



Participation in devolved commons management: Multiscale socioeconomic factors related to individuals' participation in community-based management of marine protected areas in Indonesia



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ABSTRACT

Management of common-pool natural resources is commonly implemented under institutional models promoting devolved decision-making, such as co-management and community-based management. Although participation of local people is critical to the success of devolved commons management, few studies have empirically investigated how individuals' participation is related to socioeconomic factors that operate at multiple scales. Here, we evaluated how individual- and community-scale factors were related to levels of individual participation in management of community-based marine protected areas in Indonesia. In addressing this aim, we drew on multiple bodies of literature on human behaviour from economics and social science, including the social-ecological systems framework from the literature on common-pool resources, the theory of planned behaviour from social psychology, and public goods games from behavioural economics. We found three key factors related to level of participation of local people: subjective norms, structural elements of social capital, and nested institutions. There was also suggestive evidence that participation was related to people's cooperative behavioural disposition, which we elicited using a public goods game. These results point to the importance of considering socioeconomic factors that operate at multiple scales when examining individual behaviour. Further, our study highlights the need to consider multiscale mechanisms other than those designed to appeal to self-interested concerns, such as regulations and material incentives, which are typically employed in devolved commons management to encourage participation. Increased understanding of the factors related to participation could facilitate better targeting of investments aimed at encouraging cooperative management.

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1. Introduction

During the 1990s, decentralisation reforms in many developing countries led to management of common-pool natural resources being widely implemented under institutional models promoting devolved decision-making and participation of local people, such as co-management and community-based management (Berkes, 2010). These decentralisation reforms were responses to the poor performance of centralised management and involved transfer of decision-making and financial responsibilities from a central authority to lower scales of government (Brugere, 2006). Due to

increasing recognition of local people's rights and ability to manage their local environment, decentralisation has often been accompanied by devolution, the transfer of management rights and responsibilities to local non-governmental institutions, typically user groups, which have discretionary decision-making power (Berkes, 2010). Devolved management of common-pool resources (hereafter "devolved commons management") is now part of the discourse and practice of many organisations, both government (e.g. Chilean; Gelcich et al., 2010) and non-government (e.g. the World Bank; Mansuri and Rao, 2004). However, the success of devolved commons management in achieving positive biological and socioeconomic impacts is highly variable (Brooks et al., 2012; Cinner et al., 2012).

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Devolved commons management is underpinned by participation of local people, with the extent of participation shown repeatedly to be critical to achieving positive impacts (Pagdee et al., 2006; Brooks et al., 2012). For example, a study of devolved forest management in six countries found that local participation was related to improved biological and livelihood outcomes (Persha et al., 2011). Participation of local people, especially those who will be affected by management, is often viewed as an important mechanism to provide incentives to people to use their resources sustainably, because it improves perceived legitimacy of rules, and ensures that management is likely to better reflect the needs and preferences of local people (Larson and Soto, 2008; Persha et al., 2011). Indeed, participation has been shown to improve knowledge and attitude towards community-based management of marine and terrestrial resources (Brooks et al., 2012). In addition, incorporating local knowledge of the social-ecological system through participation is thought to increase the effectiveness of management (Ostrom et al., 1993).

However, our understanding of the factors influencing local people's individual decisions relating to participation in devolved commons management is limited (Zanetell and Knuth, 2004; Larson and Soto 2008; Tesfaye et al., 2012). Much of the existing empirical literature on decentralised and devolved approaches to commons management focuses on identifying impacts (e.g. Maliao et al., 2009; Gurney et al., 2014, 2015), or the socioeconomic and institutional conditions related to them (e.g. Agrawal and Chhatre, 2006; Cinner et al., 2012). Studies that have focused on participation in devolved commons management tend not to examine individuals' participation behaviour, but rather use local government administrations (e.g. Larson, 2002; Andersson, 2006) or local communities (e.g. McKean 1992; Varughese and Ostrom 2001) as the unit of analysis (Andersson and Ostrom, 2008; Chaigneau and Daw, 2015). However, given that communities are heterogeneous social structures (Agrawal and Gibson 1999; Gurney et al., 2015), understanding participation of local people in devolved commons management also requires complementary analyses that use individuals as the unit of analysis. Indeed, there is a considerable body of related literature that examines individual private landholders' decisions to adopt conservation practices (e.g. Marshall 2009; Pannell et al., 2006). However, management of private property tends to generate largely private benefits, as opposed to management of common property, which is less excludable and generates mostly public benefits.

