



Fishers' Perceptions of the Recurrence of Dynamite-Fishing Practices on the Coast of Tanzania

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Specialty section:

This article was submitted to
Marine Conservation and
Sustainability,
a section of the journal
Frontiers in Marine Science

Received: 22 April 2016

Accepted: 01 November 2016

Published: 16 November 2016

Citation:

Katikiro RE and Mahenge JJ (2016)
Fishers' Perceptions of the
Recurrence of Dynamite-Fishing
Practices on the Coast of Tanzania.
Front. Mar. Sci. 3:233.
doi: 10.3389/fmars.2016.00233

Dynamite or blast fishing remains the most pervasive destructive fishing method in the coastal waters of Tanzania. It constitutes a major threat to small-scale fisheries through degradation of reefs and other critical habitats for fish. The Tanzanian Government has implemented several measures including a high rate of patrols and surveillance campaigns in the sea to try to deter the use of dynamite in fishing. However, most of these measures have failed to reduce its occurrence over the past years. Little is known on why existing management measures are failing to generate effective solutions to address dynamite and other forms of destructive fishing activities. This study was undertaken to examine perceptions of fishers on the persistent recurrence of dynamite-fishing activities within the present fisheries' management regulations. A random sample of 180 individual fishers was interviewed in two coastal districts using a household survey questionnaire. Key informants, semi-structured interviews and participant observations were used to collect additional data. Almost two thirds of survey respondents felt that an apparent recurrence of dynamite fishing is attributed to the inconsistencies of the fisheries management approaches deployed to thwart the use of dynamite. However, other factors such as absence of appropriate organization of the many involved actors, kinship ties, and migrant fishers played crucial role on the persistence of dynamite fishing. There was a common perception among all survey participants that lack of trust and transparency toward and within anti-dynamite initiatives negatively impacted the involvement of fishers in their efforts to reduce the use of dynamite. An improved situation where decision-making processes are coordinated among fishers, non-governmental, and governmental stakeholders is important to support ongoing management measures, in order to increase legitimacy, and long-term success of efforts to get rid of destructive fishing practices among small-scale fishers in Tanzania.

Keywords: dynamite fishing, fishers' perceptions, destructive gears, interviews, coastal tanzania

INTRODUCTION

Humans have been the primary drivers of the changes in the coastal marine environment (Lotze et al., 2006; Crain et al., 2008; Sale et al., 2008; Waycott et al., 2009) and are expected further to exacerbate pressures on coastal ecosystems (Boldt et al., 2014; Jiao et al., 2015; Lucas and Smith, 2016). The increased human pressure on marine ecosystems has caused many environmental

problems, particularly the loss of important ecosystem services (Halpern et al., 2012). Several studies (Costello et al., 2010, 2012; Coll et al., 2016) show that fishing presents one of the greatest human pressures on marine ecosystems, and one of its main threats is through destructive fishing techniques (Dayton et al., 1995; Watling and Norse, 1998; Wilkinson, 2004; Mak et al., 2005; Fox and Caldwell, 2006; Benn et al., 2010; Fenner, 2014; Petrossian, 2015).

The use of destructive fishing techniques, including explosives and poisons, has been part of many small-scale fisheries for decades (Mak et al., 2005; Palma, 2010; Authman et al., 2013; Petrossian, 2015). The literature (Saila et al., 1993; Mazlan, 2005; Fox and Caldwell, 2006; Glaser et al., 2015) shows that explosive or blast fishing has been and still is occurring in many countries around the world. For example, explosives have been used in Hong Kong waters for at least a century, leading to the introduction of legislation to ban explosives in 1903 (Cornish and McKellar, 1998). A study on the status of destructive fishing activities in the Pacific Islands showed that by the early 1980s, nearly half of the cases on reef degradation were related to damage from explosives and poisons (Veitayaki et al., 1995). In the Western Indian Ocean (WIO) region, these methods, particularly dynamite or blast fishing, are still common, especially on the coast of Tanzania (Samoilys and Kayange, 2008; Wells, 2009; Braulik et al., 2015b; Slade and Kalangahe, 2015). For example, dynamite fishing has been experienced in Tanzania since the 1960s and although it was declared illegal in the 1970s it has continued largely unabated since that time (Guard and Masaiganah, 1997; Wells, 2009; Braulik et al., 2015b). Wagner (2004) asserted that in the 1980s and 1990s, the frequency of dynamite-fishing events along the coast of mainland Tanzania reached a peak. Some extreme cases of dynamite events were also recorded. For example, over 441 blasts were recorded from October to November 1996 in Mtwara, while in Songo Songo Archipelago, 30 blasts were heard every 3 h (Francis et al., 2002). Likewise, 100 blasts were recorded during one 6-h period at Mpori Reef in the same year (Francis et al., 2002).

While destructive fishing methods are not a new phenomenon, they have posed seemingly intractable challenges to scholars and policy makers seeking to phase them out (Wells, 2009; Nurdin and Grydehøj, 2014; Heber Dunning, 2015; Petrossian, 2015; Slade and Kalangahe, 2015). The devastating impacts of destructive fishing techniques on marine ecosystems and human populations have received considerable attention in scientific studies (Jennings and Lock, 1996; McManus et al., 1997; Riegl and Luke, 1999), and the effects of dynamite fishing have also been investigated in detail (Saila et al., 1993; Guard and Masaiganah, 1997; Pet-Soede and Erdmann, 1998). Dynamite explosions are known to leave coral reefs in rubble and kill more fish than are harvested (Guard and Masaiganah, 1997; Mak et al., 2005; Fox and Caldwell, 2006). They are also potentially dangerous to the people who use them (Guard and Masaiganah, 1997). However, a lack of capacity to enforce fishing legislation, especially in the Pacific, Southeast Asia, and sub-Saharan Africa, coupled with the quest for high catch rates from dwindling fish stocks have resulted in an extreme increase of these methods

in areas dominated largely by small-scale fishers (Kuperan and Sutinen, 1998; Sumaila et al., 2006).

