



Assessing the role of information and communication technologies in responding to ‘slavery scandals’

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Abstract

The media spotlight on controversial ‘slave labour’ practices in the Asia-Pacific region has highlighted poor labour conditions across the seafood sector. Information and communication technologies (ICTs) are being promoted by NGOs, businesses and governments to help handle such labour challenges. This systematic review examines the state of knowledge and trends in the peer-reviewed literature related to the use of ICTs in offshore fisheries. While we hoped to find a robust literature in the area of ICTs-fisheries-labour, a coherent literature does not yet exist. However, our initial analysis suggests that two technologies hold promise for addressing labour abuse in fisheries, namely, (a) detection technologies, which include surveillance of the high seas, and, (b) the creation of mobile apps, particularly to help workers navigate work in fishing. This is where further evidence-based research is needed.

Keywords Offshore fishing · Working conditions · ICTs · Seafood sector

Introduction

There has been a growing interest in fish work, particularly since the media shone a spotlight on what are often labelled ‘slave labour’ practices among Myanmar and Cambodian migrants working in Thailand’s commercial offshore fisheries (Hodal et al. 2014; Urbina 2015). Unacceptable working conditions are not limited to Thailand (Environmental Justice

Foundation 2019) as labour scandals continue to emerge across industrial fisheries, often linked to the recruitment of migrant men and teenage boys (Jones 2017). Boys, men and fish have become the object of concern for many actors, thanks to the rapid sharing of images on social media that highlight the abuse that men’s bodies endure in fish work (Molland 2019). What these scandals underscore is how poor working conditions continue to persist, in addition to concerns over criminality in ocean spaces (Urbina 2019).

The ocean as a work space has long been ignored by seafood companies and fishing management bodies, in part because of the invisibility of work at sea. Unlike terrestrial workplaces, fishing vessels at sea cannot be easily inspected or observed: larger vessels can be at sea for months, or even years, at a time; and even when vessels are docked at port, worker mobility may be constrained by immigration laws or vessel owners themselves (Vandergeest 2018). Workers on these vessels cannot easily report on workplace violations (health and safety, food and fresh water access) or unacceptable working conditions (working hours, attitude of captains or supervisors) nor can they typically unionize (Vandergeest and Marschke 2020). In spite of increasing attention to working conditions on vessels among seafood buyers, governments and researchers in the field of worker health and safety (Windle et al. 2008; Finnis et al. 2019), as well as the growing influence of the United Nations Work in Fishing Convention

Highlights

- ICTs are being trialled to address work in fishing.
- Further analysis is needed to demonstrate pros and cons of such technologies.
- Detection technologies hold promise for monitoring the high seas.
- Cross-platform apps hold promise for workers navigating work in fishing.

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(ILO C-188) as a template for specifying what is acceptable in terms of work in fishing (Lewis et al. 2017), there are still significant geographic limitations to state regulatory action. This is why information and communication technologies (ICTs) may be important, enabling new complimentary governance strategies.

ICTs are broadly understood to include computer and telephone networks and the software they rely on. In this paper, we use ICTs to refer to satellite surveillance data or detection technologies, and technologies that enable synthesis of existing data sets into screening tools, along with made-for-purpose applications, or apps, that support the entry of personal observations, which can potentially be complemented with integrated sensors (e.g. built in camera, GPS, microphone). Recent developments in ICTs can render workplaces more visible, enabling workers to more easily communicate or access information. Academic research in the area of environmental monitoring suggests that the growing ubiquity of smartphones, as an example, creates enormous potential for relatively inexpensive and non-intrusive tracking of environmental conditions (see Andrachuk et al. 2019). Satellite technology also holds potential for tracking boats on the high seas, even if currently expensive and inaccessible to many.

