



Innovation and Advancement in Fishing Gear Technology by Coastal Islamic Communities in Lamongan

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Abstract. Lamongan's Islamic fishing communities are dynamic societies that have experienced continuous cultural transformation. This evolution is particularly evident in the advancement of fishing gear technologies used in their marine activities. Between 1995 and the early 2000s, significant progress occurred as fishing tools evolved from simple lines to nets, and eventually to traps. These technological adaptations emerged in direct response to environmental changes and shifting technological landscapes that affected fish availability and catch efficiency. The development of this fishing gear culture has had a direct and positive impact on the livelihoods of the local community.

Keywords: Development, Fishermen, Fishing Gear Technology.

1 Introduction

Studies concerning the coastal communities of Lamongan are inseparable from two key sub-districts within this region: Brondong and Paciran. These two sub-districts share largely similar community characteristics, predominantly fishing communities, despite variations in the percentage of fishermen across their respective villages. Paciran is one such village where the majority of the population relies on fishing for their livelihood. This area boasts a coastline approximately 3 kilometers long with relatively uniform coral reefs, leading the local populace to depend entirely on marine resources. Fishing communities are inherently dynamic societies, frequently undergoing transformations in response to environmental and temporal developments. Changes impacting their lives are often linked to fishing-related issues. In Paciran, such changes are clearly observed in their fishing practices from 1995 to the early 2000s, specifically in the evolution of fishing gear technology used for their marine expeditions.

While a wide variety of fishing gear exists, the tools predominantly utilized by the fishing communities in Paciran village from 1995 to the early 2000s included lines, nets, and traps. This technological shift in fishing gear had a significant impact on the lives of the Paciran villagers. The transformation progressed from simpler to more complex forms: initially, simple fishing lines were used, which then developed into

more intricate nets incorporating advanced technology, and subsequently evolved further into sophisticated traps designed with modern and more complex technology than their predecessors. Subsequent paragraphs, however, are indented.

In the discourse surrounding cultural evolution theory, perhaps the most prominent and persistent advocate was Leslie A. White. Although trained as a lawyer, White held a profound interest in culture, earning him recognition as the father of 20th-century cultural evolution. He developed a concept of cultural change known as *culturology*, or the science of culture. White posited that all human culture—past, present, and future—is characterized by symbols. (A symbol, in this context, can be defined as something to which value or meaning is attributed by its users.) According to White, culture comprises material objects, tools, ornaments, fetishes, actions, beliefs, and so forth, as well as attitudes that function within a symbolically marked context. These elements are inherently present and vital for the continuity of human life within society [1]. Humans are born into an existing culture within their respective regions or localities, which has already established a social order within that society. In other words, culture predates human existence. White emphasized that humans are born with nothing but culture itself [2].

White further asserted that human culture is perpetually in flux, a phenomenon he attributed to three primary factors: technology, social systems, and ideology. Among these, the technological system is considered the cornerstone of cultural evolution. This system encompasses the material, mechanical, physical, and chemical instruments integral to human life, including tools of production. The social system, conversely, represents actions arising from human interaction and communication, both collective and individual. Lastly, the ideological system comprises human beliefs and knowledge, which collectively shape societal perspectives and behavioral patterns. Thus, cultural change can be explained through the ideological system; indeed, upon deeper understanding, both ideology and the social system condition the emergence and transformation of existing technology. However, there is a distinct point of contact: the technological system subsequently shapes behavior in interactions and relationships with others, operating concurrently with the accompanying social and ideological systems. Consequently, the fundamental nature of culture is change itself, with evolving technology, social systems, and ideologies all undergoing transformations in an effort to control that technology.

Therefore, White's assertions remain highly relevant: the variations found in language, values, customs, art, and so forth are constantly undergoing change. Since language, customs, art, and similar elements are symbolic, and all specific symbols are owned by a particular group, group behavior can only be understood within its cultural context. It cannot be fully comprehended through other lenses, including psychology (which emphasizes individual adaptation to culture), sociology (concerned with interactions among individuals within a group possessing a culture), economics (related to the exploitation of cultural technology), or politics (pertaining to societal organization within a culture) [3].

