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Technological Development and The Dynamics of Juwana's Fisherman Social Structure

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ABSTRACT

Technological developments are not only about material changes, but also closely related to changes in social structure in the community. Capture fisheries community is one of many communities that have also experienced the development of fishing technology. It cannot be denied that technological sophistication is driving the production of the fishing community. However, this increase is not necessarily followed by an increase in welfare for the community. This paper aims to examine technological developments and changes in social structure in the fishing community in Juwana, and identify their implications for community welfare. The research was conducted using qualitative methods. The results showed that the development of technology brought changes in social structure in the fishing community. The economy and welfare of the community are getting better due to the efficiency of fishing with the latest technology. Solidarity that grows in the fishing communities is a key factor in preventing inter-class exploitation by maintaining the position of members of the upper stratification of fisher community from competition with upper strata outside the community, and thus providing a space for community members from the middle and lower strata to carry out social upward mobility.

Keywords: fisher, fishing technology, social structure, social mobility, solidarity.

ABSTRAK

Perubahan yang diciptakan oleh perkembangan teknologi tidak hanya tentang perubahan secara material, tetapi juga berkaitan erat dengan perubahan struktur sosial pada komunitas sebagai pengguna sekaligus penerima konsekuensi atas aplikasi teknologi tersebut. Komunitas nelayan perikanan tangkap adalah salah satu dari sekian banyak komunitas yang juga mengalami perkembangan teknologi penangkapan ikan. Tidak dapat dipungkiri kecanggihan teknologi mendorong naiknya produksi komunitas nelayan. Akan tetapi peningkatan ini belum tentu diikuti dengan peningkatan kesejahteraan bagi komunitas. Tulisan ini bertujuan untuk mengkaji perkembangan teknologi dan perubahan struktur sosial pada komunitas nelayan di Juwana, khususnya pada Desa Bendar dan Desa Bajomulyo, serta mengidentifikasi implikasinya pada kesejahteraan komunitas. Penelitian yang mendasari tulisan ini dilakukan dengan metode kualitatif. Hasil penelitian menunjukkan perkembangan teknologi membawa perubahan struktur sosial pada komunitas nelayan. Perekonomian dan kesejahteraan komunitas semakin membaik akibat efisiensi penangkapan ikan dengan teknologi terkini. Solidaritas yang tumbuh pada komunitas nelayan di dua desa, menjadi faktor kunci dalam mencegah terjadinya eksploitasi antar kelas dengan cara mempertahankan posisi anggota komunitas lapisan atas dari persaingan dengan lapisan atas di luar komunitas, sekaligus memberi celah bagi anggota komunitas dari lapisan menengah dan bawah untuk melakukan mobilitas sosial ke atas.

Kata kunci: mobilitas sosial, nelayan, solidaritas, struktur sosial, teknologi penangkapan ikan

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INTRODUCTION

A social study has a variety of different perspectives of the development that exists in the society. These changes and development are known as a social change because changes and society are reciprocal. Marx saw the production mode development caused the dynamics structure of social class in the inner society, especially when using the economic determinant of Coser (1977). Durkheim (1984) considered community development caused a shift in the mechanism of social solidarity which used to have a feature of togetherness among the inner society members to become an organic solidarity which is identified with the emergence of differentiation and specification in order to reach the same goal.Weber (1934)confirmed Marx's idea who saw society in its social class, but Weber criticized that a social class should have been seen with a wider determinant, not only by a single determinant, i.e. economy. A social class, for example, can only be determined by an individual status in the group based on his consumption pattern.

Social structure, especially class structure, in Marx's opinion appeared because of an unfair dominant of production mode due to capitalism. Marx social class can be divided into three groups, namely the upper class, who carries out exploitation, the middle class which is also called *petty commodity producer* and the lower class as an exploited party. Durkheim and Weber consider a class as a consequence of industrial revolution that demands diversification and specialization. Social class is a natural and organic phenomenon.

A study of technological development from a sociologist's perspective is not new. Marx is one of the sociologists who outline the development of technology as a production mode and he has a big role on the social structure formation of society (Ritzer, 2012). Coser (1977) outlines Marx's idea about the economic pressure of society as the main determinant on analyzing the development of society. Marx expresses the concept of materialistic as the main power on social changes that happens in the society. There are *material force production* in the form of manpower, and production tools and technology as the creator of social changes. Volti's (2014) writing on technological changes as a social process is the result of human thought as the subject of this technology. Different from Marx's view which outlines that society structures herded with the development of technology, Volti (2014) who uses the point of view of constructivism social says that social structures tends to become the determinant of technology which will survive and disappear.

Blau (1977) then criticizes Marx, Durkheim and Weber on their idea of social structures. Blau's understanding on social structures is closely related to population distribution on various social positions, which reflects and influences the relationship among people. The concept of social structure is rooted on the social differences which are made by human on their role as a social association. Blau differentiates between social structure analyses in the macrostructure levels, i.e. a relation pattern between different social positions conducted by many people, in relation with the distributed social positions that influence the social relations, and the microstructures that examine the interpersonal network (sociogram on a smaller group). Blau does not use the term class, but instead he uses the term "status" or stratification vertically and group horizontally to see the grouping of society. This classification is seen more suited for the context of agrarian society, and more relevant with the context of present time society which consists of various determinants on deciding its social position. This research is based on the development of catching tool technologies.

Right now the development of technology is not always about hardware such as catching tools, but also about the development of software such as *artificial intelligence* which helps the process of catching fishes (Muawanah et al., 2017; Kurnia et al., 2015, Surpianto et al., 2019; Zahroh & Sukojo, 2016; Newlan et al., 2015; Agus et al., 2017; Sri, 2013). The founding of shipping support equipment in the process of catching fish until trading fish on land made the activity of catching fish and capture fishery business more interesting and complex. The regulation issued by the government steers the fishermen to adapt and use digital tools as a requirement of sailing license issuance for some ships with the capacity of greater than 30 *gross ton*. In the agricultural context, the use of communication and information technology can also fasten the process of production and marketing (D. P. Lubis, 2005).

