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# Income diversification, social capital and their potential role in uptake of marine Payments for Environmental Services schemes: a study from a Tanzanian fishing community

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**Abstract**

We analyse the role of risk mitigating strategies upon the willingness to adopt a marine PES scheme in fishing households. More specifically we focus on the role income diversification and social capital can play. We find that income diversification and three social capital variables (trust, group membership and presence within a reciprocal fishing dependency network) emerged as significant predictors of willingness to adopt a proposed marine PES scheme.

Results are, however, qualitatively different. Group membership and the presence of alternative income sources increased fisher willingness to participate within the proposed PES scheme. Trust was found to have a larger incremental influence on willingness to participate within those villages located outside of the park boundary. However, 'presence within a reciprocal fishing dependency network' showed a negative correlation with willingness to participate. This reciprocal dependency relationship therefore appears to lock fishers in to their current status quo and dissuade participation in the PES scheme. We offer some explanations of the possible underlying mechanism behind this result. The results presented have valuable policy implications for those PES schemes which hope to target poor households.

## 1. Introduction

Funding deficits or indeed, the lack in palpable markets for environmental assets and services prevent local resource users from realising nature's true conservation value (Mandel et al. 2009; Tschakert 2007). More often than not the economic values provided by these environmental assets and services are not captured by those who provide them; consequently these individuals lack the incentive for resource conservation (Nelson et al. 2010; Engel et al. 2008). Payments for environmental services (PES) are thus hailed as attractive instruments to address these market failures, increase investment in resource conservation, and potentially transfer income to the rural poor. And as a result, these initiatives continue to attract growing attention in policy, non profit, private and financial arenas (Mandel et al. 2009; Engel et al. 2008).

PES instruments were not primarily designed as poverty tools and it remains unclear to what extent the two objectives of environmental conservation and poverty alleviation can be achieved simultaneously (Engel et al. 2008; Pagiola et al. 2005). Many assume that these newly emerging markets will reduce poverty through the payments made to poor resource users. Indeed the

premise that PES schemes are voluntary implies that potential actors will simply refuse to participate, or withdraw, if benefits are insufficient (Pagiola et al. 2008; Wunder & Albán 2008). However in reality, many factors other than potential future benefit can prevent participation.

In order for PES programs to both benefit the environment and the poor, the 'poor' to which we refer must not only be eligible and able to participate – whereby they retain all the requirements which enable them to enrol – they must also be willing to participate (Tschakert 2007; Pagiola et al. 2005). A household's decision to adopt any new activity is in fact influenced by several considerations, and not merely by the rewards offered (Sesabo & Tol 2005; Allison & Ellis 2001). The ability to mitigate risk[1] can also play an important role in influencing household heterogeneity. Asset endowment, income diversity, as well as social capital – e.g. local institutions, shared knowledge and norms – are some of the many mechanisms households can employ to spread risk (Sesabo & Tol 2005; Alderman & Paxson 1992). In practice poorer more vulnerable households with a lower ability to spread risk may choose to adopt the 'least risky' strategy, often perceived as maintaining the status quo (Tschakert 2007; Pagiola et al. 2005). In short, income diversification and social capital have the potential to influence decision choice above and beyond future benefits; and this may be particularly true within those communities which have already intertwined risk mitigation strategies into their broader livelihoods (St John et al. 2010).

Willingness to participate is fundamental to the success of any conservation intervention, including any marine PES effort; and for those hoping to achieve poverty reduction in line with conservation, promoting participation of poorer community members is crucial. However to date, there has been very

[1] Risk mitigation is considered a combination of risk management and risk coping behaviour. In risk management households attempt to reduce the variability of income through, for example, expanding household activities or migration. Risk coping sees households attempt to smooth consumption through such activities as savings and participation in reciprocal risk sharing arrangements (Alderman & Paxson 1992).

little critical analysis or quantification of those factors which influence an individual or household decision process, or indeed how these relate to current livelihood strategies (Sesabo & Tol 2005; Zanetell & Knuth 2004). In order to design more successful development-conservation programs, there is a need to better understand the factors motivating human behaviour and chiefly how they relate to the decision to adopt new and novel livelihood schemes.

In this paper, we look at determinants of willingness to participate in a potential marine PES program, above and beyond ability. In particular we focus upon the role that risk mitigation mechanisms, in the form of income diversification and social capital, play in the willingness of fisher households to adopt a marine PES scheme. Results of this paper have implications for PES and other novel incentive based policies relating to coastal development-conservation programs. By contributing to the greater understanding of fisher household's participation decisions, in particular how these attributes originally invoked as 'safety nets' may aid or hinder adoption of conservation schemes, we hope to improve the best practice for PES design and implementation.

The paper proceeds as follows. The next section presents an introduction to the concept of social capital and income diversification and how these relate to the individual decision processes. Section 3 discusses how these concepts may relate more specifically to PES schemes and willingness to participate. An account of the study region follows in Section 4 and a description of the survey methodology in Section 5. Descriptive results are given in Section 6. Econometric strategy is presented in Section 7 and the regression results in Section 8. We conclude the paper with a discussion of our findings and their policy implications.

**2. Risk mitigation: income diversification and social capital**

Income, and indeed livelihood diversification is an adaptation to smooth consumption and management of risk in developing countries (Dercon 2000). This diversification is an important attribute of rural livelihoods within many fishing villages (Coate & Ravallion 1993). Quite simply, a multiple income portfolio reduces the risk of livelihood failure by spreading it across more than one source thus improving the ability to withstand shocks (Allison & Ellis 2001).

For the very poor an alternative income source can be the difference between a marginally viable livelihood and destitution. However, although diversification reduces the intensity of poverty at the lower end of the poverty spectrum, it does not necessarily translate into an overall equalising effect on rural incomes (Ellis 2000). An income portfolio which best mitigates risk is one that has a low covariate risk between its components; the factors which create risk for one income source (e.g. climate) are not the same as the factors for another (e.g. urban job security) (Dercon 2000; Ellis 2000). However not all diversification strategies are created equal. In reality, poorer households are often marginalised from more favourable labour markets, which may require larger upfront capital, land or higher skill sets. As a result, diversification by the poor still tends to leave them highly reliant on the exploitation of natural resources be it fishing, agriculture or the harvesting of 'wild' products; and these risks are not as uncorrelated as one would wish. In contrast the better off are more disposed to enter into less resource dependent activities such as trade, transport, shop keeping and small businesses in general (Ellis & Allison 2004).

A much less tangible concept, the role of social capital in risk mitigation strategies has also been well cited (Fafchamps & Lund 2003; Dercon 2002; Allison & Ellis 2001; Ellis 2000; Townsend 1994; Coate & Ravallion 1993; Rosenzweig 1988). Moreover, social capital has been suggested as playing a

considerably more important role within poorer societal groups, where the possession of this capital may enable access to goods and services often commoditised by higher income groups (Wakefield & Poland 2005). Indeed, increased social capital has been shown to lead to greater risk sharing among villager members, acting as an informal safety net (Narayan & Pritchett 1997).

Yet while much of the literature concentrates on the benefits of social capital, others warn of its 'dark side' (di Falco & Bulte 2011; Woolcock & Narayan 2000; Portes & Landolt 1996). The formal rules and norms associated with social capital have also been shown to trap members within harmful social networks, or conversely marginalise others from beneficial engagements (Pretty & Smith 2004; Woolcock & Narayan 2000).

While its exact definition is subject to debate, broadly speaking social capital refers to the shared knowledge and understandings, social norms and networks which facilitate collective action (Woolcock 2001; Ostrom 1999). Notoriously difficult to measure, social capital can be divided into three distinct but related dimensions to better understand its role. These are 1) trust, 2) civic engagement and cooperation and 3) social networks (Grafton 2005).

