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SEA CUCUMBER FARMING

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AUDIENCE: CONSERVATION FIELD AGENTS

INDIAN OCEAN COMMUNITY CONSERVATION HANDBOOKS

MacArthur Foundation
Sida
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Velondriake

Although there are between 20-30 commercially valuable sea cucumber species, here in the Western Indian Ocean only a few have the potential to be raised in an aquaculture project. The most common species for which hatchery technology exists is the sandfish, *Holothuria scabra*. This species is one of the most valuable in the market place and inhabits shallow, near shore environments in tropical climates.

Community-based sea cucumber farming has the potential to improve the livelihoods of traditional fishers through the generation of additional income. However, it can also potentially improve wild stocks of sea cucumbers by reducing fishing pressure and increasing wild juvenile production through the creation of protected breeding aggregations.

How to use this handbook

This book is intended as a guide and reference for community field agents and community members who are involved in community sea cucumber farming. It should be noted that a prerequisite to sea cucumber farming is access to juvenile sea cucumbers from a hatchery. Hatcheries are expensive to construct and operate and currently present too many challenges for community management. Communities will need to partner with a hatchery (government, university, or private) before beginning the project.

Once a source for juveniles has been found, this handbook should facilitate the training of conservation field agents as sea cucumber farming technicians and help to train community members in farming techniques. Importantly, the attached comic should allow community members to envision the end goal of the project and understand more clearly the kind of time and energy that are required to reach that goal.

Suitable habitat for sea cucumber aquaculture

The following characteristics are important to consider when assessing the feasibility of a site for sea cucumber aquaculture.

- Intertidal zone of depth 2-3 metres at highest tide and 10 cm at lowest tide
- Presence of seagrass beds and proximity to mangroves
- Deep substrate (layer of sand and mud) of at least 25 - 30 cm to permit building of pens
- Fine sediment that is a mix of mud and sand and rich in organic matter
- Situated away from fresh water sources which may cause a decrease in salinity during the rainy season
- Sheltered area with minimal wave action and no strong currents

Instructions for sea cucumber farming

Presented below is an overview of the various steps involved in organising community-based sea cucumber farming.

Site selection

Preliminary site identification can be done from maps and satellite images to identify sites that fulfil the above habitat criteria. However, in the field, it is important to incorporate traditional ecological knowledge to identify areas that support *Holothuria scabra* and ensure that local communities fully participate in site selection. The use of specific intertidal zones exclusively for aquaculture may cause resource use conflicts and loss of fishing grounds. For this reason public consultation and community participation in decision making is very important, starting from the initial stages of the project.

The first step is to assemble an informal site selection team that includes the village leaders and those people most knowledgeable about and/or most dependent on sea cucumbers. The team should work with the technicians to find a place that best matches the criteria set out in the *Suitable habitat* section. When appropriate sites have been selected and confirmed by a technician, maps should be made of the area including approximate measurements to determine how many pens can be placed in the area. Each pen, if measuring 25 m x 25 m, will take up approximately 625 m^2 and so depending on whether pens are constructed in series or individually, between 10-16 pens can be placed per hectare. Considerations should also be made for passage of boats. Due to the risk of theft, most communities decide to limit access to aquaculture areas to those people tending to the project. Sites should therefore not be placed in high traffic areas if possible.

Family selection

Once a potential site has been determined, a community meeting should be held. The technician and community facilitators should explain thoroughly the sea cucumber aquaculture process from start to end and give realistic expectations of the results the project may produce in the coming year, three years and ten years. The commitments that will be needed from each villager and each participant in the project need to be explained very clearly. Those not participating in the project will still need to approve of the project's presence as they will need to give up access to aquaculture sites for fishing, gleaning, and as passage for their boats. A schedule of the project should be developed with a few families starting on a trial basis. Later, more families can be added and possibly some original families replaced if they do not fulfil their commitments to the project. The community should select the families, with the technician simply facilitating the discussion. It is important that all voices are heard in this discussion and that decisions are not rushed. After the

initial families have been selected, individual interviews should be conducted with each team member and finally with the whole team to ensure full understanding and participation of all members; the attached comic can be used to explain the kind of work that will be required to succeed with the project. Role playing and scenario-based approaches are useful at this stage. Once the final families have been selected, a contract should be drawn up between the relevant parties which clearly explains the roles, responsibilities and actions taken by each party throughout the course of the project.