Before White formulated his theory of evolution, the theory itself was already developing rapidly. White was simply one of many who offered critiques and extensions to existing evolutionary theories. The long lineage of evolution theory, which I will

elaborate on here, traces its roots back to E.B. Tylor and L.H. Morgan. As I've previously mentioned, a central figure in this theory is E.B. Tylor (1865). An English scholar, he is widely regarded as the first professional anthropologist. Tylor posited that human culture evolves from simple to complex, and that all human societies progress through three main evolutionary stages: savagery, barbarism, and finally, civilization [4].

Consistent with his belief in the progressive development of human societies, Tylor argued that contemporary societies possess varying degrees of similarity to societies of the past that have since vanished. Regarding these resemblances, Tylor emphasized the commonalities found among different peoples. He maintained that a psychic unity exists among all humankind, enabling parallel discoveries in diverse cultures and consequently leading to a shared evolutionary history. Thus, a clear connection can be drawn: due to fundamental human commonalities, distinct societies often independently arrive at similar solutions to similar problems. However, Tylor also noted that cultural elements can disseminate from one society to another through a process he termed cultural diffusion, which involves "borrowing" cultural traits as a result of contact between two cultures [5].

This theory of evolution was subsequently developed by Lewis H. Morgan (1818-1889). A New York lawyer, Morgan cultivated a deep interest in the Iroquois, defending them in legal battles to preserve their land rights. Consequently, Morgan was adopted into the tribe, granting him invaluable direct access to their customs. In 1851, he published *League of the Ho-de-no-sau-nee or Iroquois*, the first comprehensive ethnographic study of an American Indian tribe. His profound dedication to anthropology eventually led him to abandon his legal career [5]. A clear distinction lies in Morgan's commitment to field research, a methodological approach Tylor never undertook. This direct engagement allowed Morgan to acquire significantly more accurate and extensive data. Consequently, it is unsurprising that Morgan's assumptions differed somewhat from Tylor's views. This divergence is evident in his seminal work, *Ancient Society*, published in 1877.

In *Ancient Society*, Morgan, like Tylor, categorized cultural evolution into three primary stages. However, Morgan further subdivided the savagery and barbarism stages into three sub-stages: lower, middle, and upper. This classification was based on the technological advancements achieved by a society. For instance, the lower barbarism stage was characterized by the use of clay goods, middle barbarism by items derived from cultivation and animal husbandry, and upper barbarism by goods made of iron. Morgan posited that the thought processes of societies in the barbarism stage were the nascent forms that evolved from those in the savagery stage, eventually solidifying into a permanent characteristic within the core institutions of a society. Morgan's reasoning for this perspective was that the stages of technological development are intricately linked to various cultural patterns that unfold in a specific sequence [5].

Initially, this evolutionary theory successfully brought about an awareness in Europe that, much like natural sciences where phenomena could be studied, so too could cultural phenomena. It suggested that cultural phenomena and societies could be studied rationally, allowing for the derivation of underlying laws and principles. However, it

wasn't long before the evolutionary theory put forth by Tylor and Morgan elicited reactions from various European scholars. Generally, their responses involved critiques of the theory; some appreciated it, accepting its core ideas, while others outright rejected it and proposed new theories of culture [6].

Scientists like Leslie White, discussed earlier as the father of 20th-century cultural evolution, and Julian Steward offered critiques, deeming the theories put forth by Tylor and Morgan as subjective. Consequently, both White and Steward proposed new, objective evolutionary theories based on more accurate data. White introduced energy as a criterion in culture, which he believed was the primary driver of significant cultural change. Julian Steward also criticized Tylor's and Morgan's evolutionary theories for their perceived lack of accurate data, specifically their failure to conduct comprehensive fieldwork. Fundamentally, Steward did not reject the basic assumptions of evolutionary theory. He subsequently conducted fieldwork among the Shoshone Indian tribe in the United States, where he observed a primitive society that did not appear to be undergoing evolution because it had successfully adapted to its environment. This led Steward to propose that evolution is strongly influenced by the natural environment, and that cultures possess a "cultural core." He argued that the interaction between this cultural core and the environment determines the direction of evolution and the distinct pattern of a culture. Further critiques came from Malinowski and Radcliffe-Brown, who offered a new theoretical perspective: functionalism, later termed structural-functionalism [6].