Actors involved in promoting sustainable seafood, including NGOs and seafood corporations who are working together to find ways to increase supply chain transparency around seafood work, are exploring how ICTs can help them achieve their goals. Leaders in this field include international organizations such as Global Fishing Watch, whose website tracks fishing vessels on the high seas; and Thai-based organizations such as the Issara Institute, who developed the ‘Golden Dreams’ app that rates labour brokers, and the United Nations University in collaboration with the Mekong Club, who developed Apprise, a social audit app that can help to identify workers who face exploitative work situations in factories (Issara Institute 2017; Thinyane 2019). Such organizations have drawn considerable attention for their innovations in using these technologies to increase the visibility of vessels and workers. To date, however, there is an inadequate understanding of the range of ways that these technologies are being used to address labour issues in fisheries, and the strengths and pitfalls of particular forms of technology or app creation have yet to be assessed.

In this paper, we explore how this rapidly evolving field is understood among academic researchers. Our aim is to promote a discussion about whether and how ICTs can help in promoting better working conditions across fisheries, informing advocacy efforts and policy development for fisheries labour and human rights, while also maintaining attention to the potential harms that can emerge for workers who may be more closely monitored. Our systematic scoping review reveals two broad, complimentary ICTs worthy of further attention: (1) remote detection technologies that can track

the movement of vessels, but not directly produce information about labour conditions; and (2) cross-platform apps which can produce, assemble and circulate information about activities in ways useful for the seafood industry (including NGOs working with corporations), government regulators and workers. We argue that this combination of technology holds potential for contributing towards improved working conditions, and call for more evidence-based research in this arena.

Methods

The primary approach used to gather studies relevant for inclusion in this review was database searching across the peer-review literature. This process involved developing and testing search strings in three databases—ProQuest, Scopus and Web of Science—to retrieve references. Initial keywords were identified based on a preliminary review of the literature conducted by the research team. A final search strategy was then developed and applied in all three databases. Search strings were designed to accommodate various combinations of three major themes: (a) labour issues, (b) ICTs and (c) the fishing industry. These themes were combined in pairs and as a full search string that included all three themes. A first round of searching was conducted on September 21, 2018, and a second round of searching, to identify newly published materials, was conducted on February 22, 2019. Note that peer review papers emerging post-February 2019 could not be included in the literature review but, where relevant, were noted in the discussion. Search strings are fully documented in the Supplementary Data.

Relevant bibliographic data were exported from each database and imported into Covidence systematic review management software (Covidence 2018). A total of 672 articles were identified through structured database searching, from which 170 duplicates were removed, which left 502 articles for initial screening. Titles and abstracts of those articles were screened by the first two authors. Our inclusion criteria included papers that discussed labour challenges in fisheries such as forms of monitoring, surveillance or observations of people and their working conditions, along with papers that incorporated ICTs (e.g. smartphones, apps, surveillance) to address labour challenges in the seafood sector or other sectors. Our exclusion criteria included non-English publications, theses and dissertations, books, media and grey literature. Any disagreements in screening were discussed in person to resolve conflicts.

A total of 63 articles passed the first round of screening and were forwarded for further screening of full texts. The second round of screening included papers that addressed the two main themes (labour or ICTs in fisheries) or papers that were identified with ICTs and labour, and upon examination were also relevant to our understanding of such issues in the fisheries sector. After the two rounds of screening, a total of 41

studies were included for this review. We then used a basic quantitative questionnaire to scope and characterize the remaining articles. Our analysis proceeded by coding and organizing content within the articles according to our major themes, and cross-analysing insights among the literature (Fig. 1).

We also explored the grey literature, particularly examining not-for-profit and for-profit organizations operating in Thailand, since this is where significant fisheries labour advocacy has emerged. The grey literature was read to understand how actors operating in this space were working with and trialling ICTs to help address poor working conditions in fisheries. This was done using a snowball approach and visiting websites to scan activities taking place that the peer-review literature has not yet picked up on.