Different coastal states have already designed strategies and developed measures to curb increasing threats to marine fisheries from destructive fishing practices (Agnew et al., 2009; Munyi, 2009; Wells, 2009; FAO and UNEP, 2010). However, destructive fishing remains the stark reality of fishing activities in some regions, particularly in the above-mentioned regions (Mangi and Roberts, 2006; Braulik et al., 2015b; Giraldez et al., 2015; Sheppard, 2016). For example, the initiative by the Beach Management Units supported by the World Wide Fund for Nature (WWF), monitoring blast frequency at Songo Songo, located in the Lindi region in Tanzania, for 15 months up to late October 2014, recorded 8765 blasts, an average of 21 per day (Liganga, 2015). A large-scale vessel-based survey conducted over 2692 km of Tanzania's coast in 31 days recorded 318 blasts, where the highest intensity area for blasting was in the vicinity of Dar es Salaam City (Braulik et al., 2015b). However, Tanzania had previously reported an effective control of dynamite fishing in the late 1990s (Darwall and Guard, 2000). This happened when a massive crackdown on dynamite fishing was achieved under the joint operation (dubbed operation "*pono*") between the Tanzanian Navy and Marine Police with support from the local community members who had been sensitized about and mobilized to take actions against dynamite fishing. Nonetheless, numerous WIO nations have virtually no dynamite fishing (Braulik et al., 2015a,b).

Despite many advanced efforts to phase down dynamite fishing, including the success registered during the Tanzania's 1990s anti-dynamite campaign, these practices persist along much of the Tanzanian coast, including Tanga, Pangani, Bagamoyo, Temeke, Mtwara, Rufiji, and Kilwa (SeaSense, 2010; Anderson, 2011; Slade and Kalangahe, 2014). Critics argue that Tanzanian government authorities are overlooking the fact that fishers have an important role and should be at the center of actions targeting a halt of dynamite fishing. Arguably, the active role and potential capability of fishers to stop dynamite fishing remains largely unutilized and their actions have not been scaled up by fishing authorities at local governments to meet targets to halt destructive fishing. More recently, there has been some backlash against anti-dynamite campaigns (Slade, 2011; Slade and Kalangahe, 2015), where even the strongest support to fight destructive fishing activities, offered by fishing communities as symbol of their cultural value to fisheries resources, have not prevented the use of dynamite. This has eventually resulted in a fisheries management stalemate, making the use of dynamite virtually impossible to alleviate (Braulik et al., 2015b). Government reports indicate that the most acute illegal fishing issue in Tanzania is dynamite fishing (United Republic of Tanzania (URT), 2016). A recent government report tabled in the parliament during the 2016/17 budget session shows that 35 detonators, 17 explosives, and 252 kg of urea—used for home-made blasts—were confiscated during the 2015 reporting period. Anecdotal evidence suggests that dynamite incidences in Tanzania are now probably more prevalent than they have ever been. Halting dynamite will require more comprehensive information, based on the perceptions and roles of fishers in

these widespread dynamite-fishing activities, and support from government and non-governmental stakeholders for the fishing community to enhance their alternative livelihood strategies.

This paper therefore attempts to investigate the perceptions of fishers on the recurrence of dynamite-fishing activities within the present fisheries legislation and regulations that call for fishers to collaborate in fishery management. Management of fisheries in mainland Tanzania is guided by the Fisheries Act of 2003 and is supported by the Fisheries Regulations of 2009 (Fisheries Division, 2014). The research was guided by the following questions: why do fishers still resort to dynamite? Are there any internal mechanisms coastal communities might employ to discourage the resumption of dynamite fishing? Furthermore, this study aimed to unravel what social interactions (e.g., cooperation among fishers, reciprocity, and trust), if any, can be used to persuade communities whose livelihood takes place in an environment of dynamite activities, to shoulder efforts with government and other fisheries stakeholders such as community-based fisheries organizations and local Non-Governmental Organisations (NGOs) to halt these activities. A successful strategy to understand perceptions of fishers on dynamite-fishing is critical for processes dedicated to reduce it substantially. Fishers perceptions should then be fed into projects and initiatives that seek to reduce destructive fishing practices (Foster and Vincent, 2010; Heyman and Granados-Dieseldorff, 2012). Understanding perceptions of fishers is crucial for local efforts to reduce, and optimally, prevent degradation of fisheries resources, and thus promote conservation efforts (Bacalso et al., 2013; Katikiro, 2014a).

MATERIALS AND METHODS

Study Sites

Two coastal districts in Tanzania (Mtwara and Temeke) were chosen as case study sites for this research (Figure 1). Temeke district (municipality) was at the time of this research one of the three administrative districts within the Dar es Salaam region. Dar es Salaam is Tanzania's largest city and the most important one for both commercial and governmental activities. However, in 2015, two other districts were established within the Dar es Salaam region. One of this is Kigamboni, which covers part of the area previously under the jurisdiction of Temeke district. Temeke has the largest coastal stretch compared to Kinondoni and Ilala—two other districts that previously made up the Dar es Salaam region (National Bureau of Statistics (NBS), 2014). The 2012 population and housing census shows that Temeke district has 1,368,881 inhabitants, accounting for about 31% of Dar es Salaam's population United Republic of Tanzania (URT) (2013). Temeke's socio-economic profile indicates that there are 1450 registered fishers and about 2000 that are not registered (Temeke Municipal Council, 2010)

Mtwara district is located on the southernmost region of Tanzania. Based on the population census of 2012, Mtwara district had a population of 336,302 people. The fishery in the district is quite extensive with over 4500 fishers (Everett et al., 2014). Its remoteness and proximate location to the northern side of Mozambique enable easy access to dynamite perpetrators and

reduce effective control of destructive fishing activities attributed to the absence of effective border control of fishing activities.

The majority of households in these two districts depend on fishing, crop farming, and small-scale business for their livelihoods (Market Axis, 2014; NBS RC's Office Dar es Salaam, 2014; Katikiro et al., 2015).

The study districts were chosen for representing the ones possibly more directly affected by dynamite incidences in both rural and urban areas, which reflects retardation in actions to thwart destructive fishing activities. However, a recent study by Braulik et al. (2015b) using a combination of manual and semi-autonomous detection, which recorded a total of 318 blasts between March and early April 2015, revealed that 70% of the blasts came from Temeke district. Mtwara contains a substantial high number of recurrences of dynamiting events where in some areas more than two blasts per hour were heard (day and night).

Both study districts have at least community-driven initiatives that patrol against illegal fishing and at that operate a database for collecting information on dynamite incidences. For example, SeaSense—a NGO that targets the conservation of flagship species such as sea turtles and marine mammals with support from local communities—recorded 1120 dynamite blasts in 2008 in Temeke district and some other parts of Dar es Salaam (SeaSense, 2012). Mtwara benefited from the NGO SHIRIKISHO from the late 1990s to the early 2000s where it led massive anti-dynamite campaigns (Katikiro, 2014b).