2 Method

This study employed a cultural history methodology, comprising four distinct stages: heuristics, criticism, interpretation, and historiography. During the heuristic stage, or data collection phase, the aim was to gather sources for historical reconstruction. The author utilized various relevant references, supplemented by observations made during a prolonged stay in Paciran village from 1993 to 2024.

This observational approach aligns with cultural ethnography, incorporating both emic (insider) and etic (outsider) perspectives. The criticism stage involved comparing and cross-referencing different data points. Subsequently, interpretation was conducted on the collected data and observed phenomena. These four stages collectively provide a direct explanation of the contributions of Lamongan's coastal Islamic fishing communities to the development of fishing gear technology and its subsequent impact on the lives of the local population. Subsequent paragraphs, however, are indented.

3 Result and Discussion

3.1 Fishing Gear Technology of the Islamic Fishing Communities in Lamongan

In the field of anthropology, particularly among proponents of evolutionary theory, culture is viewed through three principal aspects: First, culture as a system (cultural system) encompasses abstract forms such as ideas, thoughts, concepts, values, norms, perspectives, and laws, which are held by the idea-bearers. Second, culture is also referred to as behavioral patterns, subsequently termed activities. Third, culture manifests as material objects (artifacts)—items produced by humans, whether through their creative work or as outcomes of their behavior, often labeled material culture or the products of action [7].

From an anthropological perspective, culture is understood as a system, meaning it must contain specific content or cultural elements. According to Kluckhohn, there are seven universal cultural elements: the system of tools and equipment for living, the system of livelihood, the language system, the societal system, the art system, the knowledge system, and the religious system. From this, it becomes evident that fishing gear is a cultural element, specifically falling under the category of tools or equipment for living.

At its core, evolution represents a transformation from traditional to modern, from simple to complex. It doesn't strictly adhere to Tylor's progression of Savagery, then Barbarism, and finally Civilization. For this study, we won't use these specific terms. Instead, we'll draw on the essence of Tylor's evolutionary theory: that evolution moves towards greater complexity, shifting from traditional to modern, and from basic to sophisticated. Thus, the observed changes in fishing gear technology can be understood as a form of cultural change. Another reason for this approach is that Tylor's concept of Savagery refers to ancient, primitive societies that used stone tools, engaged in hunting and gathering, and lived a nomadic lifestyle. Similarly, Barbarism describes societies that had begun using iron tools, were involved in food production through farming, no longer hunted and gathered, and started living in settled areas. Civilization, conversely, signifies a cultured society that had developed writing and utilized advanced tools capable of constructing magnificent monuments. Given this, and since this study examines the development of fishing gear technology in the modern era, it's not feasible to categorize the initial fishing tools as "savagery" or "barbarism" because these communities were already advanced. Therefore, this research describes the observed changes as a gradual progression from simple to complex. In line with this, the phenomena of change or development in fishing gear technology along the Lamongan coast from 1995 to 2024 can be mapped as follows.

3.2 Fishing Line Technology as a Fishing Tool in 1995

Initially, the Islamic fishing communities in Paciran village primarily utilized fishing lines (pancing) as their dominant traditional fishing gear. This practice was prevalent due to the abundant availability of large fish in the waters of Lamongan and its sur-

rounding areas. Fishermen frequently succeeded in catching sizable fish, such as sailfish, and often species like skipjack tuna or mackerel – a major global export commodity known for its highly nutritious meat. Other similar valuable fish, like red snapper, which has historically been, and remains, a very expensive species, were also caught.