In the context of fishermen communities, the development of technology also happens, and it can be traced according to its historical studies. The development of technology in the capture fishery sector has many steps. According to Rachman (2017), the development of fishery technology starts with the

use of basic technology such as boat without machines and developing various hooks for catching fishes. The founding of steam engine by James Watt then enables the creation of a machine which can help push the course of the fishermen's boat. The study of the fishery technology development then developed mainly on the development of technology as an object (Saputra et al., 2015). Kinseng Studies (2014); Saleha (2013); Syahdin (2013); Tri Sulistiyono (2014) and Kobesi et al (2019) also identifies the development of technology on fishermen communities as a subject of capture fisheries activity. The result of this study shows that the development of capture fisheries technology gives an impact on the social structure of fishermen communities. Technology as the determinant of change causes the change in the structure of profit sharing, status, division of work until class formation. This changes also brings another impact which is a conflict between fishermen, as a result of the injustice of structure created after the entry of a new technology.

The study of the development of technology and this fishermen and coast community becomes important because the fishermen community in general have less attention than the farmers, gardeners, and breeders community in terms of scientific studies and government policies (Turner, Polunin, and Stead 2014). The studies on technology development are basically centered on fishery technological development as the object and tends to separate the subject of this technology, namely the fishermen (Satria, 2012). One of the indicators which confirm that there is less research on fisheries is that there is no available data of fisheries over the past one year or two years especially on fishermen. The fishermen community in the village of Bendar and Bajomulyo, sub-district of Juwana, district of Pati is one sizeable fishermen communities in Central Java. Various fishermen communities which can be differentiated according to their characteristics on catching tools, types of catch and social layers can be found in these two fishermen villages. There is also a history of capture fisheries technologies which are tightly bound with the structure of the social community of these two villages.

The change of technology is a phenomenon that cannot be avoided (Volti 2014). Critical studies on the social changes which can be caused by the existence of technological development see that technological development tends to cause social problems on the subjects of capture fisheries activity. Disparity and exploitation are two things that are always in critical discussion of the production mode development. This research is aimed to see if technological development can finally bring the fishermen community in Juwana to class polarization which indicates the imbalance and unfairness like in other fishermen community researches, or if there is an internal or external mechanism that prevents polarization and ends up on social layers as the revolution consequences (Durkheim 1984, Weber 1934, Hayami & Kikuchi 1987).

METHODS

This research is a qualitative one. The primary data in this research was collected by observation and structured interview. The literary study on the previous research was carried out to get a picture of social structure of the previous fisherman community in both villages. The secondary data from the Ministry of Fishery and Marine was carried out in order to get a picture of the statistics of production and community activities being observed.

The research was conducted in Bajomulyo Village and Bendar Village, Juwana Sub-district, Central Java Province. Bajomulyo Village and Bendar Village are two of the biggest fisherman center in Pati District, and fishermen believe that it is one of the biggest catchment fish port in the northern coast of Java. The condition of the two villages is very suitable for catchment fish activities, and this makes them become the fisherman community settlement with their diverse structure. The unique characteristics of the fisherman community in these villages also enhanced the researcher to conduct a research on the fisherman social structure in both villages and its relation to the development of fishing catchment technology that is interesting to carry out.

The primary data was collected using a depth-interview method to every stakeholder in this catchment fishery chain, especially the fisherman leaders, the regional government, the boat owners, fisherman, traders, consumers, and middlemen. The interview was carried out structurally using a prepared question guide (Nasution, 2016). Informants were selected using a *purposive sampling* technique and a *snowball sampling* technique to see the data saturation. There were 17 key informants as the source of information in this research. Data analysis was carried out descriptively and interpreted using a logical method.

The paradigm used in this research is a constructivist one. It was selected based on the similar frame of thought in order to meet the research objective. Constructivism rejects the idea to separate facts from values, separate knowledge phenomenon from its historical social context (Lubis dan Adian 2011). The constructivism paradigm gives a special room for the researcher to construct knowledge based the findings in the field using a theoretical frame guide, but it also enables the researcher to get new findings which are different from the initial ones and open to new interpretation in line with the relevant field findings (Crozier, Denzin, dan Lincoln 1994). This paradigm digs the subjective meanings from the informants in relation to the change of social structure that happens because of the change in catchment fishing technology. The earliest data was collected in July 2018 and continued in December 2019 and February 2020.

RESULTS AND DISCUSSION

Social changes can be interpreted as a phenomenon which cannot be changed, cannot be dammed, and cannot be pulled back (Coby, 2011). Vago stated that social changes were conceptualized as a planned or even unplanned process, qualitatively or quantitatively, in social phenomenon which can be identified by six change components, namely identity, level, duration, direction, magnitude, and rate of changes. Vago also stated that there are some specific views regarding social changes, such as social changes viewed as structure changes of a community (Massey, 2017; Wu, 2011). Lauer (1993) added that social changes happens in various levels started from individual level to global. Technology changes or improvements in society is one of the sources of change. Lauer (1993) discuss specifically about how technology creates social changes. Technology is expressed as an incentive of social changes in society. There a few factors which were involves when technology promotes changes, it is when technology increases human alternatives, when technology affect changes by changing interaction patterns and when technology affects changes, also the development of technology raises new social problems.