The site selection was also based on: the predominance of migrant fishers who are often associated with destructive fishing methods, the significant large number of fish traders, which enables ready marketing for fishery products, and having a significant number of villages whose people have strong economic and cultural relations with marine fisheries. It was also assumed based on previous work on fisheries management in the area (Katikiro, pers. observation) that individuals taking part in this study would be aware of effects of dynamite fishing on fish stocks, the environment and human health. District fisheries officials assisted in the selection of study sites. Three villages were selected randomly in every district, making six villages altogether. The characteristics of each area to fit in the study was verified by a research team upon arrival in the district. This was made by crosschecking if the village had at least two of the criteria mentioned above. The population and sample sizes for the individual fishers surveyed are provided in Table 1.

Data Collection

Two months were spent in each district to collect data using a mixed-method approach with triangulation and the use of secondary sources including gray literature, reports, published materials and institutional documents on local fisheries and conservation activities. An overview of the methods is provided in Table 2.

Semi-structured interviews were held with a purposive, snowballed sample of 24 community members of the six study villages. Participants for semi-structured interviews were selected because they were active in or associated with the fishery, were information-rich on challenges facing fisheries in their villages and would provide different viewpoints. This could either be

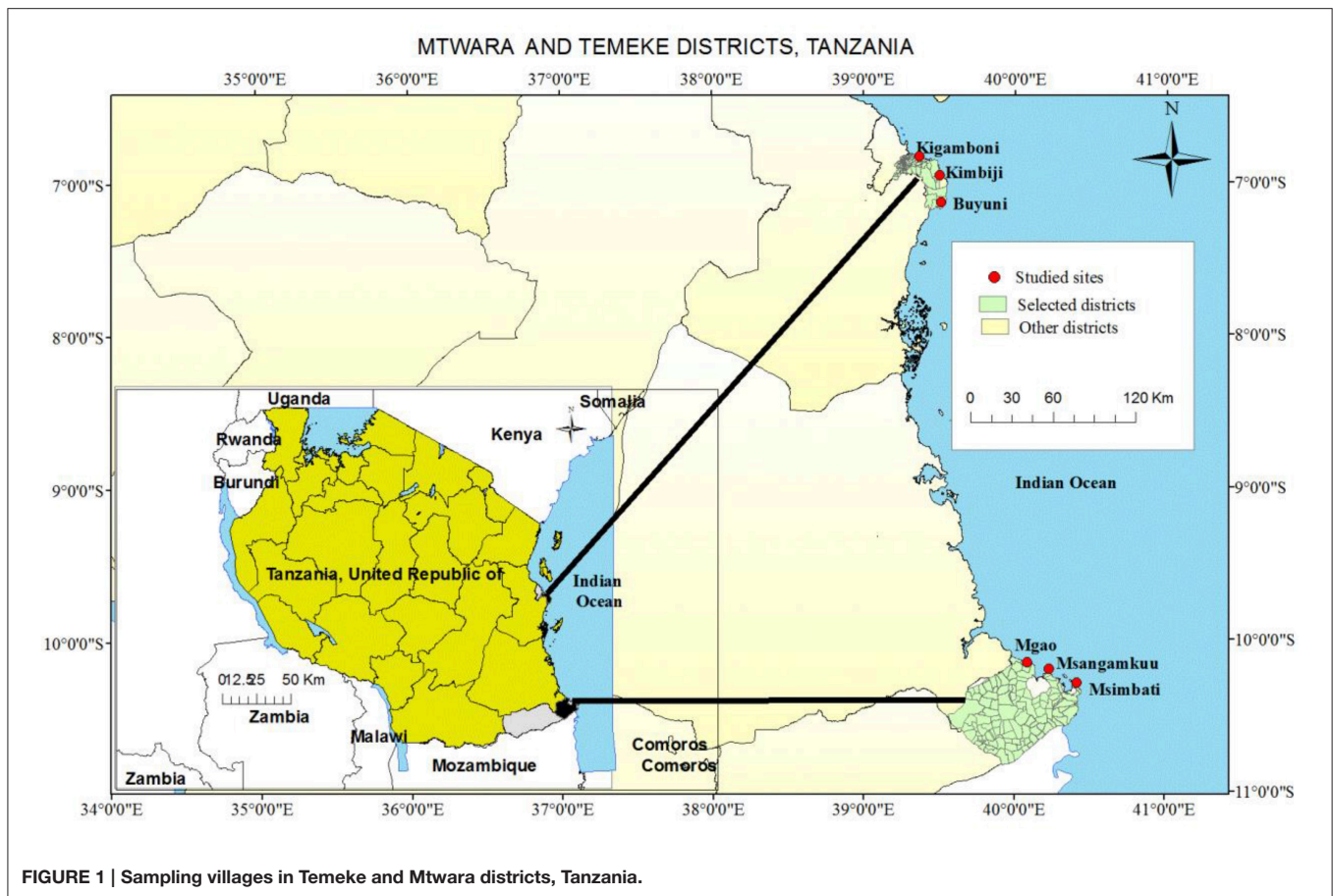


FIGURE 1 | Sampling villages in Temeke and Mtwara districts, Tanzania.

TABLE 1 | Villages and sample of individual fishers interviewed during household surveys.

District	Villages	Population	Sample
Temeke	Buyuni	6000	40
	Kimbiji	1903	22
	Kigamboni	3245	32
Mtwara rural	Msangamkuu	3180	31
	Mgao	1336	23
	Msimbati	2864	32

Source: Ward Executive Offices (2015).

directly as a fisher (illegal or legal), fish processor, fish trader, or indirectly as member of a fishing household, key stakeholders such as NGOs focusing on fisheries issues, or those working as food vendors, net repairers and other fisheries-related jobs. A summary of the topics explored during these semi-structured interviews is shown in Table 3.

Semi-structured interviews aimed at the perspective of local institutions such as village and traditional leaders, kinship relations and fishers’ organizations on how the problem and effects of dynamite fishing are framed in their understanding of improving fisheries management. The interviews took up

TABLE 2 | Data collection methods used in this study.

Method	Respondents	Sample size
Semi-structured interviews	Fishers	24
Questionnaire interviews	Heads of fishing households	180
Key informant interviews	Fisheries officials, fish traders, NGO personnel, academic researchers	21
Participant observation		

to 50 min each and were all held in Swahili. Questions were open and phrased to avoid the responses being prompted by the interviewer. The interviewer took notes for each semi-structured interview. No recording was done because of the sensitive nature of the topic and to guard the privacy of interviewees.

A questionnaire survey among local fishing households was then conducted through face-to-face interviews with a random sample of 180 individual fishers. Only one individual fisher, in most cases the head of household, was interviewed (see Table 1). Surveys are frequently used to examine perceptions and attitudes (Blair et al., 2013). For this study, the survey was designed to provide quantitative information on dynamite-fishing activities and fishers’ perceptions of its reoccurrence. The structured survey questionnaires (Annex 1) comprised questions on specific details of the surveyed households, such

TABLE 3 | Summary of the main topic questions addressed in semi-structured interviews.