Using individuals as the unit of analysis allows examination of factors that operate at multiple scales (e.g. individual and community scale) to influence behaviour. Although, individuals have different interests and characteristics that influence whether they will perform a particular behaviour (Botchway, 2001), individuals' behaviour is also shaped by the characteristics of the larger-scale context in which they are embedded (Altman et al., 1984; Ostrom 2007). Contextual factors (e.g. characteristics of the government system) are also important in devolved commons management because they represent potential levers for management. Thus, understanding what motivates individuals' decisions requires consideration of multiscale factors that reflect the nested hierarchical structure of the social-ecological system in which human behaviour is situated.

Empirical studies of environmental management behaviour that use individuals as the unit of analysis, including the few studies on participation of local people in devolved commons management, tend to focus solely on the influence of individual-scale factors on behaviour (Dolisca et al., 2009; Qin and Flint, 2010). Individual-scale factors found to be important in these studies include wealth (e.g. Agrawal and Gupta, 2005), gender (e.g. Baral and Heinen, 2007), education (e.g. Chen et al., 2013) and resource dependence (e.g. Dalton et al., 2012). While the importance of

context is often recognised and described qualitatively in these studies, inclusion of multiscale characteristics in quantitative analyses is rare. Considering all potentially influencing factors in one analysis offers the advantage of providing insights into the relative magnitude and importance of those factors (Goldthorpe, 1997; Agrawal and Chhatre, 2006).

Given the prevalence of devolved commons management and the importance of participation of local people for success, understanding the factors influencing participation is of crucial scientific and policy importance. To this end, we examine the factors related to the level of individual participation of local people in management of marine protected areas (MPAs), a primary tool employed in devolved management of marine common-pool resources. Of the few studies that have quantitatively assessed how individuals' participation is related to socioeconomic factors, to our knowledge this study is the first to do so at multiple scales in a marine context. Using data from 13 MPAs in Indonesia we ask "How are community- and individual-scale factors related to the level of individual participation of local people in community-based MPA management?"

1.1. Conceptual approach

We take an interdisciplinary approach to investigating the factors related to local participation in devolved commons management by drawing on multiple bodies of empirical and theoretical literature on human behaviour. Specifically we employ the social-ecological systems framework (Ostrom, 2007) from the literature on common-pool resources, the theory of planned behaviour (Ajzen, 1991) from social psychology, and public goods games (e.g. Aswani et al., 2013) from behavioural economics.

The social-ecological systems framework focuses on how commons-related behaviour and social-ecological outcomes are shaped (Ostrom, 2007). This multitier framework depicts elements of the social-ecological system operating at multiple scales that are thought to influence outcomes in situations involving common-pool resources (Ostrom, 2007). Four core subsystems are described: the resource system (e.g. forest); resource units (e.g. trees); actors (e.g. resource users); and the governance system. The 'action situation', around which the framework is orientated, details actors' interactions or behaviour, and social-ecological outcomes. Each of the subsystems is composed of second-tier variables that may be drawn upon to assess specific social-ecological outcomes and behaviours, such as participation in management. Given the framework emphasises the hierarchical structures of the social-ecological system in which behaviour is situated, we employ it to structure our analysis and draw on the second-tier variables to guide our choice of socioeconomic factors to examine. Many of the second-tier variables describing the actor subsystem are at the community scale (e.g. number of actors). Indeed, the second-tier variables are particularly salient to studying the conditions that facilitate communities (rather than individuals) to sustainably harvest and manage common-pool resources (Basurto et al., 2013), and are based on the existing literature on common-pool resources that tends to use communities as the unit of analysis (Chaigneau and Daw, 2015). There are a small number of studies that have empirically examined individuals' participation in devolved commons management (e.g. Agrawal and Gupta, 2005), but these have focused on terrestrial resources. Thus, to further investigate the individual cognitive facets of the actor subsystem we draw on social psychology and behavioural economics.

The theory of planned behaviour is the most commonly applied behaviour model in social psychology (St John et al., 2010), and provides guidance on individuals' cognitive decision-making processes. It suggests that the likelihood of an individual behaving

in a certain way can be predicted from his or her attitudes, subjective norms (i.e. perceived societal expectations), and perceived control towards that behaviour. Given that reviews have found that the theory generally explains behaviour incompletely (e.g. Sutton, 1998; Armitage and Conner, 2001), numerous authors have suggested additions to it, including both cognitive and contextual considerations (St John et al., 2010). Recently, there have been calls to increase the relatively few applications of this theory to conservation-related behaviour (St John et al., 2013; Pomeroy et al., 2005).