Results

Key characteristics of the peer review literature

Just over half the articles in the literature we surveyed focused on the Asia-Pacific region (21 articles), with case fisheries in Thailand (10) and New Zealand (4) together receiving more attention than all other countries in the region combined (Fig. 2). A handful of articles (4) focused on the USA, with the remaining articles being case examples from particular countries, including India, France, UK, Guinea Bissau and Madagascar (5 articles), or having a global emphasis without any country- or site-specific specific component (11 articles). Two-thirds of all articles (28) drew on original research, with the remainder of articles being review articles, consisting of literature reviews (10), focusing on methods (2) or offering a commentary (1). The number of review articles reinforces the point that there is little original research

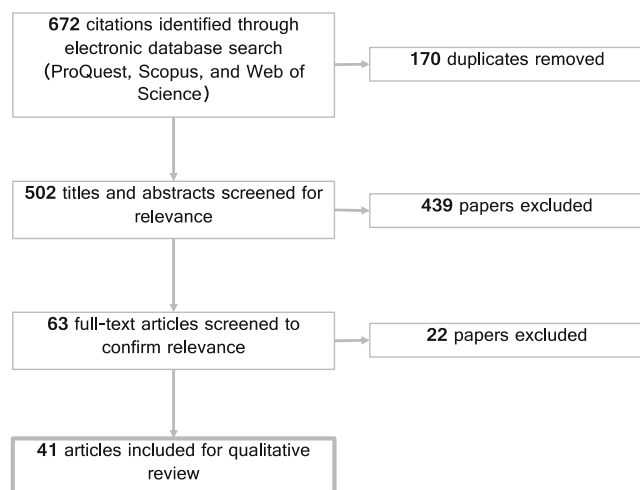


Fig. 1 Flow chart of the selection of studies

that focuses on either labour in fishing or mobile technology in fishing, let alone both.

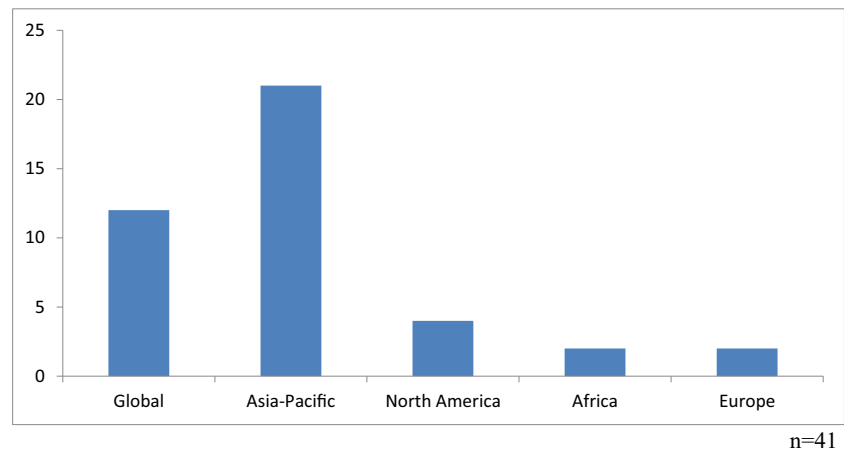
The academic literature we reviewed was bifurcated. We found an emphasis on labour conditions in off-shore fisheries, with a focus on migrant fish workers in Thailand (Derks 2010; Chantavanich et al. 2016; Marschke and Vandergeest 2016; Pocock et al. 2016, 2018; Stringer et al. 2016; Stringer and Michailova 2018; Tian 2018) and New Zealand (Simmons and Stringer 2014; Stringer et al. 2014; Stringer and Harré 2019), or reflecting on post-trafficking programs for fish workers (Rousseau 2018) or on policy and legal analysis (Ratner et al. 2014; MacFarlane 2017). We also found examples in the literature in using ICTs for fisheries management (Chauvin et al. 2010; Fitrihanah et al. 2015), on the role of mobile phones for fishers analysing weather patterns or considering marketing options (Mohamed Shaffril et al. 2015; Aricat and Ling 2018), and on traceability technology to monitor supply chains (Hardt et al. 2017) or vessels in the high seas, including transshipment (Miller et al. 2018).