Central to social capital, and perhaps its best single empirical indicator, trust helps determines the effectiveness or quality of social relations (Newton 2007; Grafton 2005). Quite simply the more people trust each other the more likely they are to contract with each other. Furthermore, trust lubricates cooperation serving to reduce transaction costs between individuals; indeed a lack of trust will have negative consequences as all economic exchanges have an element of trust embedded within them (Sekhar 2007; Pretty 2003). Trust is the most encompassing feature enabling collective action, and the other forms of social capital, for the greater part, contribute to successful collective action by enhancing trust between individuals. However, although trust among actors can often be explained as an outcome of other forms of social capital, it is also

true that some aspects of trust are not reducible to these other forms (Ostrom & Ahn 2001). For example, activity in voluntary organisations, although shown to increase trust between members, is only very weakly associated with generalised trust (Bjørnskov 2006).

Individuals come together to promote mutual interests and overcome mutual problems. Engagement in groups and networks allows those with common interests to benefit from coordination, conflict resolution, information sharing and building of common knowledge. Whereas civic engagement denotes an actor's participation, social networks relate to the structure of ones relationships and the types of connections involved.

Although social capital is created through interaction and more palpable at the group level though its network structures, it also has implications at the individual level (Woolcock 2001; Uphoff 2000). Social capital can be deconstructed into two separate but interrelated concepts: a) structural and b) cognitive (Uphoff 2000). Structural social capital is associated with the various forms of social organisation, including the roles, rules, precedents and procedures as well as the assortment of network ties. At the individual level, cognitive social capital derives from the mental processes and resulting ideas relating to trust, reciprocity and learning. These are reinforced by culture, ideology and specifically the local norms, values, attitudes and beliefs, all of which contribute to cooperative behaviour and collective action (Bouma et al 2008; Uphoff 2000). These two domains are intrinsically linked. Although true that networks with their roles, rules, precedents and procedures display a life of their own, ultimately they all come from cognitive processes, linked in practice though individual expectation. And it is this in turn, which prescribes individual behaviour (Uphoff 2000). Hence people's behaviour, experience and participation within groups and networks will have overall implications in their future choices and behaviour, as well as their knowledge of the expectations placed upon them.

## 3. Risk mitigation and determinants of participation in marine PES

Small-scale artisanal fisherfolk have been identified as amongst some of the most vulnerable socio-economic groups in developing countries and continue to grapple with high and increasing levels of poverty (Olale et al. 2010; Béné 2009). These artisanal fisheries are defined by high levels of variability, some predictable and seasonal, others not. Few land-based occupations risk the loss of all productive capital, as well as participants' lives, every time they go to work (Béné et al. 2010). In general, these groups experience high exposure to natural, physical, health-related, climate induced and economic shocks and disasters (Béné 2009; Mills et al. 2009). Moreover, mobile prey and weather conditions result in high day-to-day variation of scheduling, catch and income (Pollnac 1991), and fishers frequently experience economic reversals (FAO 2001).

In response to these uncertainties of supply, risk mitigation strategies such as income diversification and social institutions based on trust, reciprocity and agreed norms play an important role in traditional artisanal fishing communities (McGoodwin 2001). Members of fishing households often involve themselves in other economic sectors to smooth the effects of resource variations (Allison & Ellis 2001). Collaboration has been embedded in numerous forms of local associations and groups which allow actors to learn and diversify into new areas with greater security (Pretty 2008). Collective care mechanisms have emerged which anticipate and minimise risks, such as kin, neighbourhood and community income redistribution mechanisms (Kurien & Paul 2001; McGoodwin 2001). In addition fish buyers, familiar with the environmental constraints, provide loans with flexible repayment rates (Pollnac 1991), and similarly shopkeepers may extend credit in times of low catch.

To date PES research has largely focused upon the ecological, economic and political barriers. Such emphasis is perhaps not surprising given the mandate of PES to improve environmental outcomes or its reliance upon market forces to achieve this (Petheram & Campbell 2010). However, more recently there has been a recognition that equity, alongside economic efficiency, is key in the design of legitimate and effective PES programs. Accordingly, this is leading to increasing interest in the social context of PES and in particularly the ability to participate (Pascual et al. 2010).

Large part of this literature discusses the capacity of PES to be pro-poor, as well as how one can assist participation of poorer households through project design (e.g. (Wunder 2008; Pagiola et al. 2008; Zilberman et al. 2008; Pagiola et al. 2005)). Less documented is the analyses of how household determinants influence peoples' perceptions and decision choices; in particular how these variables drive or obstruct a change from current behaviours and the adoption of new PES schemes (Petheram & Campbell 2010). Of notable exception is the work of Zbinden and Lee (2005). Zbinden and Lee (2005) examined those factors motivating individual participation in PES within Costa Rica's national PES program. Analysis of both participating and non-participating forest and farm owners revealed farm size, human capital and household economic factors significantly influenced willingness to participate. In addition, participants were on average better educated, had higher incomes and were proportionally more reliant on off-farm sources, as well as enjoying higher farm incomes as well (Zbinden & Lee 2005). Similar studies relating to such choice decisions within the coastal and marine sector were, to the authors' knowledge, non-existent[2].

[2] PES schemes for coastal and marine ecosystems are at a much more fledgling stage than their commoner terrestrial cousins. More complex cause-and-effect relationships, dispersed and diverse actors, as well as complicated property right issues have tended to discourage marine PES implementation (Pagiola 2008). As recently as 2008, Pagiola reported that no PES schemes for coastal or marine environments had thus far been employed; despite the fact that, in principle, PES instruments do have the potential to protect these ecosystems. However, the last few years have seen a growth in interest surrounding marine PES.

The influence of income diversification and social capital within the PES literature has received little attention to date. Most recently, Ma et al (2010) identified land area and on-site farming practices as important considerations for PES enrolment but also found spatial variation effects, possibly from interpersonal communications as well as other socio-economic factors. Although not directly relating to PES, Sesabo and Tol (2005) found households' decision to participate in various income-generating activities were influenced by asset endowment, household structure and local institutions. In particular a household's access to social networks increased participation in other livelihood occupations. Although not at the individual level, Gong et al (2010) found that lower levels of village social capital constrained participation in a PES forest project in Guangxi, China. In addition, Chen et al (2009) found that social norms had a significant effect on an individuals intentions to re-enrol in PES projects at the village level, and that aggregated these impacts could substantially reduce PES program costs.

**4. The Mtwara region**

Like many other coastal African countries, recent years have witnessed increasing pressures upon coastal resources including illegal fishing practices, habitat destruction and growing populations (Sesabo & Tol 2005). The Tanzanian coastline currently supports a quarter of the of the country's population; a figure which is set to double by 2025 (Gustavson et al. 2009). High and increasing poverty is prevalent amongst fishers: average yearly income in most Tanzanian coastal villages does not exceed US$ 100 per person; fish supplies per person are declining and excessive exploitation of the fishery continues (Cinner 2010; Olale et al. 2010; Sesabo et al. 2006).

Located in the south of Tanzania, Mtwara region is considered among one of the country's poorest and least developed regions. Thirty eight percent of the population live below the basic needs poverty line, with the coastal

population considered amongst the poorest (Guerreiro et al. 2010; Malleret 2004). Extending along 125 km of coastline are the region's two coastal districts: Mtwara Urban and Mtwara Rural. Together these two districts account for 26% of the region's 1.1 million inhabitants (Guerreiro et al. 2010). The study area is highlighted below in Fig 1.