Public goods games are one of a number of experimental games that are used in behavioural economics to investigate human behaviour. These games have had some application to social dilemmas (i.e. situations where group outcomes conflict with individual interests) associated with common-pool resources (e.g. Ostrom et al., 1994; Castillo et al., 2011). Given that individuals' cooperative behavioural disposition underpins their behaviour in a social dilemma (such as participation in devolved commons management; Poteete et al., 2010), we used a public goods game as a stylised model of the social dilemma associated with devolved commons management (Rustagi et al., 2010; Aswani et al., 2013) to elucidate cooperative behavioural disposition. Recently, experimental economic games have been played in the field rather than in laboratories, catalysing interest in whether gaming and real world (external) behaviour are consistent (Anderies et al., 2011). To date, studies using games to study commons-related behaviour have tended to apply them to harvesting (e.g. Prediger et al., 2011; Gelcich et al., 2013), which requires a common-pool resource game, rather than participation in management (but see Rustagi et al., 2010; Aswani et al., 2013). Further, very few studies have assessed the external validity of games in the context of natural resources (Anderies et al., 2011; Vollan and Ostrom, 2010). To our knowledge, our study is the first to do so in relation to a public goods game applied to management of marine common-pool resources. Therefore, using a public goods game allowed us not only to assess people's cooperative behavioural disposition, but to test the game's external validity, providing insights into whether MPA management is considered a social dilemma in relation to a public good.

2. Methods

2.1. Study sites and sampling

We studied 13 coastal communities on the islands of Sulawesi and Bali, Indonesia (Fig. 1). Governance of Indonesia's coastal zone was decentralised to local and provincial governments under the Autonomy Act (Law 22/1999), the Financial Distribution Act (Law 25/1999), and their revisions (Law 32 and 33/2004; Siry, 2011). The Coastal Zone and Small Islands Management Act (Law 7/2007) further supports devolved coastal management and provides a framework for coordination of coastal planning and management. The communities were selected primarily because each manages a small community-based MPA, and the variation in level of participation within and between communities was known to be sufficient to address our research question. The MPAs were established with support from external institutions, primarily non-government organisations (NGOs). Support from these organisations presently differs between communities.

We collected data from 264 respondents using semi-structured interviews and public goods games. Respondents were randomly selected from a list of MPA-management participants that we compiled based on information given by key marine resource users, and government and MPA-management leaders. This sampling strategy allowed us to examine the factors related to

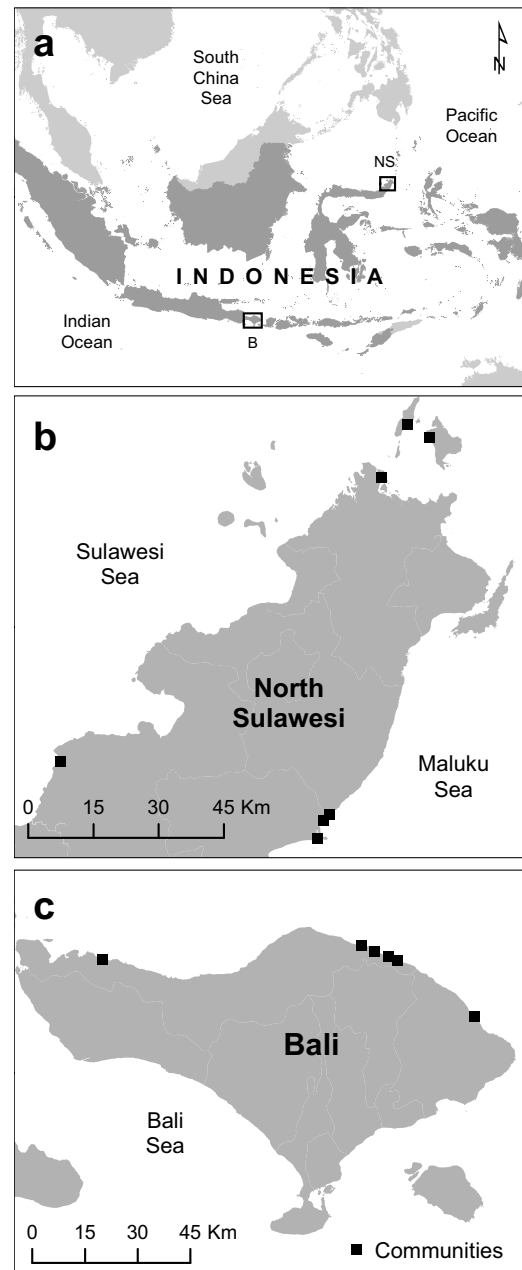


Fig. 1. Locations of study communities. (a) Study areas in Indonesia; NS indicates North Sulawesi; B indicates Bali. (b) Communities in North Sulawesi. (c) Communities in Bali.