As a fishing technology, the fishing line comprises key components such as the hook and nylon line. The hook serves as the direct means of ensnaring the fish, while the nylon line connects to the hook. Additionally, a larger rope is used to link multiple individual fishing lines that have been fitted with the nylon line. Various types of fishing lines were employed, but the most common was the ordinary line made of iron. Several fishing techniques were also observed: First, single-line fishing, involving one line and one hook. Second, multi-line fishing, where numerous lines are attached to a single main rope, equipped with floats at various points along the rope or nylon lines. This latter method was adopted to maximize the fish caught with a single retrieve.

3.3 Net Technology as a Fishing Tool in 1998

Nets are instruments utilized by the Islamic fishing communities in Lamongan for fishing activities. This technology, constructed from interwoven threads, is designed to entangle fish that approach it. In Paciran village, Lamongan, nets began to be manufactured and employed for marine expeditions starting in 1998. Prior to this, the local Islamic fishing communities primarily relied on fishing line technology, a simpler tool for their seafaring endeavors. However, the introduction and adoption of nets marked a significant improvement in fishing gear technology. Nets offered a substantial advantage, enabling larger catches and facilitating easier entanglement of fish compared to lines. The local fishing community developed and utilized various types of nets, including:

Bringsang Net

The bringsang net represents a novel innovation developed by the Islamic fishing communities in Lamongan in response to prevailing challenges, specifically the abundant availability of sailfish, or "blenung" (medium-sized sailfish), and "kembung" fish (a type of sea bream) at that time. This abundance prompted a significant uptake in the creation of this net type among local fishermen. Both these fish species are renowned for their palatability, with "kembung" particularly recognized as a major commodity in inter-city markets. Despite its small size, comparable to a human palm, "kembung" boasts a high level of deliciousness, commanding a substantial market value, especially when exported to cities like Gresik and Surabaya.

The components of the Bringsang net include the net itself, small floats attached to the upper main line, the main line, and lead weights along the lower main line. This net is made of nylon with a medium mesh density. The floats on the upper part and the lead weights on the lower part ensure that the net stands perfectly upright when deployed in the seawater. This type of net typically measures about 25 meters in length. To effectively extend the net, several lines (a term referring to one 25-meter section of the net) are required. On average, fishermen possessed three to four such bringsang net sections.

The catches obtained by fishermen using the Bringsang net were quite promising. Fishermen would go to sea almost daily with this net, which was considered highly economical and significantly contributed to the local fishermen's livelihoods. On average, daily catches using this net amounted to an estimated 30 to 50 kilograms, consisting primarily of "kembung" and "belenung" fish. However, the use of the Bringsang net gradually declined as the availability of its primary target species, "kembung" and "belenung", became increasingly scarce. Consequently, the fishing communities began exploring alternative fishing methods. Initially, the Islamic fishing communities in Paciran village primarily utilized fishing lines (pancing) as their dominant traditional fishing gear.

Enus Net

The Enus net is a specialized fishing net designed exclusively for catching squid. Constructed from nylon thread, this net features a fine mesh density specifically engineered for squid capture. Squid are a premium commodity, considered a luxury seafood due to their tender, boneless meat and versatility in various regional cuisines. To facilitate easier squid capture, the Enus net is deployed at night, illuminated by lights—a common practice among Lamongan's Islamic fishing communities. The light indirectly attracts squid, stimulating a natural response to the luminescence, thereby making them easier to entangle in the net.

The components of the Enus net technology include the net itself, an upper main line (tali ris) equipped with small floats, and a lower main line fitted with lead weights. This configuration allows the net to stand perfectly upright in the water. Made from nylon thread, the Enus net is highly effective at ensnaring squid that venture into it, preventing their escape. While squid and similar cephalopods are the primary target, other fish species can also occasionally get caught. This net was developed by the local community during a period when squid resources were abundant in the sea. However, this abundance was short-lived; by 2003, squid became scarce, leading the community to abandon squid fishing and shift their focus to new target species.

Gondrong Net

The Gondrong net, also known as a Trammel Net, emerged or was developed when squid commodities began to decline. This coincided with the appearance of a new, abundant commodity for the Paciran fishing communities: shrimp. This shift occurred in 2003, leading to the invention of a new net specifically designed for shrimp, though it could also catch other fish. This net is characterized by its three layers, each possessing a different mesh density.