<<<<INSERT FIGURE 1 AROUND HERE>>>>

Previous work by Malleret (2004) shows a vast array of livelihoods existing within the area but a high dependence on marine resources in coastal villages. This was shown to be as high as 63 – 74% of households in some sea bordering villages; furthermore 54% of households directly depended on or were involved in fishing. This figure was found to be homogeneous and consistent with other studies across Tanzania and Kenya (Malleret & Simbua 2004). In 1996, the number of registered fishers in the Mtwara region was estimated to be 2050, approximately 10% of Tanzania's total artisanal fleet; in 2010 this figure was more than double at 5,600 (Dadi 2010). This number is anticipated to be higher once non-registered male fishers are considered. Moreover, many women also engage in fishing activities and further remain unregistered. With the rare exception, these women fish using the gender-specific method 'tandilo', which involves dragging fine meshed nets (<1mm) along the shoreline at low or high tide. Tandilo was found to comprise 23% of all fishing methods within the surveyed groups (Malleret 2004).

Gazetted in 2000 by the Tanzanian government in response to these increasing environmental threats, one marine park exists in the region. Mnazi Bay-Ruvuma Estuary Marine Park (MBREMP) is located to the south of Mtwara town. The park covers 650 $km^2$, of which 200 $km^2$ are marine areas including mangrove forests, islands, sea grass and coral reef ecosystems. Fig 2 presents the Marine Park's coastal border. As a multi-purpose marine park, MBREMP continues to allow fishing within its borders, and regulations are

unchanged to those outside the area[3]. Consequently, coastlines both within and outside of the park continue to suffer from growing human pressures.

Property rights have proved a pertinent issue for PES schemes; an issue which is proving even more problematic within the marine environment. Within Tanzania a marine PES scheme could potentially be legitimate through recent legislation which grants property rights over inshore waters to Beach Management Units (BMU) [4]. These units are community fisheries organisations with clear legally empowered roles and responsibilities over local fishery legislation. In particular a BMU is *"able to set management rules locally and at lake wide level through by-laws and ordinance…. (and) allows control of access to fisheries resources by limiting number and types of fishing boats and gears in partnership with Government"* (Tanzanian Fisheries Division 2005). There remains a question as to whether this law is possible to implement, as whilst enacted in statute, there are as yet no examples of such access rights actually being established.

<<<<INSERT FIGURE 2 AROUND HERE>>>>

In 2010, CARE International, in collaboration with WWF, commissioned a study to investigate the possibility of a marine PES scheme to reduce community exploitation of fisheries for villages both within and outside of the marine park. The proposed PES design offers compensation in the form of cash to cover initial opportunity costs alongside training in alternative occupations for the longer term. Compensation is offered to mitigate the, at

[3] MBREMP was originally established to be a zoned park, in practice to date no zones have been cordoned off as restricted use areas. In park fishers do however experience higher levels of monitoring and regulation of Tanzanian fishing laws.

[4] A BMU is made up of a BMU Assembly and BMU Committee. All persons engaged in fishing activities at the beach level must register within a BMU Assembly in order to legally assess the fishery. Furthermore, BMU Committees comprise 9-15 members who are elected by the aforementioned assembly (Tanzanian Fisheries Division 2005). Within Tanzanian marine parks fishing rights are controlled by the Marine Park Authority. Although more complicated a PES scheme can be legally implemented through this authoritative body, but it is not BMUs which would set the access rights but the Marine Park Authority itself.

present hypothetical, closure of core marine zones within both the larger marine park and outside area. These core marine zones are identified relative to their biological significance, as determined in prior consultation reports[5]. Hypothetical closures are displayed in Fig. 2.

**5. Survey design and implementation**

In order to analyse the determinants of willingness to participate in the potential marine PES program we use primary data from a household and stated preference survey of 661 fishers located in Mtwara's two coastal districts. In particular we look at the effect of risk mitigation strategies on shaping decisions to adopt the proposed PES scheme.

Questionnaire design followed the principles laid out by Bateman et al. (2002). Surveys collected data on: individual and household demographics; household assets; attitudes relating to fishing, the environment and conservation; fishing practices and income; diversification strategies of the individual and household, and social capital characteristics. A valuation scenario was presented relating to the implementation of a possible PES program. The survey provided information on the current situation as well the new scenario. Under the new scenario, specific core areas important as breeding and nursing sites in the locality of the surveyed villages would be closed (as per Fig 2) and all illegal fishing would be terminated. The scenario further introduced the concept of a cash compensation scheme over a 4-year period with a further investment into alternative livelihoods. The level of cash compensation, although not offered as an initial bid at this stage, was presented as a value equivalent to current opportunity costs of participation. Information on implementing and regulating bodies was also provided as the combination of the on-ground NGOs (in this case WWF) and marine park authority within the Park and the on-ground NGO and BMU for those

[5] For more information see Samoilys (2010) and Yahya (2010)

villages outside the park. Upon description of new fishing scenario fishers were given a choice as to whether they would be willing to participate in the marine PES scheme described. Those respondents who stated a willingness to participate were then asked for the required level of compensation, although these details are not included for the purpose of this analysis.

We consider the presence of alternative occupations and social capital variables as a proxy for risk mitigation. Income diversification is measured as the number of alternative income generating activities at the individual level. These are further separated into agricultural and natural resource dependent and non natural resource dependent. Occupational diversity is also measured as number of alternative income and non-income occupations at the individual level as well as at the household level. We dissect social capital using four distinct indicators: generalised trust; group membership and involvement within two social networks (bilateral dependency with others for fishing activities and bilateral reliance with others during times of fishing hardship[6]). Variables were measured as described in Table 5.

The survey was implemented in the two coastal districts of the Mtwara Region described previously: Mtwara Urban and Mtwara Rural. Village selection was based on the prior work of Samoilys (2010) and Yahya (2010) which identified representative and appropriate villages based upon dependency on fishing as well as depleting health of coastal resources. Six coastal villages were selected: three within the marine park (Mngoji, Mkubiru and Msimbati) and three outside (Mikindani, Naumbu and Pemba). Village location is displayed in Fig 2. Focus groups and personal interviews with key informants identified relevant parties as well as shaped the design of the questionnaire.

[6] Bilateral dependency and reliance comprises three potential relationships: dependence upon other; depended on by other; or a combination of both.

Within these villages a sample of fishermen and fisherwomen were randomly selected for personal structured interview. Piloting of surveys was conducted in the month of March and final questionnaires were collected from April through to June 2010. Of a total of 661 fishers interviewed across all six villages, 101 fished outside of the core zones and were therefore not eligible for inclusion within the PES program and dropped from final analysis; a further 20 were also excluded because they were incomplete. The results below are based on the final usable sample of 540 fishers.

**6. Descriptive results**

Table 1 presents village population counts and illustrates the variation in fisher numbers between the selected villages. Population sizes vary substantially from 912 to over 11,000, however a great part of this variation is due to the presence of two larger villages within the study. Fisher representation within villages also differs widely; as little as 7.3% of Mikindani's male population are fishers, in contrast to Mkubiru, Naumbu and Pemba where approximately all men fished. Similar patterns are seen within the female population, where again these three villages are seen to rely most heavily on the fisheries. It should also be noted that although the percentages do not look as large for Msimbati, this village actually contains the largest absolute male fisher population for any one village, and joint largest for women. These differences may in part be due to the relative isolation of Mkubiru, Msimbati, Naumbu and Pemba which are further away and with less developed connections to Mtwara town.

<<< INSERT TABLE 1 ABOUT HERE>>>

Table 2 displays key demographic characteristics for the final sample of 540 fishers, and is further broken down to the village level. Patterns are fairly consisted across villages. Average fisher age is 35 years and average

household sizes range from 4.5 – 5.6. In all villages education levels were low: on average almost 40% claimed no schooling while the remaining majority held only some degree of primary education, only 2% claimed to have attended secondary education.

Fishing characteristics are displayed in Table 3. Perhaps the largest disparity can be seen in male fisher earnings: Pemba averaged a fishing income of nearly US$ 7.5 per day for those days spent fishing giving an overall daily wage of approximately US$ 1.0. 'Perceived daily income' within the male subgroup was found to be higher for those villages located outside of the marine park. This is possibly due to the higher incidence of deep-sea fishing in these villages, in particular Pemba village. Daily income from fishing was higher for men than for women in all villages, both at the 'perceived average day' level and the calculated daily rate.