1. Trends about destructive fishing practices over the last 10 years
2. The sources where most dynamite perpetrators in the village obtain explosives
3. Implementation of fisheries regulations in villages to stop the use of dynamite
4. Initiatives to stop dynamite fishing
5. Satisfaction with fisheries management
6. Existence of informal enforcement of laws against dynamite fishing practices established and run by community members
7. Social interactions such as cooperation or kinship activities that support or fight dynamite fishing
8. Role of village institutions such as village environment management committees and village government in actions to combat dynamite
9. Fishers' reasons behind the use of dynamite
10. What would make fishers stop using dynamite

as experience with destructive fishing methods; fishing patterns (e.g., seasons, operational details, species abundance, compliance to regulations, etc.); environmental and health risks of using dynamite; sources of dynamite; proportion of fishers who use dynamite; initiatives and NGOs in place to “combat” dynamite use; fishing license and knowledge on change in fishing activities. The survey also covered themes related to characteristics of dynamite fishers, attitudes of fishers toward dynamite, perceived negative impacts of dynamite fishing on their livelihoods and direct environment, and the level of consultation and involvement of local fishers in decision-making processes on dynamite and fishing in general. Survey questions were asked in Swahili. The questions were kept short and mainly closed with fixed alternative answers (mainly yes and no). Scale questions were also asked to allow respondents to agree or disagree with particular statements. In most cases, a five-point Likert scale was used for scale questions.

In addition, 21 key informants were selected to provide a broad representation of environmental organizations, fish traders, government officials engaged in fisheries management and law enforcement, and local business leaders, particularly from the tourism and hotel sectors. Key informants were interviewed using open-ended questions. The interviews focused on their perceptions on the health of fisheries resources, the occurrence of dynamite blasts, the existing regulations and enforcement measures, recent reforms in the fisheries sector, village committees to monitor and control destructive fishing, and the future condition and direction of the fishery if dynamite use remains active. Key informants were chosen utilizing both opportunistic and snow-balling techniques. Interviews ranged from 30 to 70 min. Each interview was subsequently transcribed and analyzed for key words and statements.

Because dynamite fishing is illegal and perpetrators will not want to be known to outsiders, precautions were taken to ensure that interviewees would not be influenced by wariness of and discomfort about being interviewed. This was done through protecting their identity and conducting interviews in a conversational and rather informal manner.

Throughout the fieldwork, participant observation was undertaken in all six villages to make additional observations that capture the complexity of destructive fishing activities and validate the interviews and survey data during the analysis. Detailed field notes and photos were taken (where the situation allowed) to record observations and were used for triangulating interview data.

Positionalities of the Researchers

The first author was formerly employed by the Marine Parks and Reserves Unit (MPRU). The second author is still employed by the MPRU. The MPRU is a government institution established under the Marine Parks and Reserves Act 29 of 1994, and its roles among others is to oversee the management of marine protected areas in mainland Tanzania. Part of the study areas were within the marine protected area jurisdiction (Mnazi Bay-Ruvuma Estuary Marine Park located in the southernmost coast of Tanzania) while the other one was not. Based on the authors' professional duties, they may already have been known in the study areas. This relationship enabled networking and knowledge exchange, but clearly also created a by-product, i.e., to be considered as a “government marine conservation official.” In the beginning of the research for this study, the authors were not sure if this connection would favor them or not. The authors tried to ensure that participants did not feel as mere research subjects. Obviously, some of the local community members still perceived the authors as “government officials” and not academic researchers, hence their radical criticisms about dynamite fishing, management strategies and the government's role in these. To address the issue of positionality explicitly, the authors were open about the limits of their research in effecting changes in the lives of individuals who agreed to be interviewed. They were also open in answering any questions people had about their research and clearly stated that they were trying to understand the persisting dynamite fishing activities from the participants' perspective.

Given the fact that respondents for this study were drawn from local community members, government and NGOs, the relationships of power encountered were significantly different. In the interview context, it often became clear that the authors were expected to be the power holders because they were the ones asking the questions. However, the authors attempted to traverse the landscape of power relations during interviews by attempting to create momentary spaces where their positionalities and those of respondents complemented each other. The time spent in each study site also helped to build trust as the interviews were not conducted in the form of one-off encounters which often make people more suspicious. Undoubtedly, some respondents remained suspicious to this research work, but the authors tried to strike the balance by building mutual trust and rapport where they continued to present themselves as impartial, seeking information related to fisheries and livelihoods for academic purposes.

Data Analysis

Data from the household surveys were analyzed using descriptive statistics. After data were entered and confirmed in a spreadsheet,

information was processed with the Statistical Package for the Social Sciences (SPSS 20). Qualitative information and extensive field notes were coded inductively, and themes and categories were identified accordingly (Grbich, 2007). Further analyses were then performed using content analysis (Patton, 2002). The data generated with all interview methods and secondary sources were then categorized and used in a complementary way for the presentation of the results.

RESULTS

Socio-Economic and Demographic Profile of Household Survey Respondents

Table 4 presents the basic socio-demographic characteristics of the questionnaire survey sample. Most households surveyed had at least one person from their household employed full-time in fishing and were thus receiving over 50% of their income from fisheries. Most households surveyed showed negative perceptions regarding the government support for their fisheries-dependent livelihoods by reiterating that government support for fishing activities was not enough. Furthermore, most household interviewees stated that local fishing interests such as continued fishing in areas that are set aside as no-take areas, or their preference for certain gear types, were not being addressed by the current fisheries' management regimes, resulting in conflicts between fishers and government agencies responsible for fisheries.

TABLE 4 | Socio-demographic characteristics of the survey sample (n = 180)*

Variable	Frequency of occurrence (%)
GENDER	
Men	142 (78.9)
Women	38 (21.1)
AGE	
18–30	64 (35.6)
31–50	73 (40.6)
> 50	43 (23.9)
LENGTH OF RESIDENCE	
< 1 year	8 (4.4)
1–5 years	48 (26.7)
6–10 years	80 (44.4)
> 10 years	44 (24.4)
FISHING STATUS	
Full time	143 (79.4)
Part time	37 (20.6)
LENGTH OF TIME INVOLVED IN FISHING	
< 10 years	95 (52.8)
11–20 years	32 (17.8)
21–30 years	32 (17.8)
> 30 years	21 (11.7)

*The focus was to interview the household head; in their absence any other person aged above 18 was interviewed.