The components of this net are similar to general fishing nets, including an upper main line with small floats, the net itself, and a lower main line with lead weights for ballast. The distinguishing feature of the Gondrong net, however, is its unique body construction. It consists of three layers: two outer layers (outer net) and one inner layer (inner net) positioned between the two outer layers. The primary difference between the outer and inner net layers lies in their mesh size or fineness. The Trammel net is considered an environmentally friendly fishing gear because its operation is passive and selective regarding both its target species and their size. Catches are limited to what

approaches the net. While its primary target is shrimp, it also effectively catches fish whose size is compatible with the net's mesh density.

The construction of the Trammel net's body is that of a three-layered net, comprising upper and lower main lines. Floats are made from rubber or sponge, and weights from lead and stone. The outer nets are constructed from nylon multifilament, with a thread diameter of 0.5 mm and a mesh size of 254.00 mm (10 inches). The dimensions of the outer net are 21.30 m in length and 1.17 m in depth. The rigging coefficient for the outer net is 0.55. The inner net is also made of nylon multifilament, with a thread diameter of 0.24 mm and a mesh size of 44.45 mm (1.75 inches). The inner net dimensions are 21.30 m in length and 2.07 m in depth. Its rigging coefficient is 0.36. Fishermen typically operate 30–40 sections of the trammel net. The form of the gondrong net is depicted in fFigure 1 [8].



Fig. 1. The shape of the gondrong net.

Blentik Net

The Blentik net is a variant of fishing net adopted by the local community, developed in 2007 in response to the sharp decline and near disappearance (extinction) of shrimp in the marine environment. This necessitated the creation of a new fishing technology, leading to the development of the Blentik net. This particular net is specifically designed for catching swimming crabs (*Portunus pelagicus*), a type of crab. It features a relatively loose mesh, allowing smaller fish to pass through easily, while effectively ensnaring larger fish, such as crabs, that match its mesh size.

Similar to most nets, the Blentik net comprises an upper and lower main line equipped with lead weights, and the net body itself. However, it differs slightly from other nets as it lacks floats on its upper main line. This design choice is deliberate, as the net is intended to catch swimming crabs and other crab species that typically reside near the seabed, thus requiring the net to sink to the bottom. Consequently, small floats are omitted. Nonetheless, a drawback of this design is that the net is highly prone to tangling during significant wave action due to the absence of floats. Further details regarding the blentik net are shown in Figure 2 [9].



Fig. 2. The shape of the blentik net.

3.4 Trap Technology as a Fishing Tool in the Early 2000s

The latest advancement in fishing gear technology among the Islamic fishing communities in Paciran, Lamongan, is the introduction of a new trap-like tool locally known as "wuwu." This innovative gear, specifically designed for catching swimming crabs (*Portunus Pelagicus*) (rajungan), represents a more sophisticated and efficient breakthrough compared to previous tools. Its development began in the early 2000s, precisely in 2009. Compared to nets, the "wuwu" involves a higher cost, but possesses environmentally friendly properties.[10] Firstly, it's constructed from an iron frame wrapped with a stiff net, designed to withstand the strong pincers of the crabs. The frame of the foldable fish trap (wuwu) is constructed from 4 mm diameter iron rods, with dimensions of 45 cm (length) x 30 cm (width) x 20 cm (height). Polyethylene (PE d/9) netting is used for the trap's walls, arranged in a square mesh pattern, with mesh sizes ranging from 1¼ inches to 2½ inches. The mouth of the trap measures 6 cm vertically and 30 cm horizontally.[11] Secondly, to deploy this trap, fishermen must place bait, typically fish, in the center of the "wuwu" to attract the crabs. As a trap, the "wuwu" is set on the seabed and usually left for an entire day, retrieved only the following day. This extended deployment time increases the likelihood of crabs entering the trap.