Training

The training of the first families should be open to anyone who would like to participate, not simply the families who will pilot the project. The aquaculture process should be explained, using pictures, diagrams and stories of previous projects. Written or oral tests (depending on education levels of the trainees) should be administered to check understanding. It is very important that everyone in the family attends the training and that everyone understands the process and the actions to be done. It is better to delay the project than to proceed on-schedule without the understanding and buy-in of all participants. Some families may not be able or willing to invest in the necessary time in the project training. These families should be warned early and then removed from the project if they don't live up to their commitments.

Pens

Pens should be constructed from locally available nylon fishing nets (maximum mesh size 10 mm), rope and wooden stakes. Alternatively, plastic mesh that has been treated for UV is a better option and is better value for money in the long term given its longer life-span. Families should be responsible for collecting the wood needed for the stakes and the project should bulk buy materials. The pens should be assembled on-shore two to three days before the spring tide and installed at the pre-determined sites during the spring low tide. The net should be buried at least 25 cm deep in the sediment and the height of the net should be at least 50 cm to prevent the sea cucumbers being swept out in periods of bad weather. Therefore the total height of the net will be 75 cm. It is essential that the pens are well constructed and sturdy enough to withstand bad weather. The netting should be checked for holes and weak points where sea cucumbers could get out or predators such as crabs could get in.

Delivery of juveniles

Before the delivery of the juvenile sea cucumbers from the hatchery, the pens should be checked one last time for holes and for the presence of crabs or other predators. While the juveniles are in transport, they must be kept in cool, clean seawater and shaded to avoid increases in temperature. The seawater should be renewed regularly (every two to three hours) in order to ensure

it is oxygenated and cool. The total duration of transport should not exceed 24 hours. In general, juveniles are hardy for transport at a size of 15 g, however it is normal that a few juveniles will die from the stress of transport. It is very important for communities to be ready for the delivery. As soon as the juveniles arrive, communities should be present, ready to receive their juveniles in large plastic containers filled with fresh seawater. It is important to wait for the right conditions to transfer juveniles to the pens. It is preferable to do this during neap tides, on a slack low tide at night to coincide with the daily burrowing behaviour of sea cucumbers. If the tide is too high, or there is a strong current, leave the juveniles in the containers filled with fresh seawater and wait a few hours for the conditions to improve.

Juveniles should be placed directly on the substrate one by one with the white ventral surface facing down to ensure they will not float and minimise the risk of them being swept out of the pens. The juveniles should be handled carefully to avoid damage to the skin which may lead to evisceration or lesions which may cause mortality later on. The families should record the exact number of juveniles, so that accurate records of the stock are kept. Over the first four days, the pens should be surveyed daily to collect mortality data, remove predators and update stock records. In areas close to mangrove swamps, crabs can cause huge mortalities in the first few weeks. If predation is a problem, it may be necessary to protect the juveniles in covered enclosures until they reach a larger size of 50 g.

Stocking densities and grow-out periods

Initially sea cucumbers can be stocked at higher densities, however they will need to be thinned later to ensure they have enough space and food to grow. As a general rule, stocking densities should not exceed 250 g per square metre, otherwise growth may slow or stop completely. Growth rates are strongly linked to seasonal variations in water temperature and so growth to market size of 350 g can take between six to twelve months, depending on the season and site quality.