Perceptions on Government-Led Enforcement Campaigns

Questionnaire survey responses indicated that fishers and local people who are not engaging in fishing alike are knowledgeable about the importance of patrols in the sea to stop dynamite activities. Enforcement campaigns were identified by 68% of survey respondents as a contributory agent to ensure protection of fisheries resources. The majority of survey respondents (72%) indicated that although enforcement campaigns, which happen sporadic depending on availability of funds and human resources, provided useful practical means to deter dynamite activities, they do not offer incentives for a de-dynamite pathway. Some of the incentives referred to included modern fishing gears such as large nets, cooling devices for storing fish and engine powered boats. More than half of the survey respondents (55%) believed that preparations and eventually implementation of patrols at some instances led to dynamite suspects preparing strategies to avoid being arrested. Participant observation during fieldwork and further inquiry with key informants confirmed that often not every dynamite perpetrator encountered by patrols was arrested. Many survey respondents (47%) indicated that the government agenda to stop dynamite fishing is unclear and that little attention is paid to this problem at any given time as compared with other aspects related to the misuse and degradation of natural resources (such as illegal logging and poaching of wild animals).

Almost 27% of survey respondents argued that dynamite practices were rarely resolved with law enforcement campaigns because of absence of targeted actions and ill-equipped patrolling protocols, in combination with a lack of dedicated efforts to eradicate the networks of dynamite suppliers. Instead, most dynamite perpetrators arrested by law-enforcing agents would usually end up in a situation where the suspects would retaliate by insulting or trying to harm informers. Further, it was mentioned by these respondents that the suspects may relocate into areas where enforcement is not yet existing. The majority of survey respondents (84%) cited lack of seriousness by responsible government agencies, incompatible models of resource management, bribery and unwillingness to enforce law, as factors for continued dynamite-fishing activities in their areas. When asked why the implemented enforcement measures were incapable of resolving the dynamite problem despite a high rate of patrols and surveillance campaigns, 82% of key informants argued that some of these strategies were flawed and corrupted because of different perspectives and weights given to the problem by people carrying out those campaigns. This in turn leads to leakages of information eventually reaching the potential offenders. Eventually, the potential culprits temporarily refrain from dynamite fishing or relocate to other fishing grounds during the campaigns. This was also confirmed by participant observation where the authors observed potential dynamite fishers postponing their fishing schedules after being tipped off on the forthcoming patrol missions.

Over 70% of key informants remarked that enforcement campaigns also fail to succeed because of political interests, dictating what should be done. At times when election polling

is nearing, they were asked to disengage their campaigning duties and respond to immediate pressures of politicians. But once they reduce their enforcement efforts, it becomes almost impossible to either operate campaigns or stop the spread of dynamite fishing. In the end, as explained by nearly 50% of key informants, halting dynamite through enforcement seems to be ineffective because the socio-political environment cannot credibly support such efforts. Despite these failures, a good proportion of survey respondents (48%) believed that enforcement activities usually end at least with some type of explicit reduction of dynamite supply and other illegal fishing activities.

Community Awareness and Initiatives to Curb Dynamite Fishing

Over 70% of survey respondents who began fishing longer than the past 20 years stated that dynamite was already used when they began their fishing career. The vast majority of survey respondents (90%), and almost all participants in the semi-structured interviews, agreed having noticed a series of locally driven sensitisation and awareness-raising activities spearheaded by village leaders that aimed to reduce dynamite fishing over the last 10–20 years. However, only 18% of survey respondents reported having received support, information and training to stop dynamite (and other destructive) fishing activities. Almost all key informants agreed that all fishing activities should be non-destructive. When asked why they thought dynamite is reoccurring when every fisher was aware of its effects, these key informants said that it was only another malpractice in the society (like cattle robbery), which requires a case-by-case solution and should not be generalized to all fishers. Further probing of community awareness on the dynamite problem led to the responses summarized in **Table 5**.

Information gathered from government and NGO reports, triangulated with data generated from participant observations, showed that significant efforts have been undertaken to inform communities about the effects of dynamite not only in the study sites but along the coastal districts of Tanzania. These included sponsored radio programmes to raise awareness among the local communities on the ecological and human health impacts of dynamite fishing, participatory videos (Slade, 2011) and dissemination of awareness materials. Awareness and capacity-building programmes, however, were cited by almost 45% of survey respondents to be confined to areas where the pioneer NGOs on anti-dynamite campaigns were based, and were thought to underrepresent opinions of fishers. These activities were reported to be more in Temeke than Mtwara because Temeke enjoyed relatively high coverage by the SeaSense organization. This organization however, as commented by key informants, has been somewhat dormant in recent years following lack of funding and aging of some of its founding members.

The study revealed that local people are willing to report events of dynamite fishing, but credible and trustworthy government officials where they could report to are not organized to ensure a timely flow of information and subsequent actions. Several respondents (32%) of the semi-structured interviews

TABLE 5 | Responses ($n = 180$) to the yes/no questions on awareness of the dynamite fishing problem during the household survey.

	Yes (%)	No (%)
1. Have you ever used dynamite or engaged in a fishing crew that used dynamite?	23.89	76.11
2. Do you believe the use of dynamite has spread in your village in recent years?	56.67	43.33
3. Are you aware of any legal restrictions to the use of dynamite for fishing in your village?	62.22	37.78
4. Are you aware of any local customs or local rules which relate to the use of dynamite fishing?	15.56	84.44
5. Do you know if there has been any major change in prevalence of dynamite fishing over time in your village?	57.78	42.22
6. Do you know what proportion of fishers is using dynamite in your village?	60.56	39.44
7. Do you collaborate or take part in efforts to fight dynamite fishing?	21.67	78.33
8. Is dynamite being used in addition to existing fishing gears?	64.74	35.26

Several survey statements were asked to probe the respondents' view of dynamite fishing activities. All respondents were required to answer each statement as: 1, strongly agree; 2, somewhat agree; 3, undecided/unsure; 4, somewhat disagree; 5, strongly disagree. The answers across the five categories are provided in **Table 6**.

observed that it was extremely difficult for local fishers to locate these agents. Furthermore, it emerged during household survey interviews that people who had voluntarily taken the task to monitor dynamite perpetrators and report them to the responsible authorities sometimes faced serious threats by the dynamite fishers. In some instances, dynamite detonators were placed at house compounds to intimidate the volunteers, especially in villages of Mtwara district, and there were reports of injuries after acid was splashed on their faces. Interview results indicated that while many fishers were aware of the effects of dynamite use, they find it difficult to report plans or people engaged in it because they feel they were not protected against these. Indeed, perpetrators could be close relatives, and in certain circumstances perpetrators could be linked to influential people in their communities who cannot easily be punished or fined through the current legal mechanisms and institutions.