variation in the level of participation among those who participate in management. To aid understanding of the factors affecting participation and to triangulate results, we also conducted semi-structured interviews with key informants, including government, religious and MPA-management leaders.

We examined the relationship between level of participation in MPA management and 14 individual- and five community-scale factors, which we selected based primarily on the theory of planned behaviour and the social-ecological systems framework (Table 1). We selected only variables related to the governance and actor subsystems from the social-ecological systems framework, because the resource system (i.e. coral reef) and units (i.e. reef fish)

Table 1

Descriptions of the dependent variable (level of individual participation in MPA management) and covariates (individual- and community-scale socioeconomic factors) in our model. Community-scale variables are underlined; others are at the individual scale. The dependent variable is shaded.

	Variable	Description	Methods ^a
Theory of planned behaviour			
<i>Attitudes</i>			
	Perceived benefit of participation in MPA management	4-point scale reflecting perceived benefit of participating in MPA management	SSI
<i>Subjective norms</i>			
	Perceived societal expectation to participate in MPA management	Additive index of level of perceived encouragement to participate in MPA management from friends and family, government and religious leaders (4-point scale for each of the three groups of people)	SSI
<i>Behavioural control</i>			
	Perceived barriers to participating in MPA management	Number of perceived barriers to participating in MPA management	SSI
Social-ecological systems framework			
<i>Interactions</i>			
	Participation in MPA management	Additive score of three facets of participation: (1) level of decision-making in relation to MPA management; (2) number of management activities participated in; and (3) frequency of participation. Variables were converted into z-scores prior to summing, allowing equal weighting.	SSI
<i>Governance subsystem</i>			
<i>Operational rules</i>			
	<u>Nested institutions</u>	Whether the MPA-management group was assisted by external institutions regularly (i.e. >2 times/year)	KI
	<u>Graduated sanctions</u>	Whether sanctions increase with multiple offences	KI
	<u>Clearly defined boundaries</u>	Whether there is clear delineation of the MPA	KI
<i>Actor subsystem</i>			
	<u>Population</u>	Number of people living in the community	SI
	<u>Age of MPA-management group</u>	Number of years since the MPA-management group was established	KI
	<u>Trust in leader</u>	Additive index of level of trust in government, religious and MPA leaders (5-point scale for each of the three groups of people)	SSI
Knowledge of social-ecological systems	Environmental knowledge	Additive score based on responses to eight statements concerning the relationship between coastal resources and human activities (2-point scale for each statement; see Supplementary material Text A.1)	SSI
Importance of resource	Fisheries dependence	Whether fishing is the primary livelihood for the respondent	SSI
<i>Socioeconomic attributes of users</i>			
	Wealth	Principal component score based on the type of wall, floor, and window, and the presence or absence of a fan, piped water, refrigerator, satellite dish, television and modern stove (See Supplementary material Table A.1)	SSI
	Education	Number of years of formal education	SSI
	Age	Age in number of years	SSI
<i>Norms/social capital</i>			
	Trust in community	5-point scale reflecting level of trust in other community members	SSI
	Reciprocity	3-point scale from giving and receiving favours from other community members (0 = neither gives or receives favours, 1 = gives or receives favours, 2 = gives and receives favours)	SSI
	<u>Involvement in community groups</u>	Number of community groups (other than the MPA-management group) that the respondent is involved in	SSI
	<u>Involvement in decision-making</u>	3-point scale reflecting level of involvement in general (i.e. not related to MPA management) decision-making in the community (not involved, passive, active) ^b	SSI
	<u>Cooperative behavioural disposition</u>	8-point scale reflecting contribution in public goods game	PGG

^a SSI = semi-structured interviews, KI = key-informant interviews, SI = secondary information, PGG = public goods game.