Pen maintenance and surveillance

Every day, during spring low tides, pens should be checked for the presence of predators, holes in the nets and the sturdiness of the wooden stakes. Each spring tide, a thorough cleaning of the pens, especially the removal of algae from the pens must be carried out to maintain good water exchange. Failure to check the pens regularly will result in a high loss of sea cucumbers. Often if a hole is discovered quickly, many of the escaped sea cucumbers can be found easily near the pen. A single crab can eat as many as five sea cucumbers a day if left unchecked; a few crabs can destroy the entire pen population in only a few days. If a family fails to check and maintain their pens, they should be warned and then removed from the project. Notebooks can be given to each family so they can record

all of the activities they have completed in simple tables.

Once the sea cucumbers have reached an average size of 150 g, they will be at risk from theft. As the harvest date approaches, this risk will grow exponentially. In order to protect against theft, the community must develop a night watch system whereby everyone participates in the guarding of the pens during both spring and neap tides. A guard platform near the pens can be constructed in the water to allow night watchmen to sleep without risk of missing the theft. Alternatively, pens can be watched from shore. Watchmen teams need to include members from several families to avoid the temptation of theft from the guards themselves. The village and the technician must take the night watch programme seriously. A local convention should be developed to fine anyone who shirks their responsibilities. The local convention should also provide strong penalties for those who steal sea cucumbers. See the appendix for an example local convention (*Dina*) from the Velondriake Locally-Managed Marine Area (LMMA) in southwest Madagascar.

Monitoring

Each month every family should count and weigh all of the sea cucumbers in the pen. This allows families to monitor their progress and identify any problems. As the sea cucumbers reach maturity, these numbers will be critical for the families to know how many they have to sell.

When a substantial portion of the sea cucumbers reach a size of 350 g they are ready to be sold. The results of each monthly monitoring should be communicated to the buyer as soon as they are collected to allow them to schedule a delivery and predict how many sea cucumbers will be purchased. For two nights before the sale, all the sea cucumbers above 350 g should be gathered from the pens and placed in a container within the pen. Any sea cucumbers which have not yet reached 350 g should remain in the pens as they are not ready to be purchased at this time.

When the buyer arrives, each family should already know the number of sea cucumbers they have for sale. The technicians or buyer will weigh each sea cucumber, reject any that are undersize and prepare the bills of sale.

Financial management

In order to reach the overarching goals of the project, to improve livelihoods and decrease overfishing pressure, the added income from the project needs to be invested by the families in ways that improve their medium and long-term well being. Financial training must be given to the families to ensure that some of the profits are re-invested in the maintenance and expansion of the project (repair and expansion of pens) and also invested in things such as children's education, less destructive fishing equipment, and livestock. Financial training should encourage families to be more explicit about their financial spending decisions and priorities while also being more inclusive of all family members, especially women and

children. Monitoring of the use of profits should be carried out by technicians to ensure that families are using their profits in ways that meet the goals of the project. Support should be withdrawn from families that disregard the financial training, especially if they fail to include all family members in decisions about how to spend the money.

Appendix

Local conventions or *Dina*

Local conventions or *Dina* (as known in Madagascar) empower local communities to make and enforce their own rules. This allows for self-regulation without the need for police officers, courts or government bureaucrats, which is much cheaper and more effective (see handbook 4). Local conventions should be certified by local government officials and the courts in order to give them a back-up mechanism in case community members refuse to pay fines. As an example, the aquaculture-related *Dina* for the Velondriake LMMA of Madagascar are given below.

LOCAL CONVENTIONS (*Dina*)	FINES
1. It is forbidden to pass through the aquaculture zone at low tide.	50,000 Ariary per person.
2. It is forbidden for people to enter the water when passing through the aquaculture at high tide, pirogues may pass through, however they cannot stop or anchor in the area.	
3. It is forbidden to take or steal sea cucumbers from the aquaculture area.	Pay the owner of lost sea cucumbers the full price of the loss plus 100,000 Ariary and sacrifice a goat to the village elders.