Bajomulyo and Bendar village is two of the capture fisheries central villages in Juwana Sub-districts. Geographically, both villages located side by side, separated by Silugonggo River (Image 1). Various types of fish capturing ships from both villages even from other villages, who usually rests on the riverside of Silugonggo River. Silugonggo is also the exit and entrance way of fishermen ships, because there are a fish capturing port on this river, which is called Pelabuhan Unit Juwana. Right now both villages claimed by Juwana's fishermen as one of the biggest capture fisheries central in the north-coast of Java. According to the fishermen, this were caused by the number of ships as well as the density of the ships and the capturing fisheries activity in Juwana if compared to other ports along to north coast of Java. According to BPS and the Fisheries Statistics of the Ministry of Fisheries (KKP), Central Java Province is a province with the second highest gross production after East Java (data is attached in Table 1). Nevertheless, the fisheries port data which were issued by KKP Fisheries Port Information Centre shows that fisheries production activities of Bajomulyo port is still in the lowest ranks than other fisheries ports in Jakarta, Pekalongan, Sukabumi, and Banten (BPS, 2018).

The development of technology in this situation at least highlighted the changes into three aspects of capturing fisheries activities, i.e. the development of technology of fish capturing which consists of the development of capturing tools and fish capturing armada (ships and machines which were used), and the development of supporting facilities of fish capturing activity. According to the informant, there are two periods to view the portrait of fishermen communities in Juwana, namely the time before fishermen communities in Juwana use ships as production modes, or can be called as traditional fishermen period, and the time after.

The Development of Capture Fisheries in Juwana

I. The period of traditional fishermen

Fishermen communities on both villages uses a more modest capturing fish tools in 1965 in the form of fishing rods which are made of cotton yarns and applied using hands, without machines. The boats which were used are even modest, made of woods and was driven by sails. In this early period, fish capturing activities were done by the coasts with limited cruising distance. This activity was also

depending on the weather condition and the wind direction. The fishermen's productions in this period are limited because all of the fishermen perform a *one-day fishing* activity with the products were immediately sold after harbored. In this period, fish sales were done openly in location which are now becomes TPI Unit 1 Bajomulyo. There were no selling mechanism and management on the capturing product trading location. Buyers are usually fish merchants and retail buyers for household consumption. There were not many fish management.

"*…in the past we still used a boat with sail. Thus, it was difficult to go sailing. The wind was very influential. After that it entered the boat's machine. This was very helpful, since the fishermen could go any time. It is the story of the fishermen here before the ships like now came…"* (KRI, Tokoh Nelayan Senior Dusun Karangmangu)

After the period of1965, fishermen boats started using machines. The use of these machines was not separated from the government programs which provided loans for modest boat machines with the capacity of approximately 3 PK. After recognizing machine as boat movers, fishermen were able to explore further, but were still with their *one-day fishing* activity. This technological development has made fishermen able to sail any time without being hindered by weather condition and wind direction. The types of API which were used were still fishing rods, although the materials were made from plastics and nylon. The development of API has made more capturing products because the capturing tools last longer. Sales are still carried out no so much different from the methods in the period before 1975.

II. The period of fishermen with fish boat

The next step of technological development is quite significant. In 1973, Juwana fishermen stated that trawl ships began to be seen passing by near Juwana waters. These trawl ships were not owned by the people of Juwana, however not long after that a financer from Semarang started to introduce ships in Juwana with API *purse seine* on 1978. This period is the starting point for Juwana fishermen who usually used boats as a production mode to start to use ships in their fish capturing activities. There are changes in the fishermen work system according to the role divisions on the ship. At this time skipper/helmsman/*tekong* was known as the captain of the ship. Slowly, there are a variety of professions of fishermen. Wage distribution system have started to change and developed since Juwana fishermen were introduced to the work system using ships. Fishermen sailing period has also increased up to three days until months.

"*…in 1978 the first purse seineentered Juwana. It belonged to a Letkol Handoko from Semarang. This ship first was held by Yodo, the ship captain. In the past ice was used instead of a freezer…"* (KRI, Tokoh Nelayan Senior Dusun Karangmangu)

In 1980's Bajomulyo and Bendar fishing ships started to sprung up. These ships were called fishing ships because API that were used were [*betot*] fishing rods with baits that were captured using [*payang*] or small [*cantrang*] *betot* fishing rods used were hundreds or even thousands. As time went by, the ship machines capacity increased, the number of hooks and lengths of net that were used also increased. Until this day, fishing ships were known as holler ships, because [*betot*] fishing rods which were used have been replaced by holler as many as 10,000 hooks. However, baits that were used were the same, which were small *cantrang* catches or *duplang*. Right now, holler ships have a large holding capacity and are able to sail up for as long as 40 days.

The next development is the emergence of ships with API *purse seine*. In 1985, there were local financiers who had *purse seine* ships and they kept developing. At first p*urse seine* ships in Juwana had a sailing time approximately from one to three months. *Purse seine* ships had a relatively bigger capacity than other API ships. At the beginning of its development, *purse seine* ships still used ice and salt technology to store capture fish products. The development of freezing technology such as *freezer* around 2005 has made *purse seine* ships to develop quite rapidly in terms of size and length of sailing. The implication from this cooler technology was the sailing length which started from only 1 – 3 months became 6 – 7 months. The capacity of the ships was also increasing, because fishes were able to survive longer and were in good condition onboard. This has made the owners of *purse seine* ships tend to use freezer, and then add the capacity of the ship. The additional capacity of the ship implicates

on the adjustments of WPP which requires ships over 30 GT to sail at WPP 714 (Arufuru Ocean) and WPP 713 (Makassar Strait).

In the same period, *cantrang* API ships started emerging. At first, *cantrang* or *duplang* was only used as a bait capture for fishing ships. However, because the results were pretty good and promising, some of the fishermen then decided to use *cantrang* API as their main API. The number of *cantrang* ships gradually increased and their sizes gradually developed. The fixed results from the period of 30-40 days has made the *cantrang* fishermen grow rapidly. In 1995, *cantrang* ships above 30 GT has started to appear. Recently, *cantrang* was classified as a banned capturing tool by KKP. This policy gained a major rejection from the fishermen, even pushed a massive social movement (Nasution et al., 2019).