^b Following Cinner et al. (2012) respondents' were asked if and how they participated in general decision-making and their responses were classified as: 1) not involved; 2) passive involvement = attend meeting but do not talk or participate; and 3) active involvement = actively expressing opinions whether or not solicited.

were the same for all communities in our study. While the social-ecological systems framework identifies a large number of second-tier variables that could potentially affect commons-related behaviour, it is not intended that scholars use the entire suite; as noted by Ostrom (2010) "there is no way that one can analyse the entire spaghetti plate of variables that have been identified". Thus, the socioeconomic factors that we examined (e.g. marine resource dependence, environmental knowledge) were selected based on their likely relevance to the context, identified through the authors' knowledge of the area and existing literature on common-pool resources and MPA management. In particular, the factors that we assessed for the governance subsystem were informed by Ostrom (1990) eight design principles for devolved

commons management. Further, to guide our choice of cognitive facets of the actor subsystem, we drew on the behavioural theory of human action (Poteete et al., 2010), which emphasises the importance of trust, reciprocity, and cooperation for explaining behaviour in a social dilemma. To elucidate cooperative behavioural disposition, a covariate in our model, we used a one-shot unframed public goods game, which involved giving participants a sum of money that they could either keep or invest fully or partly in a public good, with their payoff at the end of the game depending on the actions of all players in their group (See Supplementary material Text A.2).

To capture the multidimensional nature of individual participation in MPA management (the dependent variable), we

developed a composite score of three key facets of participation: (1) level of decision-making in MPA management (3-point scale); (2) number of management activities (e.g. training, monitoring for illegal fishers) the respondent participated in; and (3) frequency of participation (i.e. number of times respondent participated in the previous six months).

2.2. Data analysis

To assess how participation (the dependent variable in our model) was related to multiscale socioeconomic factors (the covariates in our model) we used a Bayesian hierarchical model implemented as a linear mixed model. We set community a priori as a random factor to account for non-independence of data arising from repeated sampling within each community (see Supplementary material Text A.3). We used non-informative uniform priors for all parameters because we did not have a priori information about parameter distributions, so the posterior estimates were informed by the data alone. We assessed the convergence and mixing of chains by assessing autocorrelation and using the Gelman-Rubin diagnostics (Gelman and Rubin, 1992). All analyses were undertaken using R (3.02) and JAGS (3.4.0) statistics packages.

3. Results

There was strong evidence (i.e. where a parameter's 95% highest posterior density interval does not intersect zero) of both individual- and community-scale factors being related to individual participation in MPA management (Fig. 2A). At the individual scale, participation was more extensive if perceived expectation to

participate from family, friends, and local religious and government leaders (i.e. subjective norms) was high. Two elements of social capital – membership in community organisations and involvement in decision-making – were also related to participation in MPA management. Our analysis suggests that those who nominated their involvement in decision-making as active, not passive, participated more extensively. At the community scale, participation was more extensive if MPA-management groups were supported by external institutions (i.e. nested institutions). For two of the covariates – age and cooperative behavioural disposition there – there was suggestive evidence of an effect (i.e. where 80–94% of the posterior distribution was positive or negative). This suggests that participation was more extensive when people were older and were more cooperative, as indexed by the public goods game.

The level of participation in MPA management differed between communities (Fig. 2B), with inter-community variation accounting for 42% of the total variance. Communities in Bali tended to have higher levels of participation than those in Sulawesi. However, participation varied between communities located on each island (Fig. 2B); thus, we found no statistical evidence that level of participation was related to whether people lived in Sulawesi or Bali when region was included as a covariate in the model (see Supplementary material Fig. A.1).

4. Discussion

We found three key factors related to level of individual participation in MPA management: subjective norms, a component of the theory of planned behaviour; and nested institutions and two elements of social capital, which are components of the social-

