6. Resource management textbook for coastal fisheries in Eritrea

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Resource management textbook for coastal fisheries

Contents

Introduction

It is said that resource management is important, because in the case of biological resources, if reproduction is carried out smoothly, the same amount of resources can be used permanently. Resource management is a variety of measures to make this possible.

In general, overfishing is pointed out when fishery resources deteriorate. However, those who manage resources need to understand well that fishery resources originally have the characteristic that the amount of resources fluctuates. In other words, stocks fluctuate with or without fishing pressure. In addition, since one female lays tens of thousands of eggs, if the survival rate is improved by a few percent, resources that have once deteriorated can be restored. On the other hand, if the survival rate is even a little poor, the resources will deteriorate in a short period of time even if the resources are in good condition. This high fluctuation system can be said to be a common feature of marine resources. And since the survival rate, which has a great influence on this resource state, is greatly affected by changes in the environment, it is necessary for humans to control changes in marine resources. Very difficult. At the same time, ownership of fish stocks is established at the time of fishing. For this reason, it has the characteristic that it is not owned by anyone when it is in the sea, or in other words, it is shared by everyone (in the case of agricultural crops, it is decided who it belongs to before harvesting). For this reason, who cares for marine resources in the sea? Who will preserve the environment? (Even if it is known that it has a great impact on the amount of fishery resources), it is necessary to carefully reach consensus among the parties concerned, including the cost burden.

Three major characteristics of marine resources
1. It is a resource that reproduces autonomously.
2. A resource with high volume variability
3. It is an innocent resource

The most important thing to avoid is to apply excessive fishing pressure and impair the natural resilience of the stock when the stock is deteriorated due to environmental deterioration. In order to avoid this, it is necessary to constantly monitor the condition of the stock and the condition of the environment that supports the stock, and create a system to prevent overfishing while preserving the environment. To this end, the cooperation and agreement of those involved in preserving the coastal environment (usually the government), those involved in fishing (a gathering of fishermen), and those involved in assessing the

environment and resources (scientists / researchers). A mechanism to do it is needed. In many countries, fishery data on fisheries and catches are collected as fisheries statistics. These fisheries statistics are analyzed by governments and experts and resource management targets are set. However, in many cases, changes in the environment that have a large effect on changes in the amount of resources are rarely included in business statistics. In addition, the details of the relationship between what environmental changes affect and how fish stocks are often unclear. In addition, when setting methods and management goals for how to evaluate stocks, the biological characteristics of the target organism are not taken into consideration, or inappropriate methods are selected, which is excessive (performed for fishermen). (Impossible) management goals may be set. In this case, the effort spent collecting, analyzing, and setting targets for the catch statistics will be wasted. In order to implement efficient and effective fishery management, it is necessary to understand the scientific basis and the current situation and set goals that are acceptable to fishermen.

The purpose of this text was created as part of JICA's "Eritrean Coastal Fisheries Development Strategy Development Project" as a resource for capacity building of Eritrean Ministry of Marine Resources (MMR) staff. By using this text, MMR staff will understand the outline of resource and environmental monitoring methods and evaluation methods based on the latest fishery resource management theory, and establish a fishery resource management system suitable for the situation in each region. I hope that we will be able to proceed with discussions on.

Types of fisheries resources

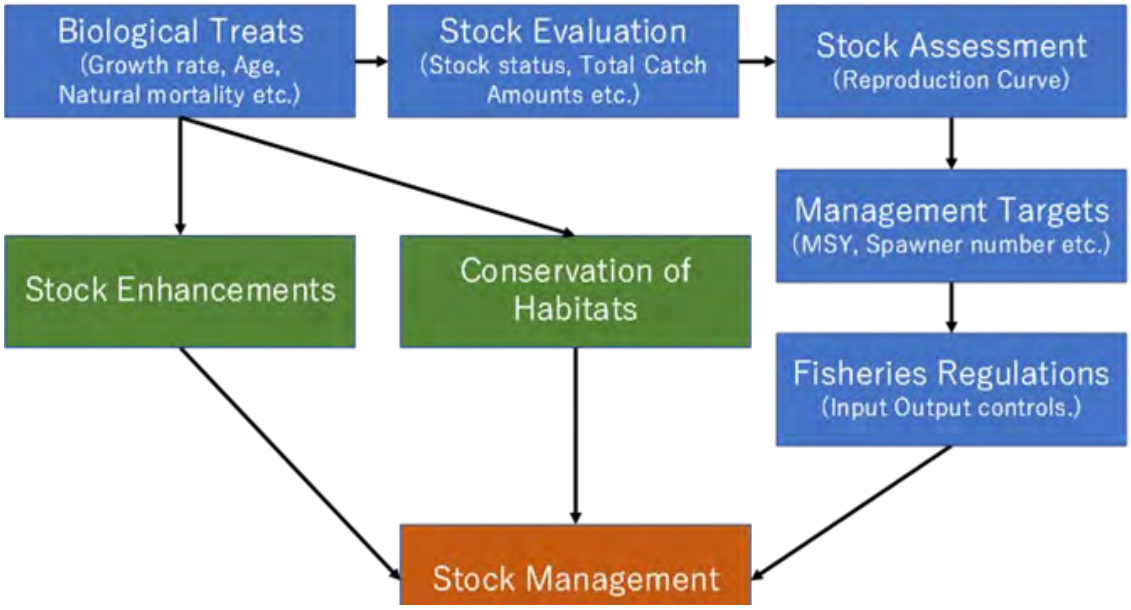
Types	Life time	Fecundity	Mobility	Environmental resistance
Highly Migration Species	Long	Many	High	High
Coastal Migration Species	Long	Many	Middle	Middle
Rock Fish	Middle	Many	Low	Low
Demersal (Benthic) Species	Long	Few	Low	Low
Shellfish & Mollusca	Short	Middle	Quite Low	Low
Seaweeds and Seagrasses	Short	Few	No	Low

Chapter 1 Concept of Fisheries Resource Management

Traditional fishery resource management has been to estimate stocks and regulate catches in order to retain the next generation of parental populations. This idea is strongly influenced by the phenomenon that resources such as whales and cod in the past have been drastically reduced due to overfishing. To be sure, overfishing is a major factor in resource deterioration for species with long lifespans and low fertility (small numbers of eggs laid at one time). In addition, there are cases where the amount of resources such as cod has been restored by reducing the catch. However, recent research has shown that a large amount of parental resources does not necessarily mean a large amount of resources for the next generation. On the contrary, there are many cases where the amount of parental resources is at least large and the amount of resources for the next generation is large. Is becoming known. In particular, for species with a short lifespan and species with a large number of eggs laid at one time, such as tens of thousands, it is said that improving the environment of the spawning ground is more important for maintaining the stock than the catch regulation.

It should be noted from another point of view that the improvement of the environment is important for the management of marine resources. This is because the deterioration of the spawning ground environment leads to a rapid deterioration of resources. And spawning grounds are greatly affected not only by the marine environment but also by changes in land. In the past, vast tidal flats spread out in Tokyo Bay, and abundant fish such as bivalves and kisses that live on the tidal flats were harvested, but during Japan's high economic growth period, the coast was reclaimed for factories and houses. , The tidal flats have disappeared, the water quality has deteriorated, and the amount of garbage has increased. In addition to the disappearance of spawning grounds and habitats due to landfill, the spawning grounds have been qualitatively destroyed due to deterioration of water quality and inflow of garbage. As a result, fishery resources in Tokyo Bay have declined sharply since the mid-1970s. This deterioration of stocks cannot be prevented no matter how the fishery is regulated. In addition to these artificial and direct changes, changes in the spawning ground environment are also caused by global warming and extreme weather. When managing marine resources, it is necessary to consider measures in consideration of the impact on resources from other than the fishery.

Chapter 2 Three Initiatives for Fisheries Resource Management



Flow chart for Fisheries stock management

Fishery resource management requires 1. Securing parent fish resources, 2. Conserving the spawning environment, and 3. Conserving the habitat. For that purpose, it would be good if we could regulate the catch to prevent overfishing, maintain the environment and smoothly carry out reproduction, but in reality, both fishery regulation and environmental conservation should be carried out at the same time. Is difficult. Therefore, in order to carry out more effective stock management, do we understand the characteristics of the target stock well and give priority to catch regulation? You need to decide whether to prioritize environmental monitoring and its conservation. Therefore, the first thing to do is to make a list of target species by fishing gear and fishing ground. On top of that, for species with particularly high catches, it is necessary to understand the spawning ground and spawning season, the number of eggs laid, the growth rate, and the stock structure (distribution range of each population) (each survey method and calculation method is See Chapters 4, 5, and 6). At that time, it is necessary to make the sea area used as a spawning ground by many species as a protected area or to establish a system to constantly monitor changes in the environment (see Chapter 3 for environmental conservation). And the last thing to work on (usually said to be the first thing to do) is to figure out the abundance of critical fish stocks (see Chapters 7 and 8 for specific methods). However, it is not always necessary to know the exact number of animals and tonnage in managing fishery resources, and in some cases (if they have been used continuously), the amount of resources tends to decrease. Understand that just grasping the

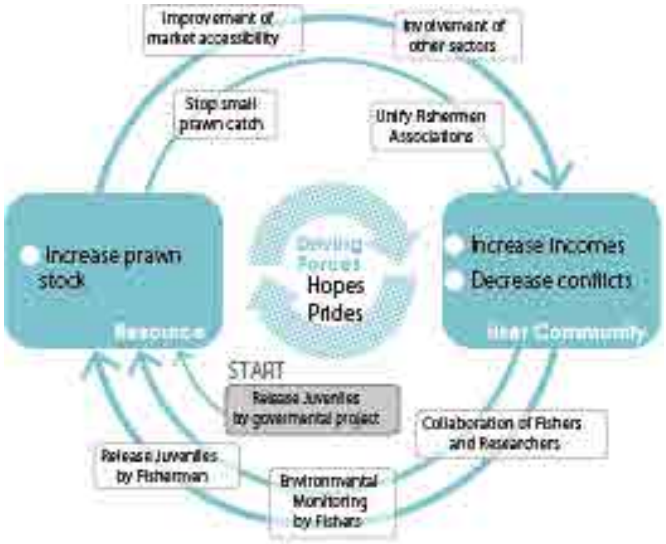
trend of resource status, such as whether it is present, increasing, or not changing significantly, may be sufficient for resource management. The belief that resource management is not possible without a detailed understanding of the amount of resources can waste a lot of time, effort, and money.

If you do not understand what kind of data is used for what and how when planning fishery resource management, you will simply collect statistical data and eventually use it for resource evaluation and fisheries. In some cases, it cannot be used for regulation. In addition, if the resilience of the stock and the variability of the stock are not well understood, there is a risk of setting excessive fishery regulations and making the lives of fishermen poor. Living poverty poses the risk of compromising compliance with fishery regulations and is the most unavoidable condition. In addition, without an understanding of the importance of environmental protection, destructive fishing activities can reduce not only the resources but also the resilience of the resources. Those involved in the fishing industry will always need to have an interest in the ocean and life.

COLUMN: Stock Enhancement in Hamana Lake, Japan

During Japan's period of rapid of economic growth in which the nation was fixated on the growth of heavy industry, much of the seashore was landfilled and reclaimed. With the loss of spawning and breeding grounds, natural fisheries resources (supply services and fundamental services provided by coastal ecosystems) deteriorated rapidly. To compensate for the lost reproductive capacity of the coastal ecosystem, the government decided to stock (raise and release) fish species important to the fisheries industry. This was the start of the aquaculture. Aquaculture research centers were established in each prefecture and began breeding and releasing hatchery-raised fish. In Shizuoka Prefecture, an aquaculture research center was established on Lake Hamana, which began stocking tiger prawns in 1980. The tiger prawn stocking program, which began as a top-down public works project, was not accepted by the local fishermen and received absolutely no cooperation from the local residents who did not believed stocking would be effective. Undaunted, the staff of the Shizuoka Prefecture Aquaculture Research Center persisted in collecting data for resource evaluation, researching aquaculture technology, conducting environmental surveys to identify suitable stocking sites, and continued to breed and stock tiger prawns, if only in small quantities. The young people of Shirasu village, who had watched the center's efforts in their own community, began to cooperate. With local support, the stocking of hatchery-raised tiger prawns increased dramatically. In turn, the increased harvest of small prawns resulting from this mass stocking opened the eyes of local fishermen to the potential of stocking prawns and led more and more fishermen to participate in each successive release. This series of changes aptly illustrates the

AC Cycle: the obvious effectiveness of stocking heightened the fishermen's interest in the resource and supporting environment and promoted understanding of the importance of caring for the resource. Thereafter, fishermen in the Lake Hamana area solidified as a community through the stocking of tiger prawns, and even went on to revise fishing regulations and improve distribution methods to more effectively use the tiger prawns, which they themselves had stocked. It is because so many local residents have come to participate and act of their own accord that the community has succeeded in augmenting its resource.



Area-Capability Cycle of the stock enhancement in Lake Hamana, Japan.

Chapter 3 Environmental Conservation Essential for Sustainable Use of Fishery Resources

Former World Bank Chief Economist Herman Edward Daly said that when it comes to sustainable use of biological resources, "sustainable use of" non-renewable resources "is a sustainable pace for renewable resources. Do not exceed the speed that can be substituted by using in. ". In other words, if resources are used without exceeding the amount to be reproduced, they can be used sustainably. This idea is also basic in fishery resource management, and the reason for leaving a sufficient number of spawning parent fish is to maintain high reproductive capacity. However, in the case of general fishery resource evaluation, it is often assumed that the reproductive capacity is constant, which is far from the reality. This is because if the environment of the spawning ground deteriorates, the number of eggs laid will decrease and the survival rate of larvae will also decrease, so the reproductive capacity will immediately decrease and the amount of resources will deteriorate. is there. For this reason, environmental conservation of spawning grounds is the most important matter for sustainable use.

In order to preserve the environment of the spawning ground, the following two points should be noted. One is the conservation of the environment in the natural state. This is an aspect of securing water quality, low quality, and a physical spawning ground. Generally speaking, environmental protection applies to this matter. The second is restrictions on the use of spawning grounds during the spawning season. Even if the water quality and low quality are good, the spawning environment is qualitatively disturbed if fishing and tourism are frequently carried out in the sea area during the spawning season. In the end, it hinders reproduction. For this reason, it is necessary to address these two issues: regular monitoring of water quality and low quality at spawning grounds and restrictions on use during the spawning season.

It is necessary to suppress the biological aspect of the conservation of the spawning ground. Many fish breed by spawning and spawning, and eggs and larvae spread over a wide area. In this case, it is necessary to maintain the condition of a wide sea area to some extent. However, in squid, octopus, crustaceans and some fish species, egg masses are laid on seaweeds and rocks. In this case, it is necessary to keep not only the target organism but also the state of seaweed and rocks, which are the spawning substrates, in a state suitable for spawning. In addition, since the seeds that produce egg masses have a relatively small number of eggs and are vulnerable to predation pressure, measures (care) to avoid predation are also required. Consideration should be given to installing an artificial spawning bed.

Although the conservation of spawning grounds is important, it is difficult for the government to hire people to do so, both in terms of cost and labor. Therefore, environmental monitoring and conservation activities are required to be carried out in cooperation with the government and those who use its resources and spawning areas (for example, fishermen and tourists). Where is the spawning ground? What time is the spawning season? In order to investigate, it is possible to conduct an efficient survey by interviewing fishermen as much as possible before conducting a biological survey. In addition, among the landed seafood, records such as when and where the egg-bearing individual is taken are also information necessary for identifying the spawning ground. By collecting this information, it is possible to identify the spawning ground and spawning time to some extent. It will be necessary to establish a system for conducting such surveys at the same time as surveying fisheries statistics and landings. At the end of spawning ground identification, it is also necessary to conduct academic and scientific research in order to carry out scientific verification (see Chapter 5 for work).

It is natural that the spawning ground and spawning season differ depending on the species. The attitude of protecting the spawning grounds of all species is impractical. Select a species that is considered to be an important fishery resource, and start conservation of the spawning ground from that species' spawning ground. In addition, the stocks of low-egg and slow-

growing species among the target species are fragile and easily deteriorated by fishing pressure. Prioritize such species when developing a spawning ground conservation plan.

Chapter 4 Geographical distribution of resources and understanding of population

Of the many target species, which species of resource management is prioritized affects not only the importance of the target species as a fishery resource, but also how much care is needed due to the poor condition of the target resource. In that case, it is naturally necessary to evaluate the resource status. The first thing to be aware of when conducting this resource assessment is the distribution range of each reproduction group of resource organisms to be evaluated.

Fisheries statistical data is often used for stock assessment. If you have the catch and effort of each fish, you can evaluate the stock (see Chapter 8 for details). However, it should be noted here that one species is not necessarily one population. It is also necessary to understand that population fluctuations (resource fluctuations) are phenomena that occur in groups. For example, sardines around Japan are divided into at least five spawning populations. For this reason, the catch amount and the catch effort amount are also calculated separately for each group, and the stock evaluation is also performed for each group.

If, in spite of the existence of multiple populations, all data are summed up and resource evaluation is performed (evaluation as one resource), there is a risk of overestimation of resource status. There is. In this case, populations with inconvenient reproduction may be overlooked, causing overfishing in certain areas. In other words, when managing resources, grasping the collective structure of resources is the first step.

There are several ways to understand the group structure. The first is a population analysis based on morphological characteristics, the second is a population analysis based on body length composition, the third is a method based on age and age, and the fourth is information such as parasites. The method, the fifth is a genetic analysis method, the sixth is a method by chemical analysis, and the seventh is a method by labeled release. In either case, the catch must be collected as a sample. Care must also be taken in how to collect the specimens.

Precautions for collecting specimens

The expected population structure and sampling plan differ depending on the ecology of the target organism. First, in the case of species that form a flock of floating fish (horse mackerel, mackerel, sardine), it is desirable to collect specimens from as wide a range as possible because of their high mobility. However, it takes time and effort to analyze by collecting a lot of them

unnecessarily. For this reason, first, information on the catch time and body size of the target species is collected from the catch data, and the areas where catches of the same body size are recognized at the same time are assumed to be the distribution range of each group. If there is no size data, collect 30 or more specimens from multiple fishing grounds typical of the peak season, create a histogram of body length, and perform statistical tests (eg, Student T test, P). Verify the size difference by <0.05). If there is a significant difference, it is assumed to be another group. In addition to size, measuring body color and pattern, number of fins, number of gills, etc. will lead to a more detailed understanding of the group structure. Squid and the like should be considered the same as this floating fish.

In addition, even for floating fish, in the case of highly migratory species (Spanish mackerel, marlin, tuna, etc.), if the migratory route is too wide than the monitorable area, resource management through spawning ground conservation may not be possible.

Especially when spawning in the open ocean, it becomes difficult to maintain the spawning ground. In this case, fishery regulations that always prevent overfishing, mesh regulations that suppress the catch of small individuals (young individuals) before spawning, and fishing season regulations are required.

In the case of rocky fish (Red sea-bream, spinefoot, etc.), individuals of different sizes often inhabit nearby areas. In addition, the spawning ground and the habitat are often the same or close to each other. For this reason, it is often possible to collect about 30 individuals from each shore and perform population analysis by measuring their size and morphological characteristics. Cuttlefish and crabs should be considered in the same way as this rocky fish.

Demersal (Benthic) fish (flatfish, Sole fish, etc.) are not as mobile as floating fish, but may be widely distributed. However, there are many species in which the distribution area of individuals in the same population changes depending on the growth stage, and 20 to 30 individuals can be collected in one sample collection at different times and locations several times during the year. It is desirable to collect. In the larval stage, most species show a swimming ecology, and many species are morphologically significantly different from adult fish, so care must be taken in species identification. Also, in morphological analysis, individuals at different stages of development should not be compared.

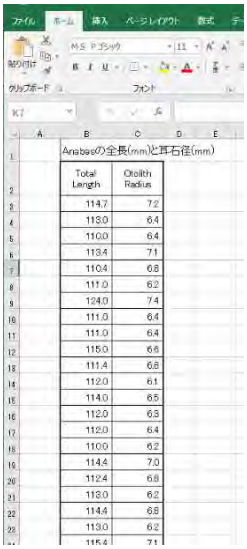
About morphological measurement and analysis

After collecting the specimens, give each individual an individual number. It is a good idea to code the individual number so that you can see the collection date and place (for individuals collected in Mitsiwa on November 3, 2020, 20201103 MAS 01, how to number and how to make tags, See FishCollectionManual)

Next, make tissue samples for genetic analysis and stable isotope ratio analysis. Save 70%

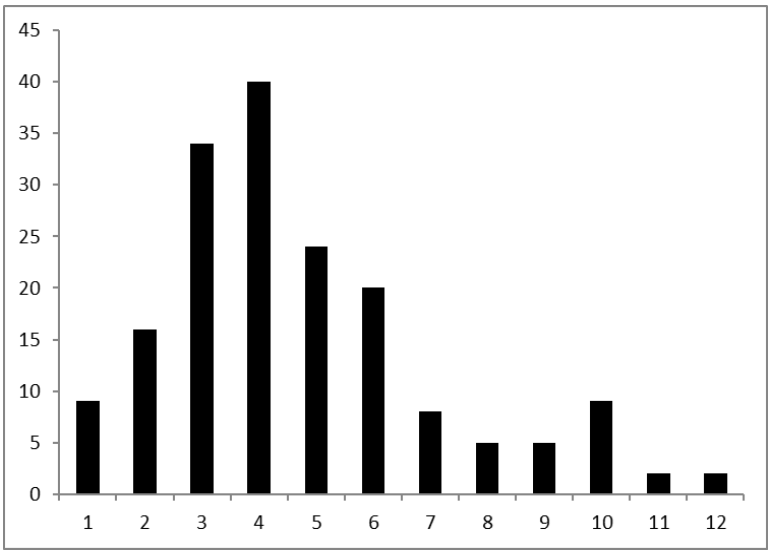
to 90% ethanol, in the case of fish, the right eyeball or muscle, or the right pectoral fin. In the case of tissue preservation, it is necessary to put each individual in another stool and assign an individual number using a stool that can be sealed. By the way, the reason for using the right side is that the morphology measurement of fish basically uses the left side. Place the photo with your head on the left side. For crustaceans and shellfish, boil once and then preserve some of the muscle. Care should be taken to avoid inclusion of shells in tissue specimens as much as possible, as shell components may contain substances that interfere with scientific analysis (see FishCollectionManual)

It is a morphological measurement. At this time, it is necessary to decide whether to measure the specimen after immersing it in a preservation solution such as formalin or to measure it in a raw state. This is because the body expands and contracts due to the preservation solution, and when immersed in the solution, the physical condition becomes shorter. Normally, raw specimens are measured. The main measurement parts are body length (or total length), body height, head length, and weight (in the case of crustaceans, shell length, weight, body width, weight, and in the case of shellfish, shell length, shell width, shell height. , Weight, etc., the measurement site differs depending on the organism, see Fish Experiment Manual).



Arabesの全長(mm)と耳石径(mm)

Total Length	Otolith Radius
114.7	7.2
113.0	6.4
110.0	6.4
113.4	7.1
110.4	6.8
111.0	6.2
124.0	7.4
111.0	6.4
111.0	6.4
115.0	6.6
111.4	6.8
112.0	6.1
114.0	6.5
112.0	6.3
112.0	6.4
110.0	6.2
114.4	7.0
112.4	6.8
113.0	6.2
114.4	6.8
113.0	6.2



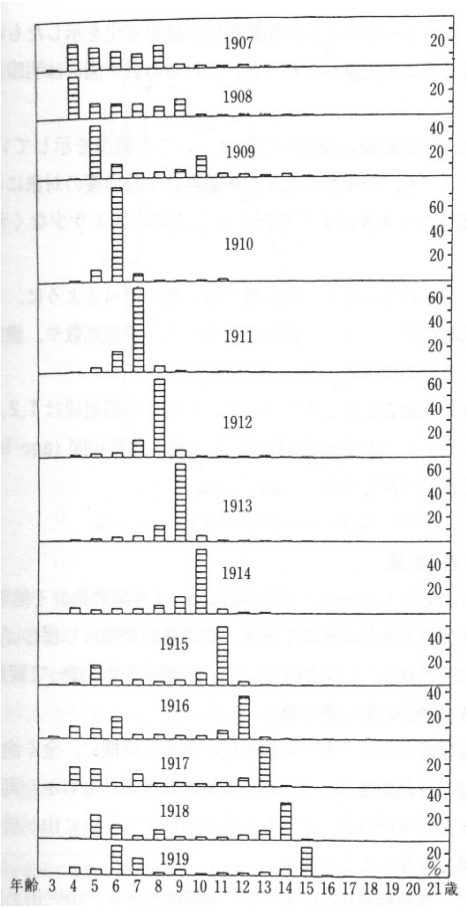
Enter the body length and weight data in one Excel column, along with the individual number.　Find the maximum and minimum values of body length (same for other data), and determine the number of histogram classes and the range of each class.

After tabulating the number of data contained in each class, draw a histogram using the Excel option.

Check the histogram to see how many mountains are formed. In future statistical tests

(comparison with other places), comparisons will be made for each peak. Therefore, when a plurality of peaks appears, it is necessary to identify which individual is included in which peak and group the individuals. In addition, data such as body length and weight may be used for grouping (the body length and weight are numerical values that are highly related, so they are not mathematically independent variables).

When examining statistical differences between groups, the Student T test (mean test) is mainly used. There are multiple peaks, but if the number of individuals in each peak is small, the Mann-Whitney U test can also be used. It can be executed with these statistical software or R program. When performing rigorous mathematical calculations, it is necessary to verify the homoscedasticity of the variance of each peak by the F-test and then perform the t-test. When comparing significant differences between multiple peaks by repeated t-test, correction for repetition (typically Bonferroni correction) is performed. However, in the case of verification of population separation in a field survey, the distribution of organisms also changes every year, so if there is no clear division (there is no difference in numerical values), one population may be used.



Monthly body length composition of herring, Norway

Column Understanding the cohort using the histogram

For long-lived species, if you make a histogram of body length every year, you can see the peaks for each outbreak group. If you look at the changes in the histogram from the data for several years, you can grasp the changes in the resources and the growth rate, and it will give you very important data for creating effective resource management measures. In addition, in the case of a species having a short life span, information on the spawning season and the initial growth amount can be obtained by sampling at a frequency of about once every month or two months and writing a histogram. It is also discretionary as training for mathematical handling, so please include it in the regular monitoring item.

Identification of distribution range using scientific analysis (genetic analysis and stable isotope ratio analysis)

Recently, genetic analysis and elemental analysis have been used for population analysis. However, in order to perform these analyzes, effective equipment and reagents are required, and specialists who actually carry out experiments are required. For this reason, these methods should be used only when it is difficult to obtain specimens and the resources are economically and socially important.

Now, even when actually performing these analyses, it is important to collect sufficient samples for the analysis. Since these analysis methods have strong judgment power, it is recommended to start by collecting and analyzing samples from the two or three points farthest from each other in the catch range. At that point, if no difference is found between the points, it may be recognized as one group at all points. By the way, in the case of genetic analysis, 20 to 30 individuals of one species may be collected at each point. On the other hand, for isotope analysis, 5 to 7 samples are sufficient.

Comparing genetic analysis and isotope analysis, isotope analysis seems to be more analytical. However, it should be noted that the two analyzes differ in what can be revealed. In the case of genetic analysis, it is determined whether the Mendel population is independent or belongs to the same population. In other words, it identifies the population that is the source of genetic diversity. This group continues across generations. On the other hand, stable isotope ratio analysis elucidates the food chain. Food chains and primary production change easily due to changes in flow and coastal environment. Therefore, it is possible to recognize the role of habitat on the spot. (See Okamoto et al. 2016)

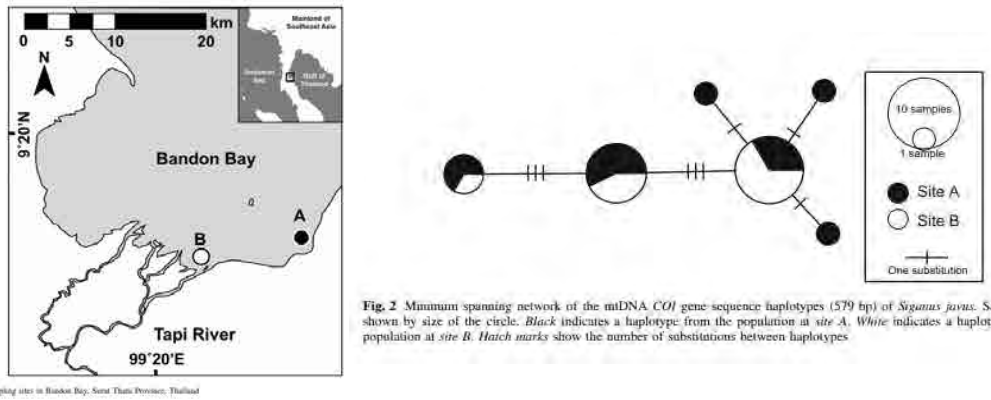


Fig. 2 Minimum spanning network of the mtDNA *COI* gene sequence haplotypes (579 bp) of *Siganus javus*. Sample size is shown by size of the circle. *Black* indicates a haplotype from the population at *site A*. *White* indicates a haplotype from the population at *site B*. *Hatch marks* show the number of substitutions between haplotypes

Fig. 1 Sampling sites in Bandon Bay, Surat Thani Province, Thailand

Okamoto et al., 2016,　They found two food chains without genetic separation in Bandon Bay, Thailand

Chapter 5 Understanding the spawning season and spawning ground

Identification of spawning season

Once the population analysis is complete and the number of important species populations and the distribution range of each population are understood, it is necessary to identify the spawning ground and spawning season of each population. If a histogram of body length is created for a long period of time, it is possible to estimate how many times a year the spawning season occurs by observing the time (month) when a new member group is formed. Then, by collecting specimens from the new recruit group and analyzing scales and otoliths, the spawning season can be clarified. In the tropics, it is said that annual rings of otoliths and scales are not formed, but it is becoming known that sun rings are formed. For small individuals, it is several months (around 200 days) after birth, and spawning can be sufficiently analyzed even in the sun (see SEAFDEC-Otolith Text for details).

Depending on the species, the age may not be assessed because the ring pattern is not formed on the otolith or scales or the ring pattern is unclear. For such species, it is necessary to specify the spawning season by another method. A way to identify the spawning season and adapt to any species is to check monthly to see if the female has eggs. The spawning season can be known by dissecting the belly of a female for 10 to 20 individuals of one species every month to see if there are any eggs. The following two points should be noted when checking for the presence of eggs. The first is that just because you have an egg does not mean that you are in the spawning season. Especially in the tropics, there may not be a definite spawning season, in which case the female is always laying eggs. The second is that not all individuals lay eggs even if they are laying eggs. Although they have eggs, there are cases where they do not mature sufficiently. Therefore, if there are egg-bearing individuals, it is important to investigate how many individuals are laying eggs in all the specimens and the increase in the laying rate in chronological order. At the same time, it is necessary to take out a part of the egg and check whether it is sufficiently matured. The shape change with maturation of the egg varies depending on the species, but in many cases, the size of the yolk, the development of the oil bulb, and the increase in the number of watered eggs are the confirmation points. The spawning season is not limited to once a year. In the tropics, many species have a spawning season twice a year, such as before and after the rainy season.

In addition to these, the accumulation of intraperitoneal fat increases in many fish before spawning, the fat mass decreases immediately before spawning, and the gonad weight reaches its maximum just before spawning and decreases sharply after spawning. A certain number of spawning seasons can be identified by collecting a certain number of specimens (20 to 30

individuals) each month and capturing changes in gonad weight and intra-abdominal fat weight. Since the gonad weight and the amount of abdominal fat are affected by the size of the body, the gonad weight index and the abdominal cavity are obtained by dividing the gonad weight or the intraperitoneal fat weight by the body weight instead of comparing the respective weights as they are. It is important to capture the time-series changes in the internal fat index. Whether to measure gonad weight or intra-abdominal fat weight should preferably have both values. However, when estimating the spawning season, in the case of a species that spawns once in one spawning season, it may be estimated based on the weight of the gonads. However, in species that spawn and fertilize several times during one spawning season, changes in gonad weight are often not significant, in which case intraperitoneal fat mass and gonad weight are reduced. The time of synchronization should be the main spawning season. It is also desirable to refer to changes in intra-abdominal fat even in species with small gonads.

Identification of spawning ground

For species whose spawning season is known, there are three ways to identify the spawning ground. One is to collect specimens from a wide range during the spawning season and narrow down the location of the spawning ground. This method is especially used for spawning and sperm breeding floating fish. After narrowing down the spawning grounds to a certain extent, collect larvae and eggs on a survey voyage to identify the spawning grounds. Once the spawning ground has been identified, it is necessary to measure the environment (water temperature, salinity, pH, etc.) of the sea area. In addition, since spawning and spawning breeding often occurs in synchronization with the age of the moon, it is efficient to carry out the collection voyage of eggs and larvae for about 5 to 7 days with a full moon or a new moon in between. is there. In addition, the spawning ground is not determined geographically in many cases, but may be defined by the structure of the water mass and the relationship (tide, salt front, etc.), so the latitude is determined at each spawning season. The longitude may change slightly. For this reason, it is necessary to record the environmental conditions of the spawning ground.

The second method is to regularly look around the seaweeds and rocks used as spawning substrates during the spawning season to see if eggs are attached. This method is important for mollusks such as squid and octopus, and for fish that lay sticky deposited eggs such as herring. In Japan, the resources of sandfish that lay egg masses, so to speak, have been drastically reduced due to the collapse of the spawning ground. Hatahata (Japanese Sandfish, *Arctoscopus japonicus*) was subsequently revived with the conservation of fishermen's eggs. For such species, the spawning ground and the conservation of eggs laid there are extremely

important for resource management.

The third is the spawning ground for species that spawn in pairs, such as rocky shore fish, but in the case of these rocky fish, the habitat and spawning ground are often almost the same or in neighboring areas. Since spawning behavior often occurs at night, it can be confirmed by conducting a survey of egg collection at fishing grounds during the spawning season. In the case of these species, if fishing is carried out during the spawning season, the fishing activity may hinder spawning. Therefore, prohibition of fishing during the spawning season is extremely important for sustainable use.

Chapter 6 Cohort Analysis

It is a basic matter to consider sustainable resource use to know the age composition in the stock by dividing the outbreak group from the histogram of the body length and weight of the catch caught by the fishery. In addition, the lifespan and growth rate of the target resource can be inferred from the changes in the histogram over time (see figure).

In the fisheries statistical data, the weight and species of the landed fish are recorded, but it is important to record the body length data for some landed fish at that time. Alternatively, for the species subject to resource management, the change in the histogram can be effectively utilized by academically grasping the relative growth of each part rather than the growth.

However, the cohort analysis can only deal with fish whose body size is the target of catch, and although it is possible to estimate the time of joining the stock, it is not possible to estimate the spawning time because it is not possible to catch small sizes. (See Chapter 5 for spawning season estimation).

In addition, if the growth of the cohort and the change in body size composition following these size data are continuously captured for 5 years or more, the change in body size composition of the stock of the target species can be seen. As a sign of deterioration of fishery resources, there is a phenomenon of shrinking body size in the target resources (Lee effect / Fishing Down). In order to capture this phenomenon, it is necessary to pay attention to the proportion of large-sized individuals and the change in the average body length of the large-sized cohort by cohort analysis.

Chapter 7 How to grasp the amount of resources

In order to manage fishery resources and continue to use them sustainably, it is of utmost importance to identify spawning grounds and spawning seasons and not interfere with reproductive behavior (necessary) for smooth reproduction. The work was described in Chapters 4 and 5). In addition, it is necessary to prevent overfishing in order to secure the number of parent resources for breeding. Therefore, it is necessary to grasp the current state of resources, that is, the number of individuals and the age composition. The age composition has already been mentioned in Chapter 6. Populations are often estimated from fisheries statistics such as catch and effort, but they have been collected over the years with reliable data and resources. It is premised that the resource characteristic values required for estimation (growth, survival, number of eggs, etc., see Chapter 8 for details) are known. In addition, the method is not always suitable for rocky fish, which are easily affected by overfishing and whose resources are depleted in a year or two. Here, we will introduce typical survey methods that can be used in coastal areas and analysis and evaluation methods of data obtained from them in order to grasp the population.

1 Grid survey line census method (reef area)

Because the number of parents is drastically reduced due to overfishing, the habitat is limited in the first place, such as rocky shore fish, as a species whose resources are likely to deteriorate. After determining the distribution of these species because they are also less mobile (see Chapter 4 for understanding the distribution), grasp the number of individuals living in a certain range such as line census and grid survey. Based on that, the total number of individuals can be estimated.

In the case of species that do not move at all, such as seaweed, or species that have extremely low mobility, such as crabs, the total amount of resources can be calculated from surveys using quadrats.

2 Mark re-capture methods (for movable organisms)

In the case of highly mobile species such as floating fish, the number of individuals cannot be ascertained by line census. In this case, the population can be examined by the labeled release method. The label discharge method includes a method of attaching a tag and a method of cutting a part of the tail and fins. Not only fish but also crustaceans that molt can be used, but it is necessary to verify how to mark each species.

Petersen method

$$N = n \times X / a$$

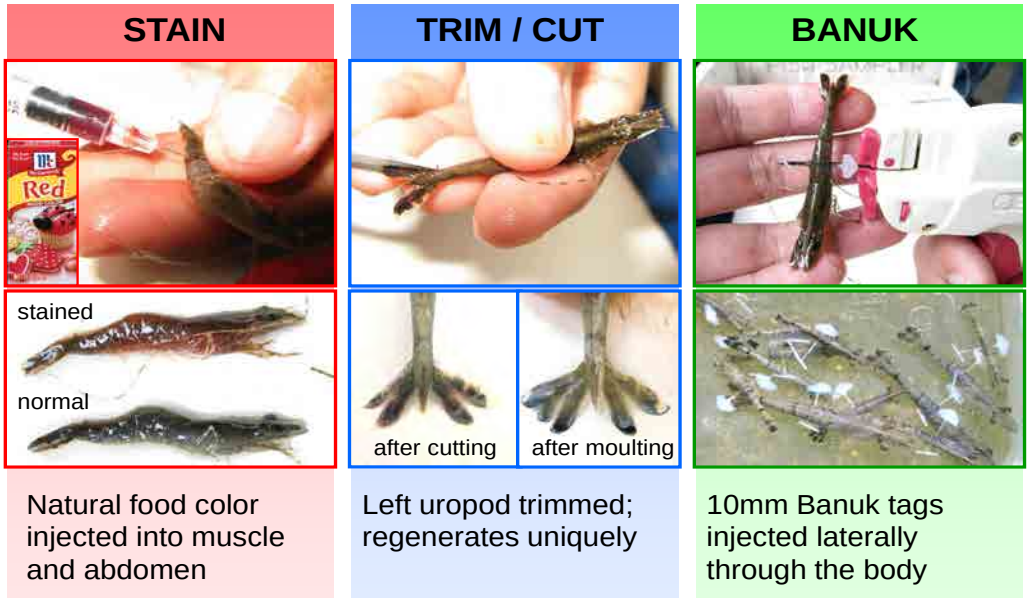
N : Individual number of a stock

n : Number of caught individuals after release

X : Number of marked individuals for release

a : Number of recaptured individuals with mark

Ex. Released 100 inds with marks, 50 individuals are caught after release, and 5 individuals have marks. $N = 50 \times 100 / 5 = 1000$



In addition, the recovery rate of the label is considerably low in the species having a wide migration range and distribution range. For this reason, it is necessary to secure a sufficient number of individuals for marking (about 1000 individuals should be prepared). Also, when marking, be careful not to put stress on the fish body so that the survival rate after marking does not decrease. At the same time, it is necessary to avoid restrictions on behavior. In addition, it is necessary to prepare to collect tagged individuals from fishermen and residents (see Chapter 9, Co-management). Therefore, the sign mark needs to be easy for anyone to understand and find. On top of that, it is important to widely inform fishermen and residents that they are conducting a tag release survey, and to create an incentive to report such as providing some benefits if an individual with a sign mark is brought. Yes (in many cases, creating systems and rules is not enough)

3 Spawning survey method (fish species spawning along the coast)

In the case of fish species that lay eggs along the coast, such as small floating fish, the stock of parent fish can be estimated from the number of eggs. Prepare a net for collecting eggs with a drainage meter (mesh is about 0.1 mm to 0.3 mm), and coefficient the number of eggs per unit volume at the spawning ground during the spawning season. From the number of eggs and the size of the spawning ground, the total number of eggs spawned during the spawning season is calculated. Therefore, the number of female parent fish can be calculated by dividing the number of eggs laid by the number of eggs contained in one female. If the sex ratio is known, the number of stocks can be calculated from the number of female parents.

However, in order to estimate the amount of resources in the spawning survey, it is necessary to understand the spawning season and spawning ground, the number of eggs that one female holds, the distinction between single and multiple spawning, and the number of days from spawning to hatch. It is necessary to collect information on spawning ecology in advance, such as grasping. On top of that, if the spawning ground is wide and it takes a long time to collect eggs, or if the spawning period is long and different individuals lay eggs on different days, hatch during the spawning period when calculating the total number of eggs. It is necessary to consider the individual to do.

$Pk = Pe^{-zk}$

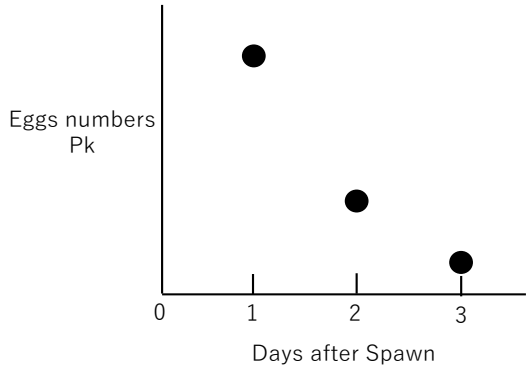
P: Total number of Eggs spawned in a day

Pk: Total number of Eggs after k days

Z : mortality of eggs par day

$\ln Pk = \ln P + \ln e^{-zk}$

$\ln Pk = \ln p - zk$



Total number of eggs spawned is obtained by regression equation.

Chapter 8 Use of Fisheries Statistical Data

If there is a record of catch and effort by type of fishing gear for several years, and if the species to be evaluated and managed is caught in a particular fishing gear, then the nature of the target species. If there is biological information such as mortality rate and growth rate, these data (fishery statistical data) can be used for resource evaluation and management. In addition, after the stock assessment, the stocks subject to resource management must be in a state of

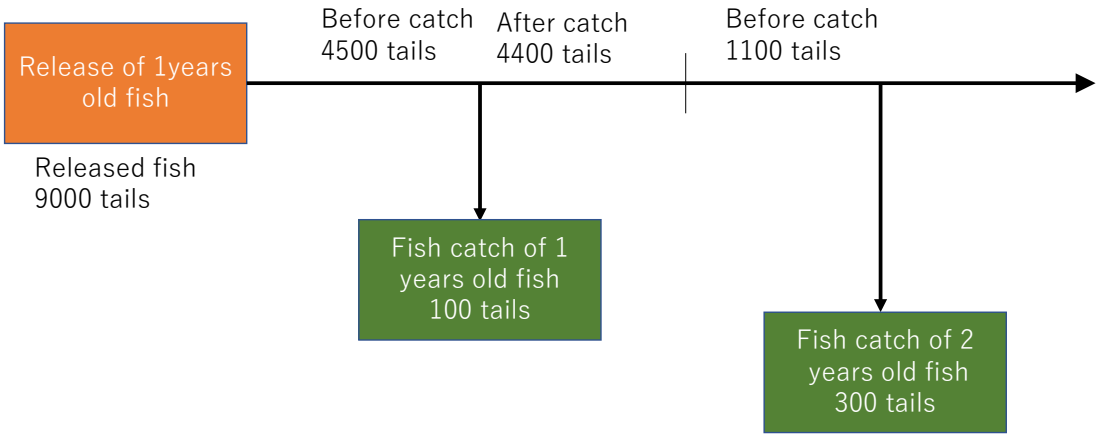
being caught only by a specific limited fishing method in order for the measures to prevent overfishing to function effectively in the fishery regulations. is there. Fisheries along the coasts of tropical and subtropical regions are often characterized by Multi-gears and Multi-target species. In this case, the impact of each fishing gear on the target stock (fishing pressure or catch mortality count) is different, so even if the stock can be evaluated, it is extremely unlikely that effective fishery regulation can be implemented. Therefore, the construction of a fisheries statistical data collection system and the statistical data analysis method, which are often used in resource evaluation and management, are not suitable. This is because these methods require the collection of a considerable amount of biological information and statistical data in order to carry out resource assessment, and there are very few situations that can be practically adapted in tropical and subtropical regions. Therefore, in this book, we will introduce these methods at the end. Here, we will introduce two methods, VPA and CPUE, that may be feasible in Eritrea.