New Entrants into the Fishery and Actions against Dynamite Fishing

While some projects by the government and NGOs were mentioned to have existed in the study sites—Temeke having more active organizations than Mtwara—over 55% of key informants and 70% of participants in the semi-structured interviews indicated that these projects often overlooked the component of empowering fishers for actions against destructive fishing. Almost all survey respondents (95%) considered that new groups joining fishing activities were not adequately introduced to options of less-destructive fishing. They suggested that these groups of individuals, which usually lack exposure to fishing or have little knowledge and experience in fishing, should receive adequate information about different gears, and the issuing of

TABLE 6 | Distribution of responses ($n = 180$) across the range of the five answer categories in a Likert scale.

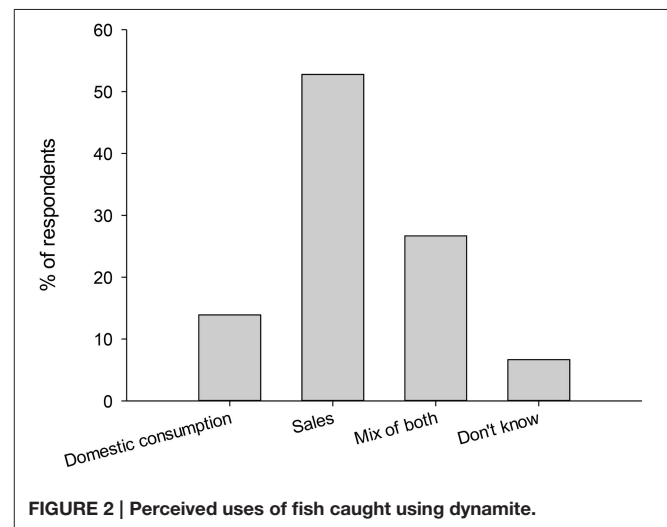
Statement	Category of answers (%) across a five points Likert scale				
	Strongly agree	Somewhat agree	Undecided	Somewhat disagree	Strongly disagree
Dynamite is carried out year round	23.89	49.44	12.22	8.33	6.11
Dynamite fishing activities in recent years have generally increased	31.11	43.89	12.78	7.78	4.44
Initiatives and actions to stop the use of dynamite have failed to yield expected outcomes	10.56	39.44	29.44	13.33	7.22
Actions currently implemented by the government would reduce ongoing dynamite fishing practices	5.00	11.67	41.67	24.44	17.22
Most dynamite perpetrators obtain dynamite from construction and mining sites	5.56	32.22	40.56	16.11	5.56
Dynamite is used instead of other fishing gears	3.33	16.11	42.78	29.44	8.33
Media coverage to raise awareness of the community on aspects related to dynamite fishing is scant	12.78	41.67	28.89	12.22	4.44
Village councils have developed by-laws and engage in monitoring and control to reduce the incidences of dynamite fishing activities	2.22	11.67	36.11	33.89	16.11

fishing licenses should also be done in a more meaningful and transparent way than is currently done. To date, anyone can gain access to fishing through the existing licensing system by paying around US \$10 annually. Respondents claimed that better inclusion of new entrants into fisheries management activities is crucial to accentuate stewardship toward the use of less harmful fishing gear. Most household survey respondents (80%) stated that because of lack of skills and adequate knowledge on fishing, new entrants are often persuaded easily to adopt destructive techniques in fishing as a way to meet their immediate income needs (Figure 2).

Government Approaches to Reduce Dynamite Fishing

Statements of nearly 40% of key informants indicated that local government authorities in the study districts did not have clear and consistent plans to protect fish stocks from dynamite activities. Most of these informants believed that poor progress in combating dynamite is partly attributed to lack of commitment by the relevant authorities where fisheries is given less priority compared to other sectors. However, nearly 70% of survey respondents clearly stated that they would value positively measures that allow fishers to share their knowledge and their greater involvement in decision making to curb dynamite

Many key informants (48%) mentioned that the dynamite problem is often approached in a fragmented manner, with the population and the environment suffering in favor of economic and political considerations. Information from household surveys also showed that local authorities have often stigmatized fishers in general as criminals. The views of almost 60% of key informants made it clear that as long as fishers feel criminalized and left behind in management and development plans, any efforts to persuade them to support a reduction of dynamite fishing are likely to encounter significant opposition and little commitment from community members. Fifty six percent of survey respondents said that this is sometimes caused by unreliable information on whether certain individual fishers or fishing villages are producing or stockpiling materials used for



dynamite fishing. To their knowledge, some of the information is baseless and diverting the truth from actual dynamite activities. According to the key informants, false and misleading information therefore often leads to reduced commitments to act against dynamite.

Improving Actions against Dynamite Fishing

Almost all participants from all interview methods used in this study, including informal conversations in the study sites, agreed that many fishers were willing to participate or invest in actions and initiatives that would result in the reduction of dynamite activities. They gave various recommendations for improving actions already undertaken, and designing of new activities to support anti-dynamite initiatives (Table 7).

While the majority of survey respondents (85%) supported the idea of deploying the Tanzanian Navy to address the dynamite problem; it was, however, noted that this cannot be the final solution but just a quick remedy to the dynamite-fishing

TABLE 7 | Suggestions given by the household survey respondents (n = 180) to improve actions against dynamite fishing.

Recommendation	Responses (%)
Improve communication between fishers and fisheries officials	15 (8.3)
More representation of fishers in control measures of fishing activities	35 (19.4)
Local leaders be involved at every stage of monitoring and control of fisheries resources	61 (33.9)
More public meetings and awareness raising programmes on effects of dynamite fishing	46 (25.6)
More support to fishers using various fishing gears from local government authority	23 (12.8)

dilemma. According to the key informants, military actions as seen during the operation *pono* in 1998–1999, could positively address the dynamite-fishing crisis. However, lack of a clear long-term policy on how to integrate the military in anti-dynamite operations did reduce its mission. Arguably, as opined by some key informants, the inefficiency of deploying the military was demonstrated by continued dynamite activities when the operations were concluded, or by complaints about incidents of human-rights violations, as was the case in other natural resource cases like the operation *Tokomeza Ujangili* of 2013. *Tokomeza Ujangili* was a planned nationwide operation to combat poaching (Legal and Human Rights Centre (LHRC), 2015). It was ostensibly aimed at poachers but was terminated following widespread charges of human-rights abuses against local community members.