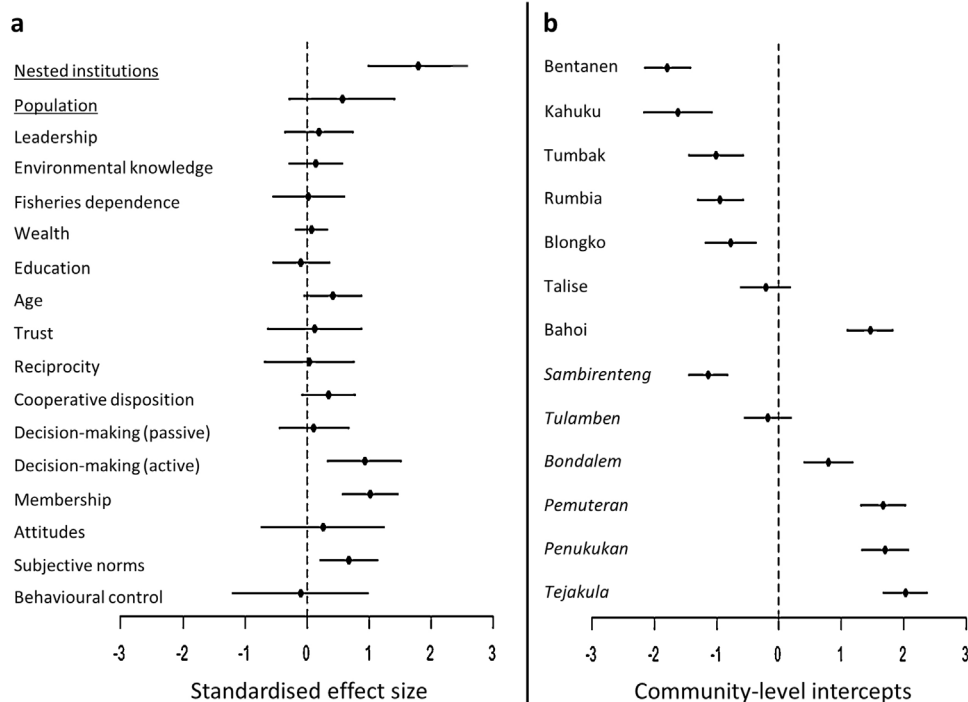


Fig. 2. Variation in participation between communities, and relationship of multiscale covariates with level of individual participation. Mean posterior estimates (dots) and 95% highest posterior density intervals (lines) for multiscale covariates (a) and community-level intercepts (b) from Bayesian hierarchical model of individual participation in MPA management. Covariates that are underlined in (a) are at the community scale, the other covariates are at the individual scale. Communities that are italicised in (b) were located in Bali, the other communities were located in North Sulawesi. Note that three covariates (i.e. age of organisation, clearly defined boundaries, and graduated sanctions) were removed prior to the final analysis because they were collinear with other community-level covariates (i.e. nested institution and population) and had higher variance inflation factors.

ecological systems framework. There was also suggestive evidence that participation was related to age and cooperative behavioural disposition, which we elicited using a public goods game.

4.1. Subjective norms

People's perception of societal expectation (i.e. subjective norms) in regards to participation in MPA management was an important factor driving their participation behaviour: those that perceived strong societal expectation to participate from peers and community leaders were more likely to participate. Although less attention has been given to subjective norms than to attitudes in the conservation literature (St John et al., 2010), studies have highlighted the importance of subjective norms in determining behaviour in relation to natural resource management, such as abiding to boating speed limits in conservation areas (Aipanjiguly et al., 2003) and involvement in planting trees (Zubair and Garforth, 2006). Subjective norms were important in our study likely because of strong motivations to comply with the expectations of families and community leaders. Indonesian society is orientated around family and is hierarchical, with respect shown to those with age, position, and status. Indeed, Ajzen (1991) specified that motivation to comply is an important component of subjective norms. However, we did not include a measure of individuals' motivation to comply with social norms in our quantitative analysis because we were not confident about measuring it reliably using our survey instruments.

In the communities where perceived societal expectation to participate in MPA management was high, NGOs worked closely with government and religious leaders to gain their support. For example, in several communities with the most participation, located in Bali, NGOs had strong links with the local Balinese Hindu religious leaders. The MPA opening ceremonies in these communities included a religious blessing, and the Hindu religious leaders actively promoted the MPAs, including through local radio. Given nature is revered in Balinese Hinduism, many existing religious norms in Bali are likely to be conducive to natural resource management. Thus, our study highlights the importance of identifying and working within existing norms and institutions. This approach, paired with close involvement of influential people within communities in designing devolved commons management, could increase the legitimacy of management and facilitate participation.

4.2. Social capital

Two elements of social capital – membership in community organisations and active decision-making – were positively associated with individuals' participation in MPA management. These elements represent structural components of social capital suggested to facilitate the cognitive components (e.g. shared norms, trust, and reciprocity) through providing a venue for repeated interactions and reinforcement of norms (Uphoff, 1993). Social capital is suggested to be critical to the success of devolved commons management (Pretty, 2003), such as co-management of fisheries (Grafton, 2005), because it lowers the transaction costs of working together, thus increasing the likelihood of participation.