<<<<INSERT TABLE 2 ABOUT HERE>>>>
<<<<INSERT TABLE 3 ABOUT HERE>>>>

Social capital and occupational diversification indicators also varied between villages. A summary is presented in Table 4. Average trust levels were consistently high, averaging 3.9 out of a possible 5. Overall group membership outside of the fishing sector was fairly low, approximately 10% of interviewees. Reciprocal support networks averaged approximately 1.4 and 1.0 for dependence to carry out fishing activities and reliance in times of bad fishing respectively. Fishers had, on average, one alternative income generating source.

<<<<INSERT TABLE 4 ABOUT HERE>>>>

**7. Econometric strategy**

The decision to participate in the PES scheme can be modelled as a dichotomous choice - a binary response – and the data collected indicates the observed choice but not the unobserved measure of 'relative attractiveness' of available options. Thus we utilise a probit model where y is the binary dependent variable indicating fisher's decision to participate and y* is a latent variable measuring fisher's utility from their choice. X is a vector of explanatory variables affecting utility and ε is the error term with an assumed normal distribution with zero mean and variance $\sigma^2$. To control for unobservable variance between villages all models are clustered at the village level within the analysis.

$$y = \begin{cases} 1 & \text{if } y^* = U(x=1) - U(x=0) \geq 0 \\ 0 & \text{if } y^* = U(x=1) - U(x=0) < 0 \end{cases} \quad (1)$$

$$y^* = X\beta + \varepsilon \qquad \varepsilon \sim N(0, \sigma^2) \quad (2)$$

From the survey a set of variables were selected for inclusion within the econometric models. The variables used are summarised in Table 5.

<<<<INSERT TABLE 5 ABOUT HERE>>>>

The regression results are reported in Table 6. We start by analysing the effects of demographics on the choice decision (Model 1 in Table 6)[7]. In Model 2 attitudinal data is further added. The key variables of interest: social capital and occupational diversity are entered in Model 3. In Model 4 we extend the model and insert an interaction term for village location within or outside of

[7] While men engage in many different types of fishing, women generally only partake in 'tandilo'. In the past 'tandilo' fishing involved catching small fish 'dagaa' from shore and timing depended on low and high tides. More recently cloth has been replaced by mosquito nets, but the method remains the same. However, given the nature of these gender differences within local fishing methods correlation was identified between the variable 'male' and those explanatory variables relating to fishing methods, which could affect the estimates' accuracy. As such we ran an auxiliary regression between 'male' and the correlated variables (Own_boat & Legal) and used the residuals as 'instruments' (Angrist & Pischke 2008).

park and average trust. We also attempt to control for possible endogeneity through a village effects model (Model 5) which controls for unobserved heterogeneity at the village level[8]. Due to collinearity between the inpark and village variables 'inpark' was dropped and in Model 5 the interaction term with trust relates to the villages specifically.

$$Pr[Y_i = 1] = \Phi(x_i'\alpha + z_i'\alpha + k_i'\alpha + [x \times k]_i'\alpha + \varepsilon) \qquad (3)$$

Final analysis of the results is conducted using Model 4, as in (3). Vector $x$ is a vector of regressors including all demographic characteristics, $z$ is a vector of regressors for all attitudinal characteristics and $k$ is the vector of regressors representing income diversification and social capital characteristics. [$x$ x $k$] denotes the vector containing the interaction term between demographic regressor location (inpark) and social capital regressor average trust (avetrust) and ε is the usual error term.

We use Model 4 in final analysis of the results over the village fixed effects model (Model 5) for the following reasons. Firstly, the results across the models are consistent and the fixed effects model showed no great variation in parameter estimates from the simpler 'inpark' model. Secondly, the ease with which these two models can be interpreted varies dramatically, in particular the interpretation of the interaction term in a non-linear model[9]. Thirdly, PES schemes will need to function within marine parks as well as outside, hence in interests of analysis and policy relevance the authors are more interested in the differences between those villages located within and

[8] Although second to an instrument (instruments are notoriously difficult to identify within cross-sectional data), screening of the data identified no viable instruments to control for potential endogeneity of social capital variables.

[9] Unlike in linear models the magnitude and sign of the interacted variables are not equal to the marginal effect of the interaction term in a non-linear model (Ai & Norton 2003). In a non-linear model the interaction effect requires computing the cross derivative as the magnitude of this effect depends on all covariates within the model. Moreover the interaction effect can have different signs for different observations. For a more detailed discussion please see Ai and Norton (2003). For this reason we analyse the interaction effect using the approach described in Norton et al (2004). This methodology is compatible with the presence of only one interaction term within the model.

outside of the park verses the individual villages themselves. Lastly, in order to quantify the implications of the model on the decision to participate we compute the partial effects[10], estimated at the sample means, for Model 4 (Model 4b, final column Table 6).

## 8. Regression results

<<<<INSERT TABLE 6 ABOUT HERE>>>>

As is seen in Table 6 the outputs from all models are broadly consistent. Focusing in on the social capital and occupational diversity variables (Models 3-5 Table 6), our first main result is that four of the five risk mitigation variables influence the willingness to participate in a marine PES scheme. The various social capital conditions also show differing influence on each gender type. These results are explained in further detail below.

### 8.1 Income diversification

Respondents indicating the presence of alternative income activities (Alt_inc) were positively correlated with an increased willingness to partake in the PES scheme (Table 6, Model 4). The marginal effect was 0.095 (Model 4b). Predicting participation from Model 4 for those with no alternative income sources (Alt_inc=0) and those with one (Alt_inc=1), holding all other variables at the mean, changed the predicted probability of PES participation from 0.551 to 0.648 respectively.

One might wonder if the presence of alternative livelihoods encompasses those less committed fishers hence those more willing to exit the fishery or reduce effort. If this were the case, one would expect fishing income (calculated as a function of daily income and fishing effort) to be negatively

[10] Partial effects are computed using dprobit function in STATA 11.

correlated with willingness to participate. However, fishing income showed no significant correlation with willingness to participate, implying that the presence of alternative occupations has an effect on participation independent of 'fisher commitment'. Possibly, experience with alternative occupations, particularly income generating occupations, provide fishers with alternative skills and experience which allow them to more easily and more comfortably branch away from fishing. In addition to the possibility of gained experience, those with alternative activities would likely gain more from the PES scheme as in addition to payments these individuals can increase monetary and time investments into these alternative activities; this may be particularly true of income generating activities. In a similar vein, those who are aware that they rely solely on fishing activities may be more risk adverse towards new fishing conservation schemes; more often than not these interventions promoted increased restrictions as well as a reduction in fishing effort.

As discussed previously the literature suggests that some alternative occupations are more favourable over others to spread risk, and as such different income activities could have differential effects upon participation choice. In order to investigate this, we reran the analyses for alternative model specifications substituting individual alternative income activities (Alt_inc) with individual farm income (Alt_farm_inc) and non-farm income (Alt_nonfarm_inc) separately[11]. Replacing Alt_inc in Model 4 with these variables gave no significantly different outputs, and both income types were strongly and positively correlated with participation. Again substituting Alt_inc in Model 4 with Alt_activity also gives similar results within the model[12]. This implies that, although some activities may be more fruitful than others, in respect to PES participation it is the occurrence and perhaps experience of other successful alternatives, rather than the alternative itself which aids participation.

[11] Model results are not presented within this paper but are available from authors upon request

[12] Again model results are not presented within this paper but are available from authors upon request

### 8.2 Group membership

Membership within a non-fishing group (Grp_memb) emerges as one of the most influential social capital variables, with a partial effect of 0.150 (Table 6, Model 4b); or in other words the presence of a respondent within a non-fishing group increases the probability of participating in the PES scheme by 15.0%. It is probable that group participation outside of the fishing sector provides a means to learn and gain knowledge as well as experience relating to other livelihood strategies. In this case, non-fishing group participation mostly related to membership within a community banking system, fish farming or horticulture which further enabled a great sense of security to experiment with new livelihood strategies.