1　VPA-Virtual Population Analysis (suppoeted by Prof. Matuishi, Hokkaido Univ.)

VPA is a method of estimating the number of stocks using the number of fish caught by age (note that it is not weight). It is an internationally standard resource valuation method, and is also used in the calculation of Total Allowable Catch (TAC) of various international organizations and Japan. Recently, theoretical development research has been conducted to estimate more accurate numbers, and complicated VPA calculation methods have been proposed, but here, basic theories and practical examples are proposed so that they can be adapted to the circumstances of the land. Introducing.

Theory example

A large number of 1-year-old fish were released into a pond in January of a certain year. The number of released fish decreases to 25% per year (natural mortality rate of 75% per year). After the release, the fish were caught every June, and 100 fish were obtained in the first year,



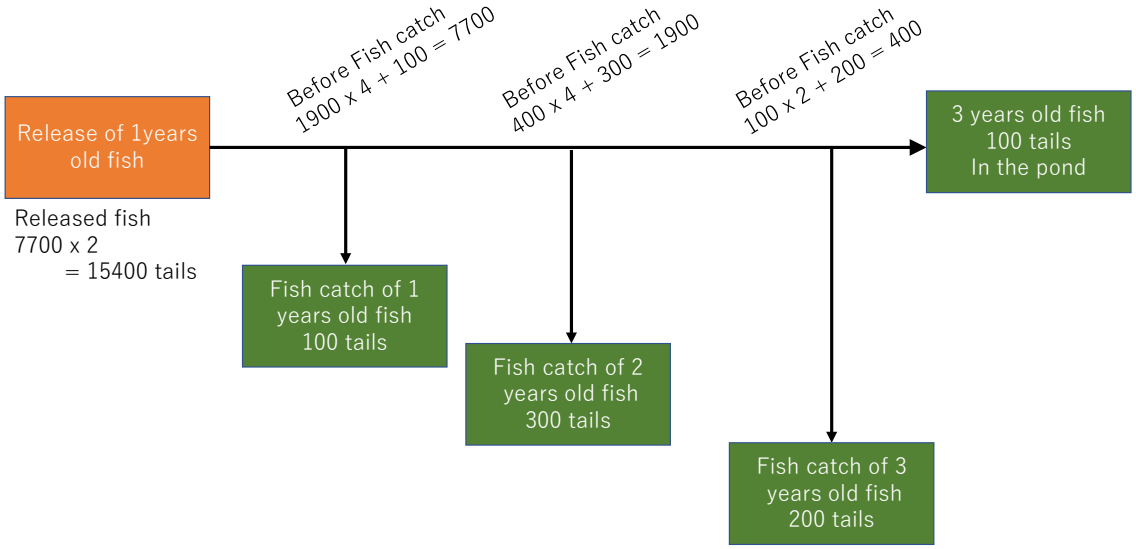
300 fish in the second year (when the fish was 2 years old), and 200 fish in the third year. How many fish were originally released? (Discharge is only once)

Way of thinking

200 fish were caught in June of the third year. The survival rate of 25% (1/4) means that the number of individuals will be halved (1/2) in half a year. Therefore, there should have been 400 fish in January of the third year. And in July, the second year, half a year ago, there were 800 fish. Since 300 fish were already caught in June of the second year, there were 300 + 800 = 1100 fish before the fishery was carried out in June of the second year.

Applying the same calculation from January of the third year to June of the second year from before the June fishing of the second year to before the fishing of June of the first year, it is January of the second year. Should have inhabited at least 2,200 fish, and six months ago, in July of the first year, there were 4,400 fish.

In addition, since 100 fish were caught in June of the first year, there must be 4,500 fish before the fishery in June of the first year. From there, it can be seen that at least 9,000 1-year-old fish were released when they were released six months ago.



In addition, if there are individuals that have been missed in the fishery in June of the third year, the number of released fish that became the basis for them must be additionally calculated. If 100 3-year-old fish survive, the number of 1-year-old fish released must be 15400 or more.

When calculating VPA, if the natural mortality coefficient (survival rate ≒ mortality rate due to factors other than fisheries) changes, the value will change. This natural mortality coefficient needs to be calculated in advance by biological research. It should be noted that the natural mortality coefficient does not change between each age, or the average value of

the mortality coefficient of several years is often used. Also, the value of the initial amount of resources changes greatly depending on the number of surviving individuals. Information on the amount of stock (number of fish) after the end of fishing is also required by acoustic surveys.

It is necessary to know in advance the number of prey individuals by age, the natural mortality coefficient M, the estimated stock amount after catching, the relational expression between body length and weight, the composition of the caught object, and the maximum individual age.

1 st Step

$$N_{a+1,t+1} = [N_{a,t} \times \exp(-M/2) - C_{a,t}] \times \exp(-M/2)$$

$N_{a,t}$: Individual number in a stock of age a in year t

M: Natural mortality

$C_{a,t}$: Individual number caught by Fishery Catch of age a in year t

2nd Step

$$N_{a,t} = C_{a,t} \times \exp(M/2) / 1 - \exp(-F_{a,t})$$

$F_{a,t}$: Fishing coefficient on a most elder cohort

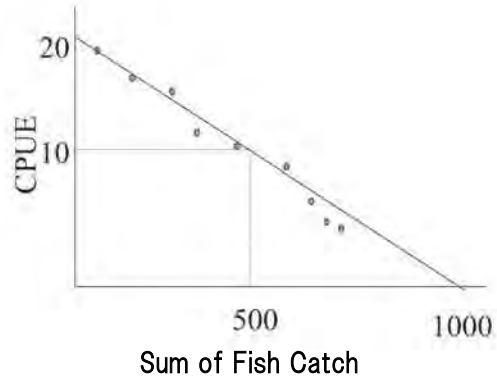
($F = q \times X$, q: catchability coefficient of a fishing gear, X : Fishing effort,

($N = F \times S$, N : Fishery Catch, S : Stock size)

$$F_{a,t} = -\ln [1 - (C_{a,t} \times \exp(M/2)) / N_{a,t}]$$

q and F may fluctuate with age, but if the catch is stable, the average value of q and F for several years can be used.

2 CPUE (DeLury method)



This is a method of estimating the amount of stock from the decreasing trend of catch per unit effort (CPUE). The required data are the catch C and the catch effort X for each fishing season. This method requires the conditions that 1) CPUE is proportional to the stock, 2) fishing gear efficiency q is constant, 3) natural death, increase / decrease in stock due to movement, and no recruitment due

to reproduction. Since there is no subscription, the stock will decrease from the initial state due to catch mortality. CPUE will also decrease in response to this (see figure). For this reason, it can be adapted to rocky fish with a long life span and a limited distribution range and population. On the other hand, it is not suitable for highly migratory species and floating fish with a short life span and many spawning seasons.

Formula

$$CPUEt = qNt = q(N0 - Kt) = qN0 - qKt$$

CPUEt : CPUE at fishery season t (Month or season)

q : catchability coefficient of a fishing gear

N0 : Stock size before fishing season

Nt : Stock size at beginning of fishing season t

Kt : Sum of fish catch until fishing season t-1

Formula 2 Using sum of fishing efforts instead of sum of fish catch

$$Nt = Nt\text{-}1 \times \exp(-qXt\text{-}1) = N0 \times \exp(-qEt)$$

Et : sum of fishing efforts until fishing season t-1

$$Ln(CPUEt) = \ln(qN0) - qEt$$

Chapter 9 Creation of Resource Management Law

Chapters 7 and 8 introduced resource evaluation methods such as resource estimation. These provide important information for resource management. The terms resource assessment and resource management are often confused. However, there is a clear difference between the two. Resource evaluation is to obtain the characteristic values of resources (growth and survival, growth rate, reproductive ecology, etc.) and to estimate the amount of resources. These are scientific activities carried out by utilizing data such as fisheries statistics and by biological research. On the other hand, resource management is an activity to prevent people from destructively using fishery resources and the environment, and is an activity that brings about sustainable regional development. In other words, it is an act of restricting human activities based on resource evaluation information. Especially in the case of marine resources, it is unclear who is responsible for conservation and sustainable use due to their non-physical properties, and care such as realistic resource monitoring and usage restrictions is provided by users (≒ fishermen). It will be carried out as a volunteer act or as a public project by the government. In addition, the amount of prolific and prolific resources fluctuates on a large scale due to the weather and environmental changes during the spawning season, even if the

fishery is not carried out. For this reason, monitoring the resource status is extremely important, but it is difficult for the government to carry out daily monitoring because of the labor costs and the budget for survey equipment. For this reason, many countries and regions have introduced participatory resource management that collects information and data from users, analyzes them by administrative organizations, and feeds back the results to users. In this chapter, we will introduce specific examples of this participatory resource management, as well as the activities and precautions necessary for its introduction.

1 Co-management (Community based set-net fishery and/or stock enhancements)

The state in which a business operator and an administrative agency cooperate to manage resources is also called co-management. In the case of participatory resource management, the management rules are decided by the administrative organization, but in the case of Co-management, the fishermen and the administrative organization exchange opinions and ideas from both sides, and the management rules and monitoring methods are based on the doctrine. Is decided. Here, we will introduce the creation of a Co-management system, taking as an example the set net fishery carried out in the Kingdom of Thailand and the stocking project carried out in Japan and the Philippines (see Text of Community-based stock enhancement for details).

Co-management in Thailand Coastal area using community based set-net fishery

In many areas, it is quite difficult to collect enough fishery statistics data for a stock evaluation, especially in tropical zone due to the high biodiversity and multitype fishing gears use. However, detailed fisheries statistics data collection using community-based stationary fishing gear has been conducted in Rayong, Thailand. The Japanese type of set-net, "Otoshi-ami," was introduced in the coastal waters off of Mae Rumpheung beach, Rayong Province, Thailand, in 2003. The Set-net was established by the fisherman community with support from the Southeast Asian Fisheries Development Center (SEAFDEC) and the Eastern Marine Fisheries Research and Development Center (EMDEC) of the Department of Fisheries, Ministry of Agriculture and Cooperatives, Thailand. And the stationary fishing gear has been operated by the fisherman community from the beginning (SEAFDEC, 2005, 2008). Additionally, Japanese fishermen of Himi City in Toyama prefecture who are conducting similar type of stationary fishing, and several researchers of Tokyo University of Marine Science and Technology (TUMSAT) gave some technical supports to the fishermen community for their fishing operations and post-harvest treatments, including managing fish sales under the grass-root program of the JICA. Himi City is very famous in Japan because of its long history of stationary fishing gear fishery (set-net fishery).

The International Set-Net Fishing Summit was held in Himi City by the Himi City government in 2002. One of the SEAFDEC staff members who participated in this summit obtained the permission of the introduction of a set-net in the coastal zone, because those type of fishing gears are prohibit in Thailand water by the domestic law. And he conducted a campaign to introduce set-net in front of Mae Rumpheung beach in 2003. The main members of the set-net fishermen community were the participants of this campaign. They live in seven villages along the Mae Rumpheung beach, and they have different jobs, including professional fishermen, farmers, and factory laborers. All fish caught by the set-net are sold by cooperative selling; half of the profits are shared by community members as their salary, and the remaining profits are stored by the community for the management costs of the set-net (Manajit et al. 2011, Mumprasit et al. 2012). After the completion of the JICA project in 2005, set-net operation and maintenance was conducted by the fishermen community.

In the first year of the project, there were many troubles in the operation and maintenance of the set net, due to the limited knowledge and understanding of the operation of fishers and the planner. Design of the set-net was improved based on the suggestion from Himi fishers and researchers of TUMSAT. And Himi fishers taught how to do the cleaning and maintenance of nets to the community members, then loads on the community had been reduced and fish catch had been increased. Besides, some staffs of TUMSAT supported to build and manage the fish market at the landing site on the beach. Fish catch of the set net were sold in this fish market under pooling system, so all amounts and prices were recorded sorted by kinds of fish products through this system. As set-net fishery holds passive fishing feature, it had been recognized as low impacts on environments and fishery stocks. And the fish catch by set-net can show the trends of fish stocks, then this fishery activity also has a function of fish stock monitoring. These features of the set-net attracted some medias including newspaper and TV programs, and broadcasted through of them. Then, good reputation of the set-net fishery spread, and prides of the fishers, which the set-net fishery can contribute to sustainable fishery and conservation of nature, were cultivated.

The case of the set-net in Rayong, Thailand suggests the possibility that community-based fishery activity can help to create a fishermen community with sustainable management (SEAFDEC 2005, 2008, Area-Capability concept book 2015). Additionally, collaborative selling and sharing of profits make it possible to collect detailed fisheries catch data that can be used for stock trends and trophic level analyses (Seak et al. 2011, 2012, Manajit et al. 2011). The collaborative management of the set-net fishery can improve management capacity of fishermen (SEAFDEC 2005, 2008). A similar approach to the set-net introduction in Thailand could be applicable for other developing countries, including Eretria.

Community-based Stock Enhancement in Philippines

Community-based Stock Enhancement national project was conducted around Hamana Lake, Sizuoka prefecture, Japan from 1972. The background of this project lunching, fishermen's protest demonstrations against national government of Japan promoted indoctrination of coastal area under heavy industry priority policy. Due to those indoctrinations, coastal habitats and nurseries of fishery species had been widely destroyed and those resources were drastically decreased. Japanese government started the community-based stock enhancement project as a compensation for fishers and countermeasures to fishery stock reductions. The stock enhancement project had succeeded especially in Hamana Lake, the resources were increased and cares on environments by fishers were increased because fishers recognized the conservation being necessary and important to support the reproductions of their target species (Area-Capability concept book 2015).

The deterioration of coastal habitats has been evident for many developing countries, especially. Particularly in the Philippines, rural coastal zones and estuaries are now being characterized by declining wild fisheries resources and degrading environment. This chapter presents as an example of the stock enhancement project conducted in the typical rural coastal town of New Washington, Aklan, Philippines. The project shows us how the concept of community-based shrimp stock enhancement can provide incentives to restore the environment and provide sustainable fishing livelihood in the area.

The New Washington Estuary (NWE) in northeast Panay Island, Philippines was a productive fishing ground that has been suffering from degenerating brackish water fisheries and estuarine environment. Average daily catch declined from 24 kg on per fishing gear in 1970s to 0.7 kg at present. Shrimp fisheries, the most important livelihood, declined in quality and quantity. The highly-priced and once very abundant tiger shrimp Penaeus monodon was replaced with smaller-sized and lower-priced species like the *Metapenaeus ensis*. These can be attributed to the conversion of 95% of mangroves to culture ponds in the past 50 years and more than 400% increase in fishing gears since the 1990s. The need is evident to reduce fishing structures and rehabilitate mangroves. However, these drastic changes directly affect fishers' livelihood. This paper explores the prospects of Tiger shrimp *Penaous monodon* stock enhancement as "positive reinforcement" for the NWE rehabilitation. Number of gears per capita may have to be reduced but shrimp catches will be relatively high-priced.

Some Japanese researchers belonging to Area-Capability project of Research Institute for Humanity and Nature (RIHN) planned to conduct a stock enhancement project in NEW aiming to sustainable fishery based on the community activities. The members of RIHN visited to the municipal office to get permission of the release of small shrimps to the estuary.

Then the staffs of RIHN held meeting with fishermen association in New Washington to share the vision, process, activities and the goal of the stock enhancement project. After coordination and preparation of the project, small shrimps for intermediate aquaculture were purchased from private hatcheries in the province. Then, intermediate aquaculture was conducted by the fishermen association, they check the water quality and reared shrimps, and put tags on shrimps for tracing them after released.

After two- or three-month intermediate aquaculture, shrimps were released to the estuary. Impacts on resources was evaluated based on the records of fishery catch noted by the fishermen association. Initially, almost all members of the association did not believe the positive impacts by the release works, however, after three months from the first release, some large size shrimps with the tags were caught by fishers, then the attitudes of them were changed and collaboration between researchers and fishermen was promoted. Improvement of shrimp catch per capita and the stock enhancement of shrimp was ensured by calculation of statistics data, then, the mayer of New Washington praised this success.

Through this release works and evaluation on environment, fishers recognized the important of microhabitats for stock enhancement. Campaigns on mangrove importance especially as shrimp habitat can encourage locals to reforest the estuary especially in abandoned ponds. With effective management, law enforcement, and sustained support from different sectors, shrimp stock enhancement can be a positive strategy in estuarine rehabilitation and livelihood sustainability in the NWE.

2 Feedback management

The analysis results of fisheries statistical data should not be used only for resource evaluation and fishery regulation in order to carry out sustainable and effective resource management. This is because fishermen are not cooperative in collecting fishery statistical data if fishery statistical data are being collected solely for fishery regulation. As a result, sufficient and reliable data cannot be collected. Also, no matter how strict the system is, it is impossible to fully implement the strict system and rules with a top-down approach, because the sea is wide and the monitoring cost is too high. Therefore, voluntary cooperation of fishermen and observance of laws and regulations are indispensable for the implementation of practicable and sustainable resource management measures. In this sense as well, the use of statistical data that merely imposes restrictions should be avoided.。

Fisheries statistical data need to be used by fishermen to understand the current situation, in addition to assessing stock status. It is important to show numerically the activities related to resource management and the expected results, such as what the current state of the stock is, how much the fishing effort should be reduced, how long and how much the stock can be

recovered. Is. Around Batan Bay in the Philippines, fishermen believed that sometime resources would recover, despite mangrove logging drastically reducing catches. Such excessive expectations for the ability of nature to recover resources pose a major obstacle in preventing overfishing. Disclosure of analysis results and clarification of expected results are basic matters in building a cooperative relationship between fishermen and the government.

Participation of fishermen in collecting data also increases the reliability of analysis results. It should also be noted that mere presentation of scientific analysis results does not provide that understanding.

For fishery resource evaluation, academically specialized and complicated calculation formulas have been proposed. These are useful for making more accurate forecasts, but calculations that are too complicated will not be understood by fishermen.

3 Area capability approach

Coastal areas are more biodiversity than the open ocean and have a large number of useful biological resources. On the other hand, the amount of individual resources is small. In addition, it is more volatile and vulnerable than the open ocean because it is affected by the coastal environment that nurtures these resources and environmental changes in both land and sea areas. Therefore, in order to carry out sustainable fisheries in coastal areas, it is necessary to monitor and conserve the habitat and spawning ground environment of these resources in addition to monitoring the catch resources.

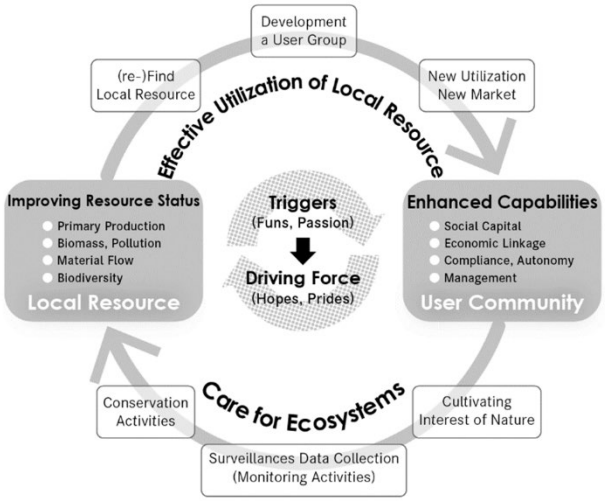
However, both maintenance activities and monitoring activities require cost and labor. There is a limit to covering this only as a national budget or administrative expenses. In addition, when carrying out conservation activities and monitoring as a job, the purpose is to carry out the activities themselves, and the relationship between actions and results, such as the original purpose of assisting resource proliferation and sustainable resource use, is weakened. There is a risk that it will end up. The purpose of conservation and monitoring is the sustainable use of biological resources, and it is necessary to create a mechanism that directly contributes to the increase of resources and the development of sustainable fisheries as a result of activities. For that purpose, the participation of fishermen who are direct resource users is indispensable for both conservation activities and monitoring.

Monitoring of stocks and the environment through fishing activities by fishermen has been shown to be possible with set nets in Thailand and shrimp stocking projects in the Philippines. On the other hand, there are many cases in which fishery regulations and conservation activities carried out only by people without specialized knowledge and skills have caused deterioration of resources and environmental destruction (phenomenon of sea turtle population and coral due to artificial hatching of sea turtles). Transplant business, etc.). For

this reason, cooperation between fishermen and humans with specialized knowledge is indispensable for conservation activities and resource evaluation.

Coastal and marine areas are not personally owned in many areas and are owned by the state or government. Also, unlike fields and forests, it is difficult to regulate entry, so in most cases anyone can come and go. In such an open access state, even if resources increase due to conservation activities and release activities, there is a high risk that people (free riders) who do not have management obligations will use (stolen) resources without permission. It is better to avoid the conflict of fishermen with this free rider because it creates a disturbance of public order and is highly dangerous. Therefore, when planning the effectiveness of environmental conservation and resource management in the sea area, it is necessary to set certain usage restrictions and entry restrictions by the government. At the same time, if conservation activities are carried out by fishermen, as mentioned in the previous paragraph, fishermen and experts (scientists) need to cooperate, and administrative cooperation needs to be added.

Administrative organizations regulate the use of areas where conservation, monitoring, and resource management are carried out, and fishermen and specialists carry out conservation and monitoring activities. It is indispensable for sustainable resource use that the data and results are shared by these three parties and form a cycle leading to the next activity.



Concept of Area-Capability Cycle. This cycle can be used for planning framework and checking platform of a project as matching with sustainability.

In conclusion

Most of the marine resources live in water and are highly mobile, so it is difficult to accurately grasp the amount of resources. Moreover, it lays more eggs than terrestrial organisms, which makes it highly volatile. In particular, the spawning season of aquatic organisms in the tropical and subtropical regions is generally long and fast growing. For this reason, if it is too important to accurately grasp the amount of resources, the labor for collecting necessary data becomes enormous, and there are many cases where resource evaluation and resource management based on it cannot be reached.

The purpose of resource management is for the sustainable development of fisheries, and all that is required is regulation of fisheries during the spawning season, prohibition of fisheries that destroy the environment, setting of appropriate fish prices, and resources. Protection of exacerbated species. Therefore, it is necessary to grasp the spawning ground and spawning season, grasp the characteristics of fishing gear, and evaluate the amount of resources. It is necessary for both the administrative officer in charge of resource management and the fishermen to fully understand this relationship. It is important to prepare catch statistics, but it is important not to collect data for stock assessment. Moreover, no matter how many rules and systems are created, sustainable development cannot be expected unless they are followed. From this point of view, it can be said that building a good relationship between fishermen and the government is the most important issue for resource management. At the same time, only resources should not be protected and the lives of fishermen should not be in dire straits. Poverty is the number one cause of poor compliance. We sincerely hope that Eritrean fishermen, surrounded by abundant nature and abundant resources, will have a rich life. We hope that this book will help you.

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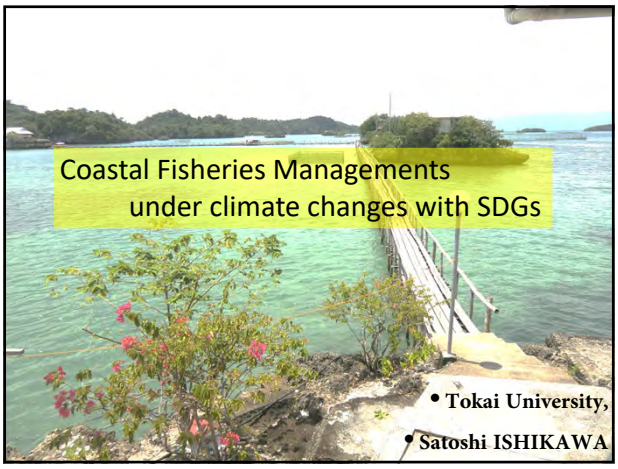
OKAMOTO Yuki, MUTO Nozomu, KON Koetsu, WATANABE Kazuya, YOSHIKAWA Takashi, SALAENOI Jintana, ISHIKAWA Satoshi, 2016, May, Stable isotope analysis suggests the existence of multiple populations of streaked spinefoot (*Siganus javus* L.) in Bandon Bay, Southern Thailand. Int. Aquat. Res., 8 : 169-178. DOI 10.1007/s40071-016-0132-3

エリトリア国における水産資源管理に関するテキスト

東海大学　石川智士

目次

7. Coastal Fisheries Managements under climate changes with SDGs



Stable Environment have fostered human cultures

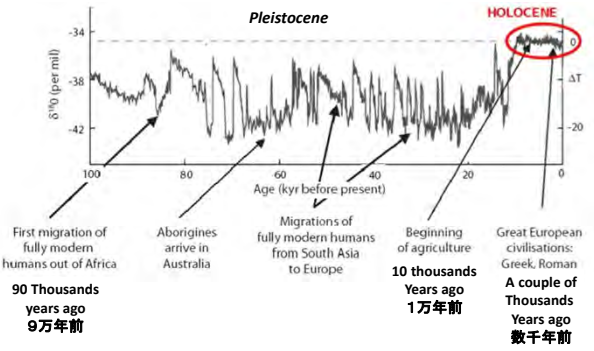
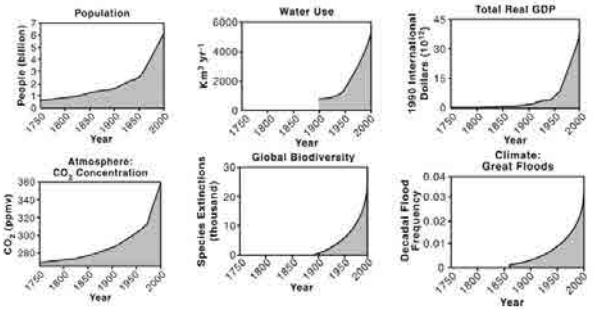


Fig. 1. The last glacial cycle of 18O (an indicator of temperature) and selected events in human history. The Holocene is the last 10 000 years. Adapted from Young and Steffen (2009).

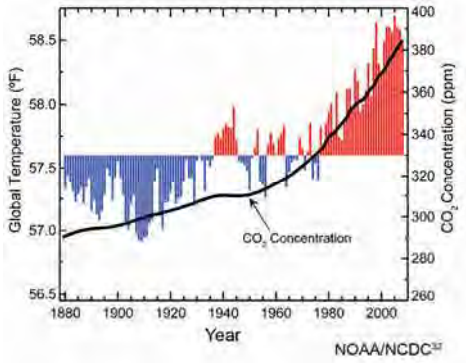
Back ground of RIHN

Rapid expansion of human activities affected on the earth systems

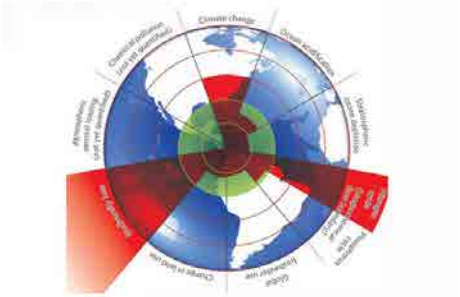


Back ground of RIHN

Earth system has been changed, and Human cannot stop this change

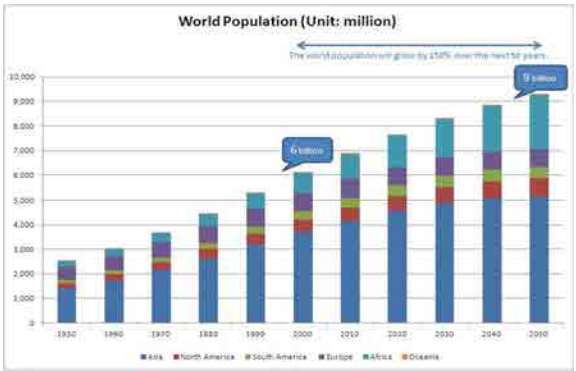


Impacts of Human Activities already exceeded Planetary Boundary



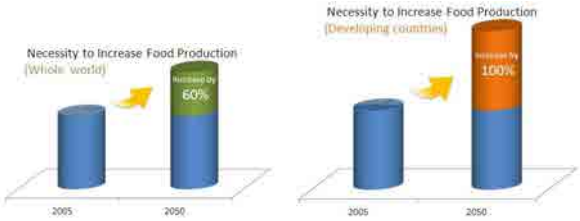
Source: Steffen et. al. Planetary Boundaries: Guiding human development on a changing planet. Science, 16 January 2015.

World's population growth forecast



Food safety has top priority for Mankind

According to the forecast by FAO. To feed the growing world population, a 60 percent increase in food production will be required by 2050. Particularly in developing countries, 100% increase in food production will be required.



Protein production is most serious

As a result of the population growing, the demand for animal protein is also increase. Then, the demand for grain for protein production will be continuing to rise.

The amount of grain required to produce 1kg livestock

- Cows need 11kg
- Pigs need about 7 kg
- Chickens need 4 kg
- Eggs need 3kg

Can we expand agricultural Production?

Same situation was in the past

- Expansion of crop fields
- Invention of artificial fertilizer
- Breeding innovation
- Global trades of foods

We got over food shortage so far. However The consequence of these countermeasures Is current global environment

Can we expand agricultural Production?

Unfortunately, it is difficult

- Not be able to increase crop yields as well as it used to,
- Long-term decline of public investment,
- Desertification,
- Shortage of fresh water,
- Conversion of agricultural land to non-agricultural purposes,
- Increasing negative impact of climate change,
- etc.

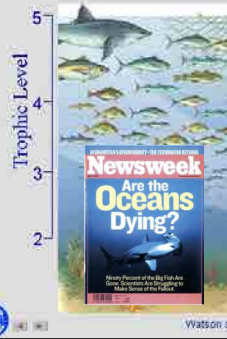
How to feed the growing population

- Marine resources have high potential to feed growing population, because the marine area covers more than 70% of the earth surface. (large habitats)
- Marine resources do not need grains *in general*.
- So, Effective marine resource utilization is the most important subject for our future.

Crisis of Ocean Ecosystem

Fishing Down Marine Food Webs

Fishing down in Global trend…?



Empty Net
(Emerson, 1994)

Fishing Down
(Pauly et.al, 1998)

Are the Oceans Dying?
(Newsweek, 2002)

Empty Oceans
(Hayden, 2003)

We can not eat fish in 2048
(Worm et.al, 2006)

Watson and Pauly In: Atlas of the Ocean NATIONALGEOGRAPHIC

Common Fisheries Resource Management

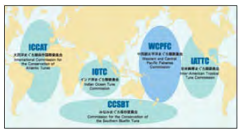
1995 FAO

Code of Conduct for Responsible Fishery

Statistical Data Collection → Stock Assessment → Regulation Fishing Activity → Resource Management

International Commission of several important Fish Resources

Data Collection, Stock Evaluation of Particular Fish
Limits of total catch amount of each species



Large-scale Commercial Fishery can be applied.

FISH and FISHERIES, 2015, **16**, 633–64

Examining common assumptions about recruitment: a meta-analysis of recruitment dynamics for worldwide marine fisheries

Cody S Szuwalski[1–3], Katyana A Vert-Pre[1,2], André E Punt[1], Trevor A Branch[1] & Ray Hilborn[1]

They measured 224 stocks of the world and 85% of stocks did not have positive linkages between mother stock sizes and next generation stock sizes. So those stock fluctuation were derived from environmental factors not by mother stock sizes.

Importance of coastal small scale fishery

Large Scale fishery	Coastal small-scale Fishery
 Single-Species, Selective Fishery	 Multi-Species, Multi-Fishery, Mixed Catch
 Professional Fishery & landing sites	 Many Fishery and Stakeholders & many landing sites
Data collection relatively easy	Data collection quite difficult

Different approach for stock assessment is required

Importance of coastal small scale fishery

Large Scale fishery	Coastal small-scale Fishery
	
About 30 million tons Catch	About 30 million tons Catch
About ½ Million Employees	Over 12 Million Employees
About 35 million tons Fuels	About 5 million tons Fuels
8 – 20 million tons Discarded	Discarded fish Very Little

Jacquet and Pauly 2008

Many issues happen in coastal areas


Destruction of Habitats


Over Fishing


Destructive action


Natural Disaster

Deterioration of Ecosystem Services

Vicious Spiral

Reduction of Productivity
Reduction of Stocks
Aggravation of Poverty


Inefficient Use

Poverty Reductions, Economic Improvement, Effective utilization of resource, Interests on Ecosystems

---

1960~1980 Rapid economic growth and urbanization in JAPAN

- Salaries were increased.
- nobody concerned the nature around us.

- Population increased in and around cities,
- Coastal habitats were diverted to industrial and housing zones
- Tidal flats and seagrass beds were disappeared
- Air and water were polluted by waste materials

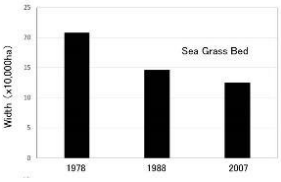
1960~1980 In Japan
Rapid economic growth and industrialization

Large seagrass beds and tidal flats were reclaimed for industrial developments. And many aquatic resources were deteriorated due to habitat losses.

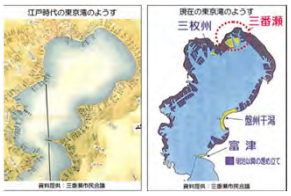
Fishermen's life became worse.
Many fishermen criticized the habitat losses and protested governmental decisions of industrialization.

Government started *stock-enhancement project named "Tsukuru-Gyogyo" in local level*. For this project, stock enhancement centers were established at all prefectures.

Seagrass Beds and Tidal flats are important habitats for reproduction of coastal organisms



In 1940s, 70% of seagrass beds were destroyed in Set Inland Sea

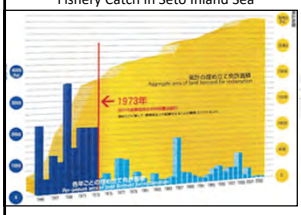


From 1940 to 1980, 90% of tidal flats were reclaimed in Tokyo Bay

These changes gave negative impacts on coastal resources and ecosystem services.

Habitats (Spawning grounds) losses derived large impacts on fishery resources.

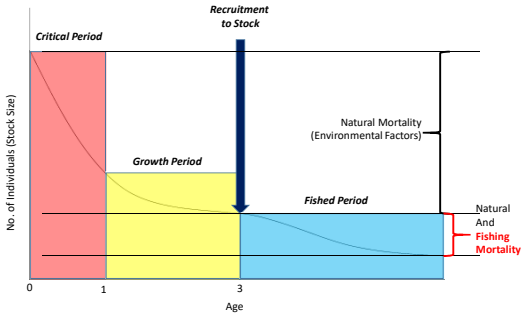
Fishery Catch in Seto Inland Sea



Fishery catch in Tokyo Bay

Land use changes give much impacts on coastal ecosystems and fisheries resource reproductions than over fishing.

Population Dynamics of a fisheries resource



Spawning and growth habitats conservation should be also taken into account.

Habitats losses have great impacts on coastal resources more than over fishing.

- **Spawning and nursery habitats** including wetlands and Sea grass beds should be conserved for sustainable resource managements.
- **Material flows** and linkage between land and ocean should be taken into account in rural and urbanization planning.
- **Hygiene and waste water** treatments are necessary for coastal fishery resource management, because food safety is affected by water quality from Lands.

What should we do to save marine resources and marine ecosystems

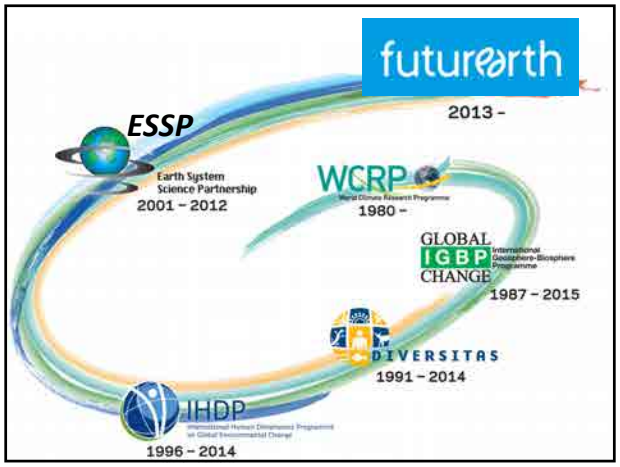
"Data collection, Stock evaluation and Set regulation" is not enough and do not function.

- To Cultivate interests of nature through effective utilizations of natural resources for poverty reduction
- To Strengthen surveillance of resource and facilitate conservation of habitats
- To Enhance social capitals and capability of people

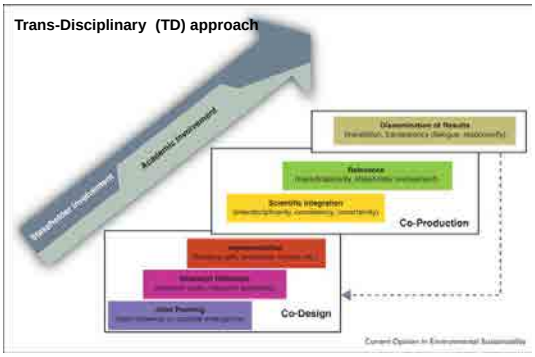
At the same time!!

For our sustainability,
We have to change our system

But, Unfortunately, No-body Know how we can do it.



futureearth *Trans-disciplinary Approach*
CO-design, CO-production

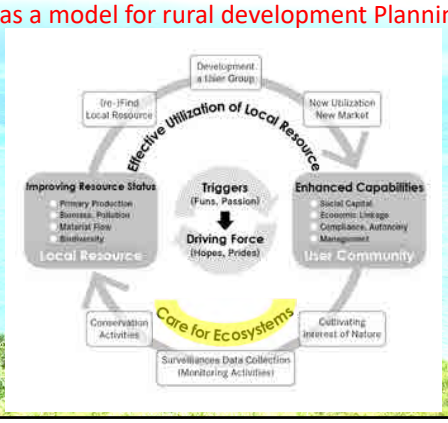


Area-capability approach

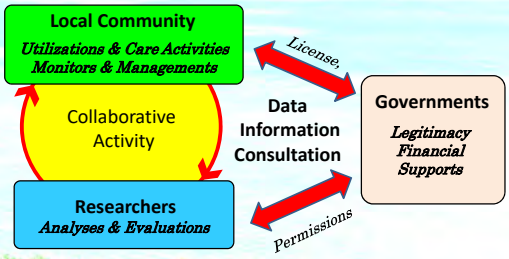
Start from utilization of resource by community

- *AN important point is **Community building and cultivate interests on ecosystem of them** through resource utilization*

Area-capability Cycle as a model for rural development Planning



Institutional Framework of Area-capability Approach



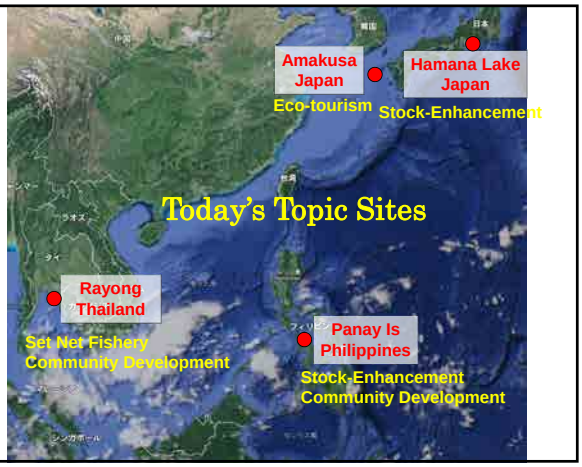
Area-capability approach is one solution!

- Existing approach is not enough to change the world.
- Nobody knows what is the trans-disciplinary approach toward changing world.
- So, we are proposing " Area-capability approach" as one model for TD action.

Area-Capability Enhancement in Southeast Asia

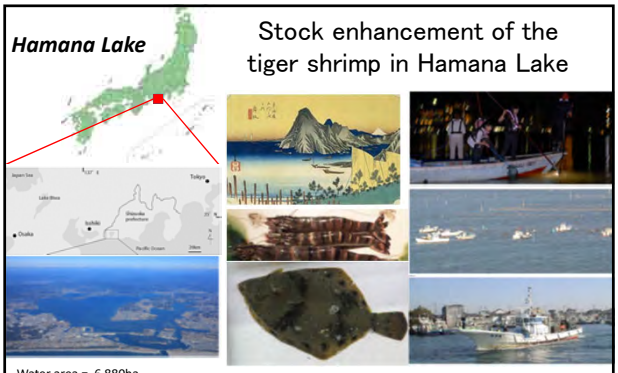
How can we find local resources with sustainable utilization ways by local communities?

We tested several good practices with local governments, local communities and researchers in various academic fields, in Japan and ASEAN contiries.



Hamana Lake

Stock enhancement of the tiger shrimp in Hamana Lake



Water area = 6,880ha
Periphery = 128km
Depth = 5m
10th in Japan

- There are traditional and modern fisheries, including both capture and aquaculture activities.
- Fishermen have been conducted as small scale commercial fishery

Basic framework and strategy of "Tsukuru Gyogyo" in Japan

In many cases,
there were no technology of breeding, and aquaculture,
there were no information about release points and timing,
there were no catch data for impact assessment.

SE Center staffs had to solve many difficulties by themselves.

Around Hamana Like

- There were 7 fishermen villages.
- They competed for fishery stocks.
- Each village had each landing.
- There were no collaborations.
- There were no exact fishery statistics.
- They did not have a sense of stock enhancement. (They conducted only capture fishery)

But, industrialization was affected on this area and fishery stocks were deteriorated rapidly.

1978 Stock enhancement Center Established and governmental stock enhancement project was started.

In the beginning, There is no experts, no technology *and no collaborations and no participation from villagers (fishers)*

Many fishers believed stocks recover naturally in near future.

Dr. Fushimi

He was a staff of stock enhancement center in chargee of the project.

Dr Fushimi conducted environmental survey to decide intermediate aquaculture site and technology developments of artificial breeding by himself. And Released 3million larvae in 1980

Young fishermen of Shirasu village locating near intermediate aquaculture site, started collaboration with Dr Fushimi.

1981 30 million larval shrimp were released

Shrimp Catch was increased, Start environmental monitoring and conservation actions

1983 Fishermen of other villages started collaboration

100million seeds were released

1985 The governmental project was terminated

Fishermen donated money for stoke enhancements

And Fishermen started release by themselves

Changes in the area

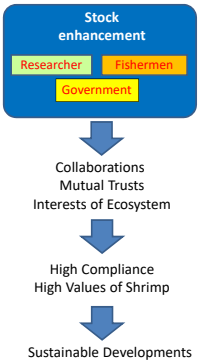
Voluntarily Actions of Fishermen

- Intermediate aquaculture of larval shrimps
- Environmental monitoring
- Stop fishing of small shrimps
- Set fishery rules by themselves and start patrolling
- Unify the wholesaling system
- Donation for stock enhancements

Mutual trust among Government, Fishermen and Researchers

- Fishery Statistics were collected
- Stock evaluation was done for regulations

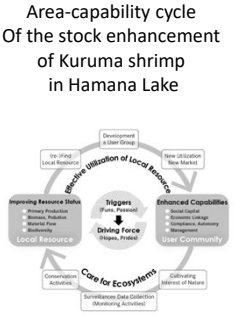
Care of nature create new values of fishery products in markets

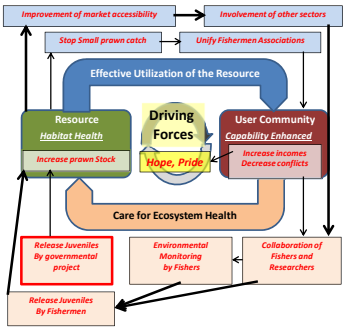


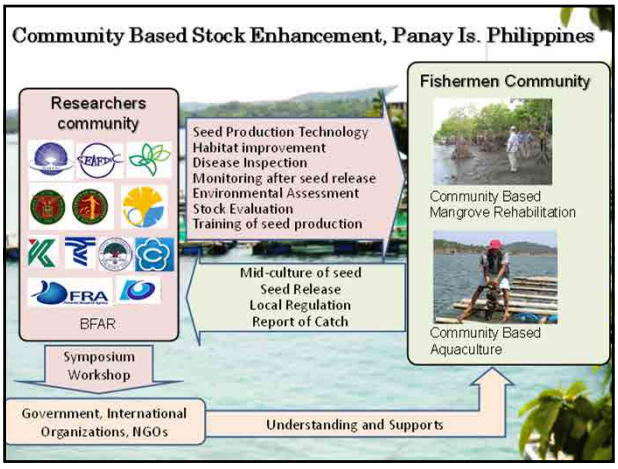
Lessons from community based Stock enhancements in Hamana Lake

1. Community based stock enhancement project can cultivate **interests of ecosystems and management minds** of fishers.
2. Reliable statistics data facilitate **effective utilization and regulation** of fishing
3. Community based trading system provide **price making power** to fishers.
4. Rules and regulations decided by users have high compliance.
5. Good balance between utilization and cares of nature provide high values of products and cultivate **prides** of fishers.