The "wuwu" trap consists of an iron frame, a rigid net covering the frame, and a main line (tali ris) that connects the trap to a larger rope (slambar or tali tampar). The design of this technology is relatively simple to construct and easy to transport, making it highly efficient. Furthermore, this technology offers a significant advantage over nets: it virtually guarantees a 100% catch rate for swimming crabs or other crabs. This is because the trap contains bait, which attracts the crabs to enter through a one-way opening, preventing their escape. The construction and physical form of the fish trap (wuwu) are presented in Figure 3 [11].

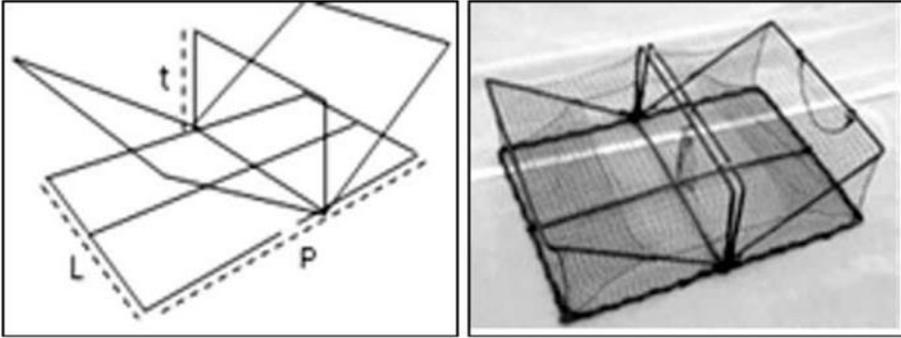


Fig. 3. Design and construction of collapsible pot for catching blue swimming crab.

3.5 Contribution of Lamongan's Coastal Islamic Communities to Fishing Gear Technology and Its Impact on Livelihoods

Whenever social or cultural changes occur within a society, there is a corresponding transformation in its worldview, behaviors, and social order [11]. Social change can encompass shifts in human life related to their living environment, including its physical, natural, and social dimensions. Conversely, social change at its broadest level encompasses transformations at the individual, organizational interaction, institutional, communal, societal, cultural, civilizational, and global levels [12].

This phenomenon is also evident in the community of Paciran, Lamongan. The changes in fishing gear technology used for their marine activities have had a significant impact on their lives. These influences from the evolving fishing gear technology among Lamongan's fishing communities encompass all aspects of life, including the economic, social, religious, educational, and cultural dimensions of Paciran society.

Economic Impact

The community of Paciran, Lamongan, predominantly comprises fishermen whose livelihoods are highly dependent on marine activities, making their incomes inherently fluctuating and contingent on natural conditions. During clear weather and favorable natural conditions, fishermen can go to sea and earn an income. However, during certain seasons, adverse weather with strong winds and high waves prevents them from fishing, leading to a temporary halt in their earnings. Regardless of these fluctuating environmental conditions, the evolution of fishing gear technology within the fishing community itself has significantly contributed to their economic stability. Historically, when fishermen primarily used fishing lines, their income was relatively modest due to smaller catches, even though daily earnings were consistent. A fisherman could only catch about 5 to 7 large red snappers and 1 to 2 mackerels per day, which was considered a substantial income at that time. However, as fish availability diminished over time, fishing technology evolved from lines to nets.

During the period of net usage, fishermen experienced significantly larger catches, including species they could not previously obtain with lines. Nets became crucial once

line fishing was no longer effective. The yields from using nets were substantial, particularly with the "Gondrong" net, which was specifically designed for shrimp but also caught other fish if they entered. Shrimp were abundant then, allowing a fisherman to catch up to 8 kg, sometimes even more, like 10 kg, per day a considerable yield. When the "Gondrong" net no longer yielded maximum results, fishermen turned to the "Blentik" net, specialized for catching swimming crabs. The population of swimming crabs was, and still is, plentiful in the ocean. However, using nets for crabs was deemed inefficient, often resulting in unexpected costs like net damage. Incomes from "Blentik" nets were not as high due to these limitations. This led to the emergence of a new fishing tool: the "wuwu" crab trap.