Articles that discussed both fish labour and ICTs in a meaningful way were rare. Many papers either focused exclusively on ICTs (11 of 41 papers), or on labour challenges in seafood (16 of 41 papers), with the remaining papers mentioning labour or ICTs in passing or mentioning how ICTs were used in another sector to deal with unacceptable work (see section ‘Uses of ICTs to address labour issues in other sectors’). For example, a paper might focus on labour abuse challenges but mention surveillance technology as one of a series of possible solutions to improve labour conditions; conversely, a few ICT articles emphasized the role of satellite tracking in identifying transshipment at sea, which is often a sign of problematic working conditions in offshore fishing, but did not investigate the labour challenges of transshipment at sea in any great analytical detail. One notable exception is the work by Katrina Nakamura et al. (2018) who argue for drawing on existing databases, traceability technology and worker interviews to help ‘see’ slavery in supply chains. Nakamura et al. (2018) show how a careful analysis of existing data can already say a lot about fisheries labour, especially when ground-truthed with worker discussions; at the same time, this analysis highlights how more original research is needed to unpack large ‘n’ data sets.

Understanding labour scandals in fisheries

In one review paper that focused on labour challenges across sectors, including seafood (Eckes 2011), pesticide use pertaining to fish farming was mentioned as a potential health risk to workers, but nothing was mentioned about off-shore or industrial fishing. This reminds us that the turn towards understanding unacceptable working conditions in fisheries is very recent. There is an emerging literature focusing on various dimensions of work in offshore or industrial fishing for

Fig. 2 Geographical focus of the literature



both the Thai and New Zealand context. These two cases provide important insights concerning serious human rights violations, poor working conditions, violence at sea, a lack of safety equipment and the role of brokers, particularly for migrant workers who may end up tied to employers or brokers through debt (for Thailand, see Derks 2010; Chantavanich et al. 2016; Marschke and Vandergeest 2016; Pocock et al. 2016, 2018; and for New Zealand, see Stringer et al. 2014; Stringer et al. 2016; Stringer and Michailova 2018; Stringer and Harré 2019). The academic research—on Thai fisheries that explores unacceptable working conditions for Myanar and Khmer migrant workers and on New Zealand fisheries that details the issues with Indonesian migrant workers on Korean vessels operating in New Zealand waters—is contributing to the broader debates on migration management, labour in global value chains, unfree labour and modern slavery. This body of work offers an important complement to initial media reports.

Several papers in our review add historical depth to work in fishing. For example, Sampson and Schroeder (2006) detail experiences of low-waged migrant seafarers working in northern German ports, analysing how work on boats became more constrained and restricted for migrant seafarers over time, something that echoes what is found in the current literature. Several authors tie the increased use of migrant workers (internal and external) to greater worker abuse and provide analysis as to why migrant workers may further be racialized and isolated (Derks 2010; Marschke and Vandergeest 2016; Belton et al. 2019). More recently Tickler et al. (2018) argue that the work conditions that fish workers experience across the global South may be worsening as fish stocks continue to decline, supporting the argument made by NGOs such as the Environmental Justice Foundation. Marschke and Vandergeest (2016) and Belton et al. (2019) heard similar arguments across their port interviews in mainland Southeast Asia. Overall, these papers offer an analysis of poor working conditions across a range of fisheries, tied to a series of factors including ecology, migration, the geographical difficulties of

regulating fish work, non-transparent value chains and identifying fish work as something few people want to do.