### 8.3 Trust and location

Given the different experiences of those villages within the park and those outside relating to enforcement and local authorities, an interaction term between trust and location was examined. Trust (Avetrust) is seen to be a significant positive determinant and the interaction term (InTrust) enters significantly and with a negative sign.

Using the Ai and Norton (2003) approach we find that the interaction effect in Model 4 is always negative and significant across the majority of the predicted probabilities, as shown in Annex 1. Plotting the predicted probabilities shows the marginal effect of trust on those within and outside of the park. Graphs are displayed in Fig 3.

<<<<INSERT FIG 3 ABOUT HERE>>>>

As is seen in Fig. 3 average trust has a positive effect on willingness to participate irrelevant of location, however the magnitude of this effect is highly dependent on location. As such the interaction effect is interpreted as follows. Primarily villages within the park are more likely to participate in the scheme than those outside, however for those individuals located outside of the park the marginal effect of average trust appears to have larger incremental influence on willingness to adopt. One possible reason why trust has a lower marginal effect within the park may result from the more intense regulation which they face. Although legally fishing laws and regulations are legally identical within the marine park and outside, fishers within the park have more contact with patrol officers and experience more intense regulation. Therefore, although trust may be a strong predictor of participation under more typical circumstances, for those fishers residing within the marine park boundaries other institutional and regulatory issues override this. For example, these fishers may feel that the 'more severe' restrictions which they face since the park was gazetted in 2000 have reduced livelihoods. And as new and future legal restrictions continue to be felt more strongly within the park, for many fishers fishing may no longer feel like the viable option it once was. Indeed for those fishers feeling that fishing is becoming more regulated and restrictive, a PES scheme may seem more like a necessity than a choice. While on the other hand, those outside of the park, experiencing lesser enforcement may be more prone to preventing any additional forms of regulation, whether they be enforced by governments or other institutions.

Although at first glance location (Inpark) appears to exert a large influence on participation, the inclusion of an interaction term between trust and location (Trust_in) means interpretation is not as simple as looking at this main partial effect (0.517, Table 6 Model 4b). A more accurate partial effect is calculated through predicting the probabilities for an average individual within and outside of the park boundaries. In fact taking into account the interaction term and holding all other variables at their mean results in a marginal effect of

0.082[13] at the sample mean with respect to location, whereby those living within the park were 8.2% more likely to participate all other things held constant.

**8.4 Dependency networks**

Interestingly, while the previous social capital variables were significant positive determinants of a willingness to participate in the proposed PES scheme, one social capital variable showed a very different relationship. Our results indicate that being located within a dependency network (Dep_work) lowered participation likelihood. In fact, incidence within a fishing dependency network showed a negative partial effect of 0.054 (Table 6, Model 4b).

This reciprocal dependency relationship appears to lock fishers in to their current status quo and dissuade participation in the PES scheme; this could be due to a number of factors. Fishers often become indebted to local businessmen who loan equipment and bail fishers out in times of hardship. However, being within a network which provided aid in times of bad fishing (Rely_hardtime) showed no significant relationship with participation. To analyse this further, we conducted separate analyses[14] looking at each side of the fishing dependency network: that is, we separately analysed all those who are depended upon by others to conduct fishing activities and all those who depend on others[15]. The relationship towards participation was not seen to change. However, it proved extremely hard to disentangle which aspect of this network was holding people back from participation. This is perhaps because few interviewees were seen to have only one-directional networks, whereby they were seen to only depend on others to conduct fishing or only were only depended on. In fact, this was only seen for 14.1% of the sample,

[13] Calculate from the differences in predicted probabilities from inpark=1 & interaction term (intrust)=avetrust*inpark and inpark=0 & intrust=0.

[14] Analysis not shown here but available from the authors on request

[15] Two additional models were run: Dep_work was substituted with Dep_work_give or Dep_work_rec

and most fishers who were involved in such networks (56.9% of total sample) were based within bilateral reciprocal sharing networks.

Overall, the results suggest that those involved in dependency networks are less willing to participate in the PES scheme. This may be due to the belief that enrolment could result in the deterioration of strong and valued relationships; the benefits of the relationships could extend further than fishing alone. More qualitative and quantitative work is needed to verify this.

### 8.5 Gender

Of all the control variables one is worth discussing in greater detail. Gender (male) showed one of the greatest effects on participation probability. In fact, being male reduced participation probability by almost one fifth. The results for gender are interesting and in part fairly intuitive. Men are less likely to participate in a PES scheme than women; in particular those men[16] who owned their own boats or working on the larger boats (dhows) characterised by larger crews and better access to deeper areas are even less likely to enrol. It is not unexpected that men who had invested more into the sector were less inclined to enrol in a scheme which reduced effort and increased restrictions. Less obvious was why women were more willing to participate. However, overall women were less 'committed' to the sector than men. Not only does 'tandilo' require fewer initial capitals, as it also generally considered as a part-time occupation –as this type of fishing is generally only viable for two weeks of the month.

## 9. Conclusions and discussion

[16] Due to gender divisions within the fishing sector only men fished with boats and were able to gain access to the larger dhows.

PES schemes continue to attract interest from policy makers, conservation practitioners, development practitioner and communities alike. What makes them so attractive to many is the potential to pursue additional objectives beyond conservation, in particular the enhancement of regional development and poverty alleviation (Wunder & Albán 2008). However, this is primarily based on the assumption that those who cannot realise benefits will simply refuse to participate. Unfortunately, and as is always the case, it is never this simple. Firstly the targeting of the 'poor' can be difficult as they may not necessarily be the most efficient providers. But beyond this, when targeted, criteria exist which may further prevent appropriate 'poor' actors from enrolling. The decision to participate in a new scheme is often considered more risky than staying with the status quo no matter how destitute the original option. As such many factors above and beyond potential future benefits will have implications in the decision process. To date few empirical studies have focused on this, and in particular relating to those risk mitigation strategies important to the poor.

Our results suggest that income diversity and social capital have implications for PES participation. However, the directionality of these factors is not necessarily uniform across the variables. While some forms of social capital and livelihood strategies positively reinforce individual choice to engage in a PES conservation scheme, others did not. One in particular emerged from this study. Whereas the results from alternative income generating activities and group membership confirmed current thinking, presence within a dependency network indicated a reduced likelihood of participation.

These social dependency networks may prevent individuals from experimenting with new initiatives due to a reluctance to disturb current reciprocal networks. As such, these traditional reciprocal sharing or assistance norms, while beneficial in many ways, under some circumstances can be injurious to household development. It is worth noting that under the local

conditions found within the study we assume a PES scheme to be a financial improvement to individuals, freeing up time and opportunity to explore alternatives. However this may not always be the case. This said we anticipate that this result is applicable to not only to PES schemes, but also other conservation schemes and development activities.

While a full assessment is beyond this paper, the results pertaining to differences in location suggest that the levels of monitoring and enforcement may have implications for willingness to engage in PES. Those fishers within the park boundaries who have over the last ten years experienced greater monitoring and enforcement of Tanzanian coastal laws were more ready to sign up to the PES scheme. It is reasonable to expect a resistance from those communities having experienced less enforcement over the years to engage in any activities which may increase rules and regulations in their areas.