"*…hehehe, in the past fishermen looked for baits using a small cantrang. But gradually because the results were good, (and) the profit was not bad. So people said they would use cantrang …"* (SGT, Kepala Desa Bajomulyo)

Another capturing tool that emerged next was squid net which was equipped with light technology in the early 2000, followed by *cakalang* ships in 2005 which used API similar to *purse seine* but with bigger mesh. Both of these ships didn't use *freezer* technology at first. These days *cakalang* ships are already equipped with freezer, while squid net still uses ice and salt technology until today to preserve the fishes. Squid ships were allowed to lean and unload in TPPI Unit 1 Bajomulyo, and *cakalang* ships were allowed to lean and unload in TPI Unit 2 Bajomulyo.

Freezing technology onboard or *freezer* started to be developed in Juwana after 2005. This technology gave a significant influence to the sailing period for some of the ships, and also presented transportation ships which were not equipped with capturing tools. These transportation ships worked together with large capacity ships especially *purse seine*, to transport capturing production to the port or to the nearest TPI or even back to Juwana, so that those capturing ships could still operate without spending extra money to unload the fishes. The fees offered were counted in kilograms of fish and the WPP of the fish origins were subject to different tariffs. The farther the distance ofthe fish captured, the higher the cost of the fish per kilograms.

The fishermen highlighted that capturing fisheries technology in Juwana had a significant development after the introduction of machines as a driving force of the fishermen's ships until the period of the *freezer* technology development. Juwana fishermen as the fishermen community of capturing fisheries also had a technological development both from the production mode (capturing tools) aspect and supporting facilities and infrastructure of capturing fisheries activity.

"*…technological development here was the fastest. Now everything uses satellite, not to mention big vessels. Well, it can be said that everything uses satellite…"* (MST, Nakhoda sekaligus Bakul ikan)

According to the informant, the fishermen community in Juwana especially in Bajomulyo and Bendar village, have a significant technological development and it is dominated by the fishermen self-help initiatives. Some of the informants, senior fishermen even claimed that the technological development of capturing tools is all the result of the fishermen's creativity. There is also a technology which is created by a third party, such as a private party, as a product that is offered to the fishermen. This technology supports tools for ships, hulls, machines, even digital equipment. "*…it can be said that all capturing tools are the fishermen's creation. The government has never given any…"*(RMJ, Tetua sekaligus Nelayan senior di Juwana)

The factor which pushes the technological development in this fishermen community is the profit offered by those fish capturing technologies. Technology adoption carried out by the fishermen is a rational choice. The result of the 2018 observation on this fishermen community is the government and private [parties] actually have a role in various technology socialization, starting from socialization of capturing tools until offering to use machines and operational supporting materials for the fishermen's ships.

"*…here the fishermen did everything by themselves. Especially for satellites. Yeah because it is profitable. Generally they install it. Sailing becomes easier. We know weather prediction, prediction where fishes are available…"*(MST, Nakhoda sekaligus Bakul ikan)

The technology socialization motive which were done by the government and the private parties was certainly different. The government usually brought mandate to push the use of capturing tools to increase productions, to push the use of alternative capturing tools, or in order to control – observe fishermen and also capturing fisheries tools. One of the technology socializations done by the government was in 2018. It is about an alternative capturing tool a substitute for *cantrang* fish capturing tool which was banned. Another example is the advice which developed into an obligation for the fishermen ships above 30 GT (Ship tonnage is a volume which is stated in *gross tonnage* [GT] and *net tonnage* [NT]) – government regulation no. 51 year 2002 on shipping) to use *vessel monitoring system* (VMS) as an observation appliance for central ship motion.

*"…VMS was an obligatory. We must pay it ourselves. If we didn't install it, SIPI would not be issued. We were monitored directly by the Headquarter. If we turned it off, they would know… " (*SRT, Nakhoda kapal *purse seine)*

Private parties, of course has a different aim if compared to the government. Juwana is a large market share for the industry of fisheries, shipping and other types of activities which are related to capturing fish business. The observation in 2018 showed that private parties often visited the fishermen organization secretariats to offer various shipping supporting tools and materials. One of the informants even said that the Juwana fishermen community, especially in Bajomulyo and Bendar village, never had trouble with searching for shipping tools needs. All of their needs are available in Juwana. Usually the provider will visit the fishermen. It can be said that Juwana becomes one of a developed regions, especially in the capturing fisheries sector.

"*…here we have plenty, no difficulty to find anything. It is always available. If you need a spare-part, you will find it. It is not difficult…"* (MST, Nakhoda sekaligus Bakul ikan)

The API technological development after the emergence of *freezer* technology until today have not yet made any significant update. The Bajomulyo Fisheries Beach Port Office (KP3) recorded the routine statistics of the types of the ships and capturing tools that came in and out of Juwana Port before the types increased. Until January 2020, there 279 ships that entered and 310 ships that sailed off from Juwana. The development which supported the fish capturing activity was a navigation tool which right now has developed into using satellite. However, the information obtained is still around coordinates, the result of *eco-sounder* imagery with limited distance, and the use of SSB radio. This ship navigation really helps the fish capturing process. However, almost all of the ships still depend on the captain ability to decide the *fishing ground*, then the navigation tools will be used to identify the specific location. The information on the presence of the fishes is still obtained by mouth to mouth or from the radio. The access of *big data* for fish capturing are yet to be used by the Juwana fishermen.

The utilization of capturing fisheries technology using navigation tools which is now developing in Juwana according to the informant cannot be separated from its function to protect the fishermen or as a production push. For the fishermen, all of the technologies especially the digital technology which right now is largely used gives a benefit for the safety of the fishermen before and during sailing. It provides information on weather forecast, waves, the location of corals and currents also the location of capturing, and gives extra certainty for the fishermen to formulate a strategy for fish capturing. Through the help of digital and communication tools on the ocean which is getting better, the fishermen can reduce obstacles and challenges such as hot spots because of the existence of corals and sea waves which are less beneficial, and also estimate the safer path for sailing.