Uses of ICTs in the fisheries sector

We found no discussions of the apps being promoted by NGOs and organizations working on modern day slavery in fishing in the peer review literature. Smartphones are analyzed, however, in the context of environmental monitoring. For example, Jeffers et al. (2019) show how fishers trialling a shark monitoring system can use smartphone apps for systematic data entry, and both Mohamed Shaffril et al. (2015) and Aricat and Ling (2018) reflect how near-shore fishers on day trips use their smartphones to access weather, check market conditions, or to call for help in cases of emergency. We further found no examples in the academic literature of ICTs enabling the questioning or resisting of abusive or exploitative work conditions, accessing worker hotlines. There was no analysis of how cameras on smartphones may be both positive (camera to show poor working conditions or situations of abuse) and negative (limited range, difficulty charging, getting waterlogged, providing a false images).

In the case of detection technologies, Miller et al. (2018) tracked Automatic Information System (AIS) messages from ocean going vessels over 37 m between 2012 and 2017 to follow vessel loitering, which can be linked to transshipment at sea practices. They found that over half of all transshipment practices take place in the high seas, with a further 25% taking place within Russia's Exclusive Economic Zone (EEZ). Intchama et al.'s (2018) study of Guinea Bissau's fishery assesses the footprint of illegal, unreported and unregulated (IUU) fishing arguing that much of this fishery is linked to criminal activity. Here they advocate for AIS and human tracking technology to develop a full picture of the legal and illegal movements within this fishery. They argue that technology can potentially help both in terms of fish species management and in terms of people tracking.

Attention to seafood traceability (see Fitrianah et al. 2015; Fischman 2017; Hardt et al. 2017), including at the beginning of the supply chain (in the high seas) and the need for better at-sea and at-port inspections is another important theme within the literature. However, there is little analysis as to how northern buyers engage with traceability, a concern given the challenges of certification and environmental traceability more generally (see Bailey et al. 2016). There are no meta-articles that systematically compare working conditions across off-shore fishing, and technology is consistently mentioned in passing as a potential solution without referring to careful investigations or analysis. Pocket guides focusing on sustainable seafood consumption remain by far the most common way that consumers engage with fisheries, rather than the labour dimensions of seafood production (Pocock et al. 2018; Urbina 2019).

Uses of ICTs to address labour issues in other sectors

We were interested to glean insights from sectors other than fishing, where ICTs are used to help address labour abuse challenges. We observed a growing human trafficking ICT literature (Musto and Boyd 2014; Elliott and McCartan 2013; Felicity Gerry et al. 2016), which emphasizes how ICTs serve both as a facilitator and a disrupting force for human trafficking. For example, Elliott and McCartan (2013) find that mobile phone technology is increasingly being used to facilitate trafficking, from victim acquisition, transportation and forced labour. Traffickers use mobile phone technology to communicate with each other, to contact and exploit workers, and to maintain coercion and control. This literature should caution us that ICTs can facilitate as well as help to reduce abusive working conditions in fisheries, as there is good reason to suspect that recruiters or brokers in fish work would also employ ICTs, particularly across Asia where there is a high uptake of smartphones among the entire population including recruiters and workers.

We were further attentive to how ICTs can be adapted to help fish workers escape or improve their situations. Specifically, app development, drawing on satellite or phone networks to locate victims and offenders, and accessing information stored on smartphones all hold potential as argued by Elliott and McCartan (2013) for sectors other than fish work. Gerry et al. (2016) in their examination of technology to combat human trafficking argue for the benefits of using location tracking, data collection and using crewless aircraft vehicles, or drones, to find human trafficking victims. Boyd et al. (2018) illustrate how satellite remote sensing via Google Earth can determine the location of charcoal kilns in the south Asian ‘Brick Belt’ where debt bondage and child labour remain prevalent. Perhaps there is a role for Google Earth in the fisheries sector? This open access technology could complement the type of research done by Miller

et al. (2018) who drew on open-access AIS messages from ocean going vessels to track transshipment at sea.