Given that, apart from subjective norms, the cognitive elements of social capital were neither collinear with structural social capital nor related to participation, other mechanisms could be shaping the relationship between structural social capital and participation. One alternative explanation is elite control, whereby local political and social elites are better equipped and positioned to participate in management (Dasgupta and Beard, 2007). Indeed we found that only people who were involved actively in decision-making (likely the political and social elites) were more extensively

involved in management. This possible elite control could have led to elite capture of benefits, to which devolved commons management is vulnerable (Béné et al., 2009). Thus, our results suggest that organisations facilitating devolved commons management should actively promote representative community participation, by, for example, providing explicit opportunities for non-elites to be involved in decision-making and building their skills required for those positions. To further unpack the relationship between social capital and participation behaviour, future research could employ social network analysis to provide detailed descriptions and indicators of people's social capital, in particular the structural components.

4.3. Nested institutions

Participation of local people in MPA management was more extensive if institutions were nested, specifically if their associated MPA-management group received external support from NGOs and communicated frequently with them. The important role of nested governance institutions is widely recognised, especially since Ostrom (1990) specified nested institutions as one of the eight key institutional design principles for successful devolved commons management. While this principle is often interpreted as referring to vertical linkages with government institutions, our study supports the wider interpretation that includes linkages with other external institutions such as NGOs, academia and other community groups (e.g. Cox et al., 2010). These non-government institutions often assist and are involved with “appropriation, provision, monitoring, enforcement, conflict resolution and governance activities” (Ostrom, 1990), specified in the design principle relating to nested institutions. For example, support provided by the NGOs in our study sites was tailored to the needs of the communities and included: (1) providing scientific, legislative and other information; (2) training in monitoring, ecotourism and writing grant applications; and (3) facilitating dialog with government, local businesses, and other communities, including for collaboration, monitoring and conflict resolution. Importantly, these benefits came with little material support from NGOs. Although all the MPAs that we studied were established with external support, we did not consider the communities with the least participation as nested institutions because they had little or no ongoing contact with external organisations. Therefore, the strong evidence for the relationship between nested institutions and participation suggests ongoing external support is critical to local participation and thus the success of devolved commons management, questioning the short-term approach often taken in internationally-funded management (Gurney et al., 2014).

4.4. Cooperation

There was suggestive evidence that individual participation was positively related to cooperative behavioural disposition, as indexed by the public goods game. There are two potential reasons why this factor was not more strongly related to participation. First, behaviour in the game could have lacked external validity. Economic games are necessarily highly simplified models of real world decision-making, allowing disaggregation of the social-ecological system into manageable components for examining processes that are difficult to observe in the real world (Aswani et al., 2013). However, this simplification calls into question whether games adequately reflect the key conditions affecting behaviour that prevail in reality. Rather than use abstract framing (as we did), some studies employ framed experimental designs to better reflect reality (although evaluations of behaviour in framed and unframed experiments have found negligible differences; Abbink and Hennig-Schmidt, 2006). Given that the

few studies examining the external validity of economic games have had mixed results (Anderies et al., 2011) – with some finding correspondence between gaming and real-world behaviour (e.g. Rustagi et al., 2010) and others not (e.g. Gurven and Winking, 2008) – understanding the conditions under which gaming results are externally valid is a critical area for future research.

The second potential explanation for the lack of a strong relationship between cooperation and participation is that participation in MPA management might not be considered primarily as a social dilemma associated with a pure public good (which was reflected in the public goods game). MPA management might have produced private benefits that dominated over public benefits, which would have rendered management an impure public good. Impure public goods are not completely non-rivalrous and non-excludable (Perrings and Gadgil, 2003). These private benefits, essentially externally provided incentives, might have precluded pro-social motivations (Bouma et al., 2008). If so, this is an example of ‘crowding-out’, whereby an actor’s intrinsic motivation to comply with a social norm (e.g. cooperation) is weakened by extrinsic motivations in the form of externally imposed regulations or incentives (Frey and Jegen, 2001). Crowding-out has been demonstrated both in field settings (e.g. Gneezy and Rustichini, 2000) and economic games (e.g. d’Adda, 2011). Two key mechanisms through which crowding-out is suggested to occur are through external interventions that lower: (1) self-determination; and (2) the value of pro-social behaviour as a signal of one’s own moral quality (Frey and Jegen, 2001).