The results presented here have interesting implications for the development of marine PES schemes, and in particular those underlying conditions required to facilitate their development in the first place. Building trust and group participation can be seen as important prerequisites to any PES scheme. Furthermore, diversification of livelihoods – a common feature of many natural resource conservation schemes – should not be overlooked in PES design. In fact, PES should actively support their presence, particularly when a PES scheme calls for a reduction in fishing effort or indeed any natural resource harvesting. What is more, PES can call for a conditionality when running alongside alternative livelihoods interventions which previous conservation initiatives have been unable to do. For example, the PES scheme will automatically set a level of allowable exploitation or set aside which previous conservation and development schemes investing into alternatives were unable to regulate. However, not all forms of social capital emerged as conducive with the PES scheme. As such PES programs need to fully understand how these 'reciprocal dependency relationships' can influence

willingness to participate. Particularly as such reciprocal relationships may play greater importance within poorer households and communities. The implications of this can have serious consequences if PES schemes do indeed hope to target those poorer members of society.

This paper focuses on a possible marine PES scheme, and so we must ask how does this mechanism translate to PES schemes more generally. This said marine PES programs have much in common with terrestrial ones and we believe the results are relevant to the wider field of PES in general. While social capital and income diversification are important within fishing villages, they are a significant characteristic in many lower income areas. As such we believe these results are more broadly applicable.

Despite the limitations associated with our cross-sectional data, this study highlights possible linkages and barriers that various forms of social capital may play in PES uptake. However, one must note that this work is a starting platform from which other research is needed. The cross-sectional nature of the data fails to address any possible dynamic relationships within these PES schemes, for example changes in income, those potential of actors who initially take up the scheme but drop out at a later date or indeed those who initially hold back but enrol at a later date; this later group may be of significant interest given a perhaps less risky association with an established program. We conclude by noting that more research on the significance of risk mitigations strategies and safety nets with respect to participation in PES schemes is warranted, as well as more broadly, in other development schemes. Furthermore, as a instrumental variable was not available, possible existence of endogeneity bias cannot be completely ruled out. For these reasons, it will be important to repeat the current analysis over a time series, allowing use of instrumental variable examining those dynamic issues. In addition, given the large effect of gender or willingness to participate it may be interesting to further break these groups down and examine each more closely; each

subgroup may well be influenced by social capital differentially. Furthermore, it would interesting to examine other elements of social capital not discussed here and in particular if presence within other networks display similar or even opposite patterns. Indeed that one reciprocal dependency network showed a negative correlation yet another indicated no correlation whatsoever implies that these networks have complex and perhaps confounded implications for an individual's participation choice.

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<<<<TABLES>>>>

Table 1. Summary of village characteristics

| Village | No. of households | Total population | No of fishers (male) | No of fishers (female) | Fishers as % of total adult male pop | Fishers as % of total adult female pop |
|---|---|---|---|---|---|---|
| *Within Park* | | | | | | |
| Mkubiru | 360 | 1540 | 400 | 300 | 100.0 | 77.9 |
| Mngoji | 570 | 1714 | 70 | 50 | 16.3 | 11.8 |
| Msimbati | 1120 | 10140 | 1521 | 300 | 60.0 | 11.8 |
| *Outside Park* | | | | | | |
| Mikindani | 2777 | 11032 | 200 | 40 | 7.3 | 1.4 |
| Naumbu | 612 | 1758 | 600 | 150 | 100.0 | 34.1 |
| Pemba | N/A | 912 | 228 | 78 | 100.0 | 34.1 |

Source: Barr 2010

Table 2. Mean demographic characteristics of sample respondents

| | *In* | | | *Out* | | | All | In | Out |
|---|---|---|---|---|---|---|---|---|---|
| | Mkub | Mngj | Msim | Mkdn | Naum | Pemb | | | |
| No. | 151 | 73 | 74 | 46 | 117 | 79 | 540 | 297 | 243 |
| Male (%) | 37.1 | 37.0 | 37.8 | 71.4 | 45.3 | 46.8 | 43.3 | 37.4 | 50.6 |
| Age | 35.2 | 35.5 | 36.2 | 44.2 | 33.9 | 30.6 | 35.2 | 35.6 | 34.7 |
| HH_size | 4.7 | 5.6 | 5.3 | 5.2 | 5.2 | 4.5 | 5.0 | 5.1 | 5.0 |
| Education | | | | | | | | | |
| None | 25.2 | 34.3 | 52.1 | 26.1 | 47.4 | 50.0 | 38.6 | 33.9 | 44.4 |
| Primary | 70.2 | 64.4 | 48.0 | 73.9 | 50.0 | 48.7 | 59.2 | 63.5 | 53.9 |
| Secondary | 3.3 | 1.4 | 0.0 | 0.0 | 1.7 | 1.3 | 1.7 | 2.0 | 1.2 |
| Other | 1.3 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.6 | 0.7 | 0.4 |

Where: In=villages located in park, Out=villages located outside of park; Mkub=Mkubiru, Mngi=Mngoji, Msim=Msimbati, Mkdn=Mikindani, Naum=Naumbu, Pemb=Pemba

Table 3. Mean fishing characteristics of sample respondents

| | *In* | | | *Out* | | | All | In | Out |
|---|---|---|---|---|---|---|---|---|---|
| | Mkub | Mngj | Msim | Mknd | Naum | Pemb | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Male income† /day fishing: US$ | 4.7 | 2.9 | 3.1 | 4.9 | 3.3 | 7.5 | 4.4 | 3.9 | 4.9 |
| Female income/ day fishing: US$ | 2.3 | 1.6 | 1.8 | 1.9 | 2.9 | 2.3 | 2.2 | 2.0 | 2.6 |
| Male fishing days/month | 18.2 | 16.5 | 17.1 | 17.8 | 19.4 | 17.9 | 18.1 | 17.6 | 18.5 |
| Female fishing days/month | 13.0 | 11.1 | 13.3 | 13.6 | 12.1 | 13.1 | 12.6 | 12.6 | 12.6 |
| Male fish income as daily wage§: US $ | 0.67 | 0.41 | 0.28 | 0.69 | 0.49 | 1.03 | 0.61 | 0.52 | 0.70 |
| Female fish income as daily wage: US $ | 0.26 | 0.17 | 0.23 | 0.22 | 0.31 | 0.28 | 0.25 | 0.23 | 0.29 |

Where: In=villages located in park, Out=villages located outside of park; Mkub=Mkubiru, Mngi=Mngoji, Msim=Msimbati, Mkdn=Mikindani, Naum=Naumbu, Pemb=Pemba
†fishing income is reported as perceived fishing earnings for 'average' day. §actual daily wage calculated using perceived 'average' day and stated number of days a month spent fishing, where daily wage = ((income/day)*(fishing days/month)*11)/365. Annual fishing earnings were calculated using only 11 months as fishers tend to miss additional days due to illness/weather etc.

Table 4. Mean social capital and occupational characteristics of sample respondents