Screening tools to identify women who may be trafficked for sex work are in place for health professionals. However, as Bespalova et al. (2016) found, of the 11 screening tools they reviewed, only one tool was assessed for validity and reliability albeit as a pilot project within a victim service organization (i.e. not a health care setting). This begs the question as to whether screening could or should be adapted for labour abuse, exploitative labour recruitment practices and fish work. Many accidents at sea are unreported (Roberts 2010), and it is unclear how often fish workers intersect with the medical community (Kiss et al. 2015). This is particularly true for migrant workers who do not necessarily have the language skills in place to visit local doctors (Marschke and Vandergeest 2016).

Peer-review grey literature

Although the peer-review literature has a few papers that focus on detection technologies (e.g. Miller et al. 2018; Intchama et al. 2018), we found little else with regard to ICTs and unacceptable working conditions in fishing. However, we did observe the discussion of tracking apps in the sex worker literature (e.g. Elliott and McCartan 2013; Gerry et al. 2016). Since both these strategies hold promise, at meta- and micro-data levels, we turned to the grey literature for a brief review of kinds of strategies being developed by for-profit and not-for-profit organizations to address labour abuse in fisheries (Table 1).

Detection technologies hold potential in tracking controversial transshipment practices, which many observers argue facilitate poor labour practices by how they enable longer periods of isolation at sea, providing that such technologies are not being hacked for criminal purposes (see Harris 2019). A recent report estimated that IUU seafood products worth USD 142 million are transshipped in the western and central Pacific Ocean annually, with most transshipment practices being mis- or un-reported (PEW 2019). Detection technologies have considerable potential for rendering this stage in the seafood supply chain more transparent, and eliminating the worse cases of unacceptable labour and labour recruitment practices for fish work (Gibbons 2019). Here the work of organizations like MarineTraffic and Global Fish Watch is particularly important: they are using AIS data to create open access databases that track fishing vessel activities on the high seas globally, so that interested parties (actors interested in supply chain transparency, INTERPOL, environmental NGOs, government regulatory agencies, researchers) can track or determine the locations of individual vessels. Marine traffic supplements this with the ability for users to upload additional information, such as photos and ship specifications. As an example of the sort of action this enables: the

Table 1 Drawing on ICTs to combat labour abuse in fisheries

Strategies	Tools	Pros	Cons
Detection technology	Vessel Monitoring Systems (VMS)	Enforcement tool to track boats greater than a certain tonnage	Subject to confidentiality regulations
	Automatic Identification System (AIS)	Open access, safety tool; tracks vessel, country of origin, speed, location	Can be disabled or manipulated
	Synthetic-aperture Radar (SAR)	Can monitor ‘dark vessels’	Do not yet have enough satellite coverage to do this globally; will cost \$
	Unmanned Aerial Systems (UAV)	Real time, close up aerial surveillance relying on drones and cameras	Can only fly for 4 h and 17 nautical miles; just trialled; expensive
	Visible Infrared Imaging Radiometer Suite (VIIRS)	Open access; tracks vessels that use lights at night	Only works for vessels using lights at night such as squid boats. Works well with other detection technology
Apps for workers	‘Golden dreams’	Enables workers to rate their broker, captain and overall work experience	Workers may not be aware or use such apps
	‘Apprise Audit’	Cross-platform app designed to enhance worker voice during social audits	Need to get audio questions right to ensure worker needs can be noted in any given situation
	Smartphones (in general)	Can contact other fishers, boats, or at port, hotlines; can take videos	Limited cell coverage; get damaged at sea; difficult to access hotlines

Sources: Chase 2019; Haines 2019; Gokkon 2019; Thinyane 2019; Thinyane and Sassetti 2019

Panama-flagged MV NIKA, sought by INTERPOL for suspected illegal fishing operations, was captured through AIS monitoring, and a mix of Russian and Indonesian crew were found on board experiencing unacceptable working conditions (Bladen 2019).