Area-capability cycle
Of the stock enhancement
of Kuruma shrimp
in Hamana Lake





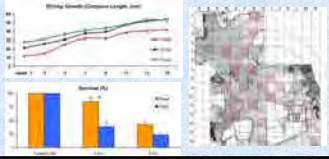


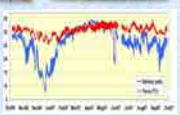
Progresses of Stock Enhancement

Stock Enhancement

- **Local Government participation**
- **Local Community Participation**
- **Implementation Discussion**
- **Base Line Survey on Livelihoods**

- **Build Intermediate Aquaculture Ponds**
- **First Trial of Community-based Aquaculture**
- **Environmental Assessment to determine the release points**





1. *To prepare and evaluate a stock enhancement protocol for New Washington*
2. *To assess impacts of stock enhancement trials and community activities*

Results: Timeline of rearing and releases

2013 July: 1st rearing (129,000 stocked)
Aug: No release (high mortality)

2014 Feb: 2nd rearing (390,000 stocked)
April: **15,000** released (4%); 100 tagged

2014 June: 3rd rearing (270,000 stocked)
July: **120,000** released (44%); 240 tagged

2014 Nov: 4th rearing (400,000 stocked)
Dec: Series of typhoons caused mortality

2015 Apr: 5th rearing (483,000 stocked)
May: **250,000** released (51%); 250 tagged

2015 Jun: 6th rearing (630,000 stocked)
Jul: high mortality caused by early prolonged rains and cannibalism

Results: Catch monitoring (Trader's logbook)

Recapture info (5th batch)

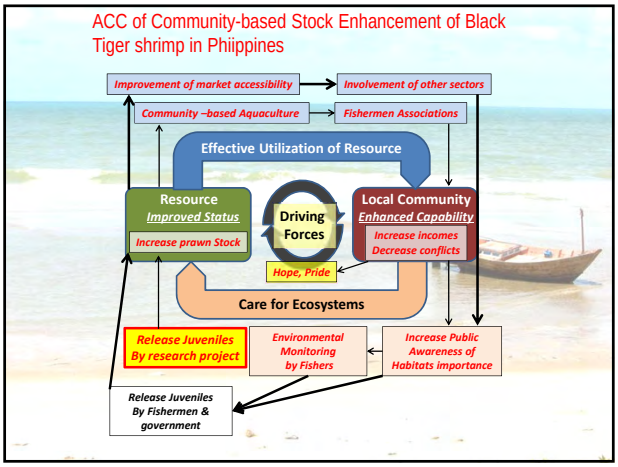
Released: May 2015
Total released: 250,000
Shrimp tagged: **250 (0.1%)**

Total recovery: 20 pcs **(8%)***
Details: July (8 pcs), 5 g (3 %)
Aug (4 pcs), 15 g (1.6%)
Sep-Oct (8), 55 g (3%)

Estimated total potential harvest:
(4 months after release):
1,100 kg (PhP220,000)

Fishers want to start other release works by themselves.

ACC of Community-based Stock Enhancement of Black Tiger shrimp in Phiippines



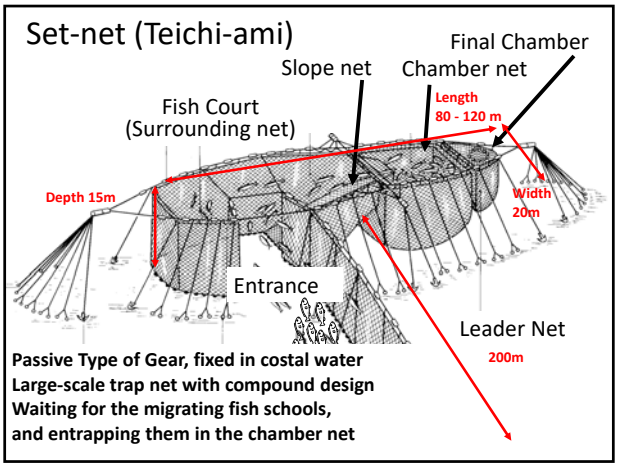
In cases the stock enhancement projects

- Participation of fisher to intermediate aquaculture and monitoring of environments cultivated their interests on nature and minds of managements.
- Realization of incomes growing and good evaluation from other sectors (tourism, education etc.) enhanced their pride on stock enhancements.

Community based Set-net fishery

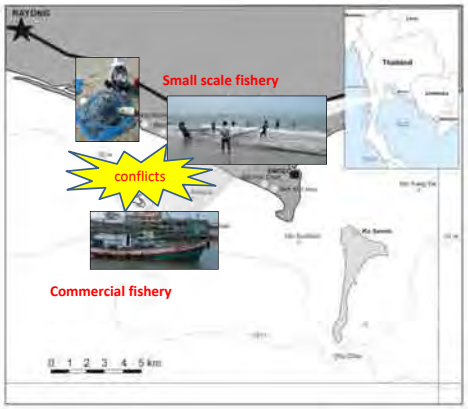
By TD/SEAFDEC and DOF/Thailand in Rayong

Set-net (Teichi-ami)

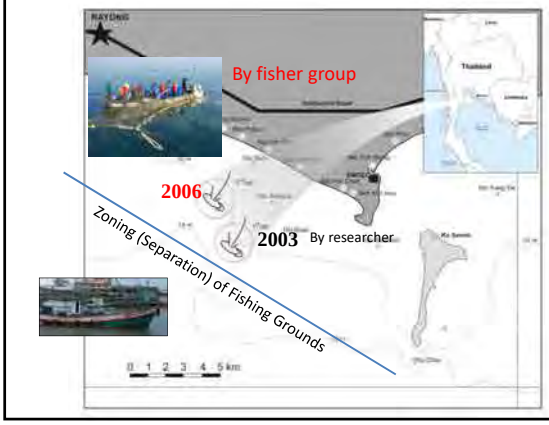


Passive Type of Gear, fixed in costal water
Large-scale trap net with compound design
Waiting for the migrating fish schools,
and entrapping them in the chamber net

Location of Rayong set-net project



Location of Rayong set-net project



History of Set-net Installation into Thailand

2001 ASEAN-SEAFDEC Millennium Conference on Sustainable Fisheries for Food Security in the Region in Bangkok

2002 International Set-Net Fishing Summit in Himi

2003-2005 Rayong Set-Net Project SEAFDEC- EMDEC-Fishermen Group

2005-2007 JICA grass-root project by SEAFDEC, TUMSAT and Himi City

2007-Present Operated and Managed by fishers group

2008 Training course for Practices and Theories Choko-ami in Chonburi, by Kasetsart Univ.

2010 New challenge in Southern Gulf of Thailand steered by DOF, Thailand

Got Idea

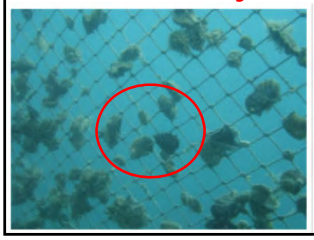
Mr. Aussanee Munprasit
Senior Officer of SEAFDEC

SEAFDEC: Southeast Asian Fisheries Development Center
JICA: Japan International Cooperation Agency
TUMSAT: Tokyo University of Marine Science and Technology, Japan
EMDEC: Eastern Marine Fisheries Research and Development Center, Department of Fishery, Thailand
Himi city: Located in Toyama Prefecture, in Japan Very famous as Set-net fishery

Problems and Difficulties in the 1st year

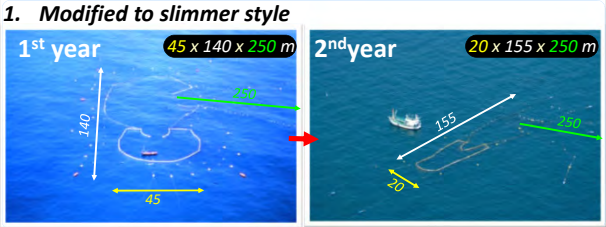
- Strong current
- Bad Design of Net
- Anchors entangled with net
- Bad Operation of fishing

Fish Catch was not good!

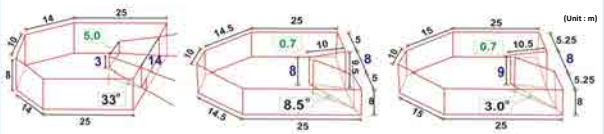


Gear Improvement since 2nd year

1. Modified to slimmer style



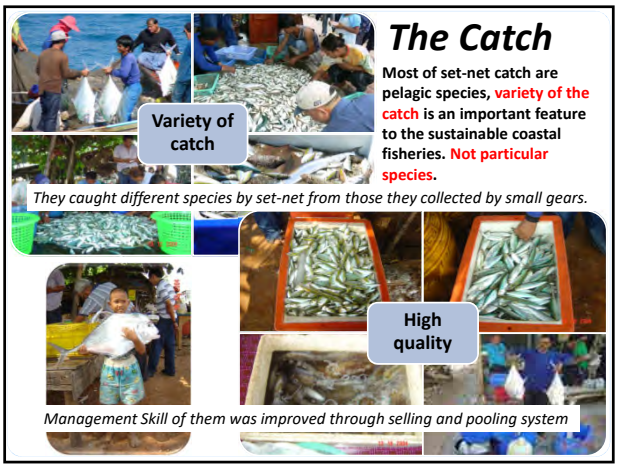
2. Developed to narrower and lower slope&entrance net



1st year; 5.0x3.0x14 → **2nd year**; 0.7x8.0x8.0 → **3rd year**; 0.7x9.0x8.0

Fishing Operation Improvements

- Man-power hauling → Morning hauling
- Every 2 days operations
- 3-4 boats, 10-12 fishermen
- 0.5-1.5 hours → *20-30 min*



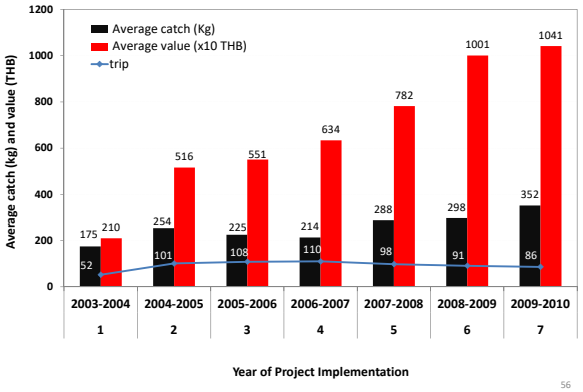
The Catch

Most of set-net catch are pelagic species, variety of the catch is an important feature to the sustainable coastal fisheries. Not particular species.

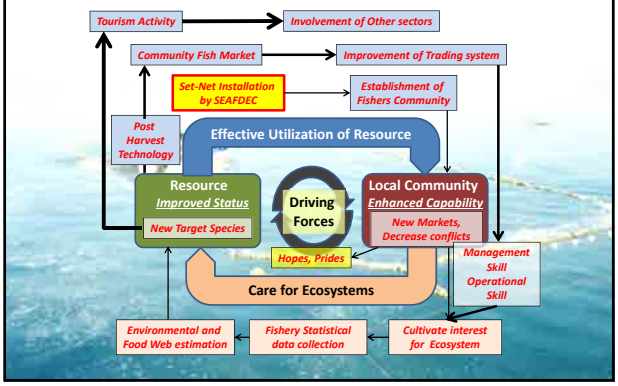
They caught different species by set-net from those they collected by small gears.

Management Skill of them was improved through selling and pooling system

Daily average catch and value



ACC of Community-based set-net fishery in Rayong, Thailand.



Lessons from Set-net Fishery

1. New utilization way can create new user group (=community), not only local resources.
2. Community based pooling system can collect enough statistic data automatically.
3. Good Evaluation from outsides can enhance Users Prides and Care Minds of them.
4. Public awareness of good balance between utilization is necessary to increase market values of their products.
5. One AC cycle can lead another AC cycle.

Area-capability approach

Community based utilization of local resources can create new community and improve incomes with conservation actions on local ecosystem.

Increase the good balanced utilization with cares leads us to sustainability.

What is a local resources?

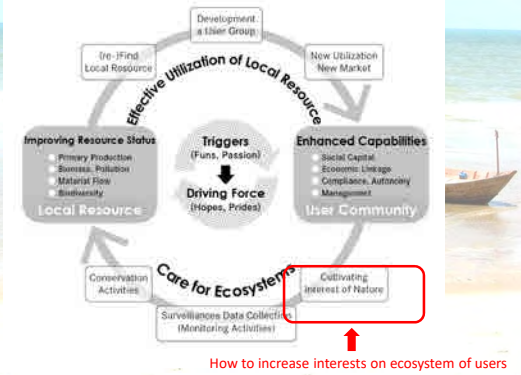
- Not only fishery resources, fishing gears and tourist attractions can be local resources.
- In some case historical and traditional foods and way of life are also used as local resources.
- Most important aspect for local resources is it is shared by local people, it is not own by particular person and/or company.

Enhance Area-capability

- How we can cultivate users' interests on Nature in order to achieve sustainable use of the ecosystems.
- From the utilization of ecosystems for improvement of users' lives. It can be acceptable for any where.
- Area-capability cycle comprised of both utilization and conservation of ecosystems.

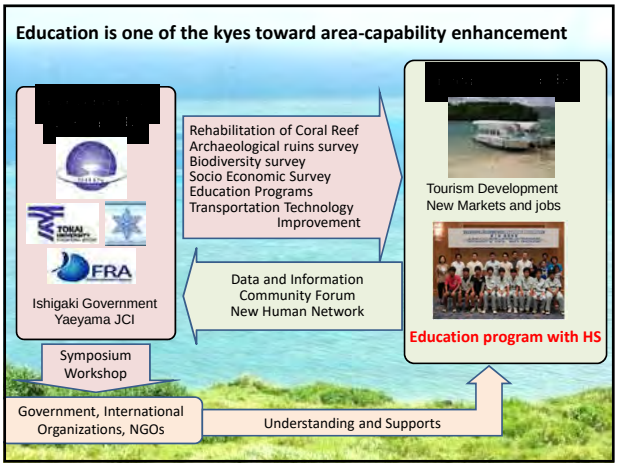
Enhancing Area-capability = Increase Area-capability Cycles

Area-capability cycle



How to increase interests on ecosystem of users

Education is one of the kyes toward area-capability enhancement



New Technology can invite many kinds peoples

We developed under water ROV

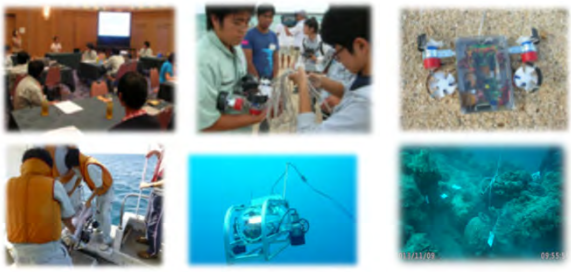
Underwater Archeological ruins survey

Workshop of ROV making as tourism events

ROV helps to create new tourisms and education programs

New Technology contribute to create new community

Making small robot in education, and then use field survey under collaboration with schools



High school students participate robot making and field survey. Their interests of Nature was cultivated through this program.

Capability of Acoustic Technology in Coastal area

Actual data collecting in Thailand

Acoustic Survey Systems, *It can be used in Shallow area, were developed recently.*

Small- PS were also developed.

Lecture and Workshops at Univ. in Thailand

These systems can help to create new community.
If many small-scale fishers install these equipment and share their information within community, we can achieve more effective uses of marine resources in coastal areas.

Numbers of AC cycles show numbers of resources, local communities, utilization methods, jobs and cares on ecosystems.

Increase the number of Area-capability cycle can be used for the index of rural development, instead of economic growth.

Making Area-capability cycle

- Find a local resource
- Make new utilization and market
- Create New local user groups (community)
- Set monitoring and regulation points with users
- Decide care activities by users with researchers
- Share the interest and information
- Make collaboration flame of Government, Users, and researchers

Making an Area-capability Cycle

We can collaborate local people in management with high surveillance and compliances

Please Try to use AC approach

- Let's consider a rural development plan in your own country, using the AC approach as a model.
  - What is a local resource?
  - How to use the resource?
  - Who is a member of user group?
  - What are monitoring points?
  - How to cultivate the interests on nature?
  - What kinds conservation activity is needed?
  - How to create collaboration flamework of government, users and researchers
  - How to increase values of their products?
- And What are restriction and obstacle?
  - How to overcome?
- What kinds collaboration with JAPAN are you need?

Area-capability enhancing should be treated as the target of developments.
For our future!!

Thank you for your attentions!

8. Fisheries Management for Rural Community Development

Fisheries managements for Rural Community Developments

Satoshi ISHIKAWA
JICA Expert/Tokai University, Japan

1

Topics

- Current situation of Marine Fisheries Resources and Ordinal Fisheries Managements
- Environmental Impacts on Fishery resources
- Required Data and Information for Stock evaluation
- Purpose of Fisheries Management
- **Collaboration with Fishers based on Area-Capability (AC) Approach**

2

Current situation of Marine Fisheries Resources and Ordinal Fisheries Managements

- Ocean Crisis
- FAO Approach

3

Crisis of Ocean Ecosystem

Empty Net
(Emerson, 1994)
Fishing Down
(Pauly et.al, 1998)
Are the Oceans Dying?
(Newsweek, 2002)
Empty Oceans
(Hayden, 2003)

We can not eat fish in 2048
(Worm et.al, 2006)

4

Frp p rq#Lvkhulhv#Uhvrxufh#P dqdjhp hqw

1995 FAO http://www.fao.org/fishery/ccrf/1/en
Code of Conduct for Responsible Fishery

Statistical Data Collection → Stock Assessment → Regulation Fishing Activity → Resource Management

The purpose of resource management research is to make regulations on fishing activity to avid overshoots

Commercial fishery targeting particular species can be done!

Data Collection, License based fishery
Cash generation is main target

5

Outputs (Cap) and Inputs and Control of fisheries

- **Output (Cap) Controls**

Set some regulations and limits on fisher products to avid over catch

- ➢Allowable Biological Catch (ABC)
- ➢Total Allowable Catch (TAC)
- ➢Maximum Sustainable Yields(MSY)
- ➢Individual Quota(IQ)

- **Input Controls**

Set some regulations and limits on the fishing efforts to reduce fishing pressures on fisheries stocks to avid over catch.

- ➢Mesh size regulation of fishing gears
- ➢Prohibit some fishing gears
- ➢Boat and engine size regulations and limits
- ➢Setting closing seasons and areas
- ➢Limit minimum size of fish

Purpose is to avid over catch
(= remaining enough parents =aiming for good reproduction of stocks)

6

Environmental Impacts on Fishery resources

- Impacts of Environmental Changes on Fisheries Resources
- History of Tokyo Bay Fishery as an example
- Life history and population dynamics of Fishery resources

7

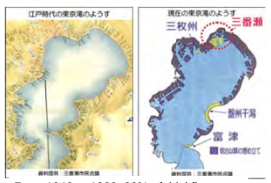
1960~1980 Rapid economic growth and urbanization in JAPAN

- Salaries were increased.
- Nobody concerned the nature around us.

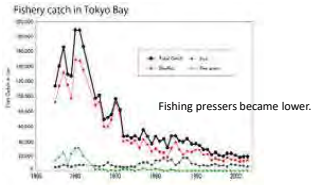
- Population increased in and around cities,
- Coastal habitats were diverted to industrial and housing zones
- Tidal flats and seagrass beds were disappeared
- Air and water were polluted by waste materials

8

Seagrass Beds and Tidal flats are important habitats for reproduction of coastal organisms



From 1940 to 1980, 90% of tidal flats were reclaimed in Tokyo Bay

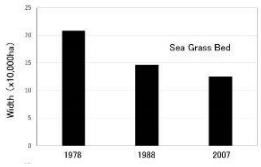


Fishing pressers became lower.

These changes gave negative impacts on coastal resources and ecosystem services.

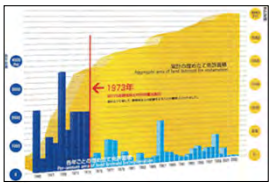
9

Habitats (Spawning grounds) losses derived large impacts on fishery resources.



In 1940s, 70% of seagrass beds were destroyed in Set Inland Sea

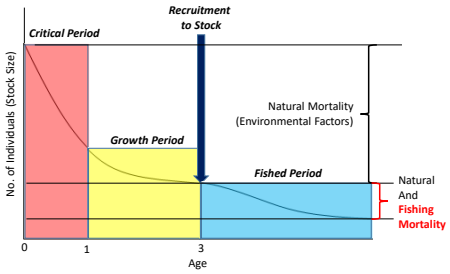
Fishery Catch in Seto Inland Sea



Can we avoid these fisheries resource deterioration by fisheries regulations?

10

Can we save fisheries resource through fisheries regulations??



Spawning and growth habitats conservation should be also taken into account.

11

Can we save fisheries resource through fisheries regulations??

1995 FAO http://www.fao.org/fishery/ccrf/1/en

Code of Conduct for Responsible Fishery

The purpose of resource management research is to make regulations on fishing activity to avid overshoots

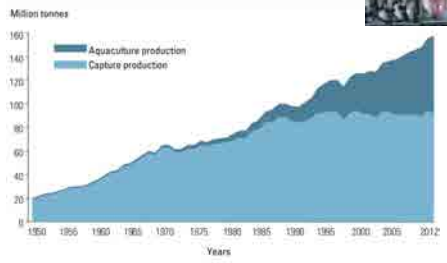
12

Required Data and Information for Stock evaluation

- Trend of World fishery production and Fishing Down
- Flows of fisheries stock evaluation
- Differences between Commercial and Coastal small scale fishery
- Data collection and environmental changes

13

World Fishery Products



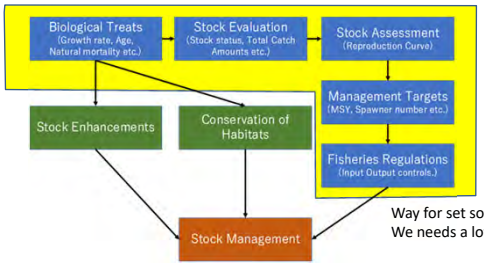
World capture fisheries and aquaculture production Source: The State of World Fisheries and Aquaculture, FAO, 2014, www.fao.org/3/a-i3720e/index.html

14

Fishing Down Marine Food Webs

Fishing down in Global trend…?

Flow chart for Fisheries stock management



Way for set some regulations!
We needs a lot of data.

16

Differences between commercial fishery and coastal small-scale fishery

Large Scale fishery	Coastal small-scale Fishery
	
About 30 million tons Catch	About 30 million tons Catch
About ½ Million Employees	Over 12 Million Employees
About 35 million tons Fuels	About 5 million tons Fuels
8 – 20 million tons Discarded	Discarded fish Very Little

Jacquet and Pauly 2008

17

Data for Stock assessment.

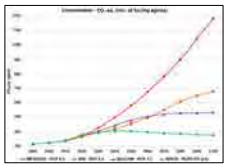
- Fish catch sorted by species
- Size components of fish catch sorted by sepsis
- Age component of fish catch sorted by sepsis
- Growth rate of a target species
- Natural mortality of a target species
- Fecundity
- Spawning season
- Migration area

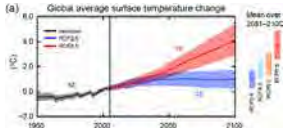
We can draw
the reproduction curve
And then we can evaluate
the stock status
And
We can calculate
MSY, ABC etc.

If the environmental drastically changed, these parameter will be changed. So, data needs to be updated

18

Climate Change and Global Warming are serious issues of the World



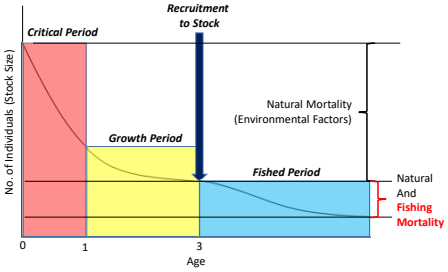


Without proper treatments of CO2 emissions, Global warming cannot stop and sea level will be rise.

Can we continue data update catching up with the global worming？ Is it possible? Reliable?

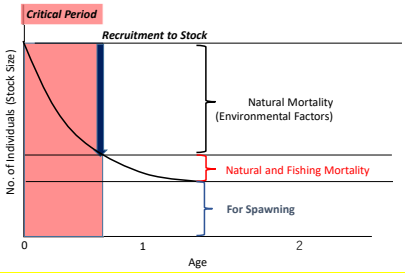
19

Can we save fisheries resource through fisheries regulations??



20

Life history of Small Pelagic fish



Environmental factors in spawning ground and season have high impact on reproduction

21

Purpose of Fisheries Management

- Differences of biological features of fisheries resources
- What is an Important action for each fisheries resource
- Purposes of the fisheries managements
- Natural and Social Data and information

22

Type of fishery resources

Types	Life time	Fecundity	Mobility	Environmental resistance
Highly Migration Species	Long	Many	High	High
Coastal Migration Species	Long	Many	Middle	Middle
Rock Fish	Middle	Many	Low	Low
Demersal (Benthic) Species	Long	Few	Low	Low
Shellfish & Mollusca	Short	Middle	Quite Low	Low
Seaweeds and Seagrasses	Short	Few	No	Low

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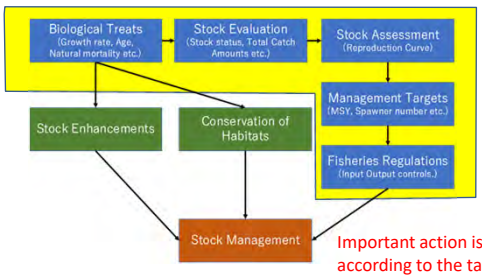
Flow chart for Fisheries stock management



Important action is different according to the target species!

24

What the purpose of fisheries management?

- Top priority of "**fisheries management**" is to achieve "**sustainable development of fisheries** activities".
- Sustainability of **fisheries resources** and **fishers' livelihoods** are necessary. Improve the QoL to keep high incentives of fishers.

◆It is not evaluating fishery stock situation.
◆It is not making fishery regulations.
◆The stock evaluation and fishery regulations are some parts of fisheries management.

25

What are necessary for sustainable developments of fishery.

Nature

Reproduction of resources
- ➢Spawning groups
- ➢Healthy spawning grounds
- ➢Healthy habitats
- ➢Primary production
- ➢Normal material flows
- ➢Biodiversity
- ➢Low pollution situation

Society

Income and Safety
- ➢Appropriate number of Fishers
- ➢Fishery catch
- ➢Fishing gears
- ➢Fishing skills
- ➢Markets Access
- ➢Incentives for sustainable fishing
- ➢Norms and rules
- ➢Awareness of legal compliance

26

Natural Science for Fishery managements

- Identify the spawning grounds and seasons
- Identify the area of material flows around spawning grounds
- Identify the food-web including target species
- Evaluate the stock status and set the limits of catch
- Understand the relationships between environmental data and fishery stock fluctuations (Temperature, Salinity, Acidification, Nutrient concentration, Winds conditions etc)

Monitor of theses data and information!

27

How do you collect various kinds of data?

- A wide variety of data is required for fishery management.
- How to collect these data is a big issue.
- Moreover, even if the regulation is based on data, it is meaningless if the fishermen do not follow it.
- Enough data collection and Make high compliance of fishers are required at the same time for fishery managements.

Collaboration of fishers and governments are quite important.

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Social Science for Fishery managements

- Understand the numbers of fishers and family members
- Understand the fishing gears and target species
- Collect fishery statistics data (Catch, efforts, fishing grounds)
- Understand markets, transportation and prices of fishery products
- Understand resource management awareness of fishers
- Understand the public awareness of fishery managements
- Understand the hopes of fishers
- Understand the problems of fishery

- ***Monitor of theses data and information***!
- How we can contribute to improve fishers' lives is top priority.

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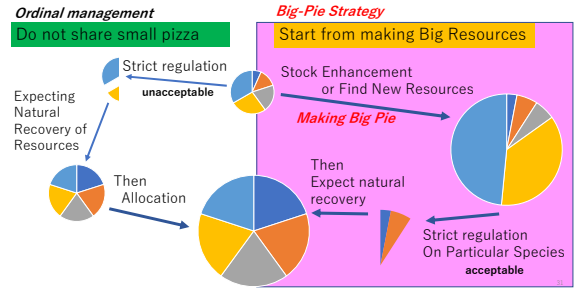
Collaboration with Fishers based on AC

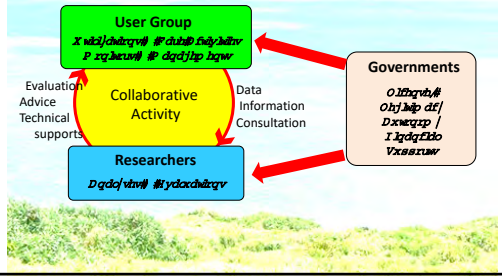
- Big-Pie Strategy
- Framework of the collaboration
- Area-Capability Approach
- Set-net fishery in Thailand as an Ex of AC approach
- Stock Enhancements in Japan and Philippines as Exs of AC
- Eco-tourism at Japan as a EX of AC
- Target of AC approach

30

For make good collaboration with fishers and governments, Big Pie Strategy is important.

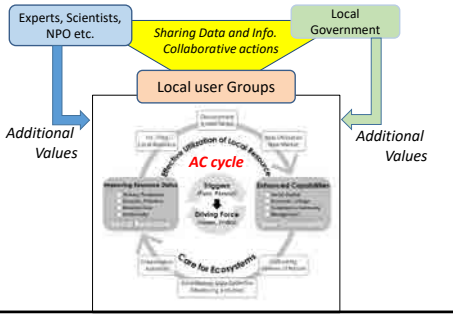


Framework of Implementation and Evaluation in Area-capability concept



Area-capability approach

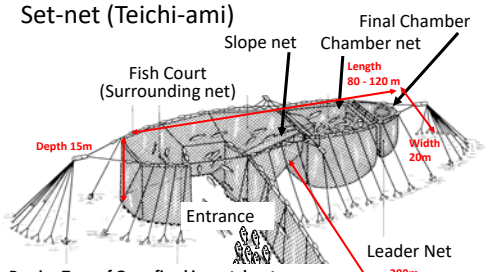
Area-Capability Cycle (AC cycle) as a model of collaborative action



Community based Set-net fishery

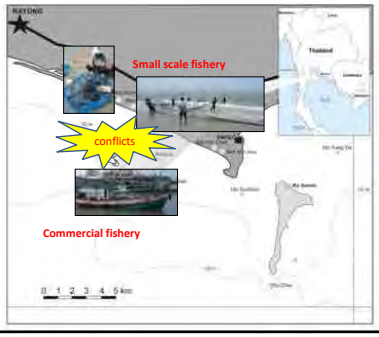
By TD/SEAFDEC and DOF/Thailand in Rayong

Set-net (Teichi-ami)

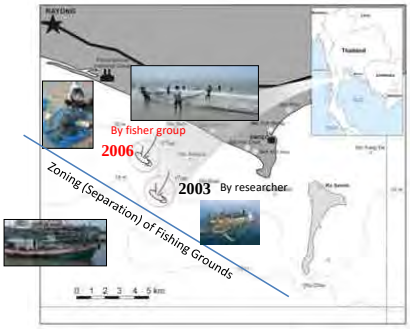


Passive Type of Gear, fixed in costal water
Large-scale trap net with compound design
Waiting for the migrating fish schools,
and entrapping them in the chamber net

Location of Rayong set-net project



Location of Rayong set-net project



History of Set-net Installation into Thailand

2001 ASEAN-SEAFDEC Millennium Conference on Sustainable Fisheries for Food Security in the Region in Bangkok

2002 International Set-Net Fishing Summit in Himi

2003-2005 Rayong Set-Net Project
SEAFDEC- EMDEC-Fishermen Group

2005-2007 JICA grass-root project by SEAFDEC, TUMSAT and Himi City

2007-Present Operated and Managed by fishers group

2008 Training course for Practices and Theories Choko-ami in Chonburi, by Kasetsart Univ.

2010 New challenge in Southern Gulf of Thailand steered by DOF, Thailand

SEAFDEC: Southeast Asian Fisheries Development Center
JICA: Japan International Cooperation Agency
TUMSAT: Tokyo University of Marine Science and Technology, Japan
EMDEC: Eastern Marine Fisheries Research and Development Center, Department of Fishery, Thailand
Himi city: Located in Toyama Prefecture, in Japan Very famous as Set-net fishery

Senior Officer of SEAFDEC

Problems and Difficulties in the 1st year

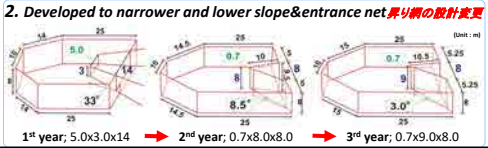
- Strong current
- Bad Design of Net
- Anchors entangled with net
- Bad Operation of fishing

Fish Catch was not good!

Gear Improvement since 2nd year 漁具設計改良

1. Modified to slimmer style *身網の設計変更*

2. Developed to narrower and lower slope&entrance net *長り網の設計変更*



1st year; 5.0x3.0x14 → **2nd year**; 0.7x8.0x8.0 → **3rd year**; 0.7x9.0x8.0

Fishing Operation in Rayong

- Man-power hauling
- Morning hauling
- Every 2 days
- 3-4 boats, 10-12 fishermen
- 0.5-1.5 hours → *20-30 min*
- September-April

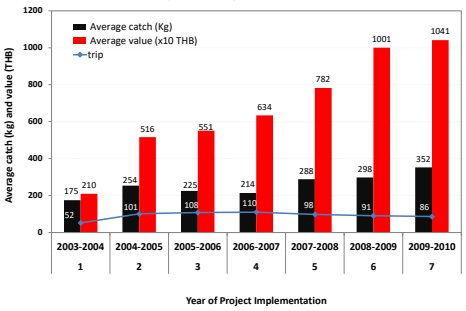
The Catch

Most of set-net catch are pelagic species, variety of the catch showed an important characteristics of the coastal fisheries resources.

They caught different species by set-net from that they collected by small gears.

Management Skill of them was improved through selling and pooling system

Daily average catch and value



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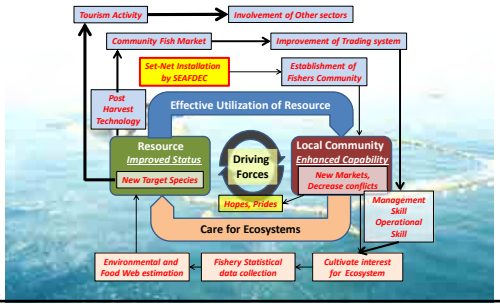

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Lessons from Set-net Fishery

1. New utilization way can create new user group (=community), not only local resources.
2. Community based pooling system can collect enough statistic data automatically.
3. Good Evaluation from outsides can enhance Users Prides and Care Minds of them.
4. Public awareness of good balance between utilization is necessary to increase market values of their products.
5. One AC cycle can lead another AC cycle.

45

Hamana Lake

Stock enhancement of the tiger shrimp in Hamana Lake

Water area = 6,880ha
Periphery = 128km
Depth = 5m
10th in Japan

- There are traditional and modern fisheries, including both capture and aquaculture activities.
- Fishermen have been conducted as small scale commercial fishery

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1960~1980 In Japan
Rapid economic growth and industrialization

Large seagrass beds and tidal flats were reclaimed for industrial developments. And many aquatic resources were deteriorated due to habitat losses.

Fishermen's life became worse. Many fishermen criticized the habitat losses and protested governmental decisions of industrialization.

Government started *stock-enhancement project named "Tsukuru-Gyogyo" in local level*. For this project, stock enhancement centers were established at all prefectures.

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Basic framework and strategy of "Tsukuru Gyogyo" in Japan

1. Government establishes stock enhancement (SE) centers in each prefecture.
2. SE Center conducts artificial breeding of target species.
3. SE Center improve aquaculture technology (density, bait, water conditions etc.)
4. SE Center and local fishermen group conduct intermediate aquaculture
5. SE Center establish release technology (size of fish, location, timing, number etc.)
6. SE Center and fishermen release juvenile fish.
7. SE Center and fishermen collect data of fish catch.
8. SE Center estimate impacts of release to stock enhancement.

In many cases,
there were no technology of breeding, and aquaculture,
there were no information about release points and timing,
there were no catch data for impact assessment.

SE Center staffs had to solve many difficulties by themselves.

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Around Hamana Like

- There were 7 fishermen villages.
- They competed for fishery stocks.
- Each village had each landing.
- There were no collaborations.
- There were no exact fishery statistics.
- They did not have a sense of stock enhancement. (They conducted only capture fishery)

But, industrialization was affected on this area and fishery stocks were deteriorated rapidly.

1978 Stock enhancement Center Established and governmental stock enhancement project was started.

In the beginning, There is no experts, no technology *and no collaborations and no participation from villagers (fishers)*

Many fishers believed stocks recover naturally in near future.

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Dr. Fushimi
He was a staff of stock enhancement center in chargee of the project.

Dr Fushimi conducted environmental survey to decide intermediate aquaculture site and technology developments of artificial breeding by himself.
And Released 3million larvae in 1980

Young fishermen of Shirasu village locating near intermediate aquaculture site, started collaboration with Dr Fushimi.

1981 30 million larval shrimp were released
Shrimp Catch was increased, Start environmental monitoring and conservation actions

1983 Fishermen of other villages started collaboration
100million seeds were released

1985 The governmental project was terminated
Fishermen donated money for stoke enhancements
And Fishermen started release by themselves

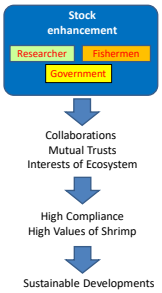
50

Changes in the area

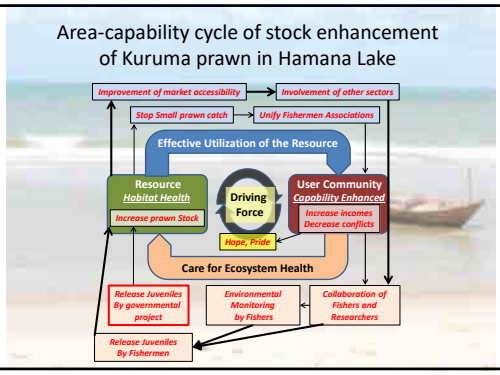
Voluntarily Actions of Fishermen
- Intermediate aquaculture of larval shrimps
- Environmental monitoring
- Stop fishing of small shrimps
- Set fishery rules by themselves and start patrolling
- Unify the wholesaling system
- Donation for stock enhancements

Mutual trust among Government, Fishermen and Researchers
- Fishery Statistics were collected
- Stock evaluation was done for regulations

Care of nature create new values of fishery products in markets



51



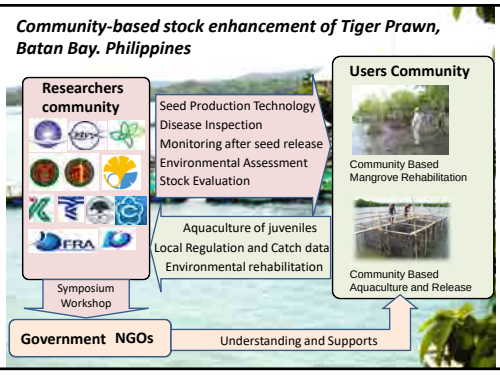
52

Lessons from community based Stock enhancements in Hamana Lake

1. Community based stock enhancement project can cultivate **interests of ecosystems and management minds** of fishers.
2. Reliable statistics data facilitate **effective utilization and regulation** of fishing
3. Community based trading system provide **price making power** to fishers.
4. Rules and regulations decided by users have high compliance.
5. Good balance between utilization and cares of nature provide high values of products and cultivate **prides** of fishers.

53

Community-based stock enhancement of Tiger Prawn, Batan Bay. Philippines



54

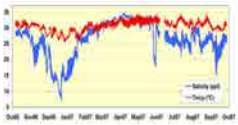
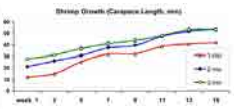

Project formulation and Information Exchange


55


Pre-survey and community making


56


Aquaculture ponds and experiments

Improve aquaculture technology and collect environmental information

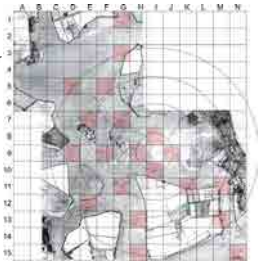
57

Environmental survey and stock assessments

Monitor actual catch from 20 monitoring zones (right)

The gear to be monitored are corral net (tigbakoe), the most dominant gear used in the area (below)

Monitoring started in January 2013, conducted twice monthly

58

Conduct community based stock enhancement




59

Results: Timeline of rearing and releases

2013 July: 1st rearing (129,000 stocked)
Aug: No release (high mortality)

2014 Feb: 2nd rearing (390,000 stocked)
April: **15,000** released (4%); 100 tagged

2014 June: 3rd rearing (270,000 stocked)
July: **120,000** released (44%); 240 tagged

2014 Nov: 4th rearing (400,000 stocked)
Dec: Series of typhoons caused mortality

2015 Apr: 5th rearing (483,000 stocked)
May: **250,000** released (51%); 250 tagged

2015 Jun: 6th rearing (630,000 stocked)
Jul: high mortality caused by early prolonged rains and cannibalism



Altamirano et al, 2015 60

Results: Catch monitoring (Trader's logbook)

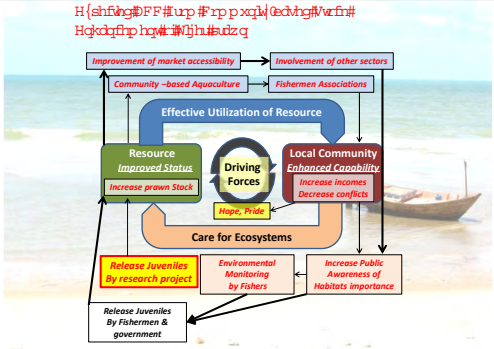
Recapture info (5th batch)

Released: May 2015
Total released: 250,000
Shrimp tagged: **250 (0.1%)**

Total recovery: 20 pcs **(8%)***
Details: July (8 pcs), 5 g (3 %)
Aug (4 pcs), 15 g (1.6%)
Sep-Oct (8), 55 g (3%)

Estimated total potential harvest:
(4 months after release):
1,100 kg (PhP220,000)

Fishers want to start other release works by themselves.
Like Hamana Lake.



Dolphin watching in Amakusa, Kumamoto Japan

Contents of Dolphin Watching

Duration : 1 hour

Price : Adult 2500JPY
Child 1500JPY

Success more than 99%

Using Fishing Boat operated By Fishermen

History of Dolphin Watching in Amakusa

1986 Mr. Nagaoka moved into Amakusa, he was surprised Dolphins near coast in Amakusa

↓

1992 Local Government conducted survey of tourism resources, Mr. Nagaoka proposed Dolphin Watching.
But rejected. Nobody believe the potential of Dolphin

↓

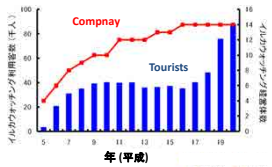
1993 5 Residents in Amakusa including Mr Nagaoka started Dolphin watching by themselves, in collaboration with Fishermen

↓

1994 More than 20 thousands tourist came

- *Other residents started Dolphin watching.*
- *They make **Dolphin watching association** by themselves and make some roles.*
- *The association started **collaboration** with researchers and governments*

Tourism and tourists of Dolphin watching in Amakusa



Tourism Companies
1992 4 companies
2008 14 companies

Tourists
1993 3219 person
2008 87852 person

Tourist concern the impacts on Dolphin, However,
Results of biological researches ensured low impact on Dolphin and environment of the eco-tourism

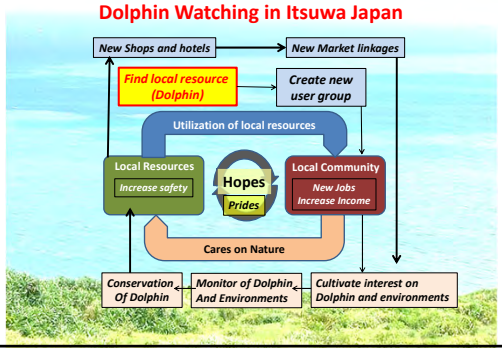
Low impacts provide additional values and cultivate the **prides** of tourism company staffs.