"*…using satellite enables us to do anything. Information on weather, fishes, corals, everything is available. The most important thing is it provides the path. We can avoid big ships. It is dangerous if it is too close. We will be hit…"* (MST, Nakhoda sekaligus Bakul ikan)

Fishermen ships can also avoid merchant ships which can be one of the main concerns for the fishermen if their sailing path is near these merchant ships. Merchant ships are bigger if compared to the size of fishermen ships. According to the informant, it often happens that merchant ships do not realize that there are fishermen ships near them, so accidents happen. Other than through satellites, fishermen can also use radio network with a 585 frequency to notify each other when in high seas. Through this channel, fishermen especially the captains can notify each other on the latest condition of the sea, ask for help and coordinate with other ships or with the officers on duty at sea.

"*…using a satellite, telephone, or radio is helpful in time of emergency. Logistics can also be ordered and sent to the mid-ocean. If a friend's ship is also in need, we can help. The important thing is to remember channel 585, special for sailing… "* (MST, Nakhoda sekaligus Bakul ikan)

Another benefit from using digital technology on capturing fisheries activity is as a pusher of increased production. According to the informant, with the guaranteed security, and the allowed clearer information and fisheries sailing, the production process becomes more effective and efficient. To determine the fish capturing areas is not too difficult anymore for the fishermen. This development clearly helps to improve production. One of the informants concluded that the function of security and that of economy for the use of digital technology of the capturing fisheries are two things which are related to one another and cannot be separated.

"*…if we consider which one is more difficult, the same, they are not separated, safety yes, getting more fishes is also yes. Thus, equal, economy and safety…"*(MST, Nakhoda sekaligus Bakul ikan)

According to the informant, right now the access to digital technology onboard are not the limiting variable. Whoever onboard can observe and learn to use digital tools. There are no certain restrictions and limitations for ship's crew. However, there are a lot of ship's crew who have not understand to operate digital tools. Ship captain are usually dominate the operation of digital tools, because their duty is to navigate the ship. The case is different if talking about the chains after the fishes arrived on land. According to the informant, the use of technology is not that significant on helping the fishermen to obtain a better selling price. The patron bond becomes one of the obstacles. On this step, digital technology is more beneficial for the fish tradeswomen as the buyers and also for the fishermen's capturing product middlemen. The tradeswoman can check the price of the fishes in a larger market to compare the prices when taking the fishes from the fishermen. According to the informant, the fishermen in Juwana are basically only as the price acceptors, because their bargaining position is weaker than the tradeswomen. Nevertheless, according to the informant, the fishermen still get a fair amount of payment for their work.

According to the informant, the use of internet for trading on cyberspace has not yet been able to replace the practice of direct buying and selling with the fish tradeswoman. The virtual trading chain system has not been established; it requires additional investment for distribution of fish such as for preservation and so on. The cut from partnering with *online platform* has not yet also been able to compete with the tradeswoman who have become their regular buyers. Overall, some of the informants stated that technological development brings a lot of improvements for the fishermen community in Juwana, especially in Bajomulyo and Bendar village. Their economic life becomes better with the help of digital tools, because it increases their production.

Several supporting industries of capturing fisheries activity developed quite rapidly in Bajomulyo and Bendar village, both in upstream and downstream industries. The fishermen did not have trouble on searching the types of shipping equipment, both sailing logistics and ship machines' equipment. The upstream industry, such as bait provider, ice factory to carry fish preservation logistic onboard, even after unloaded from the ship, is developing. Downstream industry such as fish management, fish factory and fish *fillet* is also developing. The ship repair service business (*docking*) is also well developed. There is one large ship repair location in Bajomulyo village. According to Fisheries Port Information Centre, KKP, there are at least 240 fisheries business listed with a total of 3,128 labors in Bajomulyo.

Globally, it is known that there are a few steps of industrial development which are characterized by technological development that follows, that is 1.0 industrial revolution when the society started agricultural activities technically and built housings, then followed by 2.0 industrial revolution when steam machine was found and the start of mass production. This development was followed by 3.0 industrial revolution which was marked by computerization. Right now, the world is facing 4.0 industrial revolution, which is marked by digitalization and connected with information (Salgues, 2018; Schwab, 2016). If it is linked with industrial development globally, technological development experienced by fishermen community in Juwana represents the position of 3.0 industry because they still use computerization for capturing fisheries information, and are on the verge of entering the all-connected 4.0 industry. The fishermen of Juwana actually have not yet entered the 4.0 industry

because the majority of capturing fisheries activities they are doing have not yet been able to take part in the connected information system which is more complex than the primary information.

The Social Structure of Fishermen Communities in Juwana

The community structure or the social structure has a variety of definitions. Kinseng (2017) concludes that some sociologists' opinion on social structure, among them state that social structure is a repeated relation pattern which continuously and happens routinely like social roles, groups, organizations, institution and society (Harper, 2015; Spector et al., 1977). Blau (1977) said simply that social structure refers to social position in society. Blau's view then becomes the most common definition of social structure. Fishermen community is one of the examples of community with a unique developed social structure. Fishermen as the main subjects are closely related to the capturing fisheries production process which becomes the main resource of this community.

Blau (1977) stated that the social structure of society can be observed using nominal parameter horizontally and using discrete parameter vertically. Kinseng (2017) summarizes Blau's thought by giving examples like vertical social levels that can be differentiated by income and tenure. Horizontally, social levels can be differentiated by a nominal parameter which means that there is a difference whose levels cannot be determined, like ethnic. There are various ethnics in the world, however, there are no one better or higher if compared to others.

Each fishermen community has their own specific social structure. For example, the fishermen community in India, they have a developed social structure fit for their culture and norm and also local wisdom passed on from one generation to the next (Coulthard, 2011). On the context of the fishermen community in Juwana, their social structure has developed with the presence of capturing fisheries technology. In the period of traditional fishermen, the social structure of the fishermen was not as complicated as that of the ship period. The entry of technology which enables the fishermen in Juwana to use a more complex and various ships and capturing tools becomes the turning point of social structure of the fishermen in Juwana both vertically and horizontally.