It was observed during the fieldwork for this study that without efficient government support, the village environment management committees in the study sites have not been successful in stopping the use of dynamite and other destructive fishing activities. Over 50% of the key informants argued that despite being chosen among local community members, these committees seem to have no impact on fishers' decision to continue fishing with dynamite and violate the fishing regulations. There were also complaints among local communities that these committees have been part of the problem by allegedly being involved in assisting members of their families or clans and in-migrant fishers to circumvent enforcement of fisheries regulations. At the same time, while both fishers and members of village environment management committees agree that dynamite fishing has a profound impact, including the likelihood to harm the fishers, their perceptions on the destructive effects on the environment remain vague.

Almost 60% of key informants said that planning for a national goal for reducing dynamite activities, i.e., hoping to cut the use of dynamite to a certain degree within a particular timeframe, would increase the effectiveness of anti-dynamite campaigns. They also mentioned that a significant loophole including absence of provisions in the current fisheries legislation that could impose heavy and deterrent penalties to suspects should be addressed, which allows suspected offenders to legally purchase explosives. Overall, 22% of semi-structured interview respondents emphasized that there should

be a background check on actual intention, occupation and criminal records before one is legally able to purchase explosives and detonation materials, which are commonly known to be destined for the mining sector. Furthermore, around 54% of the key informants and 20% of survey respondents mentioned that there have been various initiatives such as educational programmes and fishing grants for purchases of fishing equipment in place to combat dynamite use over the past decade, and new initiatives (both community-based and government-driven) could benefit from their lessons. The establishment of institutional arrangements needed to co-ordinate fishing activities and interactions between fishers and fisheries officials, and mainstream legal fishing activities, were also mentioned during the key informant interviews, especially by those who had knowledge of the recent government initiative for the formulation of a Multi-Agency Task Team (MATT). The MATT initiative was launched in 2015 by the Tanzanian Government to help find a lasting and effective solution to the widespread incidents of environmental crimes, including dynamite fishing. It was further said that such intervention efforts need to be focused to undermine and outsmart any efforts by dynamite fishers. For some key informants, the high level of interest demonstrated by a number of NGOs especially WWF in Tanzania should be integrated into government initiatives and actions.

DISCUSSION

The integration of fishers' perceptions may enhance their acceptance of and positive reactions toward curbing destructive fishing activities. The most noted barrier for fishers and local communities at large was the perceived low level of attention paid to their values, beliefs and livelihood challenges by policy-makers and government authorities responsible for fisheries. The lack of trust and transparency toward and within anti-dynamite initiatives also seems to be a major factor to thwart destructive fishing. Participants therefore perceived that their daily needs were widely ignored, which contributed to reduced commitment to address the dynamite problem. Although there are cases from elsewhere in the world where fishers were reported to be active in anti-dynamite programmes (Murshed-e-Jahan et al., 2009; Heber Dunning, 2015), the findings of this study show that Tanzania still has a long way to go in this respect. The household survey respondents stated that if government agencies would accord opportunities, such as fishers having key leading roles in anti-dynamite activities and sufficient participation of local people during the design and implementation of anti-dynamite programmes, their own capacity and confidence to act against the offenders would increase significantly. Basing plans and actions on opinions of all fishers irrespective of their methods of fishing would mean that the majority of fishers would no longer feel carved out in core issues of their livelihood (Hauzer et al., 2013). Doing so could lead to more participatory formulations of anti-dynamite strategies, with well targeted actions such as reducing supply of dynamite for addressing destructive fishing activities. This however may not be a panacea to destructive activities when

there is not much transparency and trust in decision-making processes.

While the challenges facing small-scale fisheries in Tanzania cannot be overemphasized, anecdotal evidence suggests that some fishers use illegal and destructive fishing methods to secure control over resources. Despite the fact that initiatives by NGOs and government departments (to phase out dynamite use) have already provided some notable results (Slade and Kalangahe, 2015; United Republic of Tanzania (URT), 2016), there is little evidence to date that this has positively influenced attitudes and perceptions toward reducing dynamite practices by either minimizing frequency or occurrence of blasts. The majority of the household survey respondents opposed these initiatives, explaining that they were not consistent with the reality of core problems of their livelihoods and seemed to divide the community instead of prompting solutions in any perceptible way. This is a context-based concern and reduces the long-term options to act against dynamite and other destructive fishing techniques. The greatest opportunity to address the local needs is to give greater recognition to and actively seek to improve fishing-based livelihoods. This may involve development of sustainable schemes that provide multiple benefits to local fishers. Typical of these include conservation programmes in Bangladesh offering hilsa fishers economic incentives (Islam et al., 2016) and compensations to fishers impacted by marine renewable energy projects in the UK and Ireland (Reilly et al., 2016).

The recurrences of dynamite blasts in many coastal areas suggest that measures already undertaken to combat destructive fishing activities in coastal waters of Tanzania have proven less successful (Sjöstedt and Sundström, 2015). While such programmes are often implemented jointly by various stakeholders, they still seem to lack detailed plans on how to integrate local community members and consider their livelihood needs. Additional steps need to be taken to deepen the co-operation between various stakeholders in combating this notorious way of catching fish. For example, Tanzania has since early 2015 started to develop a national task force and strategy that would guide activities, especially prohibition campaigns, against dynamite fishing. Although compliance and surveillance strategies are exclusively a government-led activity and not specifically aimed at putting fishers on eye-level to government officials, implementing anti-dynamite activities with fishers taken on board could help fishers feel the legitimacy of the processes and support it. While there would appear hierarchical differences because of power asymmetries between fishers and government authorities, a substantial number of key informants in this study noted that this would break down barriers that had previously prevented appropriate communication between groups with different interests. This would be in line, for example, with the case in Papua New Guinea (Rochers and Ame, 2005), where lack of credible and trustworthy communication channels between managers and fishers was the most often mentioned potential barrier to the reduction of illegal fishing activities. The uncertainty about effective communication pathways provides a reason for some individuals or groups of fishers to minimize their support for initiatives toward anti-dynamite cooperation and will have to be further investigated by future research.