Lesson from Dolphin watching in Amakusa

1. Local resource always exist around us. But many people do not realize the potential of the resource.
2. New utilization methods and New system can create **new user group** (=community)
3. Academic evidence cultivate **pride** of local people of their activities.
4. Care minds are enhanced through utilization of resources
5. Rules and regulations decided by users have high compliance.

Management should start from effective (or New) utilization of resources.

Dolphin Watching in Itsuwa Japan



67

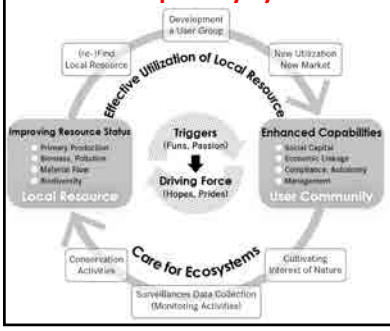
Area-capability approach

Community based utilization of local resources can create new community and improve incomes with conservation actions on local ecosystem.

Increase the good balanced utilization with cares leads us to sustainability.

68

Area-capability cycle



Framework of
1. planning of local collaboration
2. evaluation of community activity

AC cycles numbers =
1. No. resources,
2. No. local communities,
3. No. utilization (jobs),
4. No. cares on ecosystems

69

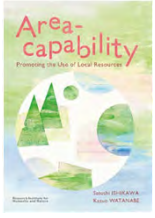
Increase of AC cycles at a local site should be a target for making sustainable future!!

73

Please find and search a local resource which can be a trigger of new AC-Cycle.
Post-harvest technology, such knowledge can be a local resource, if there is a new community.

Thank you for your attentions!

74



Guidebook of Area Capability

Field Guidebook on Fishing Gears in Thailand
Laboratory Manual for Fish Collection
Several Fish Books in Thailand, Philippines and Indonesia (PDF)

Freely Download

9. Training materials for Fishing Gears and Methods

መሰረታዊ ቅማረ መርበብ ሰኪዐት

ትሕዝቶ

- ንመ ስርሒ ሰኪዐት ዘድልዩ ጥረ ነገራት
- ዓቀን/መለክዒ ናይ ሰኪዐት
- ሓፈሻዊ መብርህን ቅመራን ናይ ክብደትን መንሳፈፍን ሰኪዐት
- ኣገባብ ኣቐራርጻን ኣሰናንዓን ሰኪዐት

መእተዊ

ዕላማ ናውቲ መግፈፊ ዓሳ ንምሓዝ ክኸውን ከሎ፡ኣተሓሕዝኡ ብዝምልከት ድማ ብ 2 ኣገባባት ክንሪኦ ንኽእል።

እቲ ሓደ ሙሉእ ብሙሉእ ኣካላቱ ኣብ ረተ ክጠናነግ ከሎ፡እቲ ካልኣይ ድማ ብማሕንቆ ክሳዱ ክተሓዝ እንከሎ እዩ።

ቅድሚኡ ግና ነዚ ዓይነት ሜላ ኢጋፍፋ እዚ ንምትግባር ምስቲ ናውቲ መግፈፊ ንጥቀመሉ ዘለና ዓይነት ረተ ዝተሓሓዝ መገጣጠሚ ክህልወና ግድን ይገብሮ።እቲ ቀዳማይ ነታ ረተ ክትንሳፈፍ ዝሕግዝ ኣንሳፋፊ ኣብ ላዕለዋይ ክፋል ክኸውን ከሎ፡እቲ ካልኣይ ድማ ክብደት ገይራ ንታሕቲ ከም ትሳሓብ ዝሕግዝ ኣብ ታሕተዋይ ክፋል ናይ ረተ ይእሰር። ብዘይካ እዚ ውን ላዕለዋይን ታሕተዋይን ክፋል ናይ ረተ(ክብደትን መንሳፈፍን) ነታ ረተ ብዝግባእ ቅርጻ ሓልያ ክትነዓዝ ይሕግዝ።

ላዕለዋይን ታሕተዋይን ክፋል ናይ ረተ(ክብደትን መንሳፈፍን) ነታ ረተ ብዝግባእ ቅርጻ ሓልያ ክትነዓዝ ይሕግዝ። እዚ ናይ ማሕንቆ(gillnet) ዓይነት ረተ ብ3 ኣገባባት ክስርሓሉ ይከኣል።እቲ ቀዳማይ ኣገባብ እታ ረተ ዕምቆት ኣብ ዘይብሉ ገማግም ኣንዳተንቀሳቀሰት ክትከውን ከላ፡እታ ካልኣይቲ ድማ ኣብ ማእከላይ ዕምቆት ዘለዎ ክኸውን ከሎ፡እቲ ሳልሳይ ድማ ኣብ ታሕተዋይ ዕምቆት ዘለዎ ቦታ ክንዝርግሑ እንከለና እዩ።እዞም ልዕል ኢልና ዝጠቀስናዮም ኣገባባት በቶም ከም ዕላማ ተታሒዞም ዘለዉ ዓይነታት ፍርያት ባሕሪ ምርኩስ ብምግባር ከም ዝስርሓሎም ምዝካር የድሊ።እምበኣርከስ ብመንጽርእቲ ዘለና መደብን ኣጠማምታን ኣብ መዳይ ቁጠባን ውሕስነትን ንናይ ምምዕባል ናይ ማሕንቆ መግፈፊ ዓሳ ጽፉፍ ኣሰራርሓን ተርኡ ዓቢ ከም ዝገብሮ ዝስሓት ኣይኮነን።

- ✓ **<u>መ ስርሒ ሰኪዐት ዘድልዩ ጥረ ነገራት</u>**

ብመሰረት ዓለምለኻዊ ውድብ መዐቀኒ ክግለጽ ከሎ<ዓይኒ ሰኪዐት>(mesh size) መርበብ ቅርጺ ዝሓዘ ኮይኑ ዘይውሱን ቅርጽን ዝሓዘክኸውን ከሎ፡ልዕሊ ሓደ ዓይነት ኣገባብ ፈትላዊ ምትሕንፋጽ ዘጠቃለለ እዩ።እቶም ንመርበብ ሰኪዐት ዘድልዩ ጥረ ነገራት ጽሕነ/ጅማት መሳሊ የጠቃልል።ንሳቶም ድማ ባህርያውያን ጽሕነን፡ሰብ-

ሰርሑ ጽሕጎን ኢልና ንሰም ዮም።እዞም ባህርያውያን ጽሕጎ እዚኣቶም ኣብቲ ናይ ቀደም እዋን ዝጥቀምሉ ዓይነት ፈትሊ እዩ።ንኣብነት ከም ጡ ጥ፡ወረቀትን ዓለባ ፈትልን እዮም።እዞም ሰብ ሰርሑ ጽሕጎ ግና ዓለምለኻውን እዋናውን ዝጥቀምሉኮይኑ ስርሓቱ ድማ ዝተጸመረ ሰብ ሰርሑ ዓለባ እዩ፡ ንኣብነት ናይሎን፣ፖሊስተር’፣ፖሊእታይሊን፣ፖሊፕሮፓይል ተባሂሎም ክጥቀሱ ይከኣሉ።

- ✓ **ናይሎን(nylon)**

እዚ ጥረ ነገር እዚ መጠን ስፍሓት ተጠቃምነቱ ኣብ ናይ መርበባዊ ገመድ ዓቢ ብምኻኑ ካብቶም ካልኦት ኣዝዩ ክቡር ኮይኑ ይርከብ።ከምኡ’ውን ናይ ምምጣጥን ምንዋሕን ተኽእልኡ ኣዝዩ ጽቡቅ ኣብ ርእሲ ምኻኑ ልዑል ድልዳለን ልስላሰን ውን ኣለዎ። ንምዕቃቡ ዝምልከት ውን ቀሊል ኣብ ርእሲ ምኻኑ ፣ብመንጽር ዘጋጥም ፍሕፍሐ ልስሉስን ድልዱልን እዩ።

እቶም በዚ ዓይነት ዓለባ ዝስርሑ ናውቲ መግፈፊ ድማ ማሕንቆ ረተ(gillnet),ጋብያ መሳሊ ረተ(castnet),ከምኡ’ውን ፍሕሶ ዝኣመሰሉ እዮም።

- ✓ **ፖሊእስተር(polyester)**

እዚ ጥረ ነገር እዚ ዘለዎ ምዱብ ስሕበታዊ ሓይሊ ንኡስ’ኳ እንተኾነ, ዘለዎ ናይ ፍሕፍሐ ዓቅሚ ኣብ ማይ ድልዱል እዩ።ኣብ ዋጋ ውን ካብቲ ካልእ ዓይነት ዓለባ ዝሓሰረ ኮይኑ ይርከብ።

ዘለዎ ጠቃምነት ኣብ መስርሕ ምግፋፍ ግና ኣዝዩ ሰፊሕ እዩ።እቲ ዝጸወቶ ተራ ይኹን፣ዝህቦ ኣገልግሎት ኣብ ከም በዓል መጅሓፍ ፣ንናይ ሕርሻ ባሕሪ ከም ኣዕጻው፣ ከምኡ’ውን ንመልሕቅ ዝኸውን መእሰሪ ገመድን ዝኣመሰሉ በዚ ዓለባ ዝተመስርሑ እዮም።

- ✓ **ፖሊፕሮፓይል(polypropyl)**

ዘለዎ መጠን ጥልቀት 0.91 ኮይኑ ንረኽቦ፣ብዘለዎ ትሑት ዓቅሚ ከም መእሰርን፣መዐሸኒ ንመራኽብ የገልግል።ኣብ ናይ ቀመማዊ ዓቅሙ እንተመጺና ተጸዋርነቱ ዓቢ እዩ።እዞም ኣብ ላዕሊ ተጠቂሶም ዘለዉ ቀንዲ ባህርያት ፈትላዊ ዓለባ ብተዛማዲ ነናቶም ብልጫታት ዘለዎም እኳ ተኾኑ፣ናይሎን ንጽል ፈትሊ ዝባሃል ዓለባ ግና ልዑል ዓሳ ናይ ምሓዝ ብቐዓት ዝውንን እዩ።ምኽንያት እዚ ዝኾነሉ እቲ ዓይነት ፈትሊ ልዑል ናይ ምትሕልላፍ ብርሃን ስለ ዝውንን፣እቶም ዓሳታት ብቀሊሉ ንኽታሓዙ ዕድል ይኸፍት። ብተወሳኺ ውን እዚ ዓለባ ካብ ድርብ ናይሎን ፈትሊ ዝሓሰረ ዋጋ ስለ ዝውንን፣ኣብ ናይ ሰኪዐት መርበብ ዘለዎ ኣገዳስነት ብተዓጻጻፊ ይዛይድ።

- ❖ **ዓቀን/ መለክዒ ናይ ሰኪዐት**

ዓቀን ወይ መለክዒ ክንብል ከለና ናይ ሓደ ነገር እንታይንነትን ሒዝዎ ዘሎ ዓቀንን ብቅዓትን ዝገልጽ እዩ።እቲ ንሰኪዐት መስርሒ ንጥ

ቀመሉ ዓይነት ፈትሊ ዝሕዞ መለክዒ እንታይን ብኸመይን ይግለጽ ምፍላጥ የድሊ።እምበኣርከስ ርጉዲ ናይ ሰኪዐት ፈትሊ ክግለጽ

ብ ዲንያር ወይ ድማ ኣሃዱ ይሕበር። እዚ መዐቀኒ እዚ ኣብ ንናይሎን ድርብ ፈትሊ ጥራይ ዝገልጽ ኮይኑ፡ብኽምዚ ድማ ክንገልጾ

ንኽእል 210D/9 እቲ 210 ተባሂሉ ዘሎ ንናይሎን ዝባሃል ፈትላዊ ዓለባ ዝገልጽ ክኽውን ከሎ፡እዚ ድማ ዘለዎ መጠን ክብደት ናይቲ

ረተ 210g እዩ፡እቲ ሒዝዎ ዘሎ ቁመት ድማ 9000m።

1mesh= ሓንቲ ዓይኒ ሰኪዐት

0.5mesh=ፍርቂ ዓይኒ ሰኪዐት

ዝሕዞ ቁጽሪ ዓቀን ዓይኒ ናይ ሰኪዐት ብሚሊመተር ይዕቀን፡ በዚ መዐቀኒ እዚ ክንዕቅኖ ከለና ድማ ነቲ ዓይኒ ሰኪዐት ድሕሪ ምግታርና ዓቀን ክንወስድ ይግባእ።

ነቶም ንናይሎን ሰኪዐት ዝገልጹ ምልክታት ብኽመይ ነንብቦም

ርጉዲ Z210D/9 ናይ ፈትሊ.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,210 ኣሃዱ ምስ ቁጽሪ 9 ፈትሊ

16 ቁጻርዘለዎ ዓቀን ናይ ሰኪዐት ዓይኒ……..20.2mm

200 ዓይኒ ኣብ ዕምቆት…….ድምር ዓይኒ ሰኪዐት ንቁመት

※ዓይነታት ሰኪዐትን ዘለዎም ኣገዳስነትን

ኣብዚ እዋን እዚ ዓለምለኻዊ ዝስራሓሉ ዘሎ ንመርበብ ሰኪዐት መስርሒ ዝኽውን ፈትላዊ ሰብ ሰርሑ ዓለባ እዩ።ዝተፈላለዓይነታት መርበብ ሰኪዐት ዝሕዝዎ ጠባያት ብዓይኒ ቕጠባን ብቅዓትን ኣብ ምግፋፍ ከምኡ ውን ብቀሊሉ ንምዕቃቡን ምሓዙን ዘለዎ ተራን ተፈላልዮም ኣብ ስራሕ ይውዕሉ።ኣብነት፡

※ቁጻር ኣልቦ ሰኪዐት(knotless)

እዚ ቁጻር ኣልቦ ዝኾነ ዓይነት ሰኪዐት ልዑል ድልዳለ ዝውንን ብምኽኑ, ዘይከምቲ ኣብ ቁጻር መርበባዊ ሰኪዐት ዝርአ ተኽእሎናይ ምፍሕፋሕ ኣብ ቁጻርን ምጉዳል ዘለዎ ድልዳለ ተመራጺ ይገብሮ።ብተዛማዲ እዚ ዓይነት ረተ ብቀሊሉ ብቅዓቱ ዝነድል ኣይኮነን።ብተወሳኺ ዝውድኦ ብዝሒዓቀን ፈትሊ ናይ’ዚ መርበብ ሰኪዐት ምስ ተሰርሐ ውሑድ እዩ።

ብዝኾነ ኾይኑ እቲ ዘለዎ ጥቅሚ ቁጻር ኣልቦ ብምኽኑ ቅርጹ ሓልዩ ክጓዓዝ ይኽእል። ብኻልእ መዳይ ድማ እዚ ዓይነት መርባባዊ ሰኪዐት ንዝፍጠር ምብልላዕን ምጽራርን ደው ክብሎ ዘለዎ ተኽእሎ ትሑት እዩ።

※ ቁጻር ሰኪዐት(knotted net)

እዚ ቁጻር ዘለዎ ሰኪዐት ውን ናቱ ጥቅምን ጉድለትን ሒዙ ዝኸይድ ዓይነት መርበብ ሰኪዐት እዩ። እዚ ዓይነት ሰኪዐት ዘለዎ ጥቅሚ ድማ ዘተሓሳስብ ወይ ውን ኣሰካፊ ዝባሃል ኩነት ዝዓብየሉ ኣይኮነን፡ከምኡ ውን እቲ ዓይኒ ሰኪዐት ብቀሊሉ ናይ ምምጣጥን ምዝርጋሕን ተኽእልኡ ልዑል እዩ። ብኣንጻሩ ቁጻር ረተ ብምኳኑ፣ብብዝሒ ዓቀን ረተ ክሃልኽ/ክውድእ ይርአ።ብተወሳኺ ውን ብሰንኪ ክለማዊ ለውጢ ዝረአ ምልኣተ ባሕሪ ዘለዎ ተጻብኦ ዓቢ እዩ።

※ኣንሳፋፍን ተንሳፋፋይን

እዞም ክልተ ኣንሳፋፍን ተንሳፈፍትን ዝባሃሉ ኣካላት ኣብ ላዕላዋይ ክፋል ናይቲ መግፈፍ ናውቲ ተታሒዙ ዝኪይድ

ኮይኑ፡እቲ ናውቲ ኣብ ባሕሪ ምስ ተዘርግሐ ቅርጹ ሓልዩ ንኽጓዓዝ ይሕግዙ።ነዚ ክውን ንምግባር ድማ ዝተፈላለዩ ኮይኑ፡እቲ ናውቲ ኣብ ባሕሪ ምስ ተዘርግሐ ቅርጹ ሓልዩ ንኽጓዓዝ ይሕግዙ።ነዚ ክውን ንምግባር ድማ ዝተፈላለዩ ዓይነታት ኣንሳፈፍቲ ጥረ ነገራት ኣለው፡ንሳቶም ድማ ልስሉስ ኣንሳፋፊ ዝባሃል ኮይኑ ምስ ሓጹር መርበብ (purse) ሰኪዐት ዝባሃል መግፈፊ ናውቲ ዝታሓሓዝ ክኸውን ከሎ፡እቲ ካልኣይ ድማ ሓጺናዊ ተንሳፋፋይ ኮይኑ ምስ ሰኪዐት ዝባሃል መግፈፊ ናውቲ ዝታሓሓዝ ክኸውን ከሎ፡፡እቲ ካልኣይ ድማ ሓጺናዊ ተንሳፋፋይ ኮይኑ ምስ ሰት ነት ዝባሃል ናውቲ መግፈፊ ተገጣጢሙ ውሱን ቅርጺ ሒዙ ክጓዓዝ ይሕግዝ።

እዚ ኣንሳፋፊ ኣካል ኣብ ላዕሊ ናይቲ ናውቲ መግፈፊ ተገጣጢሙ ዝሰርሕ እዩ። እቶም ንጥቀመሎም ጥረ ነገራት ምስ ግዜ እንዳተቀያየሩ ምስኡ ሓደ ዘይተርፍን ዝውቱርን ዝኾነ ተንሳፋፋይ መሐበሪ ሒዝካ ምስቲ ላዕላዋይ ጫ ፍ ናይቲ ናውቲ መግፈፊ ተገጣጢሙ ዝሰርሕ እዩ። እቶም ንጥቀመሎም ጥረ ነገራት ምስ ግዜ እንዳተቀያየሩ መጽዮም እዮም።ካብ ዕንጸይትን ባምቦን ናብ ጥርሙዝ ድሕሪኡ ውን ናብ ሰብ ሰርሖ ዓይነት ፕላስቲክ ማዕቢሉ።

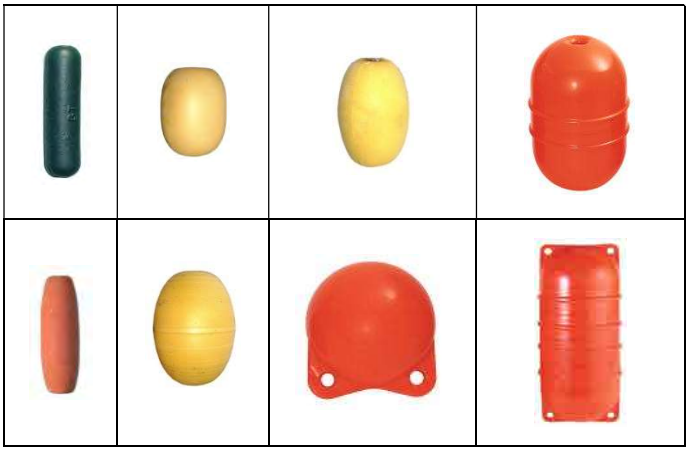
※ኣገደስቲ ጠባያት ናይ ኣንሳፋፊ ኣካል

- ማይ ዘይሰትን ልዑል ጸብለል ናይ ምባል ተኽእሎ ዘለዎን
- ኣንጻር ናይ ብሕጎጋን ልዑል ክሊማ ዊ ተጻዋርነት ዘለዎ(ማ ይ ዘየዝሩቅ)
- ትሑት ሃልኪ ዋጋ ዘለዎ ፣ንምዕቃቡ ውን ቀሊል ምስ ዝኸውን
- ንዝፍጠር ፍሕፍሐ ውን ልዑል ተጻዋርነት ዝውንን

※ዓይነታት ኣንሳፈፍትን ቅርጾምን

ኣብ’ዚ እዋን’ዚ ካብ ዕንጸይቲ ዝወጽእ ነዝዒ/ዕንዲዳ ዝባሃል ጥረ ነገር ከም መስርሒ ንመንሳፈፊ ዝኾኑ ነገራት ከም መስርሒ ይጠቅም።

እቲ ካብ ፕላስቲካዊ ጥረ ነገር ዝተሰርሐ መንሳፈፍን ከምኡ ውን ከም ንምልክት(buoy) ንጥቀመሉ ኣንሳፋፊንካብ ምብራዝን፣ ማይ ምዝራቅን ዝሓየለን ዝደልደለን ኮይኑ ይርከብ።ነፍሲ ወከፍ ፍሉይ ጠባያት ዘለዎም እዩ’ ናይ መ ንሳፈፊ ጥ ረ ነገራት ምስቲ ነዘውትሮ መ ግፈፊ ዝተዛመደን ዝተተሓሓዘን እዩ።



ቅርጽታት ናይ መንሳፈፊ ካብ ናብ ይፈላለ እዩ።እቲ ፍልልይ ድማ ኣብ ዲዛይን ናይ እቲ ናውቲ መግፈፊ ይምርኮስ።ግና እቲ ኣገዳሲ ረቂሒ ናይ መንሳፈፊ ግና ኣብ መዳይ ኣተዓቃቅብኡን፡ብኽሌማዊ ለውጢ ንዝመጽእ ተጻብኦታት ትሑት ጽልዋ ዘለዎን ዝብል እዩ።እቲ ተራን ልሙድን ቅርጺ ናይ መንሳፈፍቲ ስሊንደራዊ ቅርጽን፡ከቢብ ቅርጽን፡ግሎባዊ ቅርጽን እዮም።
ምዱብ ስሕበት ዝውኑኑ ፍሉጣት ናይ መንሳፈፍቲ ጥረ ነገራት እዞም ዝስዕቡ እዮም፡

cork	0.18	ሰብ ሰርሑ ጎማ	0.24
ዕንጸይቲ	0.60	glass bau	0.22-0.24
ሻምብቆ	0.50	styrene resin	0.28
ጽሕዲ ሊባኖስ	0.4		

ስለዚ ትሕዝት/መጠን ናይ መንሳፈፊ Vcm3 እንድሕር ኮይኑ ዝሕዞ ክብደት/ ሚዛን ኣብ ኣየር ድማ W;gram ንብል ኣለና።

ስለዚ ዘለዎ ናይ ምንስፋፍ ተኽእሎ ናይ መንሳፈፊ ክንፈልጦ ንጥቀመሉ ኣገባብ ቅጥዒ ከምዚ ይስዕብ፡

F=W(1/C-1)

ትሕዝቶ ነገራት ናይ ክብደት(መ ጥሓሊ)

ክብደት/መጥሓሊ ዝባሃል ነቲ ናውቲ መግፈፊ ዓሳ ስሕበታዊ ሓይሊ ወሲኹ ቅርጹ ሓልዩ ኽጓዓዝ ዝሕግዝ ጥረ ነገር እዩ።

ኣገደስቲ ጠባያት ናይ ክብደት/መጥሓሊ

- ዝለዓለ ስሕበታዊ ሓይሊ ዝውንን
- ካብ ምራተን ፍሕፍሐን ተሓይሩ ንነዊሕ እዋን ክጸንሕ ዝኽእል
- ብቀሊሉ ክስናዕ ዝኽእልን፡ ከም ቅዲ መርኣያ ኮይኑ ክስራሕ
- ኣብ ቀረብ ብቅዓት ዘለዎን፡ዋጋ ውን ብቀሊሉ/ትሑት ምስ ዝኸውን

ክብደት ዝሕዞ ትሕዝቶን ቅርጽን

- ክብደት/መጥሓሊ ኣብ ብዝተፈላለዩ ጥረ ነገራት ክስራሕ ይኽእል፡ኣብነት ዓረር፡ሓጺን፡ደረቅ ስሚንቶ፣እቲ ዝሕዞ ቅርጺ ድማ ስሊንደር፡ከበሮ፡ግሎባዊ ቅርጺ ዘለዎን እዮም።

<u>ክብደትን መልሕቅን</u> 		
ሓጺናዊ ክብደት	ሓጺናዊ መልሕቅ ኣብ ሑጻ እንጥቀመሉ	ናይ ሑጻ ቦርሳ
		
ክብደት ስራሓት ናይ ካይላ	ሓጺናዊ መልሕቅ ከም ንጀልባ መዐሸጊ ንጥቀመሉ	ብሓንቲ እትትሓዝ መልሕቅ ኣብ ከም ንመሕጸሪ ንጥቀመሉ

- **ዝሕዞ ምዱብ ክብደታዊ ሓይሊ ናይ መጥሓሊ**
  እንድሕር ደኣ እቲ ምዱብ ስሕበት ናይ ሓደ ክብደት ዝዓበየ ኾይኑ ካብቲ ጨዋም ማ ይን ጥዑም ማ ይን ጥልቀታዊ

ሓይሊ ክንብል ንኽእል።
ክብደት ምዱብ ስሕበታዊ ሓይሊ

ሑጻ 1.80 ሓመድ 1.50

እምኒ 2.65 ካይላ 2.60-2.70

ጥልቀታዊ ሓይሊ ናይ ሓደ መጥሓሊ በዚ ዝስዕብ ቅማረ ንረኽቦ

S=W(1-1/C)

ኣብነት፡ስሕበታዊ ሓይሊ ናይ ሓደ ዓረ 50kg ኣብ ትሕቲ ማ ይ ዝሕዞ ክብደት ኮይኑ፡ም ዱብ ስሕበታዊ ሓይሉ(c) 11.34 እዩ።

S=W(1-1/C) 50KG-50000g

=50000(1-1/11.34)

=45,591g

ምቕያም ዓቕሚ ናውቲ መግፈፊ

ኣድላይነት ምቕያም ዓቅሚ ናይ ናውቲ መግፈፊ ኣብቲ ዝሕዞ ዓቀን ናይቲ መግፈፍን ከምኡ ውን ድልዳለ ኣብ ናይ ንፋስን ማዕበላዊ ምንቅስቃስን ይምርኮስ።ብተወሳኺ ውን ኣቃልቦ ክወሃቦ ዘለዎ ተልዩ ድማ ድልዳለ ናይ እቲ ናውቲ መግፈፍን ከምኡ ውን ምስኡ ተታሓሒዙ ዝኸይድ ገመድን መልሕቅን ክንጠቅስ ንኽእል። እዚ ምቕያም ዓቅሚ ናውቲ መግፈፊ በብሓደ ዝተቀመረ ኮይኑ ፡እዚ ድማ ብናይ ነፍሲ ወከፍ ግፋ ዝካየደሉ መሬት ኮይኑ በቲ ዘሎ ደረጃ/ኩነታት ናይቲ ውቅያኖስ ምርኩስ ብምግባር እዩ።ብፍጹም ድማ ብዙሕ ዕንወትን እዚ ድማ ብብርቱዕ ማዕበል ቅልጡፍ ምልኣተ ምስ ናይ **ሓይሉ ዘመልክት ኣየርእይን እዩ።ነዚ ከምዚ ዝበለ ሳዕቤን**

ዘምጽእ ንምክልኻሉ ድማ ብዛዕባ ክሊማዊ ሓበሬታ ዝምልከት ኣቃልቦ ክወሃቦ ዘለዎ እዩ። ከምኡ ውን እቲ ናውቲ መግፈፊ ባሕርን ካልእ ዝኣመሰሉ ነገራትብጽሬት ክተሓዝን፣ ጉድኣት ዘስዕብን ተኽይኑ ንዝያዳ ግስጋሰ ካብቲ ዘለዎ ክመሓየሽ ይግባእ..።

- **መጠነ ምሕጻር ሰኪዐት(shortening)**

ሓንቲ ሬተ ምስ እቲ ከም ደገፍ ኮይኑ ዝኣቱ ገመድ ምስ ተተሓሓዘት፣እቲ ዝርጉሕ ሬተ ካብ እቲ ገመድ ሒዝዎ ዘሎ ዓቀን ቁመት ዝነውሐ ክኸውን ይግባእ።ስለዚ ድማ እዩ ትኽክለኛ ዘላቂ ዝኾነ ሰኪዐት ኣገዳስነት ዝህልዎ።ስለዚ ኣብ ሓደ ዝርጉሕ ሰኪዐት ዘሎ ዓቀን ቁመት ዝነደሎ ቁመት ናይ ገመድ ብሚእታዊት ዝሕዞ ዓቀን ናይ እቲ ዝርጉሕ ሰኪዐት ድማ እዩ ሕጽረት ናይ ሓደ ረተ/ሰኪዐት ንምርካብ በዚ ዝስዕብ ቅማረ ንረኽቦ።

ሕጽረት% = ዝርጉሕ ቁመት ረተ - ቁመት ገመድ*100/ዝርግሐ ቁመት ረተ

ንኣብነት፡ ሕጽረት ናይ ሓንቲ ሰኪዐት ቐምር/ርኽብ፡ እቲ ዘድሊ ቐረብ ድማ ሓንቲ ሰኪዐት 600 ዓይኒ ንቁመት, ቁመት ናይ ገመድ ድማ 50m ኣቢሉ ይኽውን, እቲ ዝሕዞ ዓቀን ናይ ዓይኒ ድማ 15cm እዩ።

ሕጽረት%=ዝርጉሕ ቁመ ት ረተ- ቁመት ገመድ/ዝርጉሕ ቁመ ት ረተ* 100

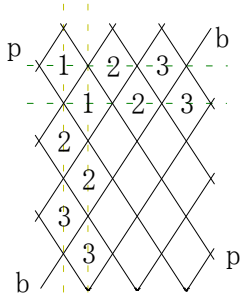
ሕጽረት = 0.15*600-50/0.15*600*100=90-50/90*100=44%

ብሓፈሻ መርበብ ሰኪዐት ክቁረጽ ከሎ ብክልተ ኣገባብ ንጥቀም።እቲ ሓደ ብክልተ እግሪ ክቁረጽ ,እቲ ካልኣይ ድማ ብሓደ እግሪ ክቁረጽ እንከሎ እዩ።

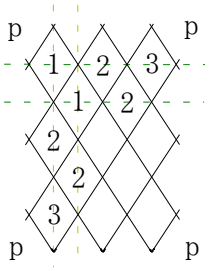
ስያፍ ዓይነት ስሉስ ኩርናዓዊ ቅርጺ ዝሓዘ ኣቆራርጻ ንከም ዓቢ መርበባዊ ሰኪዐት ብክልቲኡ ማለት ብጫፍ ወገንን፡ብጎድንን ኣገባብ ተቆሪጹ ይዳሎ።

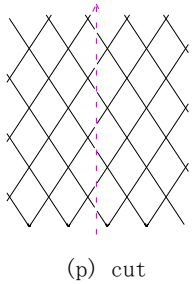
እቲ ዝሕዞ ብዝሒ ቁጽሪ ናይ ጫፍን(p) ጎድንን(B) ወገን ኣቆራርጻ በዚ ዝስዕብ ቅማረ ይዳሎ፣እቲ መስርሕ ምቁራጽ ድማ ቀሊል ይኸውን።

Cutting of netting



(ሓፈሻዊ ኣቆራርጻ)





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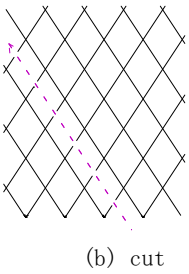
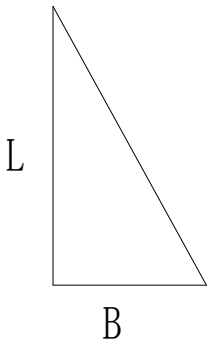
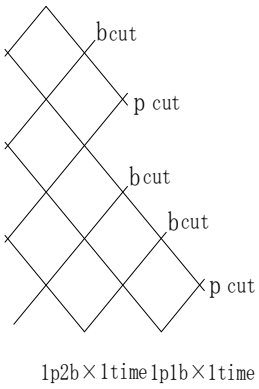


(ናይ ጎድኒ)





Formula: p=L-B

b=B×2

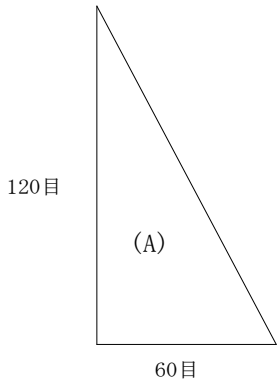
p:ብዝሒ ቁጽሪ ክቁረጽ ተደልዩ ዘሎ ኣብዚ ወገን

b: :ብዝሒ ቁጽሪ ክቁረጽ ተደልዩ ዘሎ ኣብዚ ወገን

L:ቁጽሪ ዓይኒ ኣብቲ ዝነውሐ ደረት

B: :ቁጽሪ ዓይኒ ኣብቲ ዝሓጸረ ደረት

(Example 4)



(A)

p=120-60=60

b=60×2=120

ጠቅላላ ብዝሒ ዝቁረጽ ኣብ (p) ወገንን፣ ናይ ጎድኒ ወገንን(b) በዚ ልዕልል ኢሉ ዘሎ ቅማረ ንረኽቦ።እንድሕር ደኣ እዚ ክልተ ወገን ማለት (p) ከምኡ ውን (b) ብዝሒ ዝቁረጽ ብዝተኻእለ መጠን ክውሕድ እንተ ኽኢሉ፡እቲ ሰያፍ ቅርጺ ዝውንን መ ርበባዊ ኣቆራርጻ ብለማ ጽ መ ንባዲ ክስራሕ ይከኣል።

እዚ መ ስርሕ ናይ ም ቁራጽ ብ 1p2b ክዛዝም ይከኣል ምኽንያቱ እቲ ኣብ p ዘሎ ብዝሒ ቁራጽ ካብ ናይ b ዘሎ ብዝሒ ቁራጽ ዝወሓደ ኮይኑ፡ብዝሒ ቁራጽ ናይ b ድማ ዕጽፊ ናይ p ኮይኑ ስለ ዝተረክበ 1 ይወስድ።ስለዚ በዚ ዝስዕብ ኣገባብ ድማ ይጸሓፍ። 1p2b(pbb, pbb・・・) ×60 times,.

ነዛ ስሉሳዊ ኩርናዕ ቅርጺ ዘለዋ ረተ ክንቆርጽ ከለና ንጥቅመሉ ኣገባብ ኣቆራርጻ ነዚ ኣብ ታሕቲ ዘሎ ቅማረ ንጥቀም።

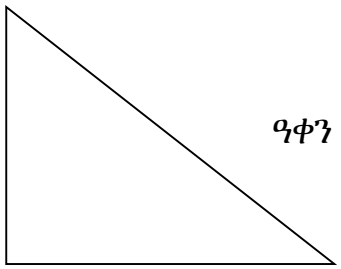
K= *ምሕጻር ሰኪዐት* **ድሕሪ መስራሕ ኣብ 30% (0.3) ቁጽሪ ናይ ዓይኒ**

77÷ (1-0.3) ÷10 = 11 ዓይኒ.

ቅማረ ቁመት ናይ ረተ H=$\sqrt{2S - S^2}$

Hang-in is 0.3, H =. $\sqrt{2 \times 0.3 - 0.3^2} = 0.6 - 0.09 = 0.51 =$
0.71414 ≒ 0.7

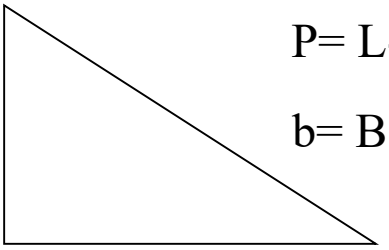
ብዝሒ ቁጽሪ ናይ ዓይኒ J is 119÷0.7÷10 = 17 meshes.

J=119cm  ዓቀን ዓይኒ ረተ 10cm

K=77cm1 ቁጽሪ ዓይኒ ናይ ረተ ኣብ j 119cm ቁመት(17 ዓይኒ ኣለዎ)

2.ቁጽሪ ዓይኒ ናይ ረተ ኣብ k 77Cm ቁመ ት(11 ዓይኒ ኣለዎ)

17me



P= L-B p=17-11 p= 6

b= B*2 b=11*2 b= 22

11mesh

1p3b*2 times 1p4b*4times

Source of REFERENCE BOOKS (ሞዉከሲ ምጽሓፍ

Comprehensible fishery

Basic rope fishing net

Translated and Edited by Dita Amanuel

መሰረታዊ ቅመራ መርበብ ሰኪዐት

Translated and Edited by Dita Amanuel

ትሕዝቶ

1.መስርሒ ሰኪዐት ዘድልዩ ጥረ ነገራት
2.ዓቀን/መለክዒ ናይ ሰኪዐት
3.ሓፈሻዊ መብርህን ቅመራን ናይ ክብደትን መንሳፈፍን ሰኪዐት
4.ኣገባብ ኣቆራርጻን ኣሰናንዓን ሰኪዐት

መእተዊ

- ዕላማ ናውቲ መማፈፊ ዓሳ ንምሓዝ ክኸውን ከሎ፡ኣተሓሕዝኡ ብዝምልከት ድማ ብ 2 ኣገባብ ክንሪኦ ንኽእል።
- እቲ ሓደ ሙሉእ ብሙሉእ ኣካላቱ ኣብ ረተ ክጠናነግ ከሎ፡እቲ ካልኣይ ድማ ብማሕንቆ ክሳዱ ክተሓዝ እንከሎ እዩ።
- ቅድሚኡ ግና ነዚ ዓይነት ሜላ ኣጋፍፋ እዚ ንምትግባር ምስቲ ናውቲ መማፈፊ ንጥቀመሉ ዘለና ዓይነት ረተ ዝተሓሓዝ መገጣጠሚ ክህልወና ግድን ይገብሮ።
- እቲ ቀዳማይ ነታ ረተ ክትንሳፈፍ ዝሕግዝ ኣንሳፋፊ ኣብ ላዕለዋይ ክፋል ክኸውን ከሎ፡
- እቲ ካልኣይ ድማ ክብደት ገይራ ንታሕቲ ከም ትሳሓብ ዝሕግዝ ኣብ ታሕተዋይ ክፋል ናይ ረተ ይእሰር። ብዘይካ እዚ ውን ላዕለዋይን ታሕተዋይን ክፋል ናይ ረተ(ክብደትን መንሳፈፍን) ነታ ረተ ብዝግባእ ቅርጻ ሓልያ ክትነዓዝ ይሕግዝ።
- እዚ ናይ ማሕንቆ(gillnet) ዓይነት ረተ ብ3 ኣገባባት ክስርሓሉ ይከኣል።እቲ ቀዳማይ ኣገባብ እታ ረተ ዕምቆት ኣብ ዘይብሉ ገማግም ብነጻ ኣንዳተንቀሳቀሰት ክትከውን ከላ፡እታ ካልኣይቲ ድማ ኣብ ማእከላይ ዕምቆት ዘለዎ ክኸውን ከሎ፡ እቲ ሳልሳይ ድማ.....