In the more traditional fishermen period, one boat both on the era before using machines and with machines, there was only the structure of owners and their partners on finding fishes. One boat was used by two to three fishermen to find fishes, with an equal profit-sharing system. No one became the master over the other fishermen. The fish capturing activities were mostly done for fulfilling the subsistent needs, and the rest was sold, but not for accumulating capital. On their development, vertically, fishermen were able to buy machines for their ships to become the actors who sit on the upper layer. However, just like in the period with no machine, there were no fishing laborers term yet. The result of fish capturing was still shared equally among the sailing fishermen (Image 2).

The change of social structure that becomes a more complex structure happens in the fishermen with ships period. During the traditional period, the fishermen community social structure was far more modest, and the relation between fishermen in one boat is equal. The upper layer was fishermen who were able to buy machines for their boats and the lower layer was fishermen who generally used boats without machines. In the period of fishermen with ships, the social structure changes to be more complex. There is a social layer differentiation, vertical and horizontal. The vertical social layer is determined by the ownership of ship assets, capital, and power variables. In the period of fishermen with ships, came the top layer which consists of big fishermen which is the owners of the ships, middle layers are skippers and caretaker of the ships, and the bottom layer is fishermen labors. The horizontal social structure differentiation is shown by the emergence of types of ships and dominant capturing tools which are used by the fishermen community in Juwana, if compared to the more traditional fishermen period which tends not to have a significant variety of boats and capturing tools.

Vertically, the research of Situmeang et al. (2020) mentioned that there are several stratifications in the fishermen of Bajomulyo and Bendar. There is a stratification outside the ship, among others, the ship owner as the highest power holder, the caretaker of the ship as the right-hand man of the ship owner as well as the one that plays a role to prepare and to make sure that the ship is ready to sail also the fishes are sold after the sail, skipper as the leader during operating the ship and ship's crew (ABK). The role of ship's caretaker on providing the ship's logistics is very important. The ship's caretaker ensures that the preparation of the baits, fuels, holding money, food and the ship papers are well available. Another

important role is as the bridge between the ship owner and the skipper. It often happens that the skippers stated that they do not know the owner of the ships, because all this time the only contacted the ship's caretaker. Meanwhile, the stratification on the ship is differentiated according to share of work and responsibilities during the fish capturing.

"*…the only person who knows everything about the ship logistics is the ship caretaker. He prepares everything before the ship departs, including document papers. Fishermen do not know anything, they just bring fish and get money…*" (PMD, Pemilik kios di TPI, mantan nelayan)

Horizontally, it is clearly seen that there are various types of ships and capturing tools that are used. Previously, there were only one type of capturing tool. However, right now there are at least six types of capturing tools that are most predominantly used. The fishermen of Juwana see the different types of capturing tools as a nominal parameter, because comparing each types of ships and capturing tools with economic and production result variables is the most difficult. There are various variables such as sailing time, types of captured commodity, also the variation of ship size, so it is difficult to know which types of ships have the highest strata.

Social structure changes are not a simple thing in public order. Mubyarto, Soetrisno, and Dove (1983) mentioned several cases of the efforts to introduce technology to push the progress of agricultural and fisheries sector in Sleman and Jepara, which resulted in social structure changes in society that tended to weaken the social moral of society. One of the significant pushes was the increasing fish capturing product and it pushed the fisheries industrial development in North Java Coast. However, on the other side, the use of big ship with this massive fish capturing tools damaged the environment. Eventually the profit from this introduction was only beneficial for the ship owners.

The changes of social structure experienced after the emergence of fish capturing technology in the north Java coast shows that technology is able to change almost all of the economic aspects of society. The same case of technological development also occurs in Bajomulyo and Bendar village, sub-district of Juwana. Nevertheless, there is a unique variable in the form of social solidarity which develops in the Juwana fishermen community. The fishermen community solidarity in both villages has a unique characteristic. Theoretically according to Durkheim (1984), solidarity is divided into two, which are mechanical and organic. For Durkheim, mechanical solidarity is characterized by repressive law, in which the members of the community tend to be similar and live up the same moral values. This co-built value is well guarded, so that the changes rarely happen. Organic solidarity is characterized by restitution law; the bond between moral values within the community is lower and is not emotionally binding. Ritzer (2010) added that organic solidarity is attached to the society which has experienced differentiation so that the people can work together better, but they tend to be more individualistic.

According to the meaning conveyed by the informant about the solidarity development as the social character of the fishermen community in both villages, it is seen that mechanical solidarity dominates the social relation of the fishermen community in Juwana more. Brotherhood pushes the emergence of mutual help practices between brothers. One of the forms is the practice of persuading the brothers to join on building the fisheries business such as contributing money to buy ships, becoming middlemen, having a fish processor business and so on. This practice is called '*nanting*' which means elevating other people's lives. If one of these assisted brothers can stand on their own, then the joint-business will be developed into an individual business, so it pushes up the social mobility for new actors. On the other hand, this solidarity also maintains the upper layer of the community to stay in their position, without competing with other funders from outside community.

"*…I was nothing, then my uncle helped me to share to buy a ship. Now I can stand on my own. Thank God. Here we help one another…"* (HAR, Pemilik kapal cantrang, sekaligus sekretaris organisasi cantrang)

In principle, according to the informant, this "helping the brothers" practice is one of the indicators that the economic and social life of the fishermen community in both villages always keep improving. The lower layers which are far away from the opportunity to do social mobility like ship workers or crews, are usually newcomers from various other regions outside both villages. This causes their economic development and social mobility are not so significant.