Crowding-out is more likely to occur when external interventions are perceived as controlling rather than supportive, existing norms of reciprocity and cooperation are strong (Vollan, 2008), and material incentives are provided (Cardenas, 2011). These conditions were more apparent in Sulawesi than Bali. Norms of reciprocity and cooperation are strong in the communities in Sulawesi, with communities frequently engaging in *mapalus*, a local word for community collective action. Most of the MPAs in Sulawesi were initiated externally under *Proyek Pesisir*, funded by USAID. Our qualitative data suggest that the project was perceived as fairly top-down, and resulted in material private benefits (e.g. boat engines, agricultural and building equipment). Thus, local people reported that they did not consider MPA management as *mapalus*. After *Proyek Pesisir* finished in 2003, the flow of material benefits ceased and participation in management decreased (Gurney et al., 2014). Participation is still low in these communities, indeed crowding-out has been shown to last after removing material incentives (Beretti et al., 2013). Crowding-out is less likely in Bali because, although norms of cooperation are strong, our qualitative data suggest that many local people perceived that MPA management was initiated by their community, with NGOs acting as facilitators and providing very little material support. Although material incentives are commonly employed in devolved commons management to encourage participation (d’Adda, 2011), they can be counterproductive, lowering pro-social behaviour and raising expectations of externally driven participation instead of encouraging voluntary collective action (Vollan, 2008). Therefore, it is critical that organisations facilitating devolved commons management carefully examine existing norms of cooperation and resource management behaviour, and tailor their approach accordingly.

4.5. Caveats

An important limitation of our study is that we considered self-reported rather than observed participation in MPA management. Although research on human behaviour often relies on self-

reporting, discrepancies between self-reported and observed behaviour can occur (Armitage and Conner, 2001). Although we cannot assess potential discrepancies in our study, our qualitative data on the extent of MPA management in communities correspond with self-reported quantitative data on participation. Another shortcoming of our study is that the small sample of 13 communities limited our ability to fully explore the effects of factors operating across communities. Community-scale factors were important in explaining participation; the variance partition coefficient, which represents the percentage of variance explained by clustering of individuals (e.g. within communities) with a specific combination of covariates (Goldstein et al., 2002), was 0.42 for the intercept-only model. Adding the two community-scale covariates (nested institutions and population) reduced the variance partition coefficient to 0.07, suggesting that nested institutions explained most of the variability in participation that was due to community-scale factors. Nevertheless, other community-scale factors that may relate to participation but that we were not able to examine include the activities undertaken by NGOs and whether management was initiated by the communities. Future research could also extend this study by examining the factors related to whether people do or do not participate in management. All of our respondents had participated in management to some extent over the past two years; thus our study was designed to explain variation in participation.

5. Conclusion

Although devolved commons management is employed globally, understanding of the factors related to people’s participation behaviour (a crucial element for success) is limited. Our study found that individuals’ level of participation in MPA management was related to socioeconomic factors operating at both individual (subjective norms and social capital) and community (nested institutions) scales. Our study advances understanding of participation behaviour in two important ways. First, our results point to the importance of considering socioeconomic factors that operate at multiple scales when examining individual behaviour. Previous empirical studies examining behaviour related to environmental management have tended to focus solely on the effect of individual-scale factors (Dolisca et al., 2009); but, as our study demonstrates, individual behaviour is also moulded by characteristics of the context in which people are nested. We extended the typical approach of considering contextual characteristics qualitatively by also examining the role of context quantitatively, which provided insights into the relative magnitude of multiscale factors in influencing behaviour. This may help identify management levers and prevent one-size-fits-all solutions by highlighting how participation behaviour can be influenced by factors that operate at multiple scales.

The second major contribution of our study is to highlight the complementarities of employing the theory of planned behaviour, the social-ecological systems framework, and experimental economic games to understanding participation behaviour. Although these approaches have tended to be used singly, our study highlights the utility of drawing on them simultaneously; each of these approaches provided insights into the factors affecting participation that would not have been apparent using just one. Employing the theory of planned behaviour and experimental games allowed us to better understand the cognitive factors affecting behaviour than if we had just drawn on the social-ecological systems framework. The social-ecological systems framework facilitated a more holistic understanding of the multiscale factors affecting participation, helping to highlight

the important role of nested institutions; a relationship that would not have been uncovered had we employed only experimental games and the theory of planned behaviour. Understanding participation behaviour is a complex multiscale problem, and as suggested by other authors (e.g. Poteete et al., 2010), such complexity can be best addressed by drawing on multiple methods and disciplines.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.envsci.2016.04.015>.

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