- ኣብ ታሕተዋይ ዕምቆት ዘለዎ ቦታ ክንዝርግሉ እንከለና እዩ።እዞም ልዕል ኢልና ዝጠቀስናዮም ኣገባባት በቶም ከም ዕላማ ተታሒዞም ዘለዉ ዓይነታት ፍርያት ባሕሪ ምርኩስ ብምግባር ከም ዝስርሓሎም ምዝካር የድሊ።
- እምበኣርከስ ብመንጽር ተታሒዞም ዘለዉ ዓይነታት ፍርያት ባሕሪ ምርኩስ ብምግባር ከም ዝስርሓሎም ምዝካር የድሊ።

- ብመንጽር ውሕስነት ንናይ ምምዕባል ናይ ማሕንቆ መማእቲ ዘለና መደብን ኣጠማምታን ኣብ መዳይ ቁጠባን መማፈፊ ዓሳን ጽፋፍ ኣሰራርሓን ተርኡ ዓቢ ከም ዝገብሮ ዝስሓት ኣይኮነን።

- **<u>መስርሒ ሰኪዐት ዘድልዩ ጥረ ነገራት</u>**
- ብመሰረት ዓለምለኻዊ ውድብ መዐቀኒ ክግለጽ ከሎ< ዓይኒ ሰኪዐት> መርበብ ቅርጺ ዝሓዘ ኮይኑ ዘይውሱን ቅርጽን ዝሓዘ
- ክኸውን ከሎ፡ልዕሊ ሓደ ዓይነት ኣገባብ ፈትላዊ ምትሕንፋጽ ዘጠቃለለ እዩ።
- እቶም ንመርበብ ሰኪዐት ዘድልዩ ጥረ ነገራት ጽሕጎ/ጅማት መሳሊ የጠቃልል።ንሳቶም ድማ ባህርያውያን ጽሕጎን፡ሰብ-ሰርሖ ጽሕጎን ኢልና ንሰምዮም።
- እዞም ባህርያውያን ጽሕጎ እዚኣቶም ኣብቲ ናይ ቀደም እዋን ዝጥቀምሉ ዓይነት ፈትሊ
- እዩ።ንኣብነት ከም ጡጥ፡ወረቀትን ዓለባ ፈትልን እዮም። እዞም ሰብ ሰርሑ ጽሕጎ ግና ዓለምለኻውን እዋናውን ዝጥቀምሉ ኮይኑ ስርሓቱ ድማ ዝተጸመረ ሰብ ሰርሑ ዓለባ እዩ፡ ንኣብነት ናይሎን፣ፖሊስተር'፣ፖሊእታይሊን፣ፖሊፕሮፓይል ተባሂሎም
- ክጥቀሱ ይከኣሉ።

- **<u>መስርሒ ሰኪዐት ዘድልዩ ጥረ ነገራት</u>**
- ብመሰረት ዓለምለኻዊ ውድብ መዐቀኒ ክግለጽ ከሎ< ዓይኒ ሰኪዐት> መርበብ ቅርጺ ዝሓዘ ኮይኑ ዘይውሱን ቅርጽን ዝሓዘ
- ክኸውን ከሎ፡ልዕሊ ሓደ ዓይነት ኣገባብ ፈትላዊ ምትሕንፋጽ ዘጠቃለለ እዩ።
- እቶም ንመርበብ ሰኪዐት ዘድልዩ ጥረ ነገራት ጽሕጎ/ጅማት መሳሊ የጠቃልል።ንሳቶም ድማ ባህርያውያን ጽሕጎን፡ሰብ-ሰርሖ ጽሕጎን ኢልና ንሰምዮም።
- እዞም ባህርያውያን ጽሕጎ እዚኣቶም ኣብቲ ናይ ቀደም እዋን ዝጥቀምሉ ዓይነት ፈትሊ
- እዩ።ንኣብነት ከም ጡጥ፡ወረቀትን ዓለባ ፈትልን እዮም። እዞም ሰብ ሰርሑ ጽሕጎ ግና ዓለምለኻውን እዋናውን ዝጥቀምሉ ኮይኑ ስርሓቱ ድማ ዝተጸመረ ሰብ ሰርሑ ዓለባ እዩ፡ ንኣብነት ናይሎን፣ፖሊስተር'፣ፖሊእታይሊን፣ፖሊፕሮፓይል ተባሂሎም
- ክጥቀሱ ይከኣሉ።

✓ ናይሎን

- መጠን ስፍሓት ተጠቃምነቱ ዓቢ እዩ
- ናይ ምምጣጥን ምንዋሕን ተኽእልኡ ልዑል እዩ
- ብመንጽር እቲ ዘጋጥም ፍሕፍሐ ድልዳለን ልስላሰን ዝወነነ እዩ
- በዚ ዓለባ ዝስርሑ ናውቲ መግፈፊ ማሕንቆ ረተ፣ጋብያ መሳሊ ረተ፣ከምኡ ውን ፍሕሶ ዝኣመሰሉ እዮም

✓ *ፖሊእስተር*

- ንኡስ ምዱብ ስሕበታዊ ሓይሊ ንኡስ እኳ ተኾነ ዘለዎ ናይ ፍሕፍሐ ዓቕሚ ኣብ ማይ ድሉዱል እዩ።
- ኣብ ዋጋ ውን ካብቲ ካልእ ዓይነት ዓለባ ዝሓሰረ ኮይኑ ይርከብ
- ዘለዎ ጠቃምነት ኣብ መስርሕ ምግፋፍ ድማ ኣዝዩ ሰፊሕ እዩ

✓ *ፖሊፕሮፓይል*

- ዘለዎ መጠን ጥልቀት 0.91 ኮይኑ ንረኽቦ
- ብዘለዎ ትሑት ዓቕሚ ከም መእሰርን ፡መዐሸጊ ንመራኽብ የገልግል
- ኣብ ናይ ቀመማዊ ዓቕሙ እንተመጺና ተጻዋርነቱ ዓቢ እዩ።
- **ዓቀን/ መለክዒ ናይ ሰኪዐት**
- ዓቀን ወይ መለክዒ ክንብል ከለና ናይ ሓደ ነገር እንታይነትን ሒዝዎ ዘሎ ዓቀንን ብቅዓትን ዝገልጽ እዩ።እቲ ንሰኪዐት መስርሒ ንጥቀመሉ ዓይነት ፈትሊ ዝሕዞ መለክዒ እንታይን ብኸመይን ይግለጽ ምፍላጥ የድሊ።እምበኣርከስ ርጉዲ ናይ ሰኪዐት ፈትሊ ክግለጽ ብ ዲንያር ወይ ድማ ኣሃዱ ይሕበር።
- እዚ መዐቀኒ እዚ ኣብ ንናይሎን ድርብ ፈትሊ ጥራይ ዝገልጽ ኮይኑ፡ብኸምዚ ድማ ክንገልጾ
- ንኽእል 210D/9 እቲ 210 ተባሂሉ ዘሎ ንናይሎን ዝባሃል ፈትላዊ ዓለባ ዝገልጽ ክኸውን ከሎ፡እዚ ድማ ዘለዎ መጠን ክብደት ናይቲ ረተ 210g እዩ፡እቲ ሒዝዎ ዘሎ ቁመት ድማ 9000m
- 1mesh= ሓንቲ ዓይኒ ሰኪዐት
- 0.5mesh=ፍርቂ ዓይኒ ሰኪዐት

- ዝሕዞ ቁጽሪ ዓቀን ዓይኒ ናይ ሰኪዐት ብሚሊመተር ይዕቀን፡ በዚ መዐቀኒ እዚ ክንዕቅኖ ከለና ድማ ነቲ ዓይኒ ሰኪዐት ድሕሪ ምግታርና ዓቀን ክንወስድ ይግባእ።
- ነቶም ንናይሎን ሰኪዐት ዝገልጹ ምልክታት ብኸመይ ነንብቦም
- ርጉዲ210D/9 ናይ ፈትሊ.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,210ኣሃዱ ምስ ቁጽሪ 9 ፈትሊ
- 16 ቁጽር ዘለዎ ዓቀን ናይ ሰኪዐት ዓይኒ.................................20.2mm
- 200 ዓይኒ ኣብ ዕምቆት..ድምር ዓይኒ ሰኪዐት ንቁመት

- **ዓይነታት ሰኪዐትን ዘለዎም ኣገዳስነትን**
- ኣብዚ እዋን እዚ ዓለምለኻዊ ዝስራሑ ዘሎ ንመርበብ ሰኪዐት መስርሒ ዝኸውን ፈትላዊ ሰብ ሰርሖ ዓለባ እዩ።ዝተፈላለዩ ዓይነታት መርበብ ሰኪዐት ዝሕዝዎ ጠባያት ብዓይኒ ቑጠባን ብቅዓትን ኣብ ምግፋፍ ከምኡ ውን ብቀሊሉ ንምዕቃቡን ንምሓዙን ዘለዎ ተራን ተፈላልዮም ኣብ ስራሕ ይውዕሉ።

✓ ቁጻር ኣልቦ ሰኪዐት

- ልዑል ድልዳለ ይውንን
- ብቀሊሉ ብቅዓቱ ዝጎድል ኣይኮነን
- ውሑድ ብዝሒ ዓቀን ፈትሊ
- ብዝግባእ ቅርጹ ሓልዩ ዝጓዓዝ ዓይነት ሰኪዐት እዩ
- ንዝፍጠር ምብልላዕን ምጽራርን ደው ካብ ምባል ተኽእልኡ ትሑት እዩ

- ቁጻር ሰኪዐት
- ዓይኒ ሰኪዐት ብቀሊሉ ናይ ምምጣጥን ምዝርጋሕን ተኽእልኡ ልዑል እዩ።
- ቁጻር ብምኳኑ ብብዝሒ ዓቀን ረተ ክሃልኽ ክውድእ ይርአ
- ብሰንኪ ክሊማዊ ለውጢ ዝርአ ምልኣተ ባሕሪ ዘለዎ ተጻብኦ ዓቢ ብምኳኑ ከም ጉድለት ይርአ።
- ዘለዎ ውጥረትን ፍሕፍሐን ምስ እቲ ቑጻር ኣልቦ ዝኾነ ዓይነት ሰኪዐት ኣረኣኢኻ ዝለዓለ እዩ።

ኣንሳፋፍን ተንሳፋፋይን

ዝተፈላለዩ ዓይነታት ኣንሳፈፍቲ ጥረ ነገራት ኣለዉ፡

- ➢ ልስሉስ ኣንሳፋፋይን፡ምስ ሓጹር መርበብ ሰኪዐት(perse sein)
- ➢ ሓጺናዊ ኣንሳፋፋይን፡ምስ ሰት ነት ተተሓሒዙ ዝኸይድ እዩ

እዞም ኣካላት እዚኣቶም ብዓይነቶም ጥራይ ዘይኮኑስ፡ብቅርጾም ውን ከይተረፈ ይፈላለዩ እዮም።ከም ኣብነት ኦቫል ፡ስሊንደሪካል፡ከምኡ ውን ግሎብዩላር ቅርጺ ሒዞም ይረኣዩ። ኣገዳስነት ናይ እዞም ኣካላት ድማ መምስ ዝተፈላለዩ ዓይነታት ናውቲ መግፈፊ ዓሳ ይፈላለን ንጥቀመሎምን።

ኣገደስቲ ጠባያት ኣንሳፋፊ ኣካል

- ማይ ዘይሰትን ልዑል ጸብለል ናይ ምባል ተኽእሎ ዘለዎን
- ኣንጻር ናይ ብሕጎጋን ልዑል ክሊማዊ ተጻዋርነት ዘለዎ(ማይ ዘየዝሩቅ)
- ትሑት ሃልኪ ዋጋ ዘለዎ ፣ንምዕቃቡ ውን ቀሊል ምስ ዝኸውን
- ንዝፍጠር ፍሕፍሐ ውን ልዑል ተጻዋርነት ዝውንን
-

ዓይነታት ኣንሳፈፍትን ቅርጸምን

- ዕንዲዳ ዝባሃል ጥረ ነገር ከም መስርሒ ንመንሳፈፊ ዝኾኑ ነገራት ከም መስርሒ ይጠቅም።
- ✓ እቲ ካብ ፕላስቲካዊ ጥረ ነገር ዝተሰርሐ መንሳፈፊ ካብ ምብራዝን፡ማይ ምዝራቅን ዝሓየለን ዝደልደለን ኮይኑ ይርከብ፡
- ✓ ነፍሲ ወከፍ ጠባያት ዘለዎም ናይ መንሳፈፊ ጥረ ነገራት ምስቲ ነዘውትሮ መግፈፊ ዝተዛመደን ዝተተሓሓዘን
- ✓ ግሎባዊ ቅርጽን ስሊንደራዊ፡ከቢብ ቅርጽን ዝኣመሰሉ ቅርጽታት ተራን ልሙድን ቅርጺ ናይ መንሳፈፍቲ

ምዱብ ስሕበት ዝውኑኑ ናይ መንሳፈፍቲ ጥረ ነገራት

- cork 0.18 ሰብ ሰርሑ ጎማ 0.24
- - ዕንጸይቲ 0.60 glass bau 0.22-0.24
- ሻምብቆ 0.50 styrene resin 0.28
- ጽሕዲ ሊባኖስ 0.4
- ትሕዘት መጠን መንሳፈፊ vcm3, ክብደት ሚዛን ኣብ ኣየር
- ድማ w;gram ንብል

ኣገደስቲ ጠባያት ናይ ክብደት/መጥሓሊ

- ዝለዓለ ስሕበታዊ ሓይሊ ዝውንን
- ካብ ምራተን ፍሕፍሐን ተሓይሩ ንነዊሕ እዋን ክጸንሕ ዝኽእል
- ብቀሊሉ ክስናዕ ዝኽእልን፡ ከም ቅዲ መርኣያ ኮይኑ ክስራሕ
- ኣብ ቀረብ ብቅዓት ዘለዎን፡ዋጋ ውን ብቀሊሉ/ትሑት ምስ ዝኸውን

ክብደት ዝሕዞ ትሕዝቶን ቅርጽን

- ክብደት/መጥሓሊ ኣብ ብዝተፈላለዩ ጥረ ነገራት ክስራሕ ይኽእል፡ኣብነት ዓረር፡ሓጺን፡ደረቅ ስሚንቶ፣እቲ ዝሕዞ ቅርጺ
- ድማ ስሊንደር፡ከበሮ፡ግሎባዊ ቅርጺ ዘለዎን እዮም።

ዝሕዞ ምዱብ ክብደታዊ ሓይሊ ናይ መጥሓሊ

- ሑጻ 1.80
- ሓመድ 1.50
- እምኒ 2.65
- ካይላ 2.60-2.70
- ጥልቀታዊ ሓይሊ ናይ ሓደ መጥሓሊ በዚ ዝስዕብ ቅማረ ንረኽቦ…….S=W(1-1/C)

1.መሰረታዊ ፍልጠት ኣብ ናውቲ መግፈፍን ከምኡ ውን ምስ ናውቲ መግፈፊ ዓሳ ዝተኣሳሰር መሰረታዊ ቅማረን

- ምውጣን ገስጋስ ልምዓት ኮም ገፈፍቲ ዓሳ

AUGUST 2010

LECTURER ፡ MOTOKI FUJII Tigrigna Translator : Dita Amanuel

ትሕዝቶ

1.ረተን ዓይነታት ገመድን

• 1.1 ዓይነታት ፈትልታት ንጥቀመሉ ኣብ ሰኪዐትን ገመድን

ኣብ ረተ ክልተ ዓይነት ፈትልታት ኣለዉ፣ ንሳቶም ድማ ባህርያውን ሰብ ሰርሑ ፈትልን ይባሃሉ።ሽሕ ኳ እዚ ባህርያዊ ፈትሊ ጠቃምነቱ ውሱን ዝርግሐ እንተለዎ፣ሕጂ ግና ኣብ ዝበዝሐ ንግዲ ናይ ዋኒን ምግፋፍ ዓሳ ብሰብ ሰርሑ ፈትሊ ተተኪኡ ይርከብ።

ባህርያዊ ፈትሊ---------ካብ ኣሕምልቲ ዝተመስርሐ ፈትሊ ናይ ዒቃ ፣ልሕጺ ፣ናይ ዘርኢ ፈትሊን ክኾኑ ከለዉ ፡ ካብ ናይ እንስሳ ዝተመስርሐ ፈትሊ ድማ ናይ ክዳን ሃሪ ዓለባን፡ ብጸምሪ ዝተሰርሐ ክዳን ይርከቦ።

ሰብ ሰርሑ ፈትሊታት

• ሰብ ሰርሑ ፈትልታት ----------

➢--ከሚካላዊ ኣስማት=POLYAMIDE(PA)

=POLYESTER(PES)

=POLYVINYL ALCHOL(PVAA)

=POLYVINYLLIDENCHLORIDE(PVD)

=POLYVINYL CHLORIDE(PVC)

=POLYETHYLENE(PE)

=POLYPROPLYLENE(PP)

ዓይነታት ሰብ ሰርሑ ፈትልታት

• ሰብ ሰርሑ ፈትልታት-

• 1.ብመልክዕ ፍሕሶ/ልግብጋብ ዝስራሕ ፈትሊ

2.ትኽ ዝበለ ልግብጋብ ዘይብሉ ዓይነት ፈትሊ(ንጽልን ድርብን ፈትሊ)

3.ዝተመቃቀለ ዓይነት ፈትሊ

ጠባያት ሰብ ሰርሑ ፈትልታት

• ሰብ ሰርሑ ፈትሊ ብከሚካላዊ ጽመራ ዝፈረየ ከይኑ ምስ ካብ ውጽኢት ናይ ኣሕምልትን እንስሳታትን ፈትልታት ናይ ተፈጥሮ ፈትሊ ኮወዳደር ከሎ እዚ ሰብ ሰርሑ ፈትሊ ዝለዓለ ተጻዋርነትን ድልዳለን ይውንን።

• እምበኣርከስ 7 ቀንዲ ከሚካላዊ ጉጅለ ናይ ሰብ ሰርሑ ፈትሊ ኣብ ናውቲ መግፈፍን ገመድን ንጥቀመሉ ኣለዉ።

POLYAMIDE……(PA)NYLON

- ዘለዎ ምዱብ ስሕበት 1.14
- ውጥረታዊ ድልዳለ (g/d) 4.8-6.4
- ተጻዋርነት ናይ ክሌማ -----ኣብ ድልዳለ ይጎድል
- ሳዕቤን ናይ ሓሰኻን ሰበባን ብቁዕ ተጻዋርነት ኣለዎ
- ልሙድ ተጠቃምነት ዘለዎም ፈትሊታት ኣብ መስርሕ ምግፋፍ ኣብ ከም በዓል መኽርደኒ ረተ፣መሸከርከሪ ፈትሊ፣ዘረፍረፍ ፍሕሶ

POLYESTER…….PES(TETORON)

- ዘለዎ ምዱብ ስሕበት፡ 1.38
- ውጥረታዊ ድልዳለ(g/d) 4.3-6.0(ምጡን ዓቀን)
- 4.3-6.0 (ምስ ጠልቀየ)
- ንውሓት (%) ፡20-32
- ዘለዎ ትህዝቶ ጠሊ% ፡0.4- 0.5
- ዘለዎ ተጻዋርነት ናይ ክሌማ፡ ኣብ ድልዳለኡ ቅሩብ ይጎድል
- ሳዕቤን ናይ ሰበባን ሓሳኹን፡ እዚ ዓይነት ፈትሊ ሙሉእ ብሙሉእ ይጻወር
- ቀንዲ ተጠቃምነት እዚ ፈትሊ ኣብ ምስርሕ ምግፋፍ ኣብ ከም በዓል ነዊህ ገመድ፣ መጅሓፍ(ኣብ ማእክላይ ባሕሪ)

POLYVINYL ALCHOL……PVAA (VINYLON)

- ዘለዎ ምዱብ ስሕበት፡ 1.26-1.30
- ውጥረታዊ ድልዳለ (g/d) 3.0-4.0
  2.1- 3.2 (wet)

ንውሓት% ፡17-22

ዘለዎ ትሕዝቶ ጠሊ % 3.5-4.5

ዘለዎ ተጻዋርነት ናይ ክሌማ፡ ኣብ ድልዳለኡ ቅሩብ ይጎድል

ኣብ ሳዕቤን ናይ ሰበባን ሓሳኹን ድማ ሙሉእ ተጻዋርነት ኣለዎ

ቀንዲ ተጠቃምነት ናይ እዚ ፈትሊ ኣብ ነዊሕ ገመድን ፣መጻወዲያ ረተን ከይኑ ይርከብ

POLYVINYLIDENE CHLORIDE…..PVD

- ዘለዎ ምዱብ ስሕበት ፡ 1.70
- ውጥረታዊ ድልዳለ(g/d)= 1.5-2.6
- 1.5-2.6
- ንውሓት %፡ 18-33
- ዘለዎ ትሕዝቶ ጠሊ -0
- ናይ ክሌማ ተጻዋርነት ድማ ኣብ ድልዳለ ቅሩብ ይጎድል
- ልሙድ ተጠቃምነት እቲ ፈትሊ ኣብ ዓበይቲ ደረጃ ዝርከባ መጻወድያ ረተ

POLYVINYL CHLORIDE ….PVC

- ዘለዎ ምዱብ ስሕበት ፡ 1.35-1.38
- ውጥረታዊ ድልዳለ (g/d); 2.7-3.7 (መጠን ዓቀን)
- 2.7- 3.7 (ምስ ጠልቀየ)
- ንውሓት% ፡ 20-25
- ዘለዎ ትሕዝቶ ጠሊ% ፡0
- ተጻዋርነት ናይ ክሌማ ድማ ኣብ ድልዳለኡ ቅሩብ ይጎድል
- ሳዕቤን ዘምጽኦ ናይ ሰበባን ሓሳኹን ሙሉእ ተጻዋርነት ኣለዎ
- ልሙድ ተጠቃምነት ናይዚ ፈትሊ ኣብ መስርሕ ምግፋፍ ኣብ ከም በዓል ዓበይቲ ናይ ረተ መጻወድያታት ይርኣ።

POLYETHYLENE……PE

- ዘለዎ ምዱብ ስሕበት ፡0.94-0.96
- ውጥረታዊ ድልዳለ (g/d)= 5.0-9.0 (መጠን ዓቀን)
- 5.0- 9.0(ምስ ጠልቀየ)
- ንውሓት% 8- 35
- ዘለዎ ትሕዝቶ ጠሊ ፡0
- ዘለዎ ተጻዋርነት ናይ ክሊማ፡ ኣብ ድልዳለ ቅሩብ ዝጎደለ እዩ
- ሳዕቤን ዘምጽኦ ናይ ሰበባን ሓሳኹን ሙሉእ ተጻዋርነት ይውንን
- ቀንዲ ተጠቃምነት ናይ እዚ ፈትሊ ኣብ መስርሕ ምግፋፍ ኣብ ከም በዓል መጅሓፍ(ናይ ትሕቲ ጽፍሒ ባሕሪ)፣ኣግማድን ይርከቡዎም።

POLYPROPYLENE……PP

- ዘለዎ ምዱብ ስሕበት፡ 0.91
- መሰረታዊ ድልዳለ(g/d) 4.5-7.5
- 4.5-7.5 (ምስ ጠልቀየ)
- ንውሓት% ፡25-60
- ዘለዎ ትሕዝቶ ጠሊ፡ 0
- ዘለዎ ተጻዋርነት ናይ ክሌማ ፡ ኣብ ድልዳለ ቅሩብ ዝጎደለ እዩ
- ዘምጽኡ ሳዕቤን ናይ ሓሰኻን ሰበባን ሙሉእ ተጻዋርነት ይውንን
- ቀንዲ ተጠቃምነት ናይ እዚ ዓይነት ፈትሊ ኣብ ገመዳት ጥራይ ተሓጺሩ ይርከብ

COTTON

- ዘለዎ ምዱብ ስሕበት፡ 1.54
- ውጥረታዊ ድልዳለ (g/d) 3.0 -4.5(መጠን ዓቀን)
- 3.3-6.4 (ምስ ጠልቀየ)
- ንውሓት % 3-7
- ትሕዝቶ ጠሊ%፡ 0
- ዘለዎ ተጻዋርነት ናይ ክለማ ፡ኣብ ድልዳለ ቅሩብ ዝጎደለ እዩ
- ዘምጽኡ ሳዕቤን ናይ ሓሳኹን ሰበባን፡ ብሰበባ ናይ ምዕናው ጠባይ ኣለዎ ክባሃል ይካኣል

መስርሕ ምልላይ ዓይነታት ፈትሊ

- ነዞም ዝተፈላለዩ ዓይነታት ፈትሊ ፍሉይ ናይ ምልላይ መስርሕ ኣብ ዝግበረሎም እዋን ኣብ ክልተ ተመቂሉ ይርከብ።እቲ ቀዳማይ ብዓይንካ ተዓዚብካን ዳህሲስካን ክፍለጥ ከሎ፡እቲ ካልኣይ ድማ ብሓዊ ኣቃጺልካ ክፍለጥ ከሎ እዩ።

- ኣብ ታሕቲ ዘሎ ስእሊ ብሓዊ ኣቃጺልካ ዝግበር ምልላይ ናይ ፈትሊ ተመልከት❋❋❋❋❋።

መስርሕ ምልላይ ናይ ፈትልታት ብሓዊ ብምቅጻል

ዓይነት ፈትሊ	ኩነታት	ጨና	ውጽኢት
PVAA(VINYLON)	ምስተቃጸለ ይጭበጥ	ኣልኮል	ተሪር/ ጸሊምሕብሪ
POLYAMIDE(PA)	ይመክኽ	ፍሉይ ጨና ኣለዎ	ተሪር,ሓመዳዊ
PVD	ኣሸጋሪ ንኽነድድ	ፍሉይ ጨና	ተሓምሻሺ/ተሰባሪ
PVC	ካብ ሓዊ ዝተፈናተተ	ዘተባብዕ ጨና	ሓሙኽሸቲ
POLYESTER	ይቃጸልን ይመክኽን	ዘገርም ጨና	ተሪር ጸሊምሕብርን
PE &PP	ይመክኽ	ናይ ዘይቲ ጨና	ሓሙኽሸቲ ኣልቦ
ጡጥ	ብቀሊሉ ይነድድ	ናይ ዝነደደ ወረቀት ጨና ኣለዎ	ሓሙኽሸቲ
ናይ ጸምሪ ዓለባ	ቀስ ኢሉ ይመክኽን ይነድድን	ጨና ናይ ጸጉሪ ንዳድ	ተሓምሻሺ ሓሙኽሸቲ

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ኣገደስቲ ጠባያት ናይ መንሳፈፊ

መንሳፈፍቲ ዝባሃሉ ኣንፈትን ቅርጽን ናይ ናውቲ መግፈፊ ካብ ዝተፈላለዩ ብምኽንያት ክብደትን ካልእ ካልእ ጀፋሊ ሓይልን ሓልዩ ክጓዓዝ ዝሕግዝ ዓይነት ወይ ድማ ንብረት ናይ መግፈፍ ዓሳ እዩ።

እቶም ኣገደስቲ ጠባያት ናይ መንሳፈፍቲ

1. ሓያል ናይ ተንሳፋፍነት ብቅዓት ዘለዎ
2. ማይ ዘይሰቲ
3. ልውል ተጻዋርነት ካብ ምጭብባት ዝውንን
4. ካብ ፍሕፍሐ ልውል ተጻዋርነት ዘለዎ
5. ብቁዕን ቀሊልን ፈጠራ ዘለዎ ኮይኑ ብርትዓዊ ዋጋ Easy and ample manufacturing at low cost
6. ኣብ መስርሕ ድማ ብቀሊሉ ክትሓዝን ክዕቀብን

2.2 ዓይነትን ቅርጽን ናይ መንሳፈፊ

ኣብ መጀመርያ ክፍለ ዘመን ክም ዕንጨይቲ፣cork,ኣርቃይ፣ስርሓት ጥርሙዝ፣ስርሓት ሓጺን ካልኦትን ዝኣመሰሉ ክም መንሳፈፊ ኮይኑ የገልግል ክም ዝነበረ ይግለጽ።

ኣብዚ ሕጂ እዋን ድማ ብሰብ ሰርሑ ዕንዲዳ ዝጥቀሙ ኮይኖም፡እዚ ድማ ምስቶም ልዕል ኢሎም ዝተጠቕሱ ጠባያት ተዋሃሂዶም ዝኸዱ ምኽኖም እዮም።

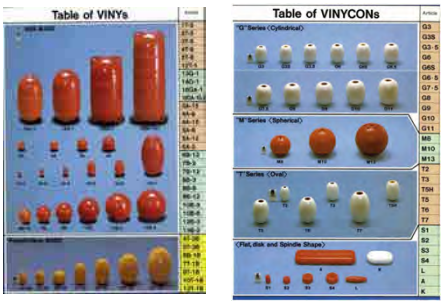
እምበኣርከስ ክልተ ዓይነት መንሳፈፍቲ ናይ ድመራ ዒቃ ኣለዉ፣እቲ ሓደ ፕላስቲካዊ ዓይነት ኮይኑ፣እቲ ሓደ ድማ ውሽጡ ባዶ ዝኾነ ፕላስቲካዊ መንሳፈፊ ዓይነት እዩ።

.....conti..

እዚ ውሽጡ ባዶ ዓይነት ዝኾነ መንሳፈፊ ምስ እቲ ናይ ፕላስቲካዊ ዓይነት መንሳፈፊ፣ፕላስቲካዊ ዓይነት መንሳፈፊ ዝለዓለ ተጻዋርነት ካብ ፍሕፍሐ ይውንን፣ ግናኸ ብምኽንያት ናይ ሓያል ናይ ማይ ድፍኢት ናይ ምንስፋፍ ተኽእሎኡ ክነድል ይርእ። እዚ ፕላስቲካዊ መንሳፈፊ ኣብ ምዱብ ዓሚቅ ባሕሪ ንመስርሕ ዓሳ ምግፋፍ ምቹእ ኣይኮነን።

ቅርጺ ናይ መንሳፈፊ ኣብ እቲ ዝካየድ መስርሕ ናይ ምግፋፍ ተመርኪሱ ካብ ናብ ዝፈላለ እኪ ተኾነ ግና'ኸ እቲ ኣገዳሲ ረቂሒ ቅርጺ ናይ መንሳፈፊ ብቀሊሉ ክዕቀብን ናይ ማይ ተጻዋርነት ዘለዎን እዩ።

እቶም ቀንዲ ፍሉጣት ቅርጽታት ናይ መንሳፈፍቲ ዝባሃሉ፡ስሊንደራዊ ቅርጺ፣ከቢብ ቅርጺ ዘለዎን፣ግሎባዊ ቅርጺ ዘለዎም እዮም።



2.3 ተንሳፋፍነት ናይ ዓይነታት ተንሳፈፍቲ

እቶም ልሙዳት ዓይነታት መንሳፈፍቲ ዝሕዝዎ ምዱብ ስሕበታዊ ሓይሊ ከምዚ ዝስዕብ ይመስል፡

Cork	0.18	Glass ball (dia. 30 cm) Oper	
Paulownia wood	0.30	Glass ball (dia. 15 cm)	0.35
Japanese cedar	0.4	Polyvinyl chloride (foam type)	0.12 – 0.28
Bamboo	0.50	Synthetic rubber (balloon type)	0.22 – 0.24
Pine	0.60	Styrene resin (hollow type)	0.28

.....conti

እቲ መጠን ትሕዘት ናይ መንሳፈፊ V cm^3 ክኸውን ከሎ ከምኡ ውን ዝሕዞ ክብደት ኣብ ኣየር ድማ ብ W gram,ይግለጽ። ስለዚ ዘለዎ ናይ ተንሳፋፍነት ናይ ዚ መንሳፈፊ በዚ ዝስዕብ ኣገባብ ክርከብ ይከኣል።

$F = V - W$

እንድሕር ደኣ እቲ ምዱብ ስሕበታዊ ሓይሊ ናይ እቲ መንሳፈፊ ተፈሊጡ በዚ ዝስዕብ ይግለጽ

$V = W/C$

ስለዚ,

$F = W/C - W$ $F = W(1/C - 1)$

.....conti

ኣብዚ ናይ ጉሕጓሕ ዓይነት መንሳፈፊ ከም በዓል ናይ ፕላስቲክ ዓይነት መንሳፈፊ ከምኡ ውን ABC ዓይነት መንሳፈፍቲ፡ ዘለዎም ናይ ተንሳፋፍነት ብቅዓት በዚ ዝስዕብ ንረኽቦ።

$F = K r^3$

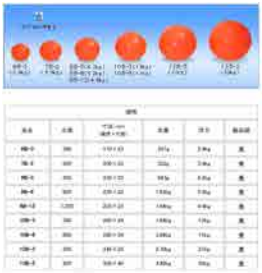
Where,

F.....ተንሳፋፍነት (Kg)

K.....ብቅዓት

r.....ዙርያ ናይ መንሳፈፊ

መግለጺ ናይ ABC ዓይነት መንሳፈፊ



3.ዓይነታት ክብደት

ኣገደስቲ ጠባያት ናይ ክብደት

ክብደት ዝባሃል ንሓደ ናውቲ መግፈፊ ዓሳ ክብደት ብምውሳኽ ቅርጹን ኣንፈቱን ሓልዩ ክጓዓዝ ይሕግዝ።

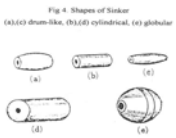
እቶም ኣገደስቲ ጠባያት ናይ ክብደት እዞም ዝስዕቡ እዮም፡

1. ዝለዓለ ስጥመታዊ ሓይሊ ዝውንን
2. ካብ ፍሕፍሐን ምራተን ተዓቂቡ እኹልን ንነዊሕ ዝጸንሕን
3. ብቀሊሉ ክስራሕን ኣርኣያ ክኸውንን
4. ብቁዕ ቀረብን ትሑት ዋጋን

3.2 ቅርጺ ናይ ክብደትን ዓይነቶምን

ክብደት ብሰፊሑ ካብ ዝተፈላለዩ ጥር ነገራት ክስርሑ ይኽእሉ። ኣብነት ፡ዓረር፣ ሓጺን፣እምኒ፣ሰሚንቶ።

- እቶም ልሙዳት ቅርጺ ናይ ክብደት ዝባሃሉ ስሊንደራዊ፣ከበሮ ቅርጺ ዝሓዘ፣ግሎባዊ ቅርጺ ዘለዎም እዮም።



3.3 ጥሕለታዊ ሓይሊ ናይ ክብደት

.

እቲ ምዱብ ስሕበታዊ ሓይሊ ናይ እቶም ልሙዳት ናይ ክብደት ጥረ ነገራት

ዓረር	11.35
ካይላ	1.72 – 2.13
ሓጺን	7.21 – 7.83
እምኒ	2.60 – 2.70
ስሚንቶ	2.40
ሑዳ	1.80

.....conti

ትሕዘት ናይ ሓደ ክብደት ብ V cm ይግለጽ ፡ዝሕዘ ሞጠን ሚዛናዊ ክብደት ውን ኣብ ኣየር W gram,እዩ ጥሕለታዊ ሓይሉ ናይ፣ቲ ክብደት ውን በዚ ዝስዕብ ይግለጽ፡

S = W – V

እንድሕር ደኣ ስሕበታዊ ሓይሉ ፍሉጥ ከይኑ በዚ ዝስዕብ ኣገባብ ይርከብ፡

V = W/C

ስለ’ዚ

S = W – W/C S = W (1 – 1/C

4. መሰረታዊ ቅማረ ምስ ናውቲ መግፈፍ ዓሳ

- 4.1 ምሕጻር ሰኪዐት(1)
- እቲ ረተ ምስ ገመድ ምስ ዝተሓሓዝ፣እቲ ተሰብሲቡ/ተሓጺሩ ዘሎ ሰኪዐት ካብቲ ገመድ ግድን ክነውሕ ይግባእ።
- እምበኣርከስ ኣብ ሰኪዐት ቅኑዕ ዝኾነ ዘላቅነት ክህሉ ኣገዳስነት ይህልዎ።
- እዚ ትርፈ ቁመት ናይ ረተ ዝጎደሎ ቁመት ናይ ገመድ ብሚእታዊት ተቀሚሩ ምሕጻር ሰኪዐት ንብሎ።

➢ምሕጻር%= L-I/L* 100

➢HR%= ምሕጻር ሰኪዐት ብተመቃራሕነት

L=ዝተገተረ ቁመት ሰኪዐት

I=ቁመት ናይ ገመድ

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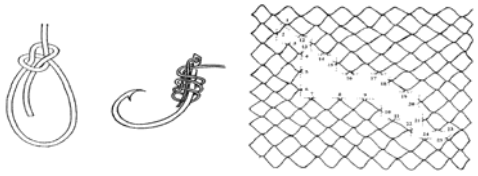
2.Fishing Technology BASIC SERIES (CFTDI/JICA, 1992)

3.http://www.floats.jp/viny/teichi.html (2010)

መሰረታዊ ፍልጠትን ስራሕን ኣብ ገመድን ሰኪዐትን



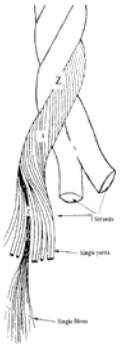
ምውጣን ገስጋስ ልምዓት ማሕበረኮም ገፈፍቲ ዓሳ

Basic knowledge and works on rope and fishing net MR motoki fujii (2010) Tigrigna translator : Dita Amanuel

ትሕዝቶ

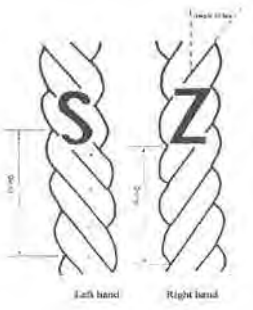
1.መሰረታዊ ዕዮ ምስ ገመድ

- 1.1 ቅርጺ ናይ ገመድ (1
- ገመድ (ሰንጣቂት 4mm, ፍሕሶ (ሰንጣቂት 4mm
- ባህርያዊ ወይ ውን ሰብ ሰርሖ ዓለባን ብሓንሳብ ምስ ዝፈሓስ ንጽል ፈትሊ የቅውም
- ሓያሎ ፈትልታት ምስ ዝፈሓሱን ድማ ፈትሊ የቅውም
- ሰለስተ ፍሕሶ ፈትልታት ተፋሒሱ ገመድ የቁሙ
- ሰለስተ ፈትላዊ ገመድ ብቀንዱ ፍሉጥ ዓይነት ቅርጻዊ ገመድ እዩ



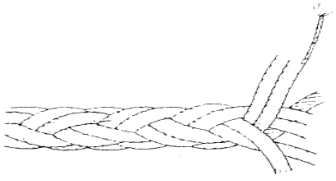
ቅርጺ ናይ ገመድ(2

- ዝተፋሕሱ ኣግማድ በቲ ዝተጠወይዎ ኣንፈት ይፈላለዩ/ይከፋፈሉ
- ንየማን ወገን ዝተጠውየ ገመድ ,፣ Z --- ፍሕሶ ገመድ
- ንጸጋም ወገን ዝተጠውየ ገመድ S---- ፍሕሶ ገመድ
- Z----ፍሕሶ ገመድ እቲ ዝውቱርን ልሙድን እዩ
- ንኣተዓቃቅብኡ ዝምልከት ናይ z---ፍሕሶ ገመድ ድማ እቲ ገመድ ካብ ዓቀን ንላዕሊ ካብ ምፍሓስ ንምክልኻል እዩ።
- ናይ እቲ ዝተቆነነ /ዝተጠምጠመ ገመድ ዝሕዙ ኣንፈት ምስ ዙረተ ሰዓት ክኸውን ይግባእ።
- ናይ እቲ ዘይተጠምጠመ ገመድ ድማ ኣንጻረ እቲ ዙረተ ሰዓት ኣንፈት ይሕዝ።



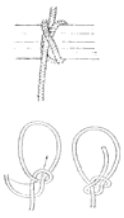
1.1 ዓይነት ገመድ

- ጽሕጎ ገመድ ፣ ዝተፋሕሰ ኣግማድ ----2,3,4 ፍሕሶ ገመድ የጠቃልል
- እቲ ካልኣይ ድማ ቁኑን ኣግማድ ኮይኑ ሸሞንተ ፍሕሶ ኣግማድ የጠቃልል
- እቲ ፈትሊ ኣብ እቲ ቁኑን ኣግማድ ዝርከብ ብጥውዮ ዝተሓሓዝ ዘይኮነስ እንታይ ደኣ ኣብኡ ኸሎ ተሰቂሉ /ተሓናጊሩ ዝኸይድ እዩ። ብድምር ካብ S ፍሕሶን Z ፍሕሶን ዘሎ ፈትልታት ብማዕረ ኮይኑ 4* 4 ጠቅላላ 8 ፈትልታት ንጥቀም።



1.2 ጠቃምነት እሳርን ቁጻርን

- **ክንቱብ ቁጻር**; እዚ ቁጻሮ እዚ ነቲ ገመድ ብጎድንን ቁመትን ናይ እቲ ባላ ክንኣስሮ ከለና እዩ።እቲ ቁጻር
- ብቅልል ዝበለ ኮይኑ ግናኸ ምስ ጠልቀየ ወይ ውን ምስ ሰጠመ ንምፍትሑ ኣሸጋሪ ይኸውን።

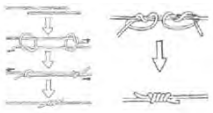


ሽንቋጥ ቁጻር፡ እዚ ዓይነት ቁጻር ልሙድ ተርእዮ ኮይኑ ፡እዚ ድማ እታ ጀልባ ኣብ ወደብ ክትዕሸግ ከላ ዝጥቀሙሉ እዩ።እቲ ቁጻር ውሑስን ስጡምን ኮይኑ ድማ ይቅጽል።

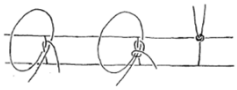
ሰንሰለታዊ ቁጻር ፡ እዚ ቁጻር እዚ ንክልተ ጭፋት ገመድ ብምጥላፍ ዝግበር ኣተኣሳስራ ኮይኑ ንትግባሪኡ ዝምልከት ድማ ቀሊልን ብቅልጡፍ ክእሰር ዝኽእል ኣገባብ እዩ።

1.2 ጠቃምነት እሳርን ቁጻርን(2

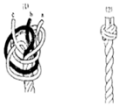
- **ብስያፍ ዝተኣስረ ቁጻር (ንጽልን ድርብን*** እዚ እሳር መብዛሕትኡ ግዜ ንክልተ ንጽል ፈትሊ ናይ ምግፋፍ መእሰሪ ዝጠቅም ኮይኑ እቲ ድርብ እሳር ግና ውጽኢታዊ ይገብሮ ካብ ኣቲ ንጽል እሳር።



- **ናይ ገፈፍቲ ዓሳ እሳር፡** እዚ ነገር እዚ ከም ንመዐሸግን መውሓስን ይጠቅም

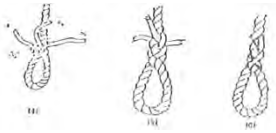


- **ብኽልተ ነገር ዝቕመ** እሳር፡ከምዚ ዓይነት እሳር ኣብ ጫፍ ገመድ ዝዓዪ ድማ ኣብ ምብትታን ዝከላኸልን ከም ኡውን መዕበሲ ኮይኑ የገልግል።

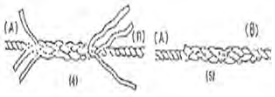


ዝተኣሳሰረ ገመደ(3- ዝተፋሕሰ ገመደ(1

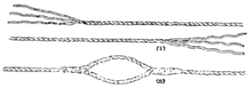
- **ናይ ዓይኒ እስርሳር**



- **ሓጺር እስርሳር**

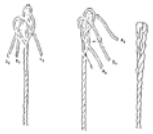


- **ዝተቆራረጸ እስርሳር**



እስርሳር ገመድ (3-ዝተፋሕሰ ገመድ(2

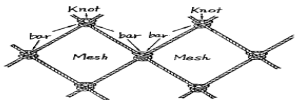
- **ናይ ድሕሪት እስርሳር**



መሰረታዊ ግደ ናይ (z-ጥውዮ ገመድ
ኣንፈት ናይ እቲ ስርሳር ገመድ ኣብ የማን ናብ ጸጋም ብስያፍ ወገን

2.መሰረታዊ ዕዮ ኣብ መርበብ
2.1 መሰረታዊ ፍልጠት ናይ ረተ (1

- **ቁጻር ሰኪዐት ፡**እዚ ረተ ዝቆመሉ ሱር መሰረታዊ ብተኽታታሊ ዝገጠመ ዓይኒ እዩ ዝበዝሑ ዓይኒ ናይ ረተ 4 ጎድኒ ዘለዎ ኾይኑ ነፍሲ ወከፍ ዓይኒ 4ጎድንን 4 ቁጻርን ዝተዓጽወ እዩ። ኣብ ቁጻር ሰኪዐት እቲ ልሙድ ቁጻር ዝጥቀሙሉ ንጽል ይኹን ብድርብ ሰንሰለታዊ ቁጻር እዩ።

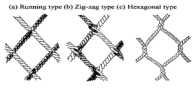


ኣብ ቁጻር ሰኪዐት እቶም ልሙዳት ቁጻር ንጥቀመሎም ንጽልን ድርብን ኢንግሊሽ ዓይነት ቁጻር ኮይኑ ብዕጽፊ ዝተኣስረ፣ ከምኡ ውን ጸፈሕ ዓይነት እሳር እዮም።

2.1 መሰረታዊ ፍልጠት ናይ ሰኪዐት(1

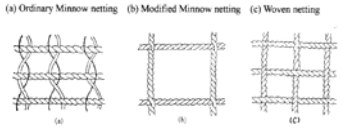
- **ቁጻር ኣልቦ ሰኪዐት፡ቁጻር** ዘይብሉ ዓይኒ ሰኪዐት ቁጻር ኣልቦ እሳር የጠቃልሉ።

ኣብነት፡ ደቂቅ ዓሳ ዝሕዝ ረተ፣ ጥልፍላፍ ዓለባ ዘለዎ ረተ ዝኣመሰሉ እዮም።



- **እስርሳር ሰኪዐት ፡** እዚ ሰኪዐት እዚ ብሓደ ልሙድ እስርሳር ረተ ብመሰለጥያ ዝተሰርሐ ኮይኑ ፡ዋማኡ ግና ካብቲ ልሙድ ቁጻር ኣልቦ ሰኪዐት ዝሓሰረ ኮይኑ ይርከብ።

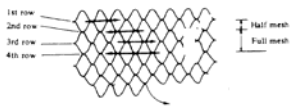
እዞም ደቀቅቲ ዓሳ ዝሕዙ ኮነ እስርሳር ቁጻር ኣልቦ ሰኪዐት በርባዕተ ወገኑ ማዕረ ዓቀን ዓይኒ ዘለዎ ኾይኑ፣ እዚ ድማ እታ ሰኪዐት ቅርጻ ሓልያ ኣብ ማይ ክትጓዓዝ ይሕግዛ።



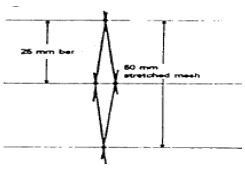
መሰረታዊ ፍልጠት ናይ ሰኪዐት(3

- **ኣንፈት/መኣዝን ናይ ሰኪዐት፡**

ቅድሚ ረተ ምስራሕን ምጽጋንን፣ኣንፈት ናይ ሰኪዐት ብጥንቃቀ ምርግጋጽ የድሊ

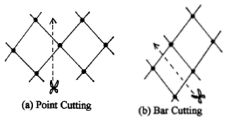


- **ዓቀን ዓይኒ ናይ ሰኪዐትን፡** ዓቀን ዓይኒ ናይ ሰኪዐት ንምፍላጥ እምበኣር ኣብታ ማእከል እሳር ናይታ ዓይኒ ክሳብ እታ ቀጺላ ዘለ ቁጻር ሙሉእ ብሙሉእ ንስያፍ ድሕሪ ምዝርጋሕ ክፍለጥ ይከኣል።



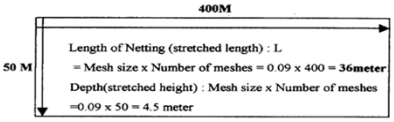
ብጫፍን ጎድንን ምቁራጽ(4

- **ናይ ጫፍ ወገን ኣቆራርጻ ፡**እዚ ማለት ካብታ ቁጻር 2 እግሪ ትኽ ኣቢልካ ምቁራጽ ማለት እዩ።
- ናይ ጎድኒ ወገን ኣቆራርጻ ብዝምልከት ድማ ሓንቲ እግሪ ኣብ ሓንቲ ቁጻር ንስደፍ ክቁረጽ ከሎ የርኢ።



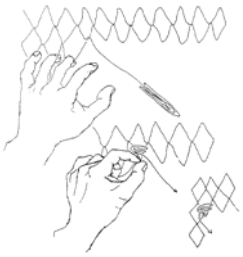
ቁመትን ንውሓትን ናይ ሰኪዐት፡
ቁመት (ዕምቆት ከምኡ ውን ንውሓት ናይ ሰኪዐት(ኣብነት ዓቀን ዓይኒ 9cm,ንውሓት*ዕምቆት =400*50m

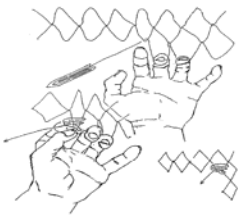
Height (Depth) and Length of Netting (Example:**Mesh size 9 cm, LxD=400Mx50M**)