Fishing with the "wuwu" trap yields substantial results, primarily because swimming crabs are abundant and, once inside the trap, cannot escape, unlike with nets where crabs sometimes manage to get out. This technological advancement represents a significant and promising evolution for the Islamic fishing communities in Lamongan. Mathematically, the income from using "wuwu" traps is considerable. A typical day's catch can range from 10 to 15 kg of swimming crabs, occasionally reaching 20 kg depending on the distance traveled to set the traps. If traps are placed in waters approximately 200 miles from the coastline, yields can reach 20 kg; otherwise, they typically range from 10 to 15 kg. This clearly demonstrates that changes in fishing gear technology have profoundly and drastically improved the economic well-being of the fishing community.

Education Impact

The influence of changes in fishing gear technology also extends to the education sector. With advancements in fishing technology, a noticeable shift in the educational landscape of the local community has occurred. Historically, the education level among these fishing communities, for both men and women, was quite low. Only about 20% of adults had completed junior high school, while the majority had either no formal schooling or did not complete elementary school. This conservative mindset persisted among the older generation of fishermen (both mothers and fathers). Furthermore, the education of their children was similarly low; most only completed junior high school, with some finishing senior high school. Pursuing higher education was often considered a waste of money and time. This conservative outlook among fishing communities consistently viewed education as unimportant, prioritizing work and earning money to ensure family well-being. Unfortunately, the available occupations were primarily fishing for men and fish processing for women. This perspective on education was prevalent from 2001 to 2005.

However, in the following years, starting around 2006, the community's perception of the importance of education began to change. This shift was undoubtedly driven by increased income from fishing activities, made possible by more advanced and productive fishing gear technology. The Islamic fishing communities, who initially believed that education was a financial burden and seemingly beyond their means, started to reconsider. From 2006 to the present, a significant number of children from these fishing families have pursued higher education. This represents a remarkable phenomenon.

By 2012, it was recorded that 337 individuals had successfully completed their bachelor's degrees, and 51 individuals had completed their master's degrees (S2).[13] This data has continued to increase up to 2025.

Religious Impact

The entire community of Paciran village, Lamongan, adheres to Islam. Generally, they are divided into two prominent Islamic organizations in Indonesia: Muhammadiyah and Nahdlatul Ulama. While both are Islamic social organizations, they hold distinct interpretations regarding religious practices. Muhammadiyah advocates for the purification of Islamic teachings in accordance with the Quran and the Hadith of Prophet Muhammad, whereas Nahdlatul Ulama is more tolerant, embracing various acculturations between Islam and local culture.

The changes in fishing gear technology among Lamongan's Islamic fishermen have also significantly influenced their religious practices. Historically, when fishermen primarily used fishing lines and nets, they never took a day off on Fridays. This was because lines and nets allowed them to return home easily before Friday prayers, as these methods didn't require extensive setup or retrieval in open waters, thus demanding less time. However, trap technology, specifically the "wuwu" trap, requires a considerably longer deployment period. After setting the traps on the seabed, fishermen return home and collect them the following day. Once the swimming crabs are harvested, the traps are reset on the seabed, and this cycle continues. Consequently, if fishermen were to go out on a Friday, they would undoubtedly miss Friday prayers. As a result, fishermen now opt to take a break from fishing on Fridays to ensure they can attend the congregational prayer.

Furthermore, the increased income generated by fishermen using more complex and productive fishing gear has fostered a growing sense of generosity. They now readily contribute to the construction of mosques and madrasahs (Islamic schools), as well as various religious activities organized by the local community. For instance, during the Eid al-Adha (Feast of Sacrifice), many Islamic fishermen contribute a portion of their earnings to slaughter sacrificial animals (Qurban) and distribute the meat to their neighbors. Many have also become financially capable of undertaking the Hajj pilgrimage, which was previously only feasible for wealthy merchants and entrepreneurs. This newfound prosperity from fishing has enabled a significant number of them to fulfill this pillar of Islam. These are clear and tangible influences resulting from the changes in fishing gear technology.