Individual states further track fishing vessels in their EEZs through VMS devices, although most states do not make this data public. There is a movement to encourage states to do so in the interest of rendering fishing efforts and supply chains more transparent, and as we write this, several countries, including Indonesia and Peru, have made their national EEZ data available through Global Fishing Watch (Emmert 2018). More sophisticated detection technologies, ranging from low-cost drones to satellites, are emerging as potential solutions to complement AIS and enable real-time monitoring to combat criminality in fishing. Concretely, a German company is proposing the use of Unmanned Aerial Vehicle Systems (UAVs) to combine modern video and drone technology to survey fishing activities from the air (Chase 2019), and satellite monitoring, using synthetic-aperture radar (SAR), is being proposed to find ‘dark vessels’ that do not transmit their AIS location data (Haines 2019). Detection technologies hold potential in further drawing out high sea vessels operating in illegal waters, holding multiple flags of convenience, fishing near marine protected areas and seldom returning to port (Jones 2017). Meanwhile, albatrosses have been outfitted with GPS trackers to detect illegal fishing activities: 37% of vessels that these birds tracked in the high seas had their AIS systems shut-off (Wu 2020). This combination of

detection technologies may be helpful in identifying the potential cases for labour abuse or criminal activities—although the major disadvantage is that they cannot detect anything about working conditions directly.

Apps designed specifically with workers in mind are emerging, and in some cases are being used by fish workers. For example, the Issara Institute yelp-like app ‘Golden Dreams’ is designed for Burmese migrant workers working across industries in Thailand, to exchange information, offer ratings and comments on employers, recruiters and service providers, aiming to empower workers by making them aware of the risks of labour exploitation. This app further includes hotline information, service providers such as hospitals and an ability to share problems directly with the NGO (Rende Taylor and Shih 2019). Another mobile app, for social audits in factories, was trialled in 2018 with vulnerable populations. The app, Apprise Audit, enables workers to respond during social audits about working conditions that take place in factories by listening to questions via an audio headset and pressing a button on the screen to answer, in this way avoiding answering questions in a way that employers can hear. Workers are able to select their preferred language, can ask for help to leave their job and signal to frontline responders any indications of vulnerability for a particular worker (Sassetti et al. 2019). Advocates of Apprise Audit argue that such data collection can be used for trafficking and forced labour prevention strategies (Thinyane 2019; Thinyane and Sassetti 2019), and enables auditors to better identify work place violations (Sassetti et al. 2019).

Discussion and conclusion

Our intent in this systematic scoping review was to reflect on, and encourage further thinking about, how and when ICTs offer the most value for improving working conditions in fisheries. Our review found three categories of peer-review papers, including those as follows: (1) unpacking working conditions on offshore boats, mainly focused on migrant workers in Asia-Pacific; (2) examining ICTs, including AIS vessel tracking technologies to monitor vessel activities and IUU fishing; and smartphones to monitor weather and the ocean ecosystem and, thirdly (3) considering how ICTs address labour abuse in other sectors, including human trafficking screening mechanisms used in health care. The use of ICTs as a means for both assessing and improving working conditions has received considerable attention in the policy community, especially among international (e.g. Global Fishing Watch, Greenpeace) and national (e.g. Issara); and we thus hoped to find a growing peer-review literature in the area of ICTs-fisheries-labour. However, such a literature does not yet exist. This, in part, reflects the complications of engaging in off-shore fisheries research (Sampson 2019) where crime (Harris 2019; Urbina 2019) and legal ambiguities are pervasive (Vandergeest 2018) but also the lag time between academic research and real world events (Molland 2019).

Even so, the combination of our assessment of the peer-review literature and an initial scoping of the grey literature suggests that detection mechanisms and cross-platform apps are two technologies worthy of further academic analysis. These technologies are complementary, in that one is very remote—detection can track vessels but cannot say anything directly about what is happening on a boat, although observers do try to use patterns in movements of vessels to guess what they might be doing. Cross-platform apps used on smartphones or tablets, by contrast, can document what is happening on ships and can be designed to provide information to workers on employers, brokers, vessels and so on. Such information can be valuable for policy-makers and seafood corporations, and can also be assembled in ways that are advantageous for workers.