2.2 ምስራሕ ረተ (ብኢድ ዝግበር ምሽራብ ረተ

A.ካብ ጸጋም ንየማን b.ካብ የማን ንጸጋም





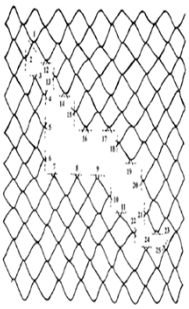
2.3. ምድጋን ረተ(1

- **ረተ ንምድጋን ዝግበር መስርሕ ምቁርራጽ**

1.መጀመርያ ኣንፈት ናይታ ሰኪዐት ምርግጋጽ የድሊ፣ድሕሪኡ ነታ ሰኪዐት ኣብቲ ግቡእ ኣንፈት ኣትሕዛ

2.ዝስዕብ እቲ ናይ ምቁርራጽ መስርሕ ምስ ተኻየደ ንምድጋን ኣብ ዝተዳለኻሉ ግዜ፣ እታ ረተ ብዝግባእ ኩሉ ናይ ጫፍ ወገን ተቆሪጹ ክዳሎ ፣ብዘይካ ሓንቲ ጎድኒ ንመጀመሪ ትኽውን ኣብ ላዕሊ ዘለን፣ንመዛዘሚ ትኽውን ድማ ኣብ ታሕቲ ዘለ ገዲፍካ

3.ምስፋይ ጀመር ካብ ሓደ ጎድኒ ቁራጽ ላዕላዋይ ሸነኽ ጀሚርካ ብኩሉ ናይ ጎድኒ ወገን ቀጺልካ ክሳብ እታ ናይ መወዳእታ መዛዘሚት ትኽውን።



2.3 ምድጋን ረተ(2

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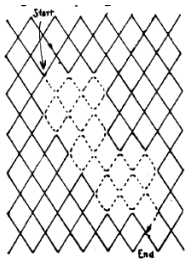

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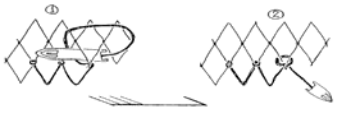

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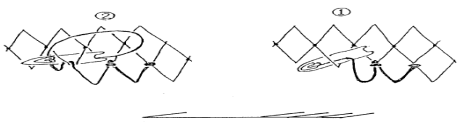

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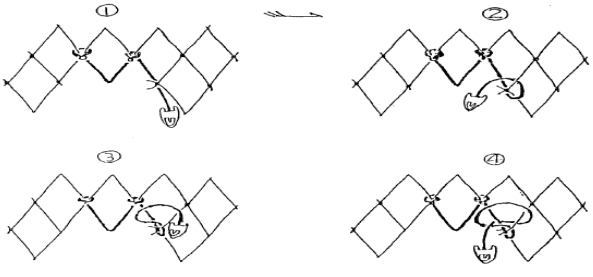

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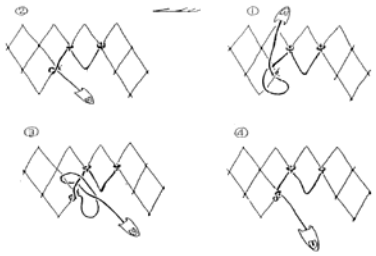

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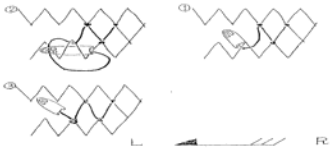

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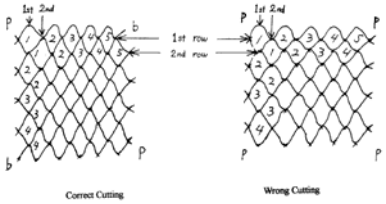

➢ **ስሉስ ኩርናዓዊ ቅርጺ ኣቆራርጻ**

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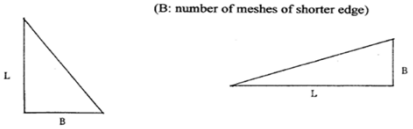

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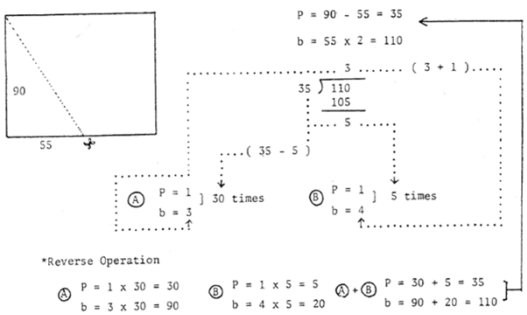

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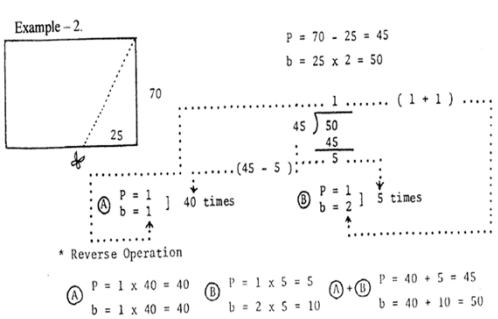

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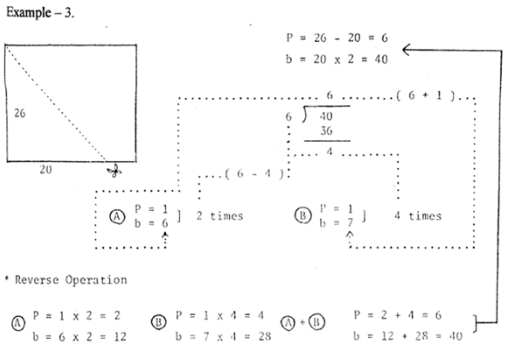

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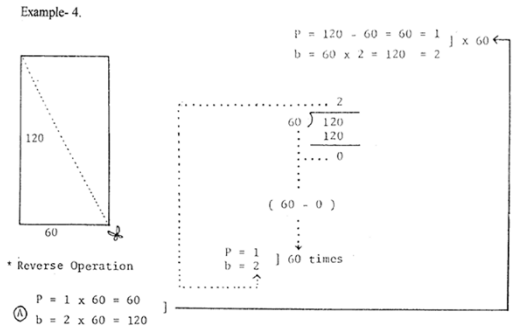

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- Fishing Technology Textbook (JICA/CFTDI) M. Fujii, J. James, L. Ellis (2001)
- Basic works on Ropes and Fishing Net, (KIFTC/JICA) (1993)
- Basic knowledge and works on rope and fishing net MR motoki fujii (2010)

10. The Technical Guidelines on the Practical Approaches for the Priority Challenges of Coastal Fisheries Development of Eritrea

The Technical Guidelines on

The Practical Approaches for the Priority Challenges of Coastal Fisheries Development of Eritrea

August 2023

Ministry of Marine Resources
The State of Eritrea

Supported by Japan International Cooperation Agency

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Published by
Ministry of Marine Resources, The State of Eritrea
In cooperation with
Japan International Cooperation Agency (JICA)

August 2023

Layout & Editing design
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LIST OF ACRONYMS

CFC..... Community Fisheries Center
COVID-19... Corona Virus Disease 2019 (SARS-CoV-2)
EEZ..... Exclusive Economic Zone
EMPC..... Eritrean Marine Products Company
FAD ..... Fish Aggregating Device
FAO ..... Food and Agriculture Organization of the United Nations
FRP..... Fiber Reinforced Plastics
FSPAC..... The Project for the Formulation of the Strategies
and Practical Approaches for Coastal Fisheries Development
GoSE ..... Government of the State of Eritrea
GPS ..... Global Positioning System
JICA ..... Japan International Cooperation Agency
MMR ..... Ministry of Marine Resources
MPPT..... Maximum Power Point Tracking
NFC ..... The National Fisheries Corporation
PA ..... Polyamide
PE..... Polyethylene
PP ..... Polypropylene
PP ..... Pilot Project
UNDP..... United Nations Development Programme

FOREWORD

The Government of the State of Eritrea, having noticed the underutilized and undercapitalized marine resources sector of Eritrea and its potential to play a major role in food and nutrition security as well as in boosting the national economy, established the Ministry of Marine Resources in 1993 through the Legal Notice 14/1993. Ever since its establishment, the Ministry has undertaken several initiatives to achieve its mission, i.e., to regulate, conserve and develop the Eritrean marine resources in collaboration with other partners.

Continuously, by utilizing every opportunity, the Ministry is endeavoring to develop the marine resources for the wellbeing of the nation and its people. However, this task is not something that can be done independently, and hence it has sought partnerships with other organizations and institutions that can offer any means of support. One of the long-time development partners is the Government of Japan through its cooperation agency, i.e., the Japanese International Cooperation Agency (JICA) and whose contribution to Eritrean fishery subsector is remarkable. And on this occasion, through the project entitled Formulation of Strategies and Practical Approaches for the Coastal Fisheries Development (FSPAC), this technical guideline is produced, which is the first of its kind in the sector.

Indeed, the road to achieve this goal had faced a multitude challenges. Among others, the project was suspended for a period of one year and half due to the impact of the COVID-19 pandemic. However, regardless of this and other challenges the Japanese study team along with their Ministry counterparts have managed to realize this achievement. Thus, the Ministry is indebted to all who contributed to this technical guideline in any manner.

On this occasion, I would like to call upon all the Ministry staff and other stakeholders to follow this guideline in developing the coastal fishery for the betterment of the livelihood of the coastal communities.

Tewelde Kelati

Minister of Marine Resources

INTRODUCTION

The Eritrean Red Sea coastline, which is located in the southern part of the Red Sea, comprises approximately 18 % of the Red Sea mainland coastline. This area, based on surveys done before and after independence of Eritrea, is confirmed to have diverse ecosystems such as coral reefs, mangroves, sea grass beds and sandy and muddy flats, which lay down a basis for potential economic development activities for the wellbeing of the coastal communities, in particular and the nation, as a whole.

To date, more than 600 species of fishes are identified in these diverse ecosystems. The utilization of these fish groups has been reported to support thousands of coastal communities from the 1950s until 1970s. Post mid-1970s, fishery collapsed and most of the fishing operations went in to obscurity until Eritrea's de jure independence in 1991. Post-independence, investment by the Government of the State of Eritrea (GoSE) was directed both towards meeting the demands of Artisanal and Subsistence Fisheries fishing inputs and developing the semi-industrial and industrial fisheries. However, Artisanal and Subsistence Fisheries were not supported in a manner to cope with the ever-changing socioeconomic situation of the nation and world climatic conditions, while the industrial and semi-industrial fisheries have suffered considerably from several constraints such as the shortage and high price of fuel, lack of skilled fishers.

The Artisanal and Subsistence Fisheries are by far the main sources of fish production to the local market despite the fact that they encountered challenges similar to those faced by the semi-industrial and industrial fisheries. The current reality is that fishers are not able to utilize the marine resources to improve their livelihoods although substantial economic gains and profits can be obtained by introducing adaptive strategies in their fishing activities. The reason is that most of them use the same fishing gear types such as gillnets and handlines which they used to fish decades ago. These fishing gears and methods used to be effective and efficient in the earlier years within the given economic situation. But with the changing circumstances, the fishing gears became more and more inefficient and thereby left the fishers victims of the circumstances.

As it was aware of the deteriorating situation of the Artisanal and Subsistence fishers, the Ministry of Marine Resources sought practical approaches for the priority challenges of the coastal fishers. The Ministry was also aware that this situation can't be handled within the capacity of its staff and hence sought a reliable development partner in this respect. It is this challenging task that gave rise to the designing of the project, the Formulation of the Strategies and Practical Approaches for Coastal Fisheries Development (FSPAC), which lasted for four years (July 2019 – October 2023) and through which this technical guideline document came in to reality.

Thus, the objectives of this technical guideline are multifaceted in that it has economic, social, environmental and political implications.

The importance of the marine resources and particularly the fishery sector's role in food and nutrition secu-

rity is not only undeniable but also critical. For this, the Macro Policy of the GoSE which was published in November 1994 clearly recognizes this fact. In addition, the GoSE's Voluntary National Review of Progress towards the Sustainable Development Goals (July, 2022) highlights the direct relationship of the prevailing climate change in the life of communities and ecosystems. Hence, this technical guideline is expected to mitigate the observed economic pressures placed upon the fishers by the changing world economic and climate situations. It will also enable the Artisanal and Subsistence fishers to cope with the changes while at the same time improving their livelihoods. In other words, it will serve as a platform to develop an economic safety net that will prevent them from falling into dire poverty.

The GoSE's development pillars are grounded on social justice, meaning no part of the community should be left behind from the benefits of national development programs.

Thus, the fishing communities have the right to benefit from the national programs drafted by the Government. Therefore, the coastal communities will have the opportunities to gain alternative approaches to improve their livelihoods through the implementation of this Technical Guidelines.

Not limited to the above, the preparation of this Technical Guidelines shows the commitment of the GoSE to international tools set forth by the UN pertaining to sustainable fishery and in particular the small-scale fishery. This, of course, will increase the understanding of all government institutions who have roles to play in the development of the Artisanal and Subsistence Fisheries in some manner, i.e., the practical approaches set forth in this Technical Guidelines will enable the other institutions to align their regulatory frameworks in line with it.

Lastly, this Technical Guidelines is prepared in such a way that each of the five parts builds on the other. These are: Part 1, which highlights the Ministry of Marine Resources Strategic Plan objectives upon which this Technical Guidelines is based; Part 2, which mentions all the issues, constraints and priority challenges that are potentially hindering the achievement of the development objectives; Part 3, which lists out the solutions (practical approaches) for both the Artisanal and Subsistence Fisheries sub-sectors; Part 4, which separately deals with each approach pertaining to each sub-sector; and Part 5, which presents each development tool piloted during the project period in summary. Thus, this Technical Guideline can be said to have laid out a framed foundation upon which the lessons learned during implementation of the practical approaches outlined herein can be built on and documented for future expansion and improvement.

Adonay Heruy
Project Director of FSPAC project
Head of Projects and Commissions Coordination Office
Ministry of Marine Resources

PART 1

Outline of the MMR-Strategic Plan

1-1 General background and purpose of the MMR-Strategic Plan

The Ministry of Marine Resources (MMR) was established in 1992 as a department and later in the 1994-2006 period as a ministry focused on marine resources related tasks. During the establishment period, the focus of MMR was mainly on the two coastal zobas (regions), namely, Northern and Southern Red Sea including the coastal towns and villages. After the extension of fisheries activities of the ministry towards fresh water fishes, in 2006, four branches in the highland and lowland zones (Maekel, Debub, Anseba and Gash Barka) have been established.

In 1994, the government of Eritrea established the Ministry of Marine Resources, with the mission of sustainable management and development of marine resources. The main objectives of the Ministry at that time were to:

- Contribute to increasing Gross Domestic Product
- Enhance the socioeconomic status of the society and contribute to food security.
- Conserve the natural resources

The main objectives of the MMR Strategic Plan are to identify the shortcomings, provide reassurance and solve the drawbacks of the sector and introduce sustainable fisheries developmental activities. To solve the main difficulties of the fisheries sector, construction of infrastructure (small pelagic fishes drying centers, engine maintenance and gear rehabilitation centers, building of accommodation and offices etc.) and establishment of a new ice machine will be of first priority. To advance this program, Ministry of Marine Resource is ready to attaining basic materials of interest, programming training with national and international partners in organizing budgets. The Strategic Plan of the Ministry focuses on all six zobas, i.e.is nationwide in scope.

The Ministry of Marine Resource is currently working for improvement of the livelihoods of fishing communities through the sustainable use of marine resources, particularly for the inhabitants of the rural and coastal areas. The MMR-Strategic Plan was endorsed in 2018 (Amended in December 2021) to measure the above-mentioned nationwide objectives and cross-cutting marine resources and fisheries issues.

1-2 Goals and objectives of MMR-Strategic Plan

The MMR-Strategic Plan will be implemented over a six-year period and it has clear objectives and goals that contribute to sustainable socioeconomic development. The plan has three strategic goals which are expected to be achieved within the implementation period.

Goal 1: To Enhance Contribution of Marine Resource to Development of the National Economy and Food Security

Strategic objective "to improve the income and livelihoods of coastal fishers and inland communities"

To achieve this goal the developmental activities that will be conducted are construction of fisheries infrastructure operations, efforts to obtain a sufficient supply of ice, establishment of fish retail market and workshops, creation of awareness, training and organization of fisheries cooperative, introduction of modern technologies of fishing equipment and spare parts (providing fishing inputs); formulation and revision of developmental policy and communications based on research, initiation of required incentives, impression of aquaculture examination to people and other developmental activities which will create opportunities for employment and productivity increases in different sectors. This will result in increasing productivity and effecting changes in the livelihoods of the communities and will have an impact on development of national economy and food security.

Goal 2: To Ensure Sustainable Management of Marine Resources and the Environment

Parallel to the development strategy, there should be proper utilization and effective management of natural resources, in order to secure environmental well-being and respond to climate changes around the world. Therefore, in order to ensure that developmental activities are not compromised regarding the environment and diversity, the following criteria will be considered. Firstly, it should be ensured that all planned developmental strategies regarding natural resources, environment, and climate change should ensure can be conducted without any causing any destruction. Secondly, vanishing natural resources and environments are serious issues that require strategies for the fastest possible recovery. Thus, conservation and

security of natural resources are considered as major strategic goals.

Goal 3: To Strengthen Institutional Capacity Regarding Managerial and Professional Skills

This is a cross-cutting goal related to the two technical goals. The objective of the goal is two-fold. It will ensure that the institutions mandated with the responsibilities of implementing and overseeing the different implementation processes of the Strategic Plan have the requisite capacity to effectively execute their respective duties. Secondly, it makes it possible to facilitate and manage the Strategic Plan in an efficient and effective manner by providing overall coordination, including planning and implementation, financial management and control, monitoring and evaluation, knowledge management and sharing, progress reporting, and liaison with all relevant institutions. For this purpose, capacity building of the Ministry and relevant stakeholders has been given high priority.

To meet the above stated three goals, the Ministry of Marine Resource has set a number of objectives related to their respective activities. The MMR expectation within the duration of time for implementation of the Strategic Plan is to implement all the goals mentioned. The focus of the first goal is putting infrastructure and technologies in place for effective and sustainable production of fish and fish products within the coastal zobas, and achieving inland fisheries development by introducing community-based aquaculture. In the strategy there are six objectives which are intended to address Goal 1, these are:

- Objective 1.1; Develop production and increase distribution of fisheries products
- Objective 1.2; Increase supply and promote consumption of fisheries products
- Objective 1.3; Ensure production and supply of quality standard salt
- Objective 1.4; Improve and strengthen fishing activities
- Objective 1.5; Strengthen the fishing port standard and capacity improvement
- Objective 1.6; Improve the livelihood status of the fishing communities

Since this technical guideline is designed for coastal fisheries development, the main contents of Goal 1 related to the purpose of the FSPAC project apply to certain objectives. For the purpose of this guideline, the focus is on the abovementioned objectives 1.1, 1.2, 1.4, 1.5 and 1.6 with their respective activities.

1-3 MMR- Strategic Plan objectives related to coastal fisheries development

1-3-1 Develop production and increase distribution of fisheries products (1.1)

Construction of fishing infrastructure which has great influence on growth of fish production, for which the required infrastructure investment was enormous. Starting from 1995, the MMR has constructed fish landing sites, processing plants, and established various plants for preservation and distribution/marketing of fish in Massawa, Asmara, Gellalo, Tio, Eddi, Berasolle, Dahlak, Assab and other towns/villages. All these facilities except fish landing site Twalet (Massawa) were transferred (reassigned) to the National Fishing Corporation (NFC), which plays a big role in market and price decisions management. The National Development policy strengthens the fishery sector in general and infrastructure in particular, and the MMR is going to work with a wide scope with serious attention placed on the Strategic Plan. MMR has a strong focus on the construction of solar fish drying facilities at four landing sites to handle increased volumes of small-pelagic fish. Solar fish drying facilities for the small pelagic fish will be constructed at strategic points along the coast. These will be established at four landing sites, of which one site will be in Zoba Northern Red Sea (ZNRS) and three sites in Zoba Southern Red Sea (ZSRS), where there is more intensive fishing of small pelagic fish. Therefore, proper management and exploitation of these resources can play a great role in improving the socioeconomic status of people living in coastal areas and islands. Moreover, there will be a developmental fisheries addition to the prior investment mentioned above.

1-3-2 Increase supply and promote consumption of fisheries products (1.2)

After independence, in 1994 the Ministry of Fisheries established nutrition department to utilize the fisheries product for human consumption. During those years the focus was on mobilizing and organizing the community for creation of awareness, to promote con-

sumption of fisheries products for improved nutrition. In 2001, the small pelagic department started with only one small facility processing the small pelagic fish for the production of fishmeal destined for the animal feed industry. the Ministry has also given training to about 3,469 women on preparation and cooking of fish products. In addition, in 2008 the Ministry displayed an exhibition of cooked fishery foods during the Fenkil celebrations conducted in Massawa and the third national festival in Sawa. Moreover, in 2016, fish cooking demonstration using the already developed fish recipes were conducted by the development department of MMR at community levels, especially in Massawa, boarding schools in Nakfa and in other locations. From these experiences, the Ministry recognized the importance of promotion activities of the fisheries product for human consumption, and proposed to conduct development and promotion of recipes and sustainable dietary intake through awareness campaigns.

The Awareness Campaign will aim for sensitization, behaviour change communication to create awareness, and explaining and communicating the important nutritional quality of fish with emphasis on small pelagic fish consumption. The channels for promotion will include radio/TV programs, newsletter, magazines, posters, training and seminars in local languages. Fish Recipe Development aims to increase dietary diversity and availability of varied nutritious products. New improved recipes will be developed by enriching locally available staples (traditional food). The recipes will be published in the forms of leaflets and booklets with translation in different local languages. Food demonstration using the new recipes will be conducted by extension workers at community levels. Sustainable Dietary Intake aims at influencing the regular availability of fish for sustainable food security. At the household level, the activities on fish promotion, behaviour change communication and nutrition education will be implemented using the household methodology approach. Strengthening capacity of MMR staff is part of the Strategic Plan. Therefore; training will be conducted to build capacity for the fish products development and implementation of the nutrition and household methodologies for MMR extension staff.

1-3-3 Improve and strengthen fishing activities (1.4)

Before independence, the socio-economic activities of the fisheries sector: especially the Artisanal Fisheries, had been greatly weakened. The landing infrastructure and facilities were destroyed and became out of service. The artisanal fishers struggled and displaced to a different place. Initially fishers were organized in to cooperatives. In each coastal and island village one fishing cooperative was established.

Fishing gear technology is one of the major disciplines in fisheries which play a great role in the development of the fisheries sector. Eritrea's fisheries sector was highly active in 1950th. During this period different technologies of fishing gear like beach seine, gillnet, hand-line, long-line and trawl had been practiced by artisanal and industrial fishing in an extensive manner, as confirmed in the previous literature. After 1960, colonization caused degradation of fishing activities and the technology of fishing became weak. Consequently, the industrial fishing collapsed, but the artisanal fishing continued at a lower level. After liberation, the government of Eritrea launched rehabilitation in the fisheries sector in both industrial and artisanal fisheries, and significant improvement had been registered. The current level of fishing gear technology for artisanal fisheries does not correspond to the amount of investment. The main reason is that the fishers are still using traditionally transferred customs, and do not reach the level of modern fishing gear technology. Modernization of artisanal fishing gear technology in order to increase fish harvest is the objective of this plan. The strategic plan of this objective is to introduce new fishing gears and fishing equipment. The prioritized plan for introduction will include increasing the beach seine net, long-line, casting net, etc. for small pelagic fish, and it is hoped that similar activities will be added.

1-3-4 Strengthen the fishing port standard and capacity improvement (1.5)

Fishing port of Massawa (Twalet) was constructed by a Chinese company and financed by UNDP in 1995. It is one of the active fish landing sites which is functional in giving service to the fishers. Nowadays, this fishing port have 23 offices and stores, a 220m long jet, 2.5 ton crane, 30m3 capacity fuel tanker; water tanker; fish landing, storage room for 10 ton of wet fish, laboratory, and 4 ice machines.

The MMR has a strategic plan to improve this landing in the coming years. According to the plan, the production of ice will increase from 10 to 20 tons per day; house rent will be collected properly; power restriction to reduce overconsumption of electricity have already being introduced; an increased number of fishing vessels will get service; crane services will be increased;

supply cleaning materials will be introduced; 2 new fire extinguisher materials will be installed; supply of water and fuel to boats will be increased; and the landing will be kept clean to improve the quality.

1-3-5 Improve the livelihood status of the fishing communities (1.6)

In addition to the fisheries intervention mentioned before, three centers (net mending center, motor repair center, office and accommodation center) and four solar fish driers will be built in the coming years in both the coastal zobas, in which some of them are progressing well. For solving the shortage of ice supply, the Ministry has already procured two new ice machines which are now in the installation process. Furthermore, the Ministry is working hard for improving the socioeconomic status of the livelihoods of the coastal communities by forming new cooperatives and empowering the existing ones.

PART 2

Issues, Constraints and Priority Challenges

This part overviews the current situation of Eritrea's coastal fisheries, issues/constraints for coastal fisheries development and it identifies the priority challenges based on the "Technical Report Current Situation, Issues and Constraints of the Coastal Fisheries in Eritrea" which is an output of FSPAC project. See to the Annex 1 as the original report for further information.

Also, the identified priority challenges are used to select practical approaches which are the targets for coastal fisheries development in the next part.

2-1 Current situation of coastal fisheries

2-1-1 Eritrean Red Sea coast

Eritrea situated in the horn of Africa is a strategic position along the coast of the Red Sea. Eritrea's Exclusive Economic Zone (EEZ) covers 120,000km2 of the Red Sea and the mainland and islands coastline is more than 3,300 km in length, stretching from Djibouti in the south to the Sudanese boarder in the north. Wind direction and strength vary based on the seasons; from November to April, south to southern easterly winds are predominant, and from July to November, frequent sandstorms are observed which adversely affect the activities of the artisanal fishers. Climatically, the coastal area is arid or semi-arid with the temperatures ranging from 32oC to 45oC during hot months and 22oC to 32oC during cool months. The average water temperature is 21oC to 26oC in hot months and 18oC to 21oC in cool months.

2-1-2 Fishing gears and methods

(1) Overview of fishing gears and methods in coastal fisheries

The gillnet fishing is one of the most popular methods in Eritrea, and other fishing techniques practiced are use of beach seines, handlines, and to some extent longline. The artisanal fishers mainly use hook and line, gillnet or a combination of both types at the same time. Most of the subsistence fishers operate mainly with handline and mullet gillnets for fishing.

Artisanal fishers use passive fishing gears to catch fish. Fishing boats are normally equipped with multi-purpose fishing gears such as gillnets, which can stretch up to 1000 meters by distance and 8-12 meters by depth from the surface of the sea. In addition, the whole crew carries on the handline fishing until the net fishing (3-5 hours) is completed. All fishing activities at sea are done by hand and it requires a very strong labor force. To drag the wet nets with fish against the drift in the sea is not an easy task for the fishers. In most cases, fishers combine two methods of fishing gears like gillnets and handlines. The average number of nets in use in one boat is 10 to 20 pieces; larger boats could use up to 30. The fishers lack modern supporting fishing technologies, such as Fish Finder, GPS/Map Plotter and radio Communication, which are vital in facilitating fishing activities for higher production.

Gillnets and landings of artisanal fishing boat

The gillnets are used to catch large pelagic fish such as sharks, spanish mackerel, queenfish and tuna whereas hand-lines are used for high value reef fishes like groupers.

(2) Drift gillnet

Drift gillnets are among the commonly used fishing nets by the artisanal fishers. It has been the dominant fishing practice, because it requires low initial investment and can easily be operated manually. Drift gillnets

are mainly operated during the cool fishing season. Drift gillnets used by the fishers are manually operated, which is labor intensive, and fish catching efficiency is low. The factors that lower the relative catch efficiency of the traditional drift gillnet are;

- The nature of the twine is multifilament which is thicker, so the probability of fish catch is low
- The color and thicker twine make high visibility which can easily be detected by the fishes and it is difficult to use such type of gillnets during full moon.
- Moreover, traditional drift gillnets are not easy to operate and a large number of crews are engaged to operate a small numbers of gillnets.

(3) Encircling gillnet

Surrounding or encircling gillnets are operated at night during the hot season, by using fish aggregating lights. The sea depth of the drift gillnet range is from 10 to 20 meters, while the surrounding gillnet is from 20 to 40 meters. However, the surrounding gillnets are not common compared to drift gillnet. The main catches using these nets are spanish mackerel, skipjack, tunas, sharks, barracuda, and queen fish.

For trial purposes, during FSPAC project an encircling fishing trial was carried out for a period of 11 days in August, 2021. The engaged fishers are inhabitants of Dehil Island and there were five participating crews. Along with the encircling fishing trial fishers were deployed to another nine pelagic drift gillnets. The fishing grounds where the trials were conducted were north of Massawa and east of Dahlak archipelago, and were mostly in Madeban with a few sites in Derdia, Mekemera, Umawd and Harat. An average of three fishing trials were done every night. The dominant fish catch showed was queen fish, while the remaining catch was similar quantities of spanish mackerel, silver grunt, common silver biddy and barracuda. The total catches and proportion of each species within the catches was similar between fishing grounds, and during the trial days queen fish recorded the highest catch in all sites.

(4) Semi-industrial Bottom longline

Some of the artisanal fishing boats based in Massawa sometimes operate the bottom long line fishing when small fishes are available that could be used as bait. Although it is known to be cheaper and more efficient than gillnet fishing, it is not operated consistently due to the difficulty in obtaining the bait. The National Fisheries Cooperation (NFC) operates the bottom long line fishery as the semi-industrial fishery using 18m class FRP fishing vessels and reel gear of tuna long line. The fishery operates year-round catching groupers, snappers, catfish, giant trevally, sharks, queen fish, and cobia. The fishing grounds are mainly around islands near Massawa, and the fishers operate in 20 to 30m depth during the peak fishing season, and over 30m depth during the hot season.

Bottom long line gear appropriated from tuna long line and catches

In the Red Sea, the sea surface water temperature rises during the hot season, causing fish populations to move to deeper waters, making it impossible to operate the main drift gillnets. During this season, fishers switch to the surrounding gillnets at deeper waters in nighttime but catches decline. Bottom long lines are a promising alternative during this season. In order to promote the use of bottom long lines among artisanal fishers in addition to developing appropriate fishing gears and methods, factors such as the supply of bait and storage facilities for artisanal fishers seem to be important.

(5) Coastal mullet gillnet and handline fishing for Subsistence Fisheries

There are two types of subsistence fisheries in operation; the gillnet fishing for mullet and the handline fishing for indian mackerel and small demersal fish in shallow waters using polystyrene floats and canoes. Some fishers (like the fishers in Massawa) rent fishing gears and boats to operate the fishing activities. The fishing grounds are around coastal towns/villages and islands.

Problems commonly claimed by fishers, are that they need boats and engines for more efficient operations but could not afford them due to high prices, the quality of fishing nets and gears is low and the supply is insufficient, the price of gillnets is high, fishing grounds are far away, rental fees are high since they don't have their own fishing gears and/or boats, and there are no fishing gears and methods that are more efficient to utilize their fish resources.

Gillnets used in subsistence fishery and fishing line sold at a shop

2-1-3 Fish distribution and consumption

The fish trade takes place in various stages starting at the coastal landing sites, local zoba settlements and inland town markets. Massawa is the port city where most of the fish trading companies are located. The products sold at Massawa market are mostly fresh products, in direct sales from the fish supplier to buying firms affiliated with NFC. The post-harvest level of the fish cold chain and market linkages are dominated by the NFC. Fishers have to sell fish to NFC through one of its subsidiaries, who then handles the post-harvest activities, including transportation, distribution, processing and marketing across the country. The private sector fish retailing business has been established in urban areas, which buy fish at wholesale prices from NFC and sell to consumers strategically located near small seafood shops and restaurants.

The problems and constraints in fish distribution and household consumption in the three typical cities of Eritrea (Massawa is a coastal city; Asmara is a metropolitan city and Mendefera is one of the local-highland cities) have been studied in 2019.

- Limited fish supply and inconsistent availability
- High fish prices as compared to meat from cattle, goat, sheep etc.
- Functional fish-retail shops to deliver fish products are very few in number, and even the existing retailers require rehabilitation in their facilities and equipment.

There is only one fish landing site in the Northern Red Sea region i.e, ERI-FISH in Massawa from which the fishes are distributed to all towns and villages. In most of Eritrean households, mothers or daughters are responsible for cooking, and common fish cooking methods are frying or making zigni (stew) or soup. Most fish buyers have high demand to buy fishery products, and if the prices could be kept down, consumption would further increase.

2-2 Issues and constraints of the coastal fisheries development

The issues surrounding coastal fisheries and the constraints hindering coastal fisheries development are identified from the results of the baseline survey and the problem analysis workshop, and reflected in two sides, the Artisanal and Subsistence Fisheries.

2-2-1 Issues of the coastal fisheries

(1) Issues of the Artisanal Fisheries

a) Issues in fishing gears and methods

The Government of Eritrea aims to make effective use of the abundant fishery resources in the Red Sea in order to improve the domestic food and nutrition situations. For achieving this purpose, it is essential to strengthen the capacity of the MMR staff and those involved in fisheries, improve the fishing gears and methods, and increase and stabilize the fishery production by disseminating the fishing technology. The following issues in fishing gears and methods for coastal fisheries development are recognized after considering the current situations and problems.

i. Insufficient capacity of MMR to support fishers

The MMR staff should understand the actual fisheries theoretically and practically in order to support the development of fisheries in Eritrea. For this purpose, it is necessary to prepare appropriate textbooks and audio-visual materials for conducting fishery trainings at the MMR Fisheries Training Center in Massawa.

ii. Engine repair and fishing gear assembly workshop

In order to increase fishery production in Eritrea, it is necessary not only to improve fishing gears and methods, but also to obtain modern fishing boats and high-quality fishing gears. However, catches are declining due to the poor performance and inefficiencies of fishing gears currently used in both Artisanal and Subsistence Fisheries. In addition, it is difficult for fishers to secure appropriate profits because the catches are purchased at a fixed price. Resolving these issues is expected to increase fish production. In general, fishers hesitate to work in the harsh and dangerous conditions in the sea when they are unable to earn enough income. Aiming to increase the number of new fishers, it is important to introduce effective fishing gears and methods, supply adequate and appropriate fishing equipment, and increase production and income.

iii. Fishing gear used during the hot season

The Red Sea is a closed sea with slow current. Schools of fish move to deeper waters as sea surface temperatures rise during the hot season. As a result, the fish catch declines. However, well-capitalized fishers continue to operate using the surrounding gillnets with fish aggregating lights during the hot season. To achieve the goal of increasing fish production even in the hot season, it is important to introduce new types of fishing gears and methods that can be used by many artisanal fishers.

b) Issues of engine maintenance for artisanal fishing boats

At the time of the baseline survey, it was confirmed that many non-operating fishing boats were moored around the port of Massawa. There is a lack of fishery-related facilities for repairing and maintaining fishing boats. In addition, it is difficult to obtain spare parts for fishing boat engines. There are many issues to be solved for the improvement of fishery status, such as the provision of available fishery-related services for fishers and the modernization of the fishing technology.

c) Issue of fishing port infrastructure and markets

The reasons for the "Lack of fishing infrastructure and facilities" raised during the problem analysis workshop were the lack of a pier, desalination equipment, and a place to maintain fishing boats and engines. Dehil Island is an island formed by uplifted coral reefs and relies almost entirely on water for not only for fishing but also for daily living items transported from the mainland by fishing fleets of Dehil Island. As the island is hardly able to produce food for its own consumption, fishing income is the major means of obtaining daily necessities, thus, fishing infrastructure and livelihood infrastructure are almost synonymous. The direct causes of the lack of fishing boat and engine maintenance facilities are the inability to maintain engines, lack of availability of parts, and inadequate structure of fishing boats, and all of these issues are characteristic of Dehil Island's reliance on boat fishing. "Lack of supply of goods necessary for production and maintaining livelihoods" was directly caused by the lack of water supply, insufficient number of fish boxes; and inadequate supply of fuel, ice, and food. The causes of "Many constraints due to inadequate institutions" include: inadequate supply of fishing gear of the right size,

quality, and quantity; poor marketing environment for the catch; and inadequate financing system. As for the poor marketing environment, the respondents in the problem analysis workshop strongly pointed out their dissatisfaction with the current marketing systems, such as the slow supply of ice, fixed fish prices, limited landing time, and limited sales to one company, NFC.

(2) Issues of the Subsistence Fisheries

The main issues of the Subsistence Fishery in the fishing community are briefly described in the following areas.

a) Main issues of the Subsistence Fisheries

The village of Hirgigo is primarily a community of small-scale subsistence fishers. The central problem is "Limited fishing activities", and causes are lack of fishing boats, inefficient fishing methods, low income due to low fish prices, and high prices of fishing gears. "Lack of marketing capacity" resulted from the low purchasing power of consumers and the lack of ice and fish boxes to keep fish fresh. The main reason cited for both "Lack of cooperative capacity" and "Lack of labor skills" is a lack of opportunities to improve capacity through training.

There are also fishing communities in Zula which depend on Subsistence Fisheries. Even in Zula village the fishing technology is inappropriate due to the absence of suppliers of fishing materials; therefore, there is no access to appropriate fishing gears. Many fish caught are discarded due to the long distance to the fishing grounds, limited opportunities to sell fish in the market, lack of good roads to transport fish, and lack of refrigerator freezers. "Lack of income opportunities for women in the fishery business" resulted from lack of training opportunities in fishing technology, fish processing and quality control technologies or starting a retail shop, indicating the need to provide appropriate training opportunities.

b) Fishing gears and methods of Subsistence Fisheries

The gears used for the subsistence fishery along the coast are low quality handline and gillnets. Also, there are no fishing boats except floating gears made of polystyrene, thus the fishing efficiency is very low. The target species are all small size pelagic fish such as mullet, indian mackerel, scud and small size spanish mackerel, which are thought to be high volume resources. So, there is a great room for resources to be exploited. Current fishing gears are neither qualitatively nor quantitatively sufficient for the utilization of these resources. It is necessary to introduce fishing gears and methods with high catch efficiency to promote the fishery development.

c) Marketing and distribution

In the coastal villages, there are many fishers and most of their catches are sold in the market in Massawa, but the high transportation cost is a cause of downward pressure on the fishers' income. Efforts to reduce transportation costs or increase the value added to raise the price of fish for sale are needed. On the other hand, most of Zula fishes are sold and consumed within the village due to the limited catches. However, since the village is located next to Foro, which is expected to have a large demand, the village envisages increasing its catches and sales volumes in the future. However, they are unable to sell their catches frequently due to limited means of transportation, and they are unable to keep their catches for long time due to the lack of storage facilities and means of keeping them cool in the village. In addition, there is no active market for fishery products in Foro, so there are limited opportunities to sell them.

d) Source of income for women

In coastal villages, the fishing net mending and making cooperatives have been organized to improve women's income, but none of them are functioning. However, there is a high need for women to improve their income, and it is clear that there is a need to develop some type of income sources.

2-2-2 Constraints of the coastal fisheries development

(1) Constraints of the Artisanal Fisheries development

a) Lack of know-how for improving fishing gear and method

Artisanal Fisheries face a number of challenges in improving and developing fishing gears and methods that are suitable for both the peak/cool season and the bottom/hot season. However, there is currently a lack of expertise to develop these technologies.

b) Limited transport links to inland areas

Fish trucks of ERI-FISH are used to transport fresh fishes from Massawa to Asmara/inland areas, but this is not sufficient for increased fishery production and supply in the future. The limited cold chain transport capacity from Massawa is one of the major constraints to the development of coastal fisheries.

c) Limited fish landing capacity of Massawa

Similarly, the current landing capacity of the Massawa fishing port is not sufficient in terms of institutional and facility capacity to increase the supply to the Asmara/inland area.

d) Controlled fish prices

The price of fishes is perceived by both fishers and consumers to be inappropriate. Fair pricing can be a major driver of fisheries development to motivate fishers to catch and consumers to buy, and it creates benefits for both. Regarding promotion of this market environment, the price control currently set by the NFC is one of the major constraints to the development of coastal fisheries.

(2) Constraints of the Subsistence Fisheries development

a) Lack of fishing technology for small pelagic fish resources

The development and effective use of small pelagic fish resources is fundamental to the future development of Subsistence Fisheries, but the fishing gears currently in use are limited to simple gillnets and handline only, making it difficult to further increase catches. Subsistence fishers' lack of fishing vessels and the difficulty of making large investments to obtain them have also been constraints to the development and introduction of efficient small pelagic fisheries technology.

b) Inadequate supply of fishing gears

The stable supply of good quality fishing gears and materials is essential for the future development of fisheries, but only limited quantities are currently available in the villages. Even in Massawa, fishing gears and materials are sold exclusively by the government and fishers cannot choose what they want.

c) No facilities for quality control and logistics

There is no infrastructure or facilities in the villages to serve as a base for quality control, processing, and distribution of fishery products. This condition is limiting means of fish distribution. Infrastructures/facilities such as cold storage, processing and transport are essential for improving the distribution of fishery products and strengthening sales to the large markets of Massawa and Asmara.

d) Lack of fish processing techniques

A key to the development of Subsistence Fisheries is the expansion of sales channels for small pelagic fishes to Asmara/inland areas where people are not accustomed to eating them. For this reason, the development of the market for processed products that involve new ways of eating fish is a challenge. For villages where electricity and refrigerators are usually not available, the development of processed fish products that can be preserved without cool storage is recommended. MMR has attempted to develop processed products, but to date there has been no demonstration of product development for the widespread consumption of processed small pelagic fish and there is a lack of expertise in these villages.

2-3 Priority challenges for the coastal fisheries development

2-3-1 Challenges for the Artisanal Fisheries

(1) Fishing gears and methods

During the peak fishing season, gillnet fishing (drift gillnets) is the main fishing method of the artisanal fishery and is thought to account for a large proportion of the catch, but fishers have pointed out problems such as inadequate mesh sizes and the high effort required to operate them. On the other hand, the demand for fish in Asmara/inland areas is higher than the supply, hence there is a need to improve fishery production and increase the supply. Increasing fishery production and supply by improving fishing gears and methods for production efficiency is a high priority for Eritrean coastal fisheries.

As noted above, supply is not keeping pace with demand for fish in the Asmara/inland area; this is more conspicuous in the hotter season when the production is lower. During the hot season, large pelagic fishes: which are the target of gillnet fishing, move to deeper water as the surface temperature of the sea rises drastically. Also, the extreme heat in the hot season makes working conditions uncomfortable, so fishers switch to the surrounding gillnets and operate at night, but catch amounts are lower than that in the peak fishing season. Many subsistence fishers also engage in bottom handline fishing which is particularly important during the hot season because it allows them to operate during the night and early morning. There are still opportuni-

ties for exploitation of bottom fish resources, thus the development and introduction of simple and widely used fishing gears and methods that enable more efficient use of resources are also required. Improvement of fisheries production in a manner that increases supply to consumers and fishers' income during the hot season is a big challenge.

(2) Market development

a) Sales promotion for market development

As mentioned repeatedly, the fish supply to Asmara and other inland areas is not keeping pace with the increasing demands as the fish consumption becomes more widespread. While it is necessary to increase fishery production to cope with this issue, the challenge is to improve the environment to ensure a stable supply of fishery products to inland areas. To achieve this, it is necessary to strengthen the ERI-FISH fish purchasing function at Massawa fishing port and the EMPC's fresh fish transportation capacity, and to activate sales points in inland cities such as Mendefera.

b) Fish price liberalization

The biggest complaint of fish consumers in Asmara/inland area is the high prices as well as the lack of supply. As fish consumption becomes more widespread and potential demand increases, the supply of fishery products at affordable prices can initiate further consumption. Conversely, for fishers, the low landing price is seen as a problem and seems to encourage many fishers to illegally land catches in neighbouring countries. It is thought that the official price set by the NFC based on the government policy is causing this mismatch in fish prices. In the past, the official pricing of fishery products was very effective policy to combat famine and to promote fish consumption. But at present time that the famine has passed and fish consumption has become more widespread, it seems that the role of official pricing is gradually coming to an end. The challenge is to promote price liberalization in the seafood trade and to strive to formulate prices that are appropriate for both fishers and consumers.

(3) Infrastructure and facilities

The artisanal fishers depend on the coastal areas of the mainland and islands, most of which lack fishing infrastructure and facilities such as jetties, boats and engine maintenance facilities. As a result, boats are anchored offshore of the island and maintenance is inconveniently carried out in Massawa. As these islands are also a place of livelihood for villagers: mainly fishers, the development of fishing infrastructure and facilities will also improve the livelihood of the communities. The development of fishery infrastructure and facilities on those islands are considered to be a necessary issue for the development of Artisanal Fisheries.

