
Depends on intervention	NS	NS	NS	^a 0.98*	NS
Worse	NS	NS	NS	^b 1.16**	NS
Depends on natural events	NS	NS	NS	NS	NS
Same	NS	NS	NS	NS	NS
<i>Reef is affected by</i>					
Natural events	NS	NS	NS	NS	NS
Fishing	NS	NS	NS	NS	NS
Other activities	NS	NS	NS	NS	NS
Ships (groundings & pollution)	NS	NS	NS	^a 1.46**	^a 13*
Nothing	NS	NS	NS	NS	NS
Tourism	^a 8.2**	NS	^a 1.31*	NS	NS
<i>State of fisheries</i>					
Bad	NS	NS	^b 0.91**	NS	NS
Declining	NS	NS	^b 0.82*	NS	NS
Good	NS	NS	NS	NS	NS
<i>Future of fisheries</i>					
Less Fish	NS	NS	NS	NS	NS
Depends on economics & regulations.	NS	NS	NS	NS	NS
Depends on fishers	NS	NS	NS	^b 1.47**	NS
<i>Fisheries affected by</i>					
Fishing	NS	NS	NS	NS	NS
Natural events	NS	NS	NS	NS	NS
Legal issues	NS	NS	NS	NS	NS
Other (noise, oil pollution, etc.)	NS	NS	NS	NS	NS
Land-based practices	NS	NS	NS	^a 1.65*	NS

The difference between means for respondents that mentioned specific response categories and significance level is indicated for significant relationships. NS = not significant * = $p < 0.05$ ** = $p < 0.01$.

^aIndicates that the respondents that mentioned the theme had a significantly higher mean socioeconomic characteristic than respondents that did not.

^bIndicates that the respondents that mentioned the theme had a significantly lower mean socioeconomic characteristic than respondents that did not.

practices. These relationships suggest that wealthier respondents are more likely to understand and be more amenable to a holistic approach to resource management (i.e. a watershed conservation initiative).

As a potential explanation of these wealth-related patterns of perceptions of the environment in Mahahual, we turn to psychological theory, particularly, Maslow's theory of a hierarchy of needs [23]. Maslow postulated that there are seven hierarchical levels of needs: at the bottom is physiological, then safety and security, belonging/social affiliation, self-esteem, cognitive, aesthetic, and finally self-actualization. Maslow maintained that abstract issues such as self-actualization could not be achieved unless basic needs such as hunger and safety have been addressed. Although Maslow did not include environmental conservation in his hierarchy, it would likely be in the third tier (because it can fulfill a sense of belonging or place in the natural world) or on top of the hierarchy (because it can fulfill aesthetic needs, a sense of purpose, and/or self-actualization) (Fig. 2). However, for the purpose of this paper, its exact place in the hierarchy is not as important as its relative position above physiological and security needs. A person who cannot meet basic demands of physiology (i.e., food, basic shelter, etc.) or safety cannot be expected to pursue goals of environmental conservation. For example, a fisherman who is free diving at 25–30m to untangle a net from coral (as is the common practice in Mahahual), cannot be too concerned with the amount of coral they are breaking to free the net. His mind is preoccupied with getting the job done rapidly so that a physiological need (i.e. breathing) can be met. Spear and net fishermen in Mahahual are continually in a position of threatened physiology and security, thus actively and continually pursuing environmentally sound behaviors can be physiologically or psychologically difficult. In addition to the occupational barriers discussed above, other factors such as nutrition, poor shelter, and economic pressure may present psychological barriers that prevent poorer residents from pursuing the loftier goals of environmental conservation. Wealthier residents may be

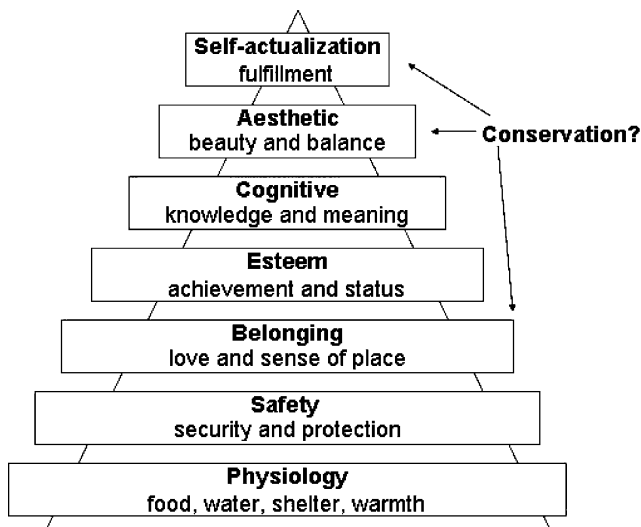


Fig. 2. Maslow's hierarchy of needs (adapted from Maslow, 1970).

able to meet their basic needs and have a heightened sense of economic security, allowing them to pursue ideas about environmental conservation.