Another area worthy of further academic investigation is the use of publicly available data to produce traceability or screening tools. These tools tend to target large-scale seafood buyers. For example, the Labour Safe Screen is an end-to-end supply chain screening tool for seafood products, whereas the Seafood Slavery Risk Tool assesses slavery risk to fisheries profiles defined by species, gear and an FAO area (e.g. skipjack tuna from Taiwan are rated at critical risk whereas MSC-certified Pacific skipjack tuna from Pacific Island countries are rated as low risk.) One risk for these tools is that they rely on public data, which may not be representative of a particular fishery (i.e. focusing on certain stocks or regions). Official government data may be more aspirational with respect to

laws and regulations than providing an accurate account of monitoring and enforcement. Getting a handle on worst case offenses, and the murky middle of unacceptable labour conditions, remains notoriously difficult (Vandergeest and Marschke 2020). A better understanding of the potential and pitfalls of screening for labour abuse across the seafood industry would be helpful.

On a more cautionary note—relevant to unpacking labour abuse in fisheries—proponents need to be aware of the potential for ICT to inflict additional harms. This is especially important where men find themselves caught up in anti-trafficking policies and protectionist work. Concretely: Tran et al. (2017), in their discussions with Burmese men who had been classified as trafficked for fish work into Indonesia, observed that men may prefer obtaining decent work conditions and salaries over being classified as victims, rescued and returned to their place of origin, especially if rescue means that they have no chance of recouping unpaid wages. Men who had been in ‘safe houses’ in Thailand, post-rescue, felt that they were monitored excessively and their freedoms severely limited (Tran et al. 2017). This suggests that technology may offer a tenuous line between ‘security and surveillance, protection and punishment, and safety and social control’ (Musto and Boyd 2014: 476). Even as technology is used, studies in the area of sex workers warn of technologies ‘double-edged sword’ and the absence of research examining the impacts of such technology (Musto and Boyd 2014).

Integration between detection technologies remains an issue, although some progress is being made. For example, Indonesia is in the process of linking VIIRS boat detection data and VMS track data as a way to get a handle on night time fishing activities (see Global Fishing Watch website). Only when these two data sets are matched in near real time can fisheries authorities identify ‘dark vessels’ that do not broadcast their location. Another area where a multi-layer system would be beneficial is to identify boats practicing transshipment at sea, since such practices tend to be linked to excessive workload for boat crews (Gokkon 2019) and human rights abuses (Marto 2019). Finally, and this is not inconsequential, the costs involved for data integration must be considered, along with data management (Andrachuk et al. 2019).

Detection technologies and app creation are not enough to stop labour abuse in fisheries. Governments need to be serious about enforcement of labour regulations for all vessels owned and operated from their national territories; auditors need to know who to contact for effective action in cases where labour abuse is identified; worker hotlines need to be staffed with multi-lingual staff capability; and use of apps needs to be discrete to avoid exposing fish workers to retaliation from labour brokers or boat owners. We do not yet have a sufficient understanding about what apps are effective, who is using them and where research and development are most necessary in terms of making a dent on poor working conditions. We

need to ask more questions about how apps advance our understanding of labour challenges, and how apps link (or not) to broader response systems and governance strategies.

Although there is a need to proceed thoughtfully, noteworthy innovation is happening when it comes to work in fishing. This is being demonstrated by for-profit and not-for-profit organizations, and there is real promise for the creativity and range of solutions that detection technologies and apps might offer. Fruitful research opportunities exist for social scientists. Greater collaboration, research, development and assessment between academics, the not-for profit and for-profit sector, and fish workers themselves are critical, along with developing a coordinated approach to end labour abuse at sea. We recognize the challenges of doing so given the number of actors involved and the challenges and costs at hand. But no one should endure the unacceptable working conditions that prevail across many global fisheries, and ICTs do hold promise in terms of how technology might be employed in the fight against ‘slavery scandals’, particularly when used in conjunction with other governance strategies.

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