Fish landings for Artisanal Fisheries are limited to the Massawa and Assab fishing ports only. In particular, the Massawa fishing port is responsible for the supply of seafood to major inland centers such as Asmara, but has only one landing facility where ERI-FISH buys the products. In addition, because the access to the port is limited to 6 am to 6 pm and the fish landing is accepted only for a short time in the morning, fishing boats are sometimes anchored in the harbor for days waiting for landing. Increasing production to meet the high demand in Asmara and inland area will be difficult if the landing capacity of the Massawa fishing port remains low. Therefore, strengthening the landing capacity of Massawa fishing port is also an essential part of coastal fisheries development.

2-3-2 Challenges for the Subsistence Fisheries

(1) Fisheries production

a) Effective use of the small pelagic fish resources

The coastal areas of Eritrea where Subsistence Fisheries operate are assumed to be less abundant in fishery resources than offshore areas, and the resources are not used effectively because of the small number of fishers. While the accurate fish catch amounts and Allowable Biological Catch are awaiting specific studies, the main target species of Subsistence Fisheries, such as mullet (*Mugil cephalus*) and indian mackerel (*Rastrellinger kanagurta*) are considered to have sufficient potential for exploitation. The effective use of small pelagic fish resources is a major challenge for Eritrean coastal fisheries, both in terms of improving the livelihoods of fishers and supplying food to consumers.

In addition, small sardines such as bluestripe herring (*Herklotsichthys quadrimaculatus*) and shorthead anchovy (*Encrasicholina heteroloba*), which are prolific small pelagic fishes, are assumed to be more abundant than mullet and indian mackerel, and their effective use has long been an issue. These species are caught by beach seines and their current fishing grounds are solely in the southern coastal areas around Assab, Eddie, Korum and Berasole. They are processed by sun drying and used as a livestock feed. Though various efforts have been made to make them edible for

human, this has not yet been established since their quality deteriorates rapidly due to the fact that they are caught by seine netting and processed without boiling, in addition to Eritrean's food customs in which small sardines have not been eaten.

b) Increasing fisheries production

According to the results of the baseline survey, seafood consumption is traditionally high in coastal areas such as Massawa, and there is a shortage of supply in Asmara and inland areas despite high demand for seafood. The MMR and FAO's efforts since the 1980s to promote fish eating in inland areas have been successful, and have now entered a stage where a larger supply chain is required. Increasing production to meet this high demand is important from the food security perspective, and also provides an opportunity to fishers to improve their livelihoods. Together with the issue of expanding fisheries production of the Artisanal Fisheries, which will be discussed below, there is a social need to increase the production of Subsistence Fisheries based on the development of small pelagic fish resources described above.

(2) Sales and marketing

a) Reducing transport costs

The fishers in Hirgigo village sell many fishery products at the Edaga market in Massawa. But there is a problem that transport costs are high when transporting fishes to the market in small batches each time the catch landed. In case of Zula village, transport costs are not a major issue due to the high demand within the village, but as mentioned above, distribution to outside the village is essential if fisheries production is to be improved through development of small pelagic fish resources. A promising market is the neighbouring town of Foro, where ice is essential to maintain the quality of fish as it has been carried over rough roads for hours. However, necessary ice has to be ordered from Massawa as it is not available in the village. Minimizing these transport costs is a major challenge to economic management of fishers and its necessity will become more apparent as fisheries production improves.

b) Improvement of the distribution environment to Massawa and other towns

The fishing communities dwelling in the Hirgigo village needed an improved distribution environment when the volume of fish production increased. At present, ice for quality control is not usually used and transportation is basically only by motorbikes. Also, there are no sales facilities at the Edaga market, hence fishes are sold in baskets placed on the street which are not well shaded. It is not possible to increase the volume of sales in this environment because it is difficult to increase the transport volume and to maintain the quality of fish for an extended period. The improvement of the distribution environment is an essential task for improving fishery production and sales volumes.

As mentioned above, Foro is the most promising market for increasing fisheries production for Zula village. However, there is no fish market in Foro like Edaga in Massawa, and the ice required in transport has to come from Massawa. The improvement of the environment for the distribution of fresh fish to Foro by ensuring sales opportunities and means of quality control will be key issues for the successful development of fishery in Zula village.

c) Establishment of distribution methods and promotion of sales to inland areas

As mentioned above, meeting the demand for fishery products in inland areas including Asmara is also required from the perspective of national food security, but to date, there has been only limited sales of fish to inland areas by subsistence fishers, and distribution methods have not been established. Larger fishes such as spanish mackerel, queen fish and groupers have become widely consumed in Asmara and inland area. However, fish supplied by the subsistence fishers are mainly small pelagic fishes. As fish is a substitute for livestock meat for consumers in inland areas, they favor large portions to be edible and limited ways to cook. There is a need to establish a way of distributing the fisheries products of Subsistence Fisheries such as mullet and indian mackerel, and to promote their consumption.

The Priority Challenges identified as a result of the above analysis are summarised in the table below. There are 12 Priority Challenges, categorized into subject areas by Artisanal Fisheries and Subsistence Fisheries.

Table 2-1. The Revealed Priority Challenges for Coastal Fisheries Development

Classification of fisheries	Subject areas	Challenges
Artisanal fisheries	Fishing gears and methods	Improvement of the fishing efficiency by the improvement of fishing gears and methods
		Improvement of the fishing productivity in the hot season
		Effective utilization of the demersal fishery resources
	Distribution and marketing	Strengthening of landing capacity by fishing port
		Strengthening of transportation capacity to the inland area
		Preparation of fish market/store in consuming areas
	Infrastructure and facilities	Strengthening of landing capacity by fishing port
		Preparation of the fishing port in islands
Subsistence fisheries	Fishing production	Effective utilization of the small pelagic fishery resources
		Improvement of the fishing productivity
	Seles and marketing	Reduction of transportation costs
		Preparation of distribution environment
		Establishment of distribution system and sales methods for inland area

PART 3

Selection of Practical Approaches

This part sets out the approaches to solve the challenges identified in Part 2, separately for Artisanal and Subsistence Fisheries. While each approach addresses a specific issue, the characteristics of the approaches may refer to several challenges which are grouped together to form a single approach. The importance of the perspective of fishing community development, particularly with regard to Subsistence Fisheries, makes it desirable to bring together a number of separate challenges into a single approach.

3-1 Practical approaches for the Artisanal Fisheries Development

For the Artisanal Fisheries, approaches related to the "Fishing gears and methods" and "Fish distribution, marketing and infrastructure" are set out. There are seven relevant challenges and six approaches to meet these challenges. Previous parts pointed out challenges related to "Distribution and marketing" and "Infrastructures and facilities" separately, and these were integrated into an approach area, "Fish distribution, marketing and infrastructure", as they were strongly related to each other and had common issues.

3-1-1 Fishing gears and methods

(1) Approach for fishing efficiency improvement

This approach addresses the challenge "Improvement of the fishing efficiency by the improvement of fishing gears and methods".

The challenge is to resolve the fact that several fishing methods of Artisanal Fisheries are inefficient due to inadequate fishing nets and lack of fishing equipment. The size of the drift gillnet, commonly used in Artisanal Fisheries, is large (* one example from the baseline survey: Mesh size 120mm x 70G x 169m, 110mm x 105G x 192m), but the strings of the net are thick (*210d/36), which makes fishing inefficient and reduces working efficiency as a result of very heavy weight due to sea water during lifting. Encircling gillnets, another mainstay of fishery, require nets three to four times the height of drift gillnet to target fish schools in deeper water, as well as eight to ten times the weight to increase sinking speed. This requires more labor to operate and also increases the danger of on-board operations.

It is therefore necessary to introduce more efficient and lighter nets and fishing equipment such as net haulers, with the aim of improving efficiency and safety in these existing fisheries. This approach will improve the efficiency of existing fisheries in Artisanal Fisheries in order to increase catches and improve working conditions.

In the FSPAC project, Pilot Project 1 (PP1), a drift gillnet using Japanese-made mono-multifilament netting was developed and its improvement in fishing efficiency and operational efficiency was verified. In addition, an electric net hauler was installed on a fishing boat operating mainly encircling/bottom gillnet to verify the efficiency of the operation.

(2) Approach for fishing productivity improvement during the hot season

This approach addresses the challenge "Improvement of the fishing productivity at the hot season".

In the Red Sea coast of Eritrea, the sea water temperature rises to extreme levels during the hot season, which has a significant impact on the fishing environment. In particular, in the waters from Massawa to the Dahlak Islands, surface water temperatures rise to nearly 30°C in May and then reach 32°C from August to October (*State of the Coast Eritrea 2006-2007, Eritrea's Coastal Marine and Island Biodiversity Conservation Project, 2007). For this reason, kingfish and queenfish, the main target fish of Artisanal Fisheries, avoid the warmer surface waters and migrate to deeper water zones under the thermocline. As air temperatures also rise dramatically and daytime working conditions are extremely hard, Artisanal Fisheries is dominated during this period by encircling gillnets operating during nighttime with fish aggregating lights for deep-water fish resources. However, operations are restricted to nighttime, and the nets should two to three times deeper (*Mesh size 110mm x 280G in the baseline study) and two to three times longer (*420m) than normal drift gillnets to target deeper water, which make the fishing gear heavier and less efficient.

This has led to requirements to improve operational efficiency by upgrading the netting to lighter weight, introducing fishing equipment such as net haulers and improving the structure of fishing gears. In addition, it is also necessary to use positively demersal fish resources such as groupers and snappers, which have previously been caught by handline fishing and small number of bottom gillnets/longlines. The aim of this approach is to efficiently increase hot season catches

through these efforts.

In the aforementioned PP1, the FSPAC project tested the effectiveness of a prototype depth-adjustable encircling gillnet using the monofilament net to reduce the weight by eliminating nets from depth zones where target species are not distributed. In addition, the above-mentioned electric net hauler was installed on a fishing boat to verify its effectiveness for efficient operation. In order to verify the effective use of bottom fish resources, an attempt was made to develop small bottom longline gear, as described in the next section, within a pilot project (PP2) of the FSPAC project.

(3) Approach for effective utilization of demersal fishery resources

This approach addresses the challenge "Effective utilisation of demersal fishery resources".

The main Artisanal Fisheries fishing methods in Eritrea are gillnets such as drift gillnet and encircling gillnet, as mentioned above, and their target species are mainly large pelagic fishes such as kingfish and queenfish. On the other hand, the demersal fishery resources are only caught in small quantities in net fishing or by handlines. Semi-industrial fisheries include small bottom trawling and bottom longline fisheries using the diverted tuna longline gears, but the number of vessels is small and the fisheries are not well developed. The catch of semi-industrial fisheries shows that large individuals such as groupers, snappers, emperor and catfish are consistently caught, suggesting that the stock is also sufficiently abundant.

The approach aims to improve catches by making effective use of these demersal fishery resources. If operations with more effective gear than handlines, such as bottom longline, could be conducted between drift gillnet and encircling gillnet operations, it would be possible to increase the catch of demersal fishes in addition to the catch from the mainstream fisheries. In the cool season, the gear can be set up at night when the drift gillnet is not operating, and in the hot season, during the day when the encircling gillnet is not operating, so there is no need for a large workload. This will also lead to shorter fishing trip times, which will improve working conditions and increase income through reduced costs.

The FSPAC project has developed and validated the bottom longline as a pilot project (PP2), and also prototyped and trialled the pod fishing gear.

3-1-2 Distribution, marketing and infrastructure

(1) Approach for strengthening landing capacity of Massawa fishing port

This approach addresses the challenge "Strengthening of landing capacity by fishing port".

Massawa fishing port is the largest fishing port in Eritrea in terms of landings and is also the most important fisheries hub for the supply of seafood to Asmara and other inland areas. However, as discussed in Part 2, its facilities are limited in size and their landing time is restricted to a few hours in the morning, so their landing capacity is not sufficient. During the peak fishing season, it can take several days for fishing boats calling in to land their catch and wait for their turn in the port. In addition, although only two fishing ports, Massawa and Assab, are able to land fish on a stable basis, Assab is far from any major consumption centers other than surrounding areas. Therefore, its fishes are not bought by fishing companies. There are several fishing villages on the coastline between Massawa and Assab, where small fishing ports have been built with the support of the African Development Bank, but these have not yet been utilized effectively.

The approach aims to enhance the landing capacity of the Massawa fishing port to improve the supply of fish products to Asmara and other inland areas and to improve income opportunities and profitability for fishers.

(2) Approach for strengthening distribution capacity to the inland area

This approach addresses the issues "Strengthening of transport capacity to the inland area" and "Preparation of fish markets/stores in consuming areas".

The current demand for seafood in Asmara and inland urban areas is high, but there is insufficient supply to meet it. One factor of this problem is a lack of landing capacity at the Massawa fishing port mentioned above, which is compounded by a lack of transport capacity due to the limited number of ERI-FISH and EMPC refrigerated vehicles responsible for buying and transporting fisheries products for sale. Even if the supply and transport volumes were improved, the lack of sales centers in the inland areas would still be a problem.

The approach aims to strengthen the fisheries products supply system by increasing the number of refrigerated vehicles and the number of inland sales points, to improve the supply of fisheries products to Asmara and other inland customers, and to improve fishers' incomes through increased fish sales.

(3) Approach for installation of fishery infrastructures in island villages

This approach responds to the challenge "Preparation of fishing ports in islands".

The Dahalak Islands around Massawa are dotted with many fishing villages, which provide a living base for artisanal fishers. Fishing is the main industry on these islands and most of the income is dependent on fishing, while fishing boats are responsible for transporting water, food and other daily commodities. Namely, fishing is the livelihood of the islanders and at the same time a lifeline, and promoting fisheries development is directly linked to improving the living standards of the population. If the volume of fish caught and sold improves through the above-mentioned approaches, income can be expected to increase. However, fishing port facilities have not yet been developed in the fishing villages on islands. There are no facilities of landing sites or fishing gear warehouses, boats are anchored offshore and fishing nets are piled up on the beach. In addition, water in barrels and daily commodities transported from Massawa are transhipped from anchored fishing boats into small boats and unloaded manually.

This approach aims to improve the maintenance capacity of fishing gears and engines, as well as the living environment of fishing villages, by building landing sites, fishing gear warehouses and engine maintenance facilities etc. on the islands.

3-2 Practical approaches for the Subsistence Fisheries Development

Regarding the Subsistence Fisheries, the approaches related to "fishing production" and "sales and marketing" are set out. There are two challenges associated with "fishing production", but due to the small scale of the fishery and limited choice of fishing methods, only one approach was taken to achieve this. There are also three challenges related to "sales and marketing", but from a fishing village development perspective, they are so interrelated that it is difficult to separate them as separate approaches, so it is reasonable to achieve them with a single approach.

3-2-1 Fisheries production

(1) Approach for fishing productivity improvement for Subsistence Fisheries

This approach addresses the challenges "Effective utilization of the small pelagic fishery resources" and "Improvement of the fishing productivity".

Subsistence fishers do not have fishing vessels and their main fishing methods are small-scale fixed gillnet fishing, which uses small nets to catch mullet and others on the beach, and handline fishing, which uses rafts made of styrofoam a canoe to catch pelagic fish such as indian mackerel and queenfish. All are extremely small-scale and are also susceptible to natural environmental conditions such as wind and waves. As a result, the catch in a single operation is small and the opportunities of fishing operation are limited.

The approach aims to improve catches by development of low-use resources, such as small coastal pelagic and demersal fishes, by small-scale technical inputs that do not require fishing vessels, complex technology or large investments. Increasing production of Subsistence Fisheries will also contribute to the food security at the national level, while also improving the income of coastal fishing communities. The technology to be introduced should be more efficient fishing gears and methods, as well as the creation of fishing grounds with Fish Aggregating Devices (FAD) to actively attract and enhance the fisheries resources.

In the FSPAC project, pound net (small setnet) and small bottom longlines were demonstrated in pilot projects (PP2 and PP3), and artificial seaweed FAD, which are being developed in Japan, were installed and their fish attracting effects were examined.

3-2-2 Sales and marketing

(1) Approach for income improvement for subsistence fishing communities

This approach addresses three challenges: "Reduction of transportation coasts", "Preparation of the distribution environment" and "Establishment of distribution and sales methods for inland areas". As these challenges are strongly dependent on each other in the "area of sales and marketing" from the fishing community development perspective, it is reasonable to take one approach rather than separate approaches.

Although the sales and marketing problem is not currently pronounced in subsistence fishing villages due to high demand for fish within the village as described in Part 2, the above three challenges need to be resolved if fisheries production is to be improved by the above approach. A series of efforts are needed to solve these challenges, including a stable supply of ice for quality

control, cold storage facilities for preserving catches to reduce transport costs, development of marketing facilities in consumption areas, development of processed small pelagic fish and promotion of consumption in inland areas such as Asmara, and establishment of methods for their transport.

In the FSPAC project, the pilot projects (PP4, PP5 and PP6) included the development of Community Fisheries Centre (CFC) as a base for ice making, cold storage and processing, developing processed products such as dried and smoked fish to increase consumption of small pelagic fishes, and selling these fish products.

The relationship between the above challenges and approaches is summarised in the following table.

Table 3-1 The matrix of the relationship between the Challenges and Approaches

Classification of fisheries	Challenges	Area of Approaches	Approaches
Artisanal fisheries	Improvement of the fishing efficiency by the improvement of fishing gears and methods	Fishing gears and methods	Approach for fishing efficiency improvement
	Improvement of the fishing productivity in the hot season		Approach for fishing productivity improvement during the hot season
	Effective utilization of the demersal fishery resources		Approach for effective utilization of demersal fishery resources
	Strengthening of landing capacity by fishing port	Distribution, marketing and infrastructure	Approach for strengthening landing capacity of Massawa fishing port
	Strengthening of transportation capacity to the inland area		Approach for strengthening distribution capacity to the area
	Preparation of fish market/store in consuming inland areas		
	Preparation of fishing port in islands		Approach for installation of fishery infrastructures in island villages
Subsistence fisheries	Effective utilization of the small pelagic fishery resources	Fisheries production	Approach for fishing productivity improvement for Subsistence Fisheries
	Improvement of the fishing productivity		
	Reduction of transportation costs	Sales and marketing	Approach for income improvement for subsistence fishing communities
	Preparation of distribution environment		
	Establishment of distribution system and sales methods for inland area		

PART 4

Application of Practical Approaches

This part describes application of approaches set out in the previous part, separately for Artisanal Fisheries and Subsistence Fisheries. The Coastal Fisheries Development Tools that are expected to be addressed in each approach and concrete methods of implementation are also presented, and the details of which are given in Part 5.

It should be noted that Development Tools may be used in more than one approach depending on their situations. In practising coastal fisheries development in the future, the choice of the Development Tools should be based on the characteristics of the fishery, and the needs of the target communities and the natural environment, as appropriate. In principle, the effectiveness of the Development Tools has been verified in pilot projects of the FSPAC project. However, some of them have not yet been proven, but were considered effective in the course of the study of the guidelines. These need to be verified in the future.

4-1 Application of practical approaches for Artisanal Fisheries Development

There are six approaches in Artisanal Fisheries categorized in two areas as follows: "Area of fishing gears and method" and "Area of distribution, marketing and infrastructure". Development Tools related to three approaches in the "Area of distribution, marketing and infrastructure" have not been validated in the FSPAC project.

4-1-1 Fishing gears and methods

(1) Approach for fishing efficiency improvement

a) Objectives

Increase the efficiency of Artisanal Fisheries' existing fishing methods through the improvement of fishing gear materials and the introduction of fishing equipment such as net haulers to increase catches and improve the work environment.

b) Basic factors

Increase catches without increasing effort

Improve the net materials and the structure of currently used fishing gear to increase fishing efficiency. In addition, by making the net lighter, the labor required for the operation can be reduced and also the time required for lifting operations can be shortened. Therefore, it leads to increase in the number of operations per unit of time. This results in the reduction in the time it takes for the catch to reach the full capacity of the fish hold of the boat, thereby improving the catch per operational hour.

Improve working environment and safety

Reduced weight of fishing gears and introduced fishing equipment/machinery can reduce onboard labor. A pilot project carried out under the FSPAC project showed that the introduction of the electric net hauler made it possible for two people to lift bottom/encircling gillnet, whereas previously 10 people were required to do the same work. Also, lifting heavy nets could be dangerous for fishers working onboard, but lighter nets and the use of net haulers could increase their safety.

Reduce operation costs

Fishery profits can be increased by improving catch per operational hour and reducing operational costs through labor saving onboard operations.

c) Important notes and lessons

Establishment of a supply system for necessary materials and equipment

Prepare the materials and equipment supply system in order to promote new fishing gear.
Conduct surveys to understand fishers' needs, then establish a system of procurement and constant supply for fishing nets which meets fishers' requirements, fishing equipment and spare parts.

Establishment of a maintenance system for fishing equipment

Train technicians for the installation and maintenance of fishing equipment on fishing vessels.

Activities for popularization

Organize training sessions and produce and distribute brochures to actively promote the new fishing gears and equipment introduction.

d) Expected Development Tools

The Coastal Fisheries Development Tools envisaged in this approach are as follows.

Mono-multifilament drift gillnet:
Improve fishing gears to be more efficient and lighter, for example, by replacing the twine nets commonly used in Eritrea with nylon monofilament or mono-multifilament nets and changing the sinker to a leaded rope with less water resistance.

Electric net hauler:
Install electric net haulers for lifting gillnet fishing gears that can be easily installed on existing fishing vessels.

Improved encircling gillnet:
Improve fishing gears to be more efficient and lighter, for example, by replacing the twine nets commonly used in Eritrea with nylon monofilament or mono-multifilament nets and changing the sinker to a leaded rope with less water resistance.

Depth-adjustable drift gillnet:
Introduce depth adjustable drift gillnets that allow the net to be adjusted to the depth zones where the target fish schools are distributed. They are particularly useful in the hot season.

(2) Approach for fishing productivity improvement during the hot season

a) Objectives

Improve fishing gears such as encircling gillnet, one of the main fishing methods in the hot season when the surface water temperatures rise, and other fishing methods that can be operated at night to improve catch in the hot season.

b) Basic factors

Increase catches without increasing fishing effort

Improve the net material and structure of currently used fishing gear to increase fishing efficiency in night time period. In addition, by making the net lighter, the labor required for the operation can be reduced and also time required for lifting operations can be shortened. Thus, this will lead to increasing the number of operations per unit of time. This will result in a reduction of the time it takes for the catch to reach the full capacity of fish hold of the boat, improving the catch per operational hour.

Introduce multiple fishing methods to increase catches

The fishing methods which are mainly operated in the hot season, such as encircling gillnets, cannot operate from early morning until sunset. If this time period could be used to operate other fishing methods, it could increase the daily catches. However, as the work cannot be carried out during daytime hours due to the high temperature, the preferred method is to set the fishing gear in the evening and catch the fish early in the morning.

Improve working environment and safety

Reduced weight of fishing gears and introducing fishing equipment/machinery can reduce onboard labor. A pilot project carried out under the FSPAC project showed that the introduction of the electric net hauler made it possible for two people to lift bottom/encircling gillnet, whereas previously 10 people were required to do the same work. Also, lifting heavy nets could be dangerous for fishers working onboard, but lighter nets and the use of net haulers could increase their safety.

Reduce operation costs

Fishery profits can be increased by improving catch per operational hour and reducing operational costs through labor saving onboard operations.

c) Important notes and lessons

Establishment of a supply system for necessary materials and equipment

In order to promote new fishing gear, the materials and equipment supply system needs to be prepared. Conduct survey to understand fishers' needs, then establish the system of procurement and constant supply for fishing nets which meet fishers' requirement, and for fishing equipment and their spare parts.

Establishment of maintenance system for fishing equipment

Train technicians for the installation and maintenance of fishing equipment on fishing vessels.

Activities for popularization

Organize training sessions and produce and distribute brochures to actively promote the new fishing gears and equipment introducing.

d) Expected Development Tools

The Coastal Fisheries Development Tools envisaged in this approach are as follows.

Improved encircling gillnet:
Improve fishing gears to be more efficient and lighter, for example, by replacing the twine nets commonly used in Eritrea with nylon monofilament or mono-multifilament nets and changing the sinker to a leaded rope with less resistance of the water.

Depth-adjustable drift gillnet:
Introduce depth adjustable drift gillnets that allow the net to be adjusted to the depth zone where the target fish school is distributed. It is particularly useful in the hot season.

Electric net hauler:
Install electric net haulers for lifting gillnet fishing gears that can be easily installed on existing fishing vessels.

Small-scale bottom longline:
Introduce small-scale bottom longlines targeting under-exploited demersal fish resources that do not require large fishing equipment.

Pot fishing:
Introduce pot fishing gear to target demersal fish resources. It will be placed in shallow water areas where fishing vessels are anchored during times when the gillnet fishing are not in operation.

(3) Approach for effective utilization of demersal fishery resources

a) Objectives

Effective utilisation of demersal fish resources: which are currently under-exploited in coastal areas, to improve the overall catch of Artisanal Fisheries.

b) Basic factors

Promote the effective use of demersal fish resources

Compared to the offshore areas being developed by Egyptian bottom trawlers, demersal fish resources in the Eritrean coastal areas are currently mostly unexploited. Utilization of those resources aimed at sustainable use is necessary. Fishing methods should be selected that are less likely to lead to overfishing and that preferably use current fishing vessels which do not require large investments.

Increase fishing efficiency through multiple fishing methods

In parallel with drift gillnet and/or encircling gillnet operations used within the same day, a fixed fishing gear targeting demersal fishes will also be installed to increase the catch per operational day.

Reduce operation costs

Fishery profits can be increased by improving catch per operational day.

c) Important notes and lessons

Establishment of a supply system for necessary materials and equipment

In order to promote new fishing gear, materials and equipment, supply systems need to be prepared. Conduct survey to understand fishers' needs, then establish a system of procurement and constant supply for fishing nets which meeting fishers' requirement, and for fishing equipment and their spare parts.

Activities for popularisation

Organise training sessions and produce and distribute brochures to actively promote the new fishing gears and equipment introduced.

d) Expected Development Tools

The Development Tools envisaged in this approacha are as follows

Small-scale bottom longline:
Introduce small-scale bottom longlines targeting under-exploited demersal fish resources that do not require large fishing equipment.

Pot fishing:
Introduce pot fishing gear to target demersal fish resources. It will be placed in shallow water areas where fishing vessels are anchored during times when the gillnet fishing are not in operation.

4-1-2 Distribution, marketing and infrastructure

(1) Approach for strengthening landing capacity of Massawa fishing port

a) Objectives

Improve facilities and landing procedures at Massawa

fishing port, the most important fishing port in Eritrea, to enhance landing capacity and to increase fishers' income.

b) Basic factors

Strengthen the supply system of fisheries products to inland areas

Currently, Asmara and other inland cities are unable to fully meet the growing demand for fisheries products. On the other hand, there are sometimes many fishing boats waiting their turn to land at the Massawa fishing port. Thus, there is a need to strengthen the landing capacity of the Massawa fishing port to increase the supply of fisheries products.

Improve income opportunities for fishers

If fishers are able to land their catch and prepare for the next trip promptly after arrival at port, this will increase the number of fishing trips and improve income opportunities.

c) Important notes and lessons

Review of required infrastructure.

Currently there is only one active landing wharf and entry point to refrigeration and processing facilities. As a result, only one fishing boat can land at a time as limits its landing capacity. There is a need to review necessary facilities and equipment, and to consider appropriate infrastructure development.

Improvement of landing procedures.

The landed catch is measured and recorded by MMR/ERI-FISH and then packed with ice and delivered to cold storage, but there is only one recording window for this. These landing procedures are also limited to a few hours in the morning. These problems in landing procedures limit the landing capacity of the Massawa fishing port. MMR, NFC, ERI-FISH, EMPC and other fishing port distribution stakeholders need to consult with each other to identify and solve this problem in the workflow and procedures of landing.

d) Expected Development Tools

The Coastal Fisheries Development Tools envisaged in this approach are as follows. However, they are not verified and required more consideration to implement for the future.

Improvement and rehabilitation of the Massawa fishing port:
Improve the landing wharf at the Massawa fishing port and rehabilitation of old facilities to improve the landing function. (*No verification of this Tool has been carried out)

Improvement of procedures and workflow of fish landing operation:
Improve procedures and work flow during landing at the Massawa fishing port to improve the landing function. (*No verification of this Tool has been carried out)

(2) Approach for strengthening distribution capacity to the inland area

a) Objectives

Improve fisheries products supplies to inland areas by strengthening the transport capacity from Massawa fishing port to Asmara and other inland areas, and by developing sales points in consumption areas. This also aims to improve the income of fishers through increased sales of fisheries products.

b) Basic factors

Contribute to food security.

Fisheries resources (allowable catches) in the Eritrean EEZ are considered to be adequate. However, the current situation does not fully meet the demand of Asmara and other inland areas. In conjunction with the aforementioned strengthening of the landing capacity of the Massawa fishing port, the distribution and marketing capacity in the inland areas will be strengthened, thereby contributing to the food security of the country as a whole.

Improve fishers' incomes

Increased distribution and sales of fisheries products will also improve the supply opportunities for fishers. It will contribute to increasing the income of fishers.

c) Important notes and lessons

Setting goals through marketing research.

Appropriate marketing research should be carried out to set distribution and sales goals in the inland areas. It also should also include the number and size of refrigerated vehicles and sales points required to achieve this goal.

d) Expected Development Tools

The Coastal Fisheries Development Tools envisaged in this approach are as follows. However, they are not verified and required further consideration to implement in the future.

Strengthening of cold supply chain by refrigerator vehicles:
Increase refrigerated vehicles to enhance the capacity to transport fresh fish to Asmara and other inland areas. (*No verification of this Tool has been carried out)

Preparation of fish supply facilities:
Activate and increase sales points for fisheries products in inland areas, such as fish markets and fish retail shops. (*No verification of this Tool has been carried out)

(3) Approach for installation of fishery infrastructures in island villages

a) Objectives

Fishing port facilities such as jetties, fishing gear warehouses and engine maintenance facilities are to be built on the islands to improve the maintenance capacity of fishing boats, gear and engines, as well as to improve the living environment of fishing villages.

b) Basic factors

Improve operational capacity

The construction of jetties, warehouses and maintenance facilities will enable proper maintenance and storage of fishing boats, fishing gears and engines. This will lead to improved operational capacities such as improved fishing efficiency and navigational safety.

Improve living environment in fishing villages

Once a jetty is in place, it will facilitate the transport of food, water and other goods necessary for the inhabitants' daily life from the mainland, thereby contribute to improving the living environment of the remote island communities.

c) Important notes and lessons

Consideration of appropriate facility sizes

Fishing villages on remote islands differ in terms of their population size and the number of fishing boats they have. In designing a facility, sufficient surveys should be carried out and care should be taken to ensure that the size of the facility is appropriate for the island.

Infrastructure development to suit the needs of the community

Fishing port facilities are the infrastructure which provide a lifeline not only for fishers but also for the entire island population. In designing the facilities, there should be a thorough exchange of views with the community to ensure that the content of the facilities meets their needs.

Fish caught by encircling gillnet

d) Expected Development Tools

The Coastal Fisheries Development Tool envisaged in this approach is as follows. However, it is not verified and requires further consideration to implement it in the future.

Construction of fishing port and related facilities in islands:
Develop fishing port infrastructure such as jetties, fishing gear warehouses and maintenance facilities in remote fishing villages. (*No verification of this Tool has been carried out)

4-2 Application of practical approaches for Subsistence Fisheries Development

4-2-1 Basic idea of the Subsistence Fisheries Development

For Subsistence Fisheries, the following two approaches are indicated in the two areas, "Area of fishing production" and "Area of sales and marketing". The fishing production and sales/marketing issues in the Subsistence Fisheries are strongly dependent on each other. The Coastal Fisheries Development Tools included in the two approaches below are also closely related to each other. Such characteristics of Subsistence Fisheries development are outlined in the afollowing figure.

There is a relationship between "Approach for fishing productivity improvement for Subsistence Fisheries" to increase fishing production and "Approach for income improvement for subsistence fishing community" in that both will convert the catches into revenue for the fishing community. Furthermore, the revenues are used to purchase and maintain fishing gear to sustain fishing production.

Each approach should be implemented on the basis of these relationships in the Subsistence Fisheries development.

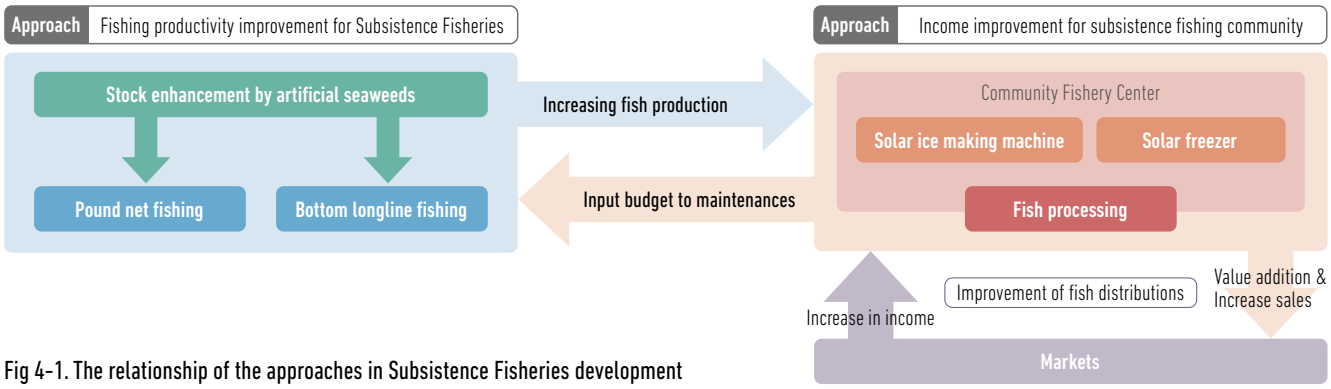


Fig 4-1. The relationship of the approaches in Subsistence Fisheries development

4-2-2 Fisheries production

(1) Approach for fishing productivity improvement for Subsistence Fisheries

a) Objectives

The aim is to improve catches of under-utilized resources, such as small coastal pelagic fish and demersal fish resources, with small-scale technological inputs that do not require fishing vessels, complex technology or large investments.

b) Basic factors

Introduction of small-scale fishing gears and methods

Subsistence fishers generally do not have large capital and operate small-scale fishing methods that do not use fishing vessels. Therefore, the fishing gears and methods to be introduced do not require large investments or complex technology, such as fishing vessels and large fishing gears.

Effective utilisation of low-use and/or unexploited resources

Exploit under-utilized resources such as mullet and indian mackerel, which are distributed close to the coast but have not been exploited as much as other resources, and which have not been fished with small fixed gillnets or handline fishing. As these fisheries resources are expected to be abundant and can be caught close to the coast, large catches can be

expected depending on the fishing method and the labor and costs associated with the operation can be kept low.

c) Important notes and lessons

Operation and management by fishing communities

With regard to the implementation of fisheries management, such as operations of the introduced fishing methods, management of fishing gears, rules for resource utilisation, and monitoring systems, a fishermen's cooperative is established in each fishing community to act as the implementing body. This is because each fisher has a very small-scale capacity of operation and management, so it is rational for them to organize associations to achieve effective fishing operation and also to give them more ownership over the support they receive from the government.

d) Expected Development Tools

The Coastal Fisheries Development Tools envisaged in this approach are as follows. However, some tools have not been verified and need to be considered in the future.

Pound net:
Small Pound net is set up on the foreshore of the fishing village to catch the migrating fish schools. This fishing gear is more complex and larger than subsistence fishers' gill nets, but the MMR provides guidance on how to make, install and maintain the gear. Fishermen's associations in each community operate and manage pound net on their own initiative.

Small-scale bottom longline:
Introduce small-scale bottom longlines that can be operated by canoe or raft to develop demersal fish resources, such as groupers and snappers, in shallow coastal waters.

Coastal FAD by Artificial Seaweeds:
Construct FADs with artificial seaweed on sandy muddy seabed to attract fish schools. This can be used as a fishing ground and also as a spawning device. It can also be substituted with other materials such as tree branches.

Small-scale purse seine fishing:
Small fishing vessels that can be operated with outboard motors and small purse seine nets are introduced to catch small pelagic fishes such as bluestripe herring and shorthead anchovy.
(*No verification of this Tool has been carried out. Technological development in the future is required)

Fish caught by pound net

4-2-3 Sales and marketing

(1) Approach for income improvement for subsistence fishing community

a) Objectives

Improving the income of fishing communities of Subsistence Fisheries through a series of activities, including the provision of ice to preserve the quality of fresh fish, cold storage facilities to reduce transport costs, the development of sales facilities in consumption areas and the promotion of sales to inland areas.

b) Basic factors

Integrated activities from production to sales

The aim is to obtain highly added value by seamlessly implementing a series of activities from quality control of catches, processing, and transport until sale the fisheries products to consumers.

Linkages with fishing production

Fishing production and marketing are inseparably linked to the realization of community's income gains. In other words, this approach is an inextricably linked activity to the aforementioned, "Approach for improving fishing productivity for subsistence fishery". It is assumed that a part of the profits of this approach will be used to fund the maintenance and purchase of fishing gears to sustain fishing production.

c) Important notes and lessons

Community-based activities

This approach is assumed as the government support for community fisheries centers and necessary equipment. fishermen's cooperatives need to be established in each community to receive this support, and to be the beneficiary to take the initiative and be the main implementation body of this approach.

Community Fisheries Center

The community fisheries center as a Development Tool, described below, will be the central hub of the community for fisheries production and marketing including ice making, cold storage and processing functions. Communities/ cooperatives need to take the initiative in making rules on how to use and manage this facility, materials and equipment.

d) Expected Development Tools

The Coastal Fisheries Development Tools envisaged in this approach are as follows. However, some Tools have not been verified and need to be considered in the future.

Solar ice block making machine:
Produce ice to keep the catch cold. The ice is sold to fishers and any surplus can be sold to other fishing villages and towns, thus generating income from other than fisheries products.

Solar chest freezer:
It is used to keep the catch cool, freeze and produce ice. Also, it is used as solar power as coastal fishing villages usually do not have electricity supply.

Cooler box:
It is used to transport fish catches with ice for maintaining their freshness and adding value for marketing.

Fish meat bone separator:
A kind of fish processing machine. It is possible to remove an unnecessary part such as bones and skin easily from fish to make a material of high value fish processing products.

Fish meat mincer:
It is equipment to make fish minces for high value fish processing products to contribute to the income generation of fishing community.

Fish dryer:
It is equipment to make dried fish, value-added fish product, for contributing to the income generation of fishing community.

Fish smoker:
It is equipment to make smoked, value-added fish product, for contributing to the income generation of fishing community.

Community Fishery Center:
This is the central facility of fishing community development that provides places for ice making, cold storage, fish processing, its selling, storing materials and community meetings.

Small pelagic fish processing:
Small pelagic fishes such as bluestripe herring and shorthead anchovy are processed into the products that meet the consumption needs of the Eritrean population. (*No verification of this Tool has been carried out. Technological development in the future is required)

Table 4-1. Composition of the Approaches

Classification of fisheries	Area of Approaches	Approaches	objectives	
Artisanal fisheries	Fishing gears and methods	**Approach for fishing efficiency improvement**	Increase the efficiency of Artisanal Fisheries' existing fishing methods through the improvement of fishing gear materials and the introduction of fishing equipment such as net haulers to increase catches and improve the work environment.	
		Approach for fishing productivity improvement during the hot season	Improve fishing gears such as encircling gillnet, one of the main fishing methods in the hot season when the surface water temperatures rise, and other fishing methods that can be operated at night to improve catch in the hot season.	
		Approach for effective utilization of demersal fishery resources	Effective utilisation of demersal fish resources: which are currently under-exploited in coastal areas, to improve the overall catch of Artisanal Fisheries.	
	Distribution, marketing and infrastructure	**Approach for strengthening landing capacity of Massawa fishing port**	Improve facilities and landing procedures at Massawa fishing port, the most important fishing port in Eritrea, to enhance landing capacity and to increase fishers' income.	
		Approach for strengthening distribution capacity to the inland area	Improve fisheries products supplies to inland areas by strengthening the transport capacity from Massawa fishing port to Asmara and other inland areas, and by developing sales points in consumption areas. This also aims to improve the income of fishers through increased sales of fisheries products.	
		Approach for installation of fishery infrastructures in island villages	Fishing port facilities such as jetties, fishing gear warehouses and engine maintenance facilities are to be built on the islands to improve the maintenance capacity of fishing boats, gear and engines, as well as to improve the living environment of fishing villages.	
Subsistence fisheries	Fisheries production	**Approach for fishing productivity improvement for Subsistence Fisheries**	The aim is to improve catches of under-utilised resources, such as small coastal pelagic fish and demersal fish resources, with small-scale technological inputs that do not require fishing vessels, complex technology or large investments.	
	Sales and marketing	**Approach for income improvement for subsistence fishing communities**	Improving the income of fishing communities of Subsistence Fisheries through a series of activities, including the provision of ice to preserve the quality of fresh fish, cold storage facilities to reduce transport costs, the development of sales facilities in consumption areas and the promotion of sales to inland areas.	

	Basic factors	Expected Development Tools
	• Increase catches without increasing effort • Improve working environment and safety • Reduce operation costs	» Mono-multifilament drift gillnet » Electric net hauler » Improved encircling gillnet Depth-adjustable drift gillnet
	• Increase catches without increasing fishing effort • Introduce multiple fishing methods to increase catches • Improve working environment and safety • Reduce operation costs	» Improved encircling gillnet » Depth-adjustable drift gillnet » Electric net hauler » Small-scale bottom longline » Pot fishing
	• Promote the effective use of demersal fish resources • Increase fishing efficiency through multiple fishing methods • Reduce operation costs	» Small-scale bottom longline » Pot fishing
	• Strengthen the supply system of fisheries products to inland areas • Improve income opportunities for fishers	» Improvement and rehabilitation of the Massawa fishing port » Improvement of procedures and workflow of fish landing operation
	• Contribute to food security • Improve fishers' income	» Strengthening of cold supply chain by refrigerator vehicles » Preparation of fish supply facilities
	• Improve operational capacity • Improve living environment in fishing villages	» Construction of fishing port and related facilities in islands
	• Introduction of small-scale fishing gears and methods • Effective utilisation of low-use and/or unexploited resources	» Pound net » Small-scale bottom longline » Coastal FAD by Artificial Seaweeds » Small-scale purse seine fishing
	• Integrated activities from production to sales • Linkages with fishing production	» Solar ice block making machine » Solar chest freezer » Cooler box » Fish meat bone separator » Fish meat mincer » Fish dryer » Fish smoker » Community Fishery Center » Small pelagic fish processing

PART 5

Coastal Fisheries Development Tools

This part explains the specific contents of Coastal Fisheries Development Tools applied in each approach defined in Part 4. Those Development Tools, mainly technologies and equipment, had been introduced and tried to verify effectiveness in the "Project for the Formulation of the Strategies and Practical Approaches for Coastal Fisheries Development (FSPAC)" implemented by MMR and JICA. Development Tools were described in a simple format that is easy to refer to when planning a coastal fisheries development project based on the approaches. Also, the Annex 2, 3 and 4 of these Guidelines should be referred to when it is necessary to know the detailed technical contents.

5-1 Objective and utilization of Development Tools

As mentioned in the preceding part, Development Tools are specific methods to implement the approaches, in other words, Development Tools are the methods to achieve the objectives of the approaches through their implementation. Even though some Development Tools are shown in the approaches in preceding part, they should be selected according to the needs of fishers/fishing communities and environmental conditions when planning an actual coastal fisheries development project. It is necessary to carefully consider which Development tool to choose by conducting discussions with the persons concerned.

In the following sections, essential points of the Development Tools are extracted such as the purpose, structure, expected effectiveness and important notes, and information is summarized into a simple format of one or two pages. This format is suitable to select appropriate Development Tools for each project of coastal fisheries development in planning.

For the details of the Development Tools, refer to the annexed document "Result of the Pilot Projects: Project for the Formulation of the Strategies and Practical Approaches for Coastal Fisheries Development (FSPAC)". There are comprehensive and important sources of knowledge for using the Development Tools that include results of the technical verification, notices and lessons to be introduced to the future projects. It is strongly recommended that they be consulted when planning a project of coastal fisheries development along with these Guidelines.

The Development Tools verified in the FSPAC project and introduced in these Guidelines are as follows.