4.2. Implications for coastal resource management

Community perceptions of natural resources should be an important consideration for coastal managers in developing the types and focus of conservation strategies. Understanding how socioeconomic factors influence these perceptions can assist resource managers in identifying root causes of environmental problems and help efficaciously apply limited funds by adapting project activities to local conditions. The variance in perceptions held by the different socioeconomic groups will likely result in variations in the levels of understanding and acceptance of conservation interventions. Thus, the effectiveness of resource management strategies could be maximized by targeting initiatives to address the concerns or gaps in the understanding of specific socioeconomic and occupational groups in the community. This suggests that even for a small community like Mahahual, several programs may be required to effectively institute sustainable resource use practices.

Results from this study also reiterate the need to address root causes of environmental degradation. Wealth, particularly among poorer segments of Mahahual, may need to be increased before paradigms of conservation can be widely adopted. Unfortunately, implementing income generation projects has been typically beyond the scope and capacity of many environmental NGOs and government-led conservation initiatives.

4.3. Development and coastal resource management in Mahahual

Residents of Mahahual are at the nexus of a large tourism development project that could drastically alter their quality of life. Tourism development in Mahahual can provide resource managers with an opportunity to couple resource management programs with development initiatives. However, a variety of issues are arising as pressure for development and changes in lifestyle increase. Although the proposed tourism development may bring an improved material style of life for some residents, the costs may include geographical displacement to a less desirable location, loss of traditional means of livelihood, environmental degradation, and loss of beach access. Despite these potential costs, there is evidence that respondents in Mahahual are interested in supplementing at least a part of their income with tourism activities. Ninety-seven percent of respondents remarked that they would like to see tourism develop in Mahahual, most of whom claim that they would seek some employment in tourism [24]. However, strategies that promote occupational changes are often difficult for development projects to implement, particularly among fishers. Fishing fulfills non-economic satisfactions that can result in fishers remaining in the fishery even when catches and income decline [25]. Thus, it is important for policy-makers to understand and address the idea that alternative income strategies for fishers should fulfill some of the same job satisfactions as fishing.

Fishers in Mahahual were particularly interested in supplemental income that did not remove them entirely from the fishery. One key informant remarked “the sea is my love, my passion, but only when she is calm. Today, when it took us five hours to remove the nets from the reef [usually a two hour job], and the waves were ten feet, I would have preferred to be working in a bar or with tourists, or something where my life is not in danger.” Many fishers were also interested in transporting tourists to dive sites, an opportunity that would allow them to utilize their skills at sea and may also fulfill some of the non-economic aspects of job satisfaction that often make fishermen reluctant to leave the fishery and quick to return. This change in occupation, however, would require language training, loans to purchase safety gear and comfort accessories, and hospitality training to make local fishers competitive guides. Fishers also suggested that the development of a local handicraft industry would be useful as supplementary income, and creative ideas utilizing marine shells were demonstrated. However, it was suggested that this handicraft-based supplemental income activity would only be practiced when the weather is bad to avoid risking their lives at sea or fishing the relatively unproductive near shore reef lagoons [10].

4.4. Conclusion

A number of factors influence how people in Mahahual perceive coastal resources. Migration, education, and wealth were all significantly related to various perceptions of the natural environment. Among these variables, wealth had maximum influence on how people perceive coastal resources. Wealthier respondents demonstrated a better understanding of the indirect activities that affect coastal resources while poorer residents were more concerned with meeting basic needs and, thus, may not be able to be concerned with aspects of conservation. Thus, an important coastal resource management strategy for Mahahual will be to promote the well being of the poorer segments of the community so that they can afford to be concerned with conservation. However, this will likely be ineffective unless it is done in a manner that compliments the desires and livelihood strategies of different stakeholder groups such as fishers. If interventions, such as alternative income generation are tailored to the understandings and needs of specific segments of the community, residents could be in a position to maximize the benefits of the social changes while promoting sustainable coastal resource use.

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