"*…a labor like me is just like this. I am not from here, I have no one. I was asked by my friend to come here on 'pursen' ship…* " (MTR, anak buah kapal/buruh)

The solidarity between classes of Juwana fishermen community becomes one of the unique factors which also makes the factor that causes class polarization not so extreme in the fishermen community of Juwana. This especially happens to the fishermen who were born and raised in Juwana. The newcomer fishermen in Juwana do not seem to get a chance of *nanting,* unlike the native Juwana fishermen. Their sense of the same fate as fishermen who try their luck to earn money at sea is far more important when facing the problems within the community, both fishermen who use API/similar types of machines and between fishermen with different capturing tools.

The existence of boundaries in thefishery chain that is beneficial for internal fishermen community of Juwana through *nanting* bond has pushed improvement in the fishermen community's welfare in both villages. Without this solidarity mechanism, the development capturing fisheries technology can create a structural imbalance which can later become bigger because of the technological mastery imbalance by some parties.

The pretty good condition of the community to maintain its economic capital flow around its members is also one of the reasons why class polarization is not clearly or extremely interpreted. According to the informant, the majority of upper class fishermen community in Juwana is occupied by the community members themselves, not the funders from outside the community, like other cases in other fishermen communities. This causes the actors of each class to be closely related. Thus, the existing exploitation relation is not too visible and the upper class is not fully exploiting either, because there is a consideration of family relation with the lower class. This applies to all of the members of the community; however, it is a little bit different for other actors who come from outside the community.

According to the informant, the *nanting* practice is one of the proofs that show how weak the polarization class is. Relation exploitation which should have covered the mobilization path of the upper class is open with the *nanting* mechanism. Brotherhood relation is another bond besides the work relation status, and it also causes communication between the upper class and the lower class to become closer. The bottom layer actors and top layer actors are very likely to have casual conversation in their *angkruk.* On this occasion, complaints and agreements of rights and obligations are discussed, especially by actors in the internal community.

The bottom class as the most vulnerable class that experiences surplus suctions (Siswanto, 2008; Suseno, 1999; Satria, 2015) is also given a freedom to choose whomever they will keep working for, Situmeang *et al*. (2020). If the sharing results are unfair, the fishermen workers can easily move to work on other ships without any resistance from the owner or the ship caretaker. This especially applies to lower class actors that come from the internal community. For lower actors who come from outside community, propensity of exploitation will be higher.

A weak polarization also influences the conflict between classes and social layers in the fishermen community in Juwana. The Javanese culture values which focus on maintaining peace, mutual cooperation, function of role models, and also religion values become the background of conflict reducer between types of API/production mode. The development of formal rules which strictly divide the fish capturing areas, sailing areas, and capturing tools specification also helps reduce the friction between fishermen with different types of API/production mode. Another example is levy provisions also manage the fishermen ships not to harm each other when looking for the belay location of production tools.

The fishermen association and organization become a quite effective problem-solving entity, both as an organization and a structure which contains role models and leaderships. Conflicts between fishermen groups with a specific API/production mode are usually solved by deliberation and also refer to advice from senior fishermen actors in Juwana. Other forms of hospitality such as social gatherings, recitation of the religious book, and gatherings outside the association can also be a communication medium to reduce conflict escalation between fishermen with specific API/production mode. Therefore, conflicts which happen within the fishermen community in Juwana are not conflicts between fishermen community with certain types of API/production mode, instead they lead to individual cases. These cases are usually resolved in kinship.

According to the informant, another factor which causes the fishermen of Juwana not to expose their conflict is that they are facing common enemies or common issues. The government policies which are generally considered detrimental to the community like sailing license suspension for ships with the capacity above 30 GT (which implicates on licensing of ships with any API), the prohibition of *cantrang* and other local issues build a community unity to concentrate on arranging a social movement to fight against those detrimental policies.

Religious values are also one of the important factors to prevent class polarization and become the conflict reducer between classes or even types of production tools. The influence of Islamic religious values especially which put forward gratitude and alms is assessed by the informant as one of the preventions of polarization and conflict. *Nanting* practice is one of the forms of 'alms', i.e., sharing sustenance with their relatives.

On one side, those religious factors are in line with Marx's thought who stated that religion is an opium that strives to obscure the exploitative relation. However, these religious factors which chime with cultural factors are also a criticism to Marx's thought which neglects the cultural factor and the community history as another determinant to analyze conflicts between classes.

The complexity of social structure that happened in the fishermen community in Juwana up to February 2020 showed that this community tended to experience social layer differentiation both vertically indicated by the appearance of other social layers and horizontally by the appearance of fishermen grouping according to API and their main capturing commodities. The technological development which was influenced by the *nanting* mechanism brought up new layers with no clear polarization in the fishermen community in Juwana.

The change on fish capturing systems caused by the fish capturing technological development at least has brought changes on the profit-sharing system, sailing duration, and onboard work division. The relation between fishermen which was previously simpler such as partners developed into owners and ship workers. However, their solidarity especially for the native Juwana fishermen is still maintained, so the relation between layers is not afar and experiences an affirmation towards polarization.

Polarization is likely to happen between the fishermen laborers from outside the fishermen community in Juwana, who work in the coast. These laborers who come from outside the community did not have a chance to do *nanting* because they do not have enough root of kinship to push their brotherhood solidarity which intertwined between the native Juwana fishermen. These laborers who come from outside Juwana tend to stay on the bottom layer and further away from the top layer. There has to be a deeper study to see how far the social protection is from exploitation that they get if compared to the native Juwana fishermen labors.

This finding corresponds with the result of the research by Hayami & Kikuchi (1987) which compares the technological development of some villages in the Philippine and West Java. However, it is noted that the research of Hayami & Kikuchi cannot fully be compared with the case of the fishermen in Juwana, because both observed communities have different ownership objects that become the determinant of the dynamical structure. Social dynamic on the villages observed by Hayami & Kikuchi (1987) happens because there are technological changes in agriculture and land domination pattern, and also every work relation which happens to the fishermen with API, ships and their production relation system as the observed production mode.