| | In | | | Out | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mkub | Mngj | Msim | Mkdni | Naum | Pemb | All | In | Out |
| *Social capital:* | | | | | | | | | |
| Trust | 3.97 (0.51) | 3.91 (0.54) | 3.88 (0.54) | 3.78 (0.57) | 3.97 (0.60) | 3.90 (0.57) | 3.92 (0.55) | 3.93 (0.52) | 3.91 (0.59) |
| Grp membership | 0.17 (0.38) | 0.15 (0.36) | 0.12 (0.33) | 0.15 (0.36) | 0.02 (0.13) | 0.00 (0.00) | 0.10 (0.30) | 0.15 (0.36) | 0.04 (0.19) |
| Dependence fishing | 1.41 (1.89) | 1.25 (1.44) | 2.53 (2.22) | 1.22 (1.66) | 1.10 (1.00) | 1.27 (1.14) | 1.44 (1.66) | 1.65 (1.95) | 1.19 (1.19) |
| Reliance 'bad' fishing time | 1.19 (1.31) | 1.21 (1.36) | 1.00 (1.05) | 0.72 (1.00) | 0.79 (1.08) | 0.68 (0.86) | 0.96 (1.17) | 1.44 (1.26) | 0.74 (0.99) |
| *Alternative activities:* | | | | | | | | | |
| Fisher income | 0.89 (0.93) | 0.73 (0.84) | 0.54 (0.81) | 0.72 (0.91) | 0.64 (0.78) | 0.77 (0.86) | 0.73 (0.87) | 0.76 (0.89) | 0.70 (0.83) |
| HH income | 1.28 (1.27) | 1.08 (1.10) | 0.66 (0.91) | 1.07 (0.80) | 1.05 (1.10) | 1.00 (0.95) | 1.06 (1.10) | 1.08 (1.17) | 1.03 (1.00) |
| Non-farm income (HH) | 0.89 (1.05) | 0.62 (0.83) | 0.54 (0.69) | 0.85 (0.63) | 0.91 (0.95) | 0.91 (0.95) | 0.80 (0.90) | 0.74 (0.93) | 0.88 (0.86) |
| Fisher activity | 2.24 (1.06) | 1.82 (1.01) | 1.95 (1.03) | 1.5 (1.33) | 1.69 (1.15) | 1.69 (1.15) | 1.91 (1.17) | 2.06 (1.05) | 1.72 (1.28) |
| HH activity | 2.62 (1.00) | 2.3 (1.08) | 2.20 (0.94) | 1.96 (1.11) | 2.16 (1.31) | 2.16 (1.31) | 2.34 (1.13) | 2.45 (1.02) | 2.20 (1.25) |

Where: In=villages located in park, Out=villages located outside of park; Mkub=Mkubiru, Mngi=Mngoji, Msim=Msimbati, Mkdn=Mikindani, Naum=Naumbu, Pemb=Pemba
(*) indicates standard deviations

## Table 5. Variable list and descriptive statistics of independent variables

| Variables | Definition | Mean/ (%) | min | max |
|---|---|---|---|---|
| Male | Dummy for gender: male =1; female =0 | 43.3% | 0 | 1 |
| Inpark | Dummy for location: village found inside park borders =1; village located outside =0 | 55.0% | 0 | 1 |
| Age | Age of respondent (in years) | 35.3% | 16 | 82 |
| Education | Dummy for respondent's level of education: 1= attended secondary or above; 0 otherwise | 61.6% | 0 | 1 |
| Hhsize | Number of members in household | 5.03 | 1 | 22 |
| Fish_income | Continuous variable for respondent's daily income from fishing (US $) | 0.433 | 0 | 7.53 |
| Own_boat | Dummy for those fisher's who owned own boat: 1=own boat; 0=don't own boat | 23.9% | 0 | 1 |
| Dhow | Dummy for fishing from dhow (a larger boat able to access outer reef): 1=fishes from dhow; 0=fishes from other or no boat | 15.7% | 0 | 1 |
| Legal | Dummy for those fishing using legal methods: 1=fish legally; 0=fish illegally | 32.6% | 0 | 1 |
| MSL | Material score index created from respondent household's assets. Index is calculated from presence of assets: 'high' quality of housing (roof and walls), ownership of transport vehicles and household appliances. Higher values indicate a higher asset wealth. | 5.83 | 3 | 11 |
| Land_area | Continuous variable for area of land owned | 1.81 | 0 | 30 |
| *Attitudes* | | | | |
| Perceive_ben | Likert scale 1-5 for perceived change in number of fish caught in last 5 yrs: 1=a large decrease; 5=a large increase | 2.17 | 0 | 5 |
| Better_off | Likert scale 1-5 for perceived change in standard of living in last 5 yrs: 1=a large decrease | 2.12 | 0 | 5 |
| Cons_benefit | Likert scale 1-5 for attitude relating to potential benefit of marine conservation: 1=a large detriment; 5=a large benefit. Proxy for believes in conservation as beneficial | 3.01 | 0 | 5 |
| Happy_child | Likert scale 1-5 for attitude relating to feelings if son/daughter became fisher: 1=very unhappy; 5=very happy. Proxy for satisfaction with current fishing situation | 2.86 | 0 | 5 |
| *Social capital and income diversification* | | | | |
| Alt_inc | Count variable for presence of alternative income | 0.733 | 0 | 3 |
| Alt_farm_inc | Dummy for presence of alternative cash activity from farming | 23.1% | 0 | 1 |
| Alt_nonfarm_inc | Count variable for presence of alternative non farm income | 0.459 | 0 | 2 |
| Alt_activity | Count variable for presence of alternative activity | 1.91 | 0 | 4 |

| | | | | |
|---|---|---|---|---|
| Grp_mem | Dummy for respondent member of non-fishing group: 1=member; 0 = otherwise | 14.3% | 0 | 1 |
| Dep_work | Count variable for number of dependency networks respondent is located within for fishing related activity corrected for village average, i.e. number of people respondent depends on and/or is depended upon by others to conduct fishing activity | 1.00 | 0 | 4.11 |
| Dep_work_give | Count variable for number of networks whereby respondent gives assistance to others for fishing activities corrected for village average | 1.00 | 0 | 4.92 |
| Dep_work_rec | Count variable for number of networks whereby respondent receives assistance from others for fishing activities corrected for village average | 1.00 | 0 | 4.14 |
| Rely_hardtime | Count variable for number of networks respondent is located within for consumption smoothing corrected for village average, i.e. number of people respondent can turn to and/or is turned to during times of fishing hardship | 1.00 | 0 | 7.63 |
| Avetrust | Respondent's average level of trust. Average value of all trust variables. Continuous variable 1-5: 1 = no trust; 5 = fully trust | 3.92 | 1.56 | 5 |
| *Interaction term* | | | | |
| Trust_in | Interaction term between avetrust and Inpark | 2.18 | 0 | 5 |

Table 6. Estimation results: effects of income diversity and social capital on willingness to participate in PES.