The strong perceptions of lacking consultation and participatory involvement in decision-making on dynamite fishing are not only relevant to Tanzanian fishers. A growing literature reported complaints by fishers (and those working in fisheries) about their lack of participation in management processes (Mikalsen and Jentoft, 2001, 2003; Symes and Phillipson, 2009; Trimble and Berkes, 2013; Holm et al., 2015). But the reasons behind this perceived or real lack of participation are always critical and challenging aspects. In the current study, it remained unclear how participation of fishers could in fact influence decision-making for sustainable fisheries, including the design of community-managed fishing areas. Participation is anticipated to include the ultimate users of resources as active participants in decision making and certainly allow their needs to be accommodated. Pita et al. (2010) elaborated that fishers in Scotland feel that the nature of their participation does not allow them to have a strong voice and stake on matters contested. Their study also suggested that presence of many representatives of fisheries management institutions lead to low and passive participation of fishers in the implementation of management actions. As a result, fishers were found to have a small role, which is consistent with what de Vivero et al. (2008) defined as the participation paradox. Fishers found themselves losing prominence and importance, fading into the spectrum of interests that compete with their own (Pomeroy et al., 2001; Wilson et al., 2003; Yandle, 2003; Gray and Hatchard, 2008). When the processes were open to a broader group of stakeholders, exchange of information and the management process could gradually become more open and transparent (Mikalsen and Jentoft, 2003, 2008; Trimble and Berkes, 2013). When many groups are involved, fishers may feel less stigmatized and the chances to consider their concerns may increase.

Official approaches to tackle dynamite fishing should avoid direct accusations of fishers as “the sole perpetrators.” Blaming, judging and eventually criminalizing fishers about reoccurring destructive fishing activities not only violates their basic rights and contributes to ignoring their voice, but also comes with severe social dynamic consequences. Norton (2015) found that for South Africa, the highly restrictive laws do not decrease incidents of degradation of natural resources without addressing the reasons that have created poor conditions for fishing communities in the first place. Instead, they lead to higher rates of illegal fishing activities (Norton, 2015). This may result in further consequences, including the relocation of destructive practices to other areas. For example, many survey respondents during this study said that some fishers who were unable to access the fish stocks because of poor fishing gears have been arrested for trying to purchase materials used for preparing dynamite bombs. Criminalizing fishers without first addressing their livelihood concerns is likely to have a disproportionate impact on more vulnerable groups of fishers, like those without efficient fishing gear, appropriate skills and capital.

This study also highlighted the existence of low priority and coverage of the dynamite crisis in the Tanzanian media. Until recently, the manner of how NGOs and community-based initiatives prioritized the anti-dynamite agenda remained

vague. There are few cases of conservation volunteers, both local and foreign, who could act as champions to instill people transiting to legal and less destructive fishing practices. A lack of political will and strong socio-cultural patterns such as kinship and family relations in coastal areas seem to have influenced a high tolerance of destructive fishing activities and promoted low national attention. When the capacity of local institutions and actors on anti-dynamite campaigns could be improved by working closely with fishers, in an open and transparent way (Pet-Soede and Erdmann, 1998; Kokorsch et al., 2015), measures and strategies deployed to reduce dynamite fishing could be viewed as more legitimate. So far, most of these measures and strategies were viewed by fishers as illegitimate, and even village governments may seem to give a go ahead for dynamite fishing in their areas as opposition to what they perceive to threaten their access to resources.

While some regions around the world have similar problems with compliance to fishing regulations like Tanzania, they are strictly enforced in other countries of the WIO region such as in Mozambique and Kenya. Despite the positive support some fishers in Tanzania have shown toward the implementation of fishing regulations, already designed measures to reduce the use of dynamite are not easy to implement and enforce on a long-term basis. Sometimes, corruption issues become vivid, especially when untrustworthy officials side with offenders and get away with destructive practices. The current fisheries legislation does not explicitly address dynamite issues, resulting in a lack of penalties attached to destructive actions. While a review of the current fisheries legislation is still underway, the process will also need to take in measures that would limit the supply of dynamite materials. Ideally, anti-dynamite campaigns, especially patrols and surveillance, should serve as a tool to identify areas of improvement to make sure that every fishing household has the opportunity to benefit from fish stocks and to identify persistent barriers for enhancement of livelihoods. But too often, as was the case in this study, they do not, and fishers have been dissatisfied with the current approach to curb not only dynamite but also other destructive fishing techniques.

Given the extent to which the coastal marine environment is facing degradation from dynamite practices, especially in peri-urban fishing areas, the findings of this study show a need to address a critical set of fisheries' management issues. Despite the lack of data for site-specific management decisions to halt dynamite use, this article has pointed out some general interactions between fishers and fisheries officials that need to be improved through partnership between different fishers and the government. Those interactions combine with the good governance which takes in crucial issues for both parties to determine relevant information that could help curb dynamite use. Future studies should explore how transition to legal fishing techniques could deter dynamite-fishing activities at the local level and how they could be favored by individual fishers whose livelihoods so far depended directly or indirectly on dynamite fishing.

CONCLUSION

While Tanzania boasts of various initiatives already in place to combat dynamite fishing, the lack of a nationally unified fisheries management approach and of institutional arrangements needed to co-ordinate and mainstream legal fishing activities, contribute to the low success of these initiatives. Fishers interviewed generally felt ignored by fishing authorities, criminalized as employing destructive fishing methods, while they were given little chance to express their opinions, views and involvement in the use of dynamite. Fishers need to participate in meaningful ways for actions against dynamite use to be effective. Despite the fact that different fishers in the study sites were not completely certain of the potential of top-down measures such as patrols and surveillance campaigns, an overall negative attitude toward these initiatives prevails. This is one of the many barriers toward the success of limiting dynamite use over time. Consideration of fishers' perceptions and their heterogeneous behavior are prerequisites for the development of strategies to legitimize actions against dynamite use and other destructive fishing techniques, and will increase responsibilities and accountability of fishers at individual levels. If destructive and non-destructive fishers like participate in the management process, there could be potential to change their destructive fishing behavior rather than feeling ignored by policy makers. There is not much scope for local fishers to play a crucial role in the success of management measures in situations where different stakeholders often manifest clearly divergent values and interests, as in the case of dynamite, where the "greedy" are likely to benefit the most.

AUTHOR CONTRIBUTION

RK conceived and designed the study. RK and JM conducted interviews for data collection. JM contributed secondary data. RK analyzed the data and wrote the paper.

FUNDING

This work was completed with financial support to the first author from Evangelisches Studienwerk e.V. Villigst (grant number 850661).

ACKNOWLEDGMENTS

We are grateful for the valuable contributions of the individuals and organizations we interviewed and for their participation in this study. We also thank fisheries officials and village government leaders in the study sites for supporting this research. We would like to thank the two reviewers and the editor for useful comments.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <http://journal.frontiersin.org/article/10.3389/fmars.2016.00233/full#supplementary-material>

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Conflict of Interest Statement: The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

The handling Editor declared a past supervisory role with one of the authors, RK and states that the process nevertheless met the standards of a fair and objective review.

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