Religious Impact

The shift in fishing gear technology among Lamongan's Islamic fishing communities has directly impacted their culture. This is largely due to the inherent openness of these communities to external cultural influences, often leading them to adopt or even create new cultural practices. This can be clearly observed in their behavior. Historically, the fishing community held the view that it was improper for women to work outside the home, as it was seen as deviating from their role as housewives. During the eras of using fishing line technology and even the subsequent development of net technology,

fishermen never processed their catch. Instead, they would simply sell their fish directly to middlemen, including the swimming crabs caught with the Blentik net.

However, following the transition to trap technology, specifically for catching swimming crabs, the fishing community began to adopt a new cultural practice: processing their catches. This transformation was primarily driven by women, the wives of fishermen, who started processing the crabs with the aim of achieving higher profits than if the crabs were sold raw. The processing involves carefully skinning the crabs and separating the meat from the shells, ensuring the meat remains intact a challenging task for novices but easily managed by the local fishing women. Typically, they begin processing the crabs after their husbands return from sea and bring the catch home. The crabs are cooked first, then individually peeled.

This development has led to a significant cultural shift, transforming the role of women from solely being housewives to becoming working women. Their involvement in processing the catch is directly aimed at contributing to the family's economic well-being.

3.6 Driving Factors Behind Changes in Fishing Gear Technology in Lamongan

Environmental Factors

Evolutionary theorist Julian Steward's fieldwork among the Shoshone Indian tribe in America revealed a curious finding: this society remained in a state of Barbarism, having not progressed to Civilization. This observation led Steward to understand that environmental factors profoundly influence evolution. The Shoshone people, he realized, had indeed evolved, but on their own terms. Their adaptation to their specific environment brought them to this state of Barbarism. Drawing from Steward's evolutionary theory, we can infer a parallel here: the primary driver of evolution—specifically, the changes in fishing gear technology—is the natural environment. These transformations unfold organically, developing in response to environmental challenges. In other words, these changes occur as a reaction to the demands of their surroundings.

This dynamic is clearly seen in Lamongan's fishing communities. The initial use of fishing lines in 1995 was a direct response to the abundant availability of fish like mackerel, red snapper, and sailfish. However, as these species became scarce and other types, such as squid, shrimp, and swimming crabs, became plentiful, the fishing community developed new net technologies around 1999 to target these newly available resources. This demonstrates that the technological shifts were fundamentally driven by natural factors, primarily the changing availability of fish in their environment.

Technological Development

The transformation of fishing gear, from simple fishing rods to nets and subsequently to traps, has been significantly propelled by advancements in technology. As articulated by Leslie White, technology serves as the primary driver of cultural evolution. Indeed, technology continually progresses in tandem with societal development, a reality that cannot be denied. This technological sophistication has facilitated a shift in the fishing tools employed by the Muslim fishing communities along the Lamongan coast, moving from instruments of rudimentary technology to those boasting advanced capabilities. In

this context, simple technologies include the fishing rod and net, while the trap represents a tool embodying sophisticated and cutting-edge technology.

Moreover, the progression of more advanced technology necessitates that essential tools are designed to be both simpler and more sophisticated. Technological advancement also demands tools with high levels of efficiency. This trend is evident in the evolution of fishing gear, consistently moving towards more advanced and complex technologies. The trajectory from the basic fishing rod to the more advanced net, and further to the high-tech trap, exemplifies a design evolution in fishing equipment that aligns with the accelerating pace of technological progress.

4 Conclusion

The evolution of fishing implements among Muslim fishing communities along the Lamongan coast has been demonstrably influenced by both environmental and technological factors. Environmental factors have played a pivotal role. The diminishing availability of certain marine fish resources necessitated that these communities adapt by developing novel capture tools to target alternative species. This continuous adaptive pressure ultimately culminated in the adoption of sophisticated fish traps. Concurrently, technological advancements have been a key driver. The increasing sophistication of technology has fostered a demand for fishing equipment that is not only highly advanced but also efficient, user-friendly, and capable of yielding substantial catches. Consequently, fishing implements have progressively evolved from basic fishing rods to more advanced nets, and ultimately to the highly effective traps.

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