| Variables | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 4b partial effects |
|---|---|---|---|---|---|---|
| Male | -0.432* | -0.363* | -0.457*** | -0.444*** | -0.472*** | -0.169 |
| | (0.244) | (0.188) | (0.150) | (0.138) | (0.162) | (0.050) |
| Inpark | 0.462*** | 0.251 | 0.208 | 1.451*** | | 0.517 |
| | (0.175) | (0.214) | (0.194) | (0.560) | | (0.168) |
| Age | -0.001 | -3.0e-04 | -0.002 | -0.003 | -0.006 | -0.001 |
| | (0.003) | (0.003) | (0.004) | (0.004) | (0.004) | (0.001) |
| Education | 0.067 | 0.083 | 0.080 | 0.075 | 0.090 | 0.029 |
| | (0.109) | (0.107) | (0.103) | (0.101) | (0.125) | (0.039) |
| HHsize | 0.035 | 0.019 | 0.022 | 0.023 | 0.040* | 0.008 |
| | (0.019) | (0.019) | (0.024) | (0.025) | (0.024) | (0.009) |
| Fish_income | -0.087 | 0.632 | 0.455 | 0.478 | 0.501 | 0.182 |
| | (0.042) | (0.636) | (0.510) | (0.519) | (0.520) | (0.197) |
| Own_boat | -0.328* | -0.459*** | -0.404** | -0.401** | -0.457*** | -0.153 |
| | (0.192) | (0.159) | (0.197) | (0.188) | (0.180) | (0.074) |
| Dhow | -0.242* | -0.309** | -0.254** | -0.255** | -0.285*** | -0.099 |
| | (0.109) | (0.129) | (0.111) | (0.108) | (0.093) | (0.043) |
| Legal | -0.180 | -0.304* | -0.193 | -0.218 | -0.141 | -0.083 |
| | (0.183) | (0.182) | (0.183) | (0.190) | (0.218) | (0.074) |
| MSL | -0.021 | -0.015 | -0.006 | -0.004 | -0.006 | -0.001 |
| | (0.041) | (0.034) | (0.040) | (0.041) | (0.047) | (0.015) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Land_area | -0.019 | -0.038* | -0.054*** | -0.051*** | -0.042*** | -0.019 |
| | (0.021) | (0.020) | (0.015) | (0.016) | (0.012) | (0.006) |
| Perceived_ben | | -0.169* | -0.156 | -0.159 | -0.149 | -0.060 |
| | | (0.091) | (0.104) | (0.104) | (0.103) | (0.041) |
| Better_off | | -0.138** | -0.168** | -0.165** | -0.171** | -0.063 |
| | | (0.052) | (0.064) | (0.067) | (0.070) | (0.025) |
| Cons_benefit | | 0.227*** | 0.219*** | 0.216*** | 0.252*** | 0.082 |
| | | (0.011) | (0.012) | (0.012) | (0.028) | (0.005) |
| Happy_child | | -0.194*** | -0.197*** | -0.198*** | -0.218*** | -0.075 |
| | | (0.052) | (0.052) | (0.051) | (0.055) | (0.018) |
| Alt_inc | | | 0.249*** | 0.251*** | 0.265*** | 0.095 |
| | | | (0.037) | (0.041) | (0.051) | (0.018) |
| Grp_memb | | | 0.422*** | 0.425*** | 0.397*** | 0.150 |
| | | | (0.142) | (0.143) | (0.154) | (0.046) |
| Dep_work | | | -0.144*** | -0.141*** | -0.167*** | -0.054 |
| | | | (0.033) | (0.032) | (0.031) | (0.011) |
| Rely_hardtime | | | -0.017 | -0.019 | -0.021 | -0.007 |
| | | | (0.047) | (0.047) | (0.046) | (0.018) |
| Avetrust | | | 0.135** | 0.285*** | 0.357*** | 0.108 |
| | | | (0.069) | (0.096) | (0.068) | (0.036) |
| Trust_in | | | | -0.315** | | -0.098† |
| | | | | (0.139) | | (0.027) |
| *Vill_trust interact* | | | | | | |
| Mkubiru | | | | | -0.489*** | |
| | | | | | (0.127) | |
| Mngoji | | | | | -0.473*** | |
| | | | | | (0.157) | |
| Msimbati | | | | | -0.144 | |
| | | | | | (0.097) | |
| Naumbu | | | | | 0.067 | |
| | | | | | (0.103) | |
| Pemba | | | | | -0.362** | |
| | | | | | (0.170) | |
| _cons | 0.207 | 0.729** | 0.447 | -0.125 | -0.098 | |
| | (0.320) | (0.340) | (0.616) | (0.735) | (0.825) | |
| N | 513 | 513 | 509 | 509 | 509 | |
| LogLikelihood | -320.921 | -288.259 | -274.954 | -274.027 | -265.705 | |
| PseudoR² | 0.0724 | 0.1668 | 0.1977 | 0.2004 | 0.2247 | |

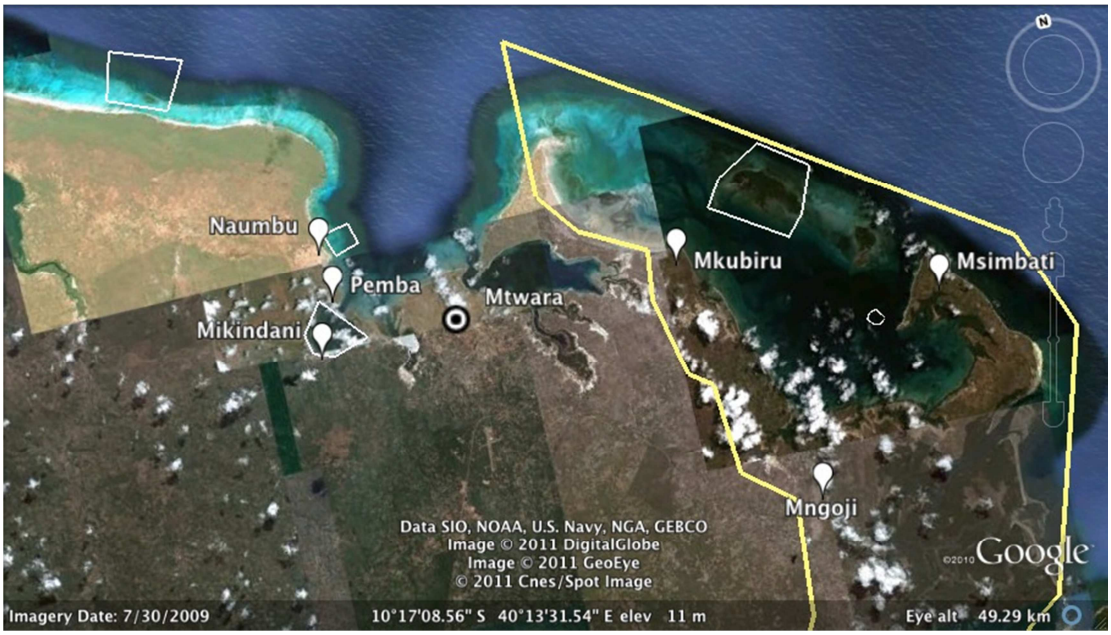
Robust standard errors have been used. (*) denotes significance at the 10% level, (**) at the 5% level and (***) at the 1% level. Standard errors are displayed in brackets. Village fixed effects not displayed; full results available on request. †as reported by inteff function in STATA.

<<<FIGURES>>>

Fig 1. Location of the Mtwara Region and study site within Tanzania

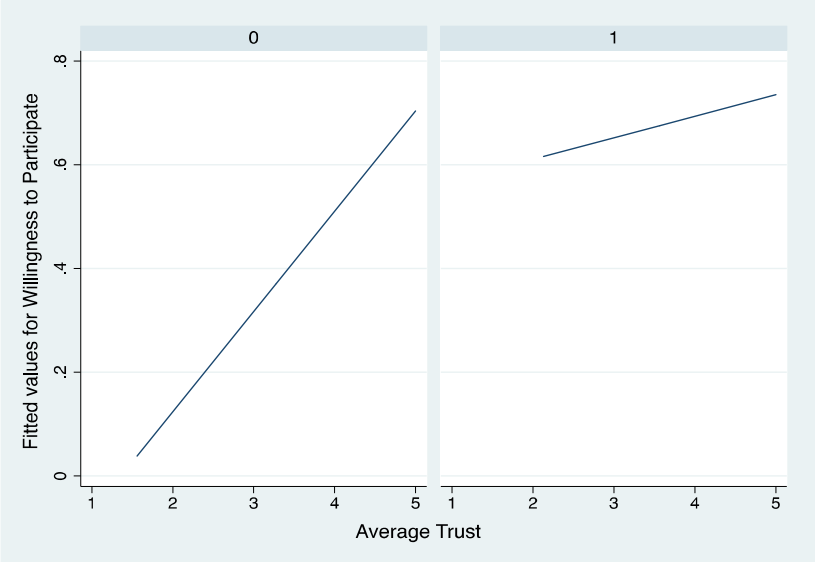

Mtwara Region shown as shaded area. Boxed area indicates coastal area and study sites. Adapted from http://en.wikipedia.org/wiki/Mtwara_Region (12 June 2011).

Fig 2. Map of local area indicating study villages, Marine Park and hypothetical closure sites




Marine park border shown outlined in thick yellow, hypothetical closures indicated by thinner white boxes. Taken and adapted from Google Earth (Version 6.0.1.2032) [Software}. Mtwara coastal view, TZ: Google Inc (2011). Available from: http://www.google.co.uk/intl/en_uk/earth/index.html

Fig 3. Fitted probabilities for willingness to participate against average trust (avetrust) for subgroups inside (subheading 1) and outside of park (subheading 0)




<<<<ANNEX>>>>

Annex 1. z-statistics of interaction effect as given by the Ai & Norton (2003) function