On the research of Hayami & Kikuchi (1987) there are villages that experience technological development then pushes the tenure and work system on agricultural sectors. The observed villages show the social structure dynamics which lead to social stratification because there is no capital accumulation happening (in this case agricultural lands) in a group of actors. There is tenure distribution on a smaller size caused by the pressure of the total population. Nevertheless, the changes in an arable system and employment contract cause an uneven income and wealth distribution.

The polarization in the villages observed by Hayami and Kikuchi shows that there is expansion effort on agricultural lands by the rich farmers in a large commercial scale so that the polarization happens between the rich farmers and the people with no lands. In the Juwana case, the technological development has indeed pushed the top layers, but the vertical mobilization is not closed like in larization case on the research of Hayami and Kikuchi.

Economic Improvement and Fishermen's Welfare

The Implication of The Development of Capture Fisheries Technology and the Fishermen's Welfare

The welfare of fishermen community is one of the reasons of exploration and utilization of fisheries technology. The effort to see the implication of technological development and community welfare tends to be interesting, especially from the point of view of the fishermen as the subject of capture fisheries activities. Various research on fishermen communities raise the issue of fishermen welfare as the top goal of empowerment and fisheries technology introduction (Mahulette & Nugroho, 2017; Tajerin et al., 2017; Imaniar, 2017). According to the previous researches, community welfare can be understood as an assessment relevant to economic variables, participation on development and access, and also the use of coastal resources. The research conducted in other countries (Hussain et al., 2011; Nurul Islam et al., 2014; Zaiman et al., 2017; d'Armengol et al., 2018; Alemu &Azadi, 2018) descriptively and qualitatively was also based on understanding the welfare of the similar variables as the fishermen community in Indonesia.

The presence of fish capturing technology that simplifies production process and is supported by post capturing facility according to the informant has given a great contribution for the economic development of both villages. In quantity, the amount of fisheries production in Juwana according to the cumulative data of fisheries production in Central Java in the period 2010-2016 always increases (BPS, 2018). Sofianto's (2017) studies also stated that Juwana has a unique policy on poverty alleviation. This is also confirmed by a few informants, that the development of capturing fish technology in Bajomulyo and Bendar today provides welfare to the fishermen and the society at large.

"*…technology that is developing has clearly led to improvement. Now catching fish becomes faster and is easily predicted. If the weather is bad, we will not go sailing. To find fish location is easy by using satellite…everything is fast…"* (MST, Nakhoda sekaligus Bakul ikan)

"*…if fishermen use sophisticated tools, they will get a lot of fish…it's beneficial.. .starting from fishermen, middlemen, women who make fish fillet, stalls. In other words, if the capture is good, economy will also become better…*" (PMD, Pemilik kios di TPI, mantan nelayan)

The improvement of economy in Bajomulyo and Bendar is not only felt by the fishermen. According to the previous research in 2018, various fishermen organization stated that the proceeds from fishing improves, as well as gave an impact to the village's welfare. The village government of Bendar also gave the same explanation that fishermen organization also gives contribution to the construction of various public facilities in Bendar and Bajomulto village. Through fishermen organization, fundraising for social and society activities are also done, so the construction of roads, house of worships, donation for the orphans, and financing on cultural activities like sea charity always receive a big contribution from the fishermen.

"*…organization usually collects money from each ship. It is collected from each trip. Then the money will be managed by the organization. For example, our ship cantrang, the money will be collected by cantrang organization. It is for social activities, like the mosque, roads, orphanage, sick persons, or accidents. Yesterday we gave our opinion to Jakarta and the money was also from organization…*" (HAR, Pemilik kapal cantrang, sekaligus sekretaris organisasi cantrang)

Another indicator that the technological development gives a good impact to the economy is the independency of the fishermen, especially ship owners, ship managers, and skippers to strive the utilization of the new technology for their fish capturing activities. This shows that the rationality of the fishermen economy is clearly visible through the adoption of fish capturing technology which is conducted independently with their own expense. "*…everything here uses satellite. Usually at our own cost. We don't mind because it pays off…"* (MST, Nakhoda sekaligus Bakul ikan)

CONCLUSION

The fishermen community in Juwana, especially in Bajomulyo and Bendar village face production mode changes as part of the capture fisheries technology development. The changes in fish capturing technology starting from capturing tools, ancillary equipment for fish capturing up to the process after capturing the fishes have made Bajomulyo and Bendar village develop into one of the big central fisheries in North Coast of Java. There are two important periods in the development of fish capturing technology in both villages, namely traditional fishermen period and fishermen with ship period. The break-in of modern ship modes and capturing tools is a turning point for the social structure of fishermen communities in Juwana. The use of technology for this community gives a significant impact on their production activities up to their ability to improve the economy and welfare of fishermen in both villages.

The development of technology causes some changes in the social structure of fishermen community in Juwana. In the traditional fishermen period, the social structure of fishermen community was far more modest with an equal relation for fellow fishermen in one boat. The top of the layer belongs to fishermen who are able to buy machines for their boats, and the layer below is fishermen who generally still use boats without machines. In the fishermen with boats period, the social structure experience a complex development. There are a differentiation of social layers vertically and horizontally. Vertical social layers are determined by variables such as ownership of ship assets, modal, and authority. Differentiation of horizontal social structures are shown by the emergence of various types of ships and dominant capturing tools which are used by fishermen community in Juwana.

The development of technology has changed the orientation of capturing fisheries activity in Juwana from subsistent needs fulfilment to capital accumulation effort. However, these change end to push the development of stratification more than fishermen class polarization. The fishermen in Juwana are likely to experience social layer differentiation both vertically and horizontally with the emergence of various fishermen groupings based on API and main capturing commodities. The development of technology which was affected by social solidarity in the form of *nanting* mechanism brings out new layers without a firm polarization on the fishermen community in Juwana. This solidarity mechanism becomes the guarantor of the social welfare for the community to avoid disparity between social layers.

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