[Development Tools for Artisanal Fisheries]

(1) Mono-multifilament drift gillnet
(2) Improved encircling gillnet
(3) Depth-adjustable drift gillnet
(4) Electric net hauler
(5) Small-scale bottom longline
(6) Pot fishing

[Development Tools for Subsistence Fisheries]

(1) Pound net
(2) Coastal FAD by Artificial Seaweeds
(3) Solar block ice making machine
(4) Solar ice making chest freezer
(5) Solar chest freezer
(6) Cooler box
(7) Fish meat bone separator
(8) Fish meat mincer
(9) Fish dryer
(10) Fish smoker
(11) Community Fishery Center (Type 1)
(12) Community Fishery Center (Type 2)

5-2 Development Tools for Artisanal Fisheries

(1) Mono-multifilament drift gillnet

Purpose:

To increase the productivity and production of the existing drift gillnet by developing other techniques and materials.

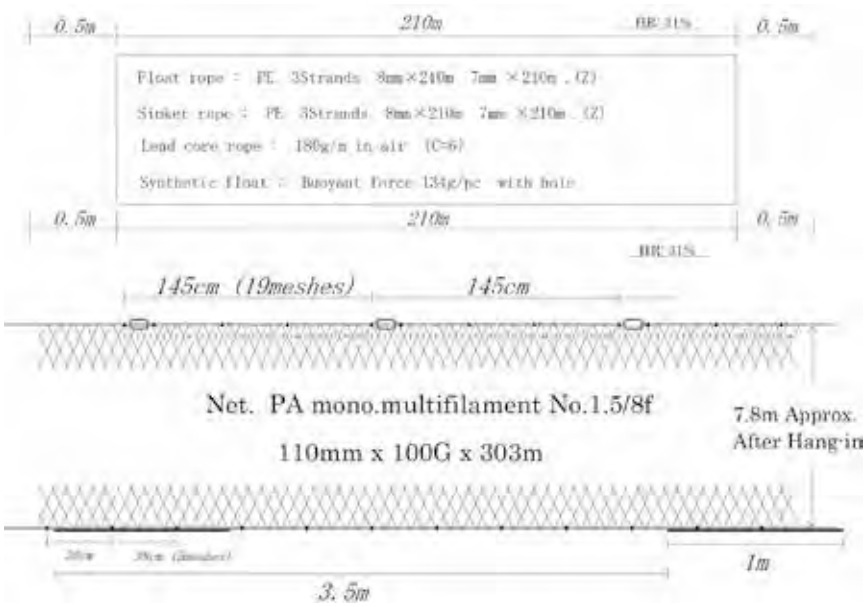
Outline

This type of gillnet verified in the FSPAC project is a mono-multifilament netting that has 0.3mm thickness 8 filaments, 110mm mesh size, green colour, 100G and 303meter length.

In the experimental fishing, good results were obtained by Artisanal fishers. From the fishers' view-point the factors contributing to the relatively higher catch efficiency of the newly produced gillnet over the existing gillnet might be that the nature of the twine is mono-multifilament: which is thinner, so the probability of fish catch being not only enmeshed but instead entangled is increased. The green colour and thinner twine create low visibility resulting in more fish being encountered even if it is used during a full moon. Moreover, fishers prefer it because it is very light so they can operate large numbers ff such gillnet by a smaller number of crews.

Materials and Costs per set:

Netting: PA Mono-Multi. 0.3/8 110mm (Mesh size) × 100G × 303 meter length* green color.
Rope for head line: 8mm, 200meter
Sinker line; lead core braided sinker of180 g/meter and 70meter length
Float; Y-20×90 pieces
Total estimated cost: appr.1000 USD



Recommendations

From three experimental fishing and the fishers' indications, the following information was found that the drift gillnets produced by the FSPAC project were more efficient in catching and workability than the fishers' drift gill-nets. On the other hand, they also had problems such as weak lines and difficulty in repair.

Based on the information obtained, it is necessary to reconsider the material, line thickness, and mesh size of the nets. In addition, the buoyancy and sinking force and hang-in ratio should also be recalculated in order to introduce appropriate fishing nets.

The MMR fishing gear unit has capacity regarding the basic calculations and construction methods of gillnets and is ready to implement measures to improve the gear.

(2) Improved encircling gillnet

Purpose:

To develop alternative fishing gear and a method of Artisanal Fisheries that can be operated during the hot season to maximize income.

Outline:

Encircling gillnet is a type of gillnet which is practiced during the hot season when the sea water temperature is rising. Eventually, the targeted fish of Artisanal fishers are forced to migrate deeper. This leads the fishers to not engage actively in this season.

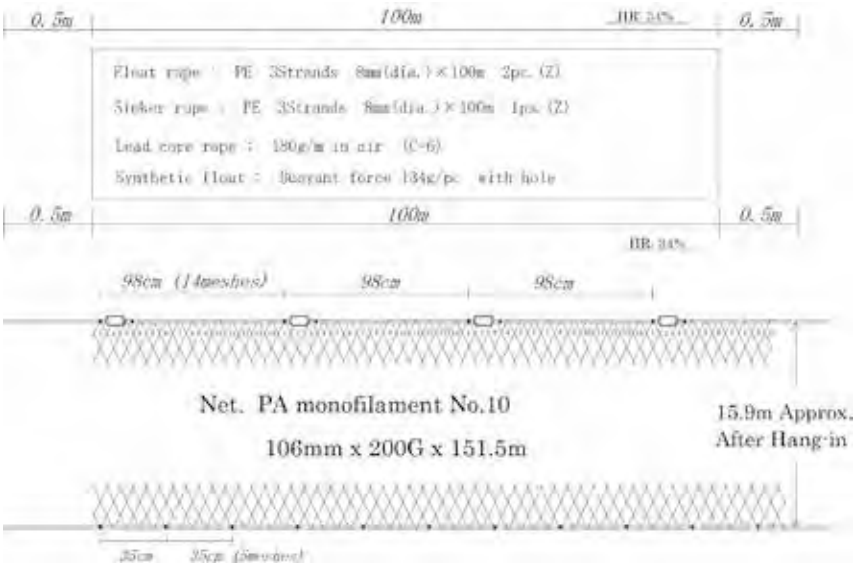
The improved encircling gillnet which is verified in the FSPAC project has monofilament netting which has 106 mm mesh size, 200 mesh in depth x 151.5meter length and green color. A total of three sets of 100m length and 16m net depth were constructed and test operations were conducted with Artisanal fishers.

In the fishing experiment of the encircling gillnet the following information was provided from Artisanal fishers.

(1) The net is lighter and requires less labor, making it more profitable.
(2) There is a higher catch rate than the fishers' encircling nets.
(3) The use of lead core sinker makes less noise when cast into the water, preventing fish from escaping.
(4) With lead core sinker rope, net deployment and hauling is smooth and the rope does not get tangled in the net during operation.
(5) Fish are easily caught due to less visibility of the net. On the other hand, the disadvantages are as follows:
(6) The netting line is thin and light, so the nets break easily and are difficult to repair.
(7) The net is too slow to deploy in the sea due to the lack of sinkers and floats. (Modified by fishers)
(8) The net depth is 16m, which is shorter than the fishers' net depth of 28m.

Materials and Costs per set:

Net: PA monofilament No.10 * 106 mm * 200 G * 151.5meter* green colour
Head rope; PP three stranded 8mm/dia, 100meter length
Footrope; PP three stranded 7 mm/dia, 100meter length
Sinker; braided lead core type sinker 180g/m* 200meter length
Float; Y-20 100 pieces
Total estimated cost: 650 USD



Recommendations

The selection of materials for monofilament type of encircling gillnets also needs to be reconsidered because of the weakness of the netting line and the difficulty of repairing it. When monofilament net is used, the size of the netting line should be increased to strengthen the durability. Although the multifilament twine is slightly more expensive than the monofilament twine, it is easier to repair and more durable. In the case of gillnets made of multifilament twine, it is recommended to use thinner twine (For example: 210D/18-24). In addition, the buoyancy and sinking force are recalculated as necessary to increase the working efficiency and the catching efficiency.

(3) Depth-adjustable drift gillnet

Purpose:

To develop alternative fishing gear and method of Artisanal Fisheries that can be operated during the hot season for maximizing income.

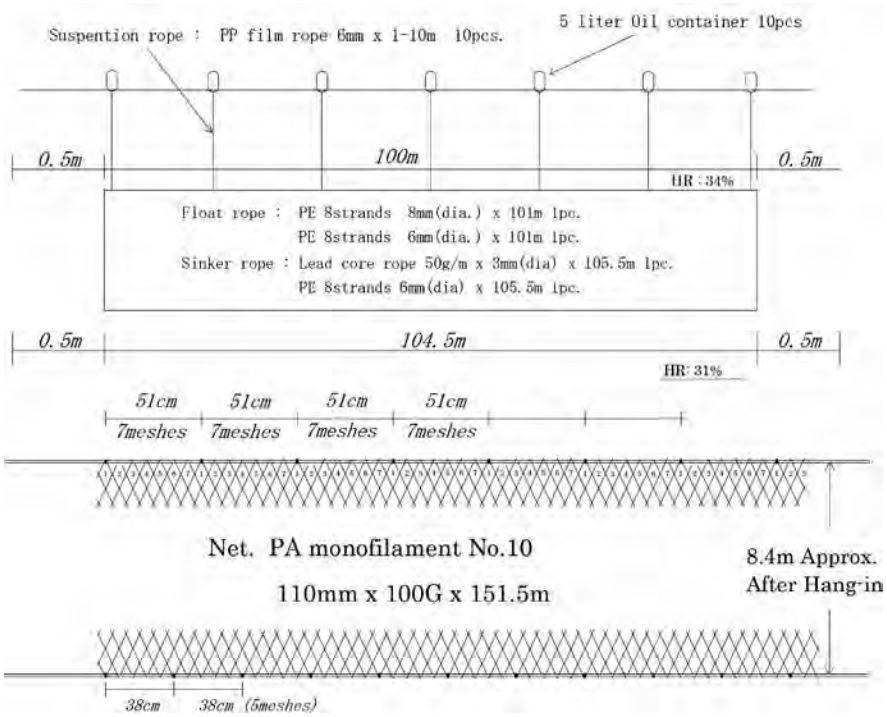
Outline:

under the FSPAC project, a new prototype drift gillnet is designed to sink gradually in the water and has no floats attached to the head rope.

The unique feature of this gear is that buoys are attached to the head rope at intervals of 10 to 20m. By adjusting the length of the buoy rope, the net can be deployed at any depth of the target fish, which varies with the seasons and growth of the fish.

Materials and Costs per set:

Net: PA monofilament No.10*110mm*100G*151.5 meter* brownish color.
Head rope: 6 mm/dia. x 100 m
Footrope: 6mm/dia. 100 m
Sinker; Tetron braid rope lead core 50g/meter
Suspension rope; PP film rope 6mm/dia. 60 meter,
Buoy; 5 litre Plastic oil container
Total estimated cost: 650 USD



Recommendations

Spanish mackerel and queen fish, which are the main targets of the Eritrean drift gillnet fishery, are subject to seasonal changes in seawater temperature and swimming depth during their growth process. However, the fishers' drift gillnet is not suitable for year-round operation because the depth of the net cannot be adjusted. To solve these problems, a depth-adjustable drift gillnet was designed and test operations were implemented. From this operation, it was judged that this net was effective in increasing the operating time and improving the productivity of small-scale fishing boats. However, the fishing gear used in the survey is a prototype and should be optimally improved in terms of gear buoyancy, sinking force, appropriate length of suspension rope, buoy shape and buoyancy, etc. Moreover, the frequency of operation was very low. Therefore, such experiments should be tested independently to get comprehensive data.

(4) Electric net hauler

Purpose:

To minimize the labor cost or manpower and thereby introduce new fishing technologies to enhance the income of Artisanal Fisheries.

Outline:

Gillnetting in Eritrea is inefficient because it requires a large number of fishers due to the thicker line and heavier net. To address these problems, a feasibility study on the introduction of a net hauler was initiated in the FSPAC project. The test operation of the net hauler for gillnet fishing was conducted on board the Artisanal fishing boat. Same of the advantages of the net hauling machine are that it works with 24V/DC so it consumes less power, it simply generates power from batteries and the design is simple and easy to monitor it.

Materials and Cost:

Net hauler machine; Koshin, Mag-roller MR-4024\
Drum for Net hauler; Roller MR-360
Battery; GS/Yuasa(MRN-130F51)
Battery charger; Meltec MP-230 25A
Battery charger; Ohashi-sangyo SMART CHARGER 25A
Breaker for DC24V; Fuji electric Intermediate circuit breaker for 30A
Total estimated cost: 3000USD

Recommendations

From the results of the test operation, it was concluded that the gillnets used by the Eritrean fishers are heavy and therefore some modifications to the net hauler are necessary. In addition, this net hauler was left on the fishing boat for further testing. So far, according to the fishers' opinion, the net hauler was very efficient for lifting gillnets with minimalized manpower. In addition, the drum of this net hauler is convenient for the use of bottom gillnet fishing, since the bottom gillnet fishing is operated as deep as 80 meters, which is difficult to haul manually. Even this machine could be effective for long-line fishing if the drum were made bigger to roll longer main line.

(5) Small-Scale bottom longline

Purpose:

To develop new fishing techniques to increase catches and diversify fishing methods and to promote the development of demersal fisheries resources.

Outline

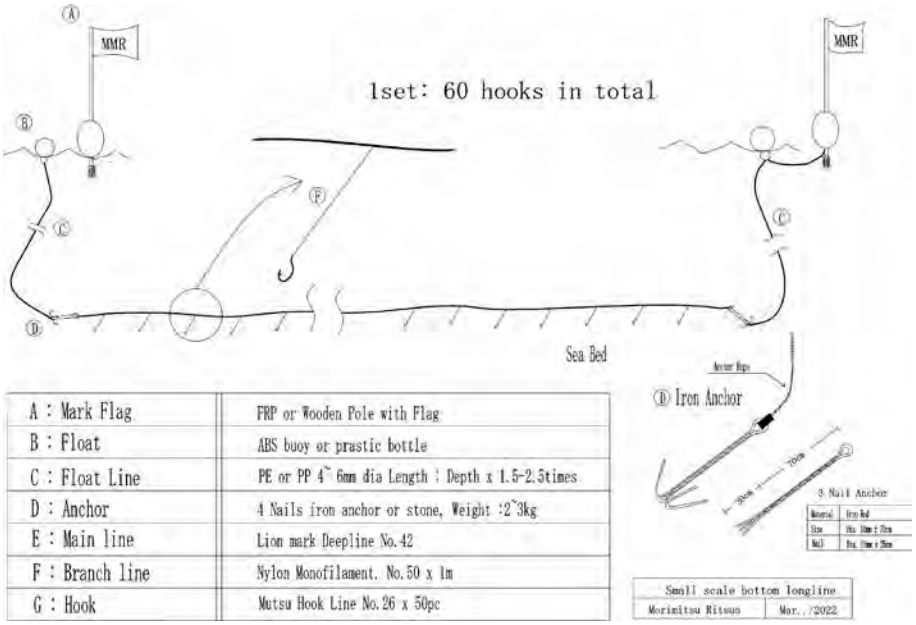
The preparation of this longline is a simple method, which is produced by using locally available materials. A type of the small-scale bottom longline which was verified in the FSPAC project is one full basket (locally produced hook bin), has 130meter of mainline with 50 branch lines, and each branch line is 60cm long, attached at 6m intervals. The main parts of the longline are the main line made of braided rope line number 42, the monofilament branch line number 50 having one milli-meter thickness and the circle type hook number 26. The fish caught are mostly coral reef fishes like red snapper, grouper, emperor, guitarfish, catfish, and shark.

The advantage and disadvantage of small-scale bottom longline fishery, obtained from the experimental sea-going practice.

Advantage	Disadvantage
No sea bottom pollution	It requires more bait and fuel
Easy to set and retrieve	It can cause harm to fish at the time of operation
Catch fresh fish	
No ghost fishing	
Used in different sea bottom	

Materials and costs

Mainline; Lion mark, Deep line No.42 x 500m 4kg
Hook; Mutu type circle hook No. 26 and 28. 100 Pcs.
Branch line; Nylon Monofilament No. 50/1mm dia. one coil.
Hook bin; meshed Plastic basket.
Rope for anchor; PP 3 strands Z type 4mm(dia.) × 200m
Total Estimated cost 500 USD



Recommendations

Small bottom longline fishing can operate not only during the full moon but also during stormy weather, in the shadow of islands, or in bays where the fishers can avoid the effects of wind and waves. If this fishing can be operated year-round, including during periods of the hot season. It is expected to increase the income of the fishers and improve their livelihoods by expanding fishery production and providing a stable supply of marine products to the people of Eritrea. If the fishers can keep their bait fish in cold storage at the Massawa fishing port facilities, it is likely that the small-scale bottom longline fishing will be quickly promoted.

(6) Pot Fishing

Purpose:

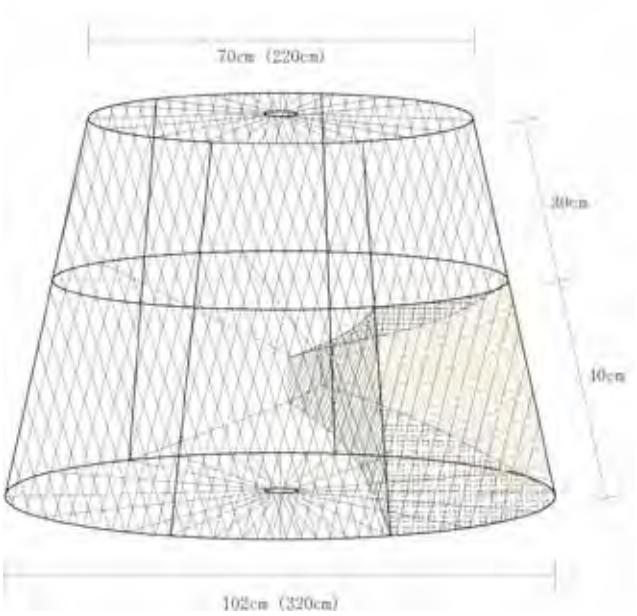
To diversify fishery technology to increase catches by promoting the development of demersal fisheries resources.

Outline:

Pot fishing (baited traps) is a fishing technology that typically has lower impacts on the natural environment than many other industrial fishing gear. Pots are transportable and typically use bait to attract target species, with retention devices to prevent escape. The benefits of using pots include lower by-catch rates, minimal impact on marine habitats, and a reduced contribution to ghost fishing (when constructed with biodegradable twine) compared to gill-nets. The benefits also include easy operation, high efficiency catch and low costs. Pots have also been classified as Low Impact and Fuel Efficient (LIFE) gear because they require less fuel to catch fish than other fishing gear. In the FSPAC project, the results of the at-sea surveys using two types of pot fishing gear demonstrated that good gear selection can reduce gear damage and allow for efficient fishing in coral reef areas.

Materials per set:

For frame making; Iron rode 8mm 12meter length
Net; PE English knot * 43.3 mm
Total estimated cost: 75 USD



Recommendations

This fishery is easy for even small-scale fishers to engage in, and will be effective in developing a variety of fisheries in the future. In addition, the pots constructed by MMR are designed to be stacked onboard and occupy little space.

In the future, it is expected that appropriate information will be collected through test operations of the pot fishing gear in order to promote the pot fishing industry.

5-3 Development Tools for Subsistence Fisheries

(1) Pound net

Purpose:

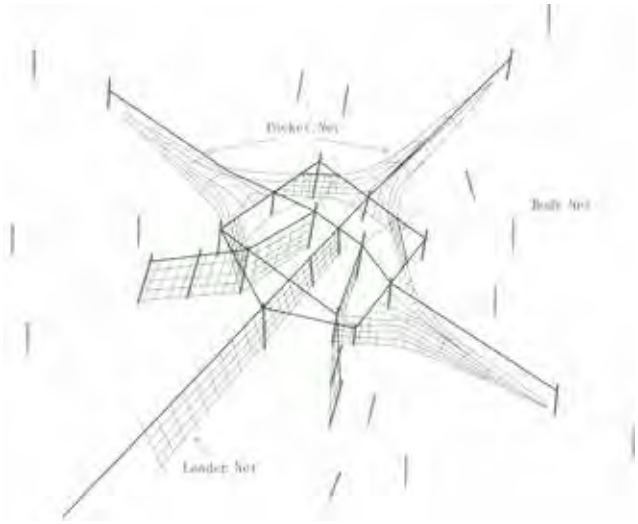
To increase catches of Subsistence Fisheries by making efficient use of shallow-water resources that can be operated on foot for fishers who do not own fishing vessels.

Outline:

Pound net is a type of small-scale setnet that is set up in shallow water areas such as mudflats and fished using the ebb and flow of the tides. The design by FSPAC project is: height of the net is 1.5 meters, the body net is 6 x 6 meters wide, the three tubular pocket nets are 1.2 metres in diameter and 4.5 metres long, and the leader net is 80 metres long. The fish caught are migratory species along the coastline, mainly indian mackerel, but also small queen fish, jackfish, guitar fish, catfish and a wide variety of other fish species. The fishing season is from May to October, excluding the hot season, but is affected by water temperature changes from year to year. While it can be set up without a fishing boat and stable catches can be expected, it also has disadvantages: it cannot be operated during the hot season because the water temperature along the coast is very high, and it also cannot be operated during strong winds and waves because the nets may be broken. Care must also be taken in the selection of the installation site, as there is a risk that if the seabed material is too soft, the piles may come loose and the nets may be washed away.

Materials and Costs:

Body nets: PE English knot. 200D/24 x 50mm x 40G x 30m
Leader nets: PE English knot, 400D/15×76mm×100G x 50
Pocket nets: PE English knot, 400D/12×43.3mm×100 x 30m
Frame rope: 8 mm/dia. x 90 m
Anchor rope: 6mm/dia. 140 m
Wood stack: 30-50 mm/dia. 2.3 m, 27 pieces
Iron tool for setting; 1800mm×35 dia.
Pocket net ring: PE pipe 8mm,
Total estimated cost: 750 USD



Recommendations

It is a very effective fishing gear in shallow coastal waters, especially on mud flats and muddy, sandy-bottomed beaches. It is suitable for fisheries development in the small-scale Subsistence Fisheries communities, as it can be set up and operated without the need for fishing vessels or major investment. However, as they are strongly affected by wind and waves, consideration should be given to the location of the installation. It is recommended that this tool should be used in conjunction with other tools such as community fisheries centers and ice machines to improve community incomes.

Preparing a business/management plan is necessary for sustainability of this tool.

(2) Coastal FAD by Artificial Seaweeds

Purpose:

To generate new fishing ground in the coastal area and increase fishing trip opportunity while improving biodiversity of the ecosystem and enhancing fisheries resources.

Outline

Coastal areas of Eritrea are sparsely wooded and have limited nutrient supply from land. In addition, there are few large seaweed beds that provide spawning and nursery grounds for marine organisms, due to the sandy and muddy bottom in coastal areas.

Artificial seaweed beds are expected to function as a spawning bed for fish and marine organisms, especially in tropical sandy coastal areas as well as fishing ground. Therefore, the FSPAC project conducted Fish Aggregating Device (FAD) development examination using artificial seaweed "C-lant" in the Hirugigo coastal area.

The preparation procedure was (1) for anchorage and basement of the c-lant belts, 15 sand bags each weighing 20kg were prepared, (2) then all sandbag were wrapped by a square mesh net using connectors and (3) finally six c-lant (artificial seaweed) were attached to every sandbag by using snaps to the square meshed net.

In the survey of the FSPAC project, a time-lapse camera was set up to take one snapshot every 10 seconds after the installation of the FAD with C-lant. Taking images using this time-lapse camera took place for a one week period every month from May to October 2022. As the result, it was shown that a number of fish schools and species were aggregated around the FAD continuously through the survey period. The main species aggregated are black-spot snapper, Indian mackerel and barracuda. Especially, black-spot snapper was dominant.

Materials

Artificial seaweeds (c-lant) (200cm*5cm) 84 pieces.
Plastic net (80cm*100cm) 15 Pieces.
Empty sand bag 15 Pieces
Connectors 84 pieces.
Cutter one piece

Recommendations

It was found that a new fishing ground for both small pelagic fish and large fish can be formed by installing artificial seaweed's FAD in relatively shallow coastal areas in Eritrea. However, in order to ensure the long-term fish aggregating effect of the FAD, it is necessary to take care (maintenance) such as cleaning the surface of C-lant. In addition, since shallow water fishing grounds are easily accessible to everyone, there is a danger of easily overfishing. For this reason, it is considered necessary to impose some restrictions, in other words, to make some limited entry system, for the sustainable use of fishing grounds. It is suggested that a community that contributed to making the fishing grounds and doing the maintenance on the FAD should have exclusive use right of the fishing grounds. According this strategy, community enhancements and stable fishery catch could be achieved.

(3) Solar ice block making machine

Purpose:

To make block ice for preserving the QUALITY of fish for distribution. The ice produced will reduce the post-harvest losses by keeping the quality of fish at sea and during transport to marketplace. This will increase the income of the fishing community.

Outline:

It makes block ice automatically using solar power and supplied water. The capacity of ice making depends on the number of batteries and solar panels but usually it is expected to make ice two to three times a day.

An example of the machine introduced by the FSPAC pilot project in Zula CFC is:

OMT DOTB10, made in China

(1) Ice block making machine: 30pcs/3hrs. Ice block size 10 x 9.5 x 50cm (4.4kg). Refrigerant HFC R404a. Max. Ambient temperature 43°C.

(2) Solar power system: Solar panel, 275W x 32 pcs. Battery, 12v150AH x 16 pcs. MPPT controller, 100A/96V, input 145V-200VDC. Three-phase inverter, 30KW DC96V AC380V 50Hz.

(3) Installed in Zula Community Fishery Center (CFC).

Cost: ($26,875: (1) Ice block making machine set, $8,844, (2) Solar system set, $18,031

32 pcs of solar panels installed and fenced in Zula CFC

Water cooling tower for condenser cooling, and water tank (2m²) and tower

Inverter and 16 pcs of solar batteries

Ice Block Making Machine in Zula CFC

Ice blocks came out of the machine

Ice blocks ready for distribution

Recommendations

- Operational in coastal villages that are not connected to the power grid.
- Modern ice block making machine produces 60pcs 264kg (average) per day (7 hour, 2 batch).
- Simple structure, without use of brine water for cooling.
- Solar system is specifically designed for the Eritrean coastal area to operate the ice machine in 43°C max. ambient temperature.
- Preparing a business/management plan is necessary for sustainability of this tool.

(4) Solar ice making chest freezer

Purpose:

To make ice for preserving the QUALITY of fish for distribution. The ice produced will reduce the postharvest losses by keeping the quality of fish at sea and during transport to marketplace and make it possible to store the remaining fish from initial sale to the next market day. This will increase the income of the fishing community.

Outline:

The refrigerator uses solar power to make ice in plastic containers. It has a more simple structure, utilization and installation than ice block making machine. The costs of procurement and maintenance are also low.

An example, the solar chest freezer installed by FSPAC pilot project in Hirgigo are;

FREECOLD RCSI410L complete kit, made in France, (maker was liquidated)

(1) Chest Freezer: Capacity 410L. Type SN-T (10°C - 43°C). 800W/h. Refrigerant R134a. Size 88 x 156 x 71cm. Uses plastic container (1.9L/pc) with lid to form ice.

(2) Solar power system: Solar panel, 330W x 2pcs. Solar battery, AGM 210Ah x 2pcs (EU origin). MPPT Controller. Mount frame set.

(3) Installed in Hirgigo Community Fishery Center (CFC).

Cost: $2,920-: (1) + (2)

Chest freezers installed in Hirgigo CFC

Solar panels and water tank installed in Hirgigo CFC

Installation of MPPT controller and batteries

Pouring water into plastic containers for ice making

Plastic containers with water piled in the chest freezer

Recommendations

- Operational in coastal villages that are not connected to the power grid .
- Simple operation and maintenance, and easy to make ice.
- Possible to make ice in hot coastal areas with max. ambient temperature of 43°C.
- Freezer is convertible into refrigerator.
- Preparing a business/management plan is necessary for sustainability of this tool.

(5) Solar chest freezer

Purpose:

To STORE harvested fish for optimum timing of distribution. This keeps the fresh fish cool and freezes fish to reduce the post-harvest losses of caught fish and increase the income of the fishing community.

Outline:

The solar chest freezer uses solar power to store fish in as good quality as fresh or frozen fish.

An example, the solar chest freezers installed by the FSPAC pilot project in Hirgigo and Zula are;

FREECOLD RCSI410L complete kit, made in France, (same equipment used for ice making in Hirgigo CFC).

(1) Chest Freezer: Capacity 410L. Type SN-T (10°C - 43°C). 800W/h. Refrigerant R134a. Size 88 x 156 x 71cm. Use plastic container (1.9L/pc) with lid to form ice.

(2) Solar power system: Solar panel, 330W x 2pcs. Solar battery, AGM 210Ah x 2pcs (EU origin). MPPT Controller. Mount frame set.

(3) Installed in Hirgigo and Zula Community Fishery Center (CFC).

Cost: $2,920-: (1) + (2)

Chest freezer installed in Zula CFC to store fish

3 Chest freezers Installed in Hirgigo CFC, one is for fish storage and the rest are for ice making

Solar panels installed in Zula CFC

Solar panels installed in Hirgigo CFC

Recommendations

- Freeze and store fish after harvesting for optimum distribution, i.e. cumulate harvests and distribute at community market days.
- Operational in coastal villages that are not connected to the power grid.
- Possible to operate in hot coastal areas with max. ambient temperature of 43°C.
- Convertible into refrigerator.
- Preparing a business/management plan is necessary for sustainability of this tool.

(6) Cooler box

Purpose:

To TRANSPORT harvested fish for distribution. This will help the fishers to transport ice to the sea and to store and transport the fish from the sea to the CFC and to the marketplace while keeping the quality of the fish good. This helps to sell the fish that was thrown out before and increase fishers' income.

Outline:

Cooler boxes are used to store fish for a prolonged time with good quality and to store ice taken out to sea while keeping the ice from being melted.

An example, the cooler box supplied by FSPAC pilot project in Hirgigo and Zula are;

Coleman, made in USA, Polylight 48QT. Polypropylene. Capacity 45L. Ice retention 3 days. Size 63 x 33 x 39.5cm. Weight 4.1kg.

Coleman Cooler Box, out view

Coleman Cooler Box, lid opened (45 liter)

Cooler Box delivered to Hirgigo Cooperative (total 9 pcs)

Cooler Box delivered to Zula Cooperative, covered with hand-made hemp jute cloth for protection (total 9 pcs)

Recommendations

- High cold retention (ice for 3 days) and easy to carry (weight 4.1 kg).
- Inside space accommodates Zula block ice (L=50cm).
- Use for fish transport together with ice, to preserve quality and prolong the shelf life of fish.

(7) Fish meat bone separator

Purpose:

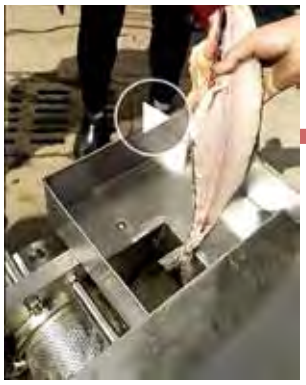
To extract and collect the fish meat by separating the fish skin, bones and fins. This will solve the problem of eating fish with bones, which is not preferred by the people. Cooperative members will consume all of the small size fishes which have small bones by producing fish paste. The produced fish paste will allow the cooperative members to prepare value-added products such as fish cake, fish balls and fish hamburger to increase their income.

Outline:

It separates the fish meat from skin and bones easier and more quickly than by manual separation. Therefore, it is suitable for making fish paste as materials of fish meat products for mass production.

An example, the fish meat bone separator installed by the FSPAC pilot project in Hirgigo is;

Luohe QT-A11, made in China. Capacity 180kg/h. Voltage 220V. Power consumption 2.2kw. Belt; thickness 20mm, length 1450mm. Cylinder; diameter 219mm, length 300mm, thickness 8mm. Mesh diameter 3.4mm. Size 80 x 55 x 80cm. Weight 180kg. Stainless steel. Delivered to MMR and Hirgigo Cooperative. Amount of meat harvested can reach 90%.



Fish meat separated

Processing side view, Meat outlet (front) & Bone outlet (right)

Back side of machinev

Recommendations

- Easy to obtain fish flesh to make fish meat balls and other products.
- Whole machine made of anti-corrosive stainless steel.
- Improve the utilization rate of raw materials and save labor cost.

(8) Fish meat mincer

Purpose:

To mince the fish flesh. This will help the cooperative members to prepare different value-added fish products to increase their income.

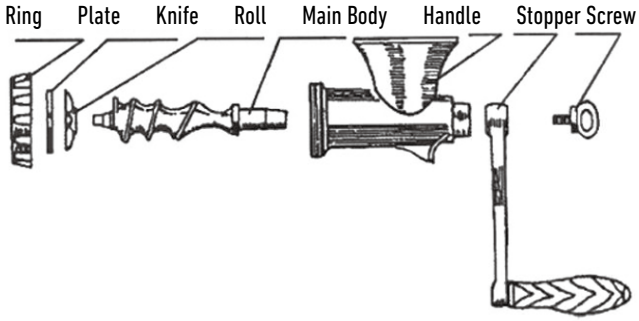
Outline:

It is used to prepare minced fish meat manually. Installation and maintenance are easier than the meat bone separator. The procurement and maintenance costs are also low.

An example, the Meat Mincer installed by FSPAC pilot project in Hirgigo is:

Meat Mincer/Chopper MT-32. Size 32 x 16 x 20.1cm. Weight 8kg. Mesh diameter 4-5mm. Stainless steel & wood (handle). Delivered to Hirgigvo and Zula Cooperatives.

Cost: $130-



Meat Mincer MT-32

Recommendations

- Easy to mince fish flesh to make fish meat balls and other products.
- Operational without electricity, good in rural setting.
- Simple operation and maintenance, easy to dismantle and wash.

(9) Fish dryer

Purpose:

To dry fresh fish for preservation and to prepare different value-added fish products such as fish powder and fish sauce. This will help the community to prepare dry fish which can be stored for a long period of time and prepare fish powder which is important to fight malnutrition and increase their income.

Outline:

Fish driers can be prepared in different shape and size to dry fish. The fish dryer supplied to Hirgigo and Zula by FSPAC project is Cabinet dryer, made by MMR Engineering Division. Wood frames with 4 shelves. Covered with mesh for good ventilation and protection from insect attack. Size 1.0 x 1.0 x 1.2m. Delivered to Hirgigo and Zula Cooperatives.

Cost: $400-

Cabinet dryer, front view

Surface of dryer shelf

Drying fish

Dried fish products

Recommendations

- The most efficient dryer among 6 types tested by MMR.
- Simple to manufacture with locally available materials.
- Easy to transport and install in any place.

(10) Fish smoker

Purpose:

To smoke fresh fish for preservation and to add flavour to fish to make value-added products. This will help the cooperative members to produce marketable smoked products and increase their income.

Outline:

Smoking kiln is prepared from different materials and in different designs to smoke fish for preservation and value addition. The smoking kiln given to the cooperatives in Hirgigo and Zula by FSPAC project is a full size drum can smoker, made by MMR Engineering Division. It is a drum can with Injera lid. It has removable 3-layered metal mesh shelves inside. Delivered to Hirgigo and Zula Cooperatives.

Cost: $100-

Fish smoker, outer view

Inside view of smoker

Smoked wood at the bottom of smoker

Harvesting smoked fish

Smoked fish products

Recommendations

- Use well-dried wood for making smoke which should be white and thin, and kept for 3 hours.
- Simple to manufacture with locally available materials.
- Easy to transport and install in any place.

(11) Community Fishery Center (Type 1)

Purpose:

To provide places for ice making, fish processing and selling, storing materials and community meetings. This will give the community the chance to work together and produce a source of income.

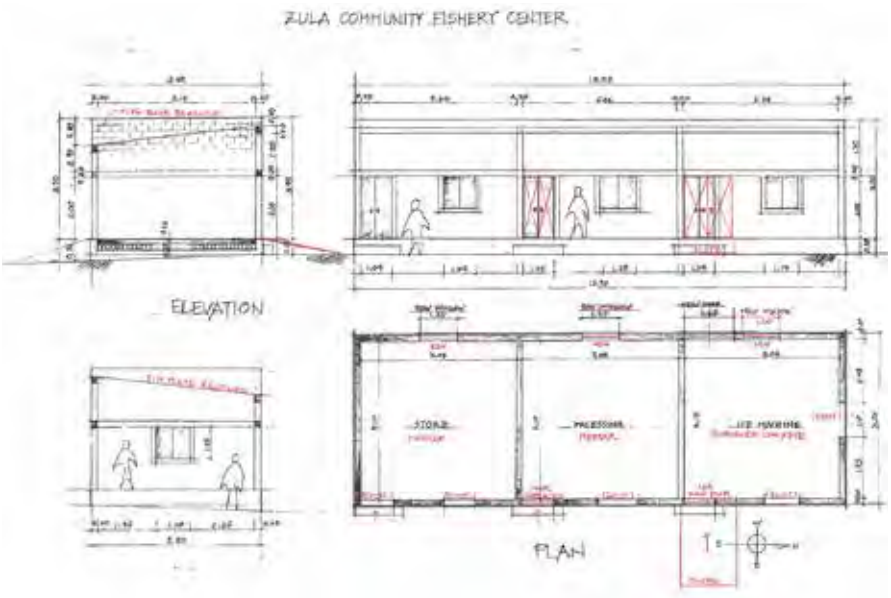
Outline:

The Community Fishery Center (CFC) is a place where people can process and sell fish in a central place. The CFC Type 1 that was built in Zula under the pilot project of the FSPAC project is a renovated existing building (former Arabic school). It has an installed ice making machine, fish storage freezer, water supply system. It has working space (44m2) for fish processing, training, workshop, accommodation, storage of equipment.

Cost: $10,215-

Zula CFC. Roof, windows and doors were renovated

East-south side view



Renovation plan

3 new windows installed in the west side

Recommendations

- Place to be a hub of fishery activities in the community.
- Place to foster the vitality which nurtures and expands fishery activities.
- Place to foster the community's ownership of fishery development activities though cooperative works and meetings for decision making.
- Preparing a business/management plan is necessary for sustainability of this tool.

(12) Community Fishery Center (Type 2)

Purpose:

To provide places for ice making, fish processing and selling, storing materials and community meetings. This will give the community the chance to work together and produce a source of income.

Outline:

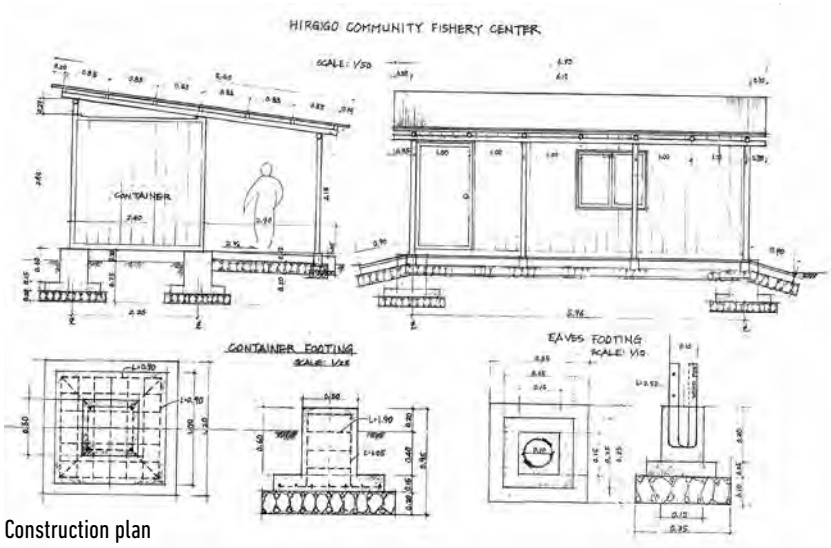
Community Fishery Center (CFC) is a place where people can process and sale fish in a central place. The CFC Type 2 that built in Hirgigo under the pilot project of the FSPAC project is an installed modified 20 feet container with a door, windows, roof, eaves and water supply. It has work space (27m2) for ice making, fish processing, training, workshops and storage of equipment.

Cost: $11,792-

Hirgigo CFC. Modified container house with windows, door and roof

Front view. Entrance and working space

Installing modified container

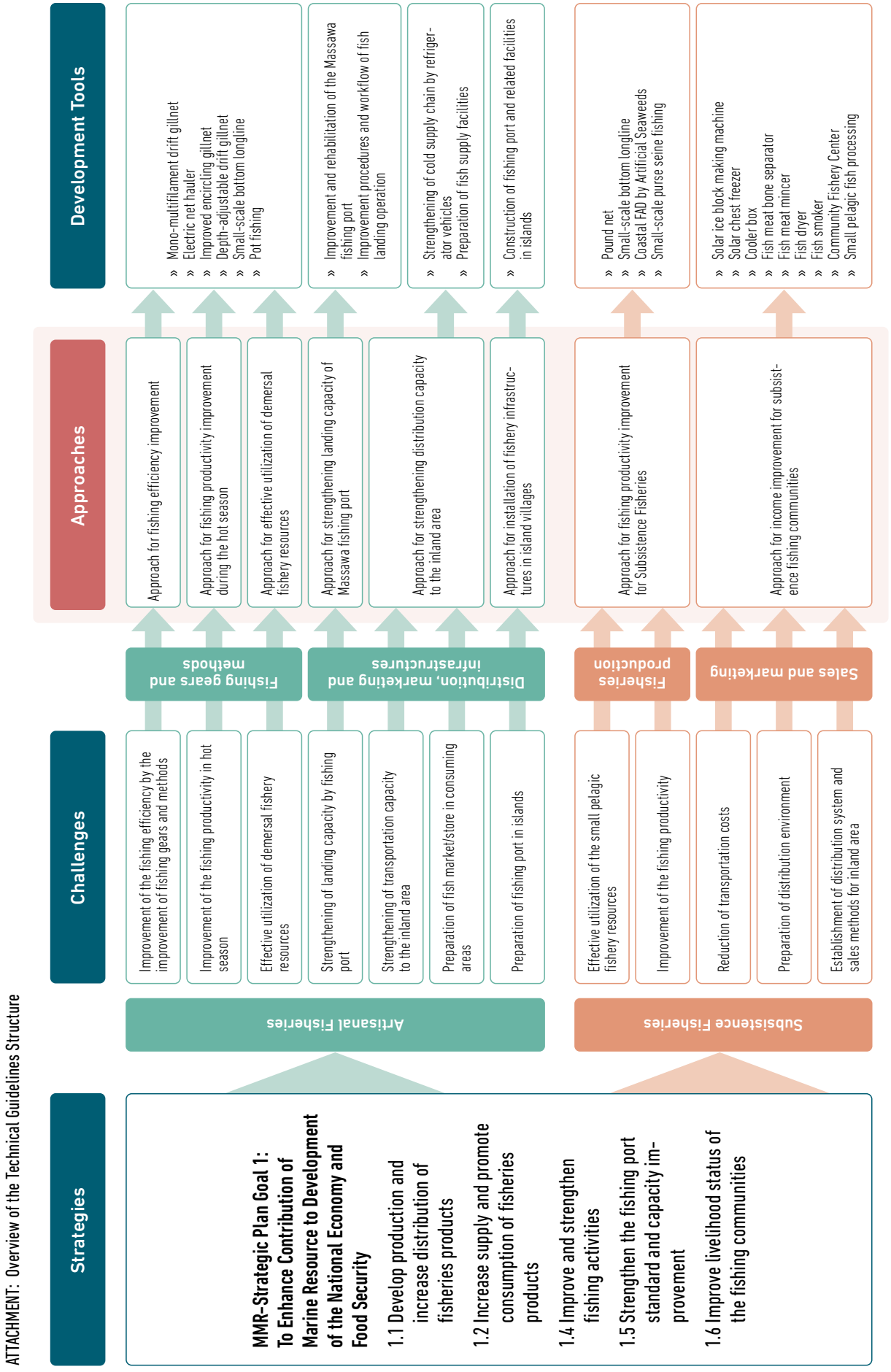


Construction plan

Recommendations

- Place to be a hub of fishery activities in the community.
- Place to foster the vitality which nurtures and expands fishery activities.
- Place to foster the community's ownership of fishery development activities though cooperative works and meetings for decision making.
- Preparing a business/management plan is necessary for sustainability of this tool.

ATTACHMENT: Overview of the Technical Guidelines Structure



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Ministry of Marine Resources
The State of Eritrea

2023

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