Sea Cucumber Farming

INDIAN OCEAN COMMUNITY CONSERVATION HANDBOOK 7

SEA CUCUMBER FARMING

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Velondriake

SEA CUCUMBER FARMING STARTS WITH A MEETING WITH THE SUPPORT ORGANISATION. AT THIS MEETING THE COMMUNITY WILL LEARN ABOUT SEA CUCUMBER FARMING AND DECIDE WHETHER TO START A PROJECT OR NOT.

IF YOUR FAMILY DECIDES TO JOIN THE PROJECT, EVERYONE WILL NEED TO TAKE PART. YOU WILL NEED TO COLLECT WOOD POLES AND SEW NETS TO MAKE THE PEN.

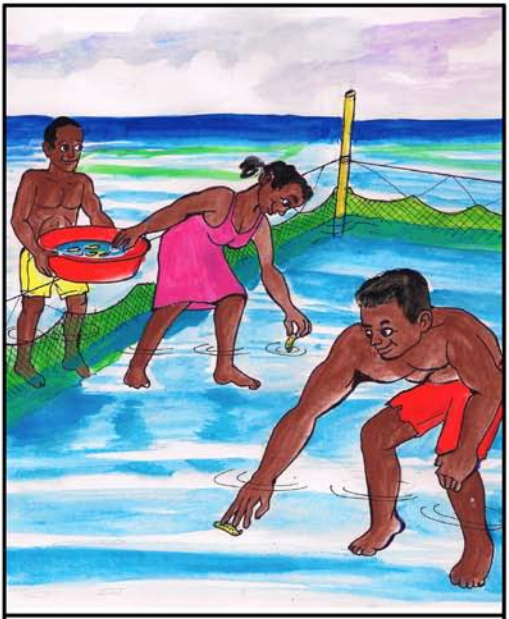
BUILD PENS IN A SHALLOW AREA THAT HAS AT LEAST 10 CM OF WATER AT LOWEST TIDE AND 2-3 METRES AT HIGHEST TIDE. THE SUBSTRATE SHOULD BE SAND AND MUD. AREAS WITH MANY NATURALLY OCCURING SEA CUCUMBERS ARE BEST. INSTALL THE NETS AT LOW TIDE ON A SPRING TIDE.

BEFORE THE JUVENILES ARRIVE FROM THE HATCHERY, CHECK THE NETS FOR ANY HOLES OR DAMAGE. SEA CUCUMBERS CAN QUICKLY ESCAPE IF THE NETS AREN'T WELL CONSTRUCTED.

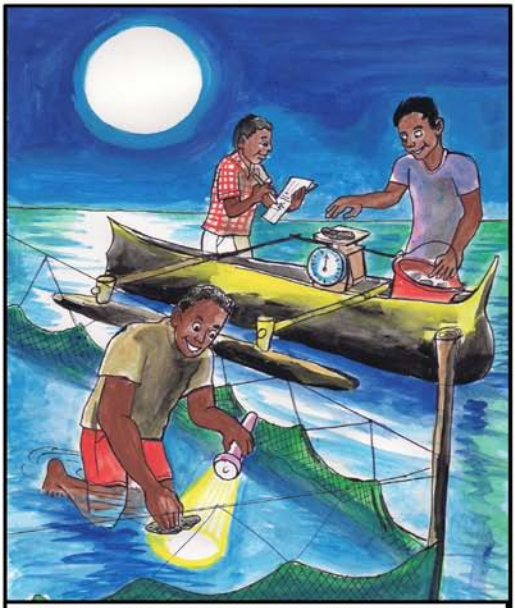
THE JUVENILES WILL ARRIVE BY BOAT OR TRUCK. YOU NEED TO ACT QUICKLY TO GET THEM IN THE PENS AS SOON AS POSSIBLE. THE JUVENILES ARE FRAGILE AND DON'T LIKE TO BE MOVED AROUND OR HANDLED.

GENTLY MOVE JUVENILES FROM CONTAINERS ON THE BOAT TO YOUR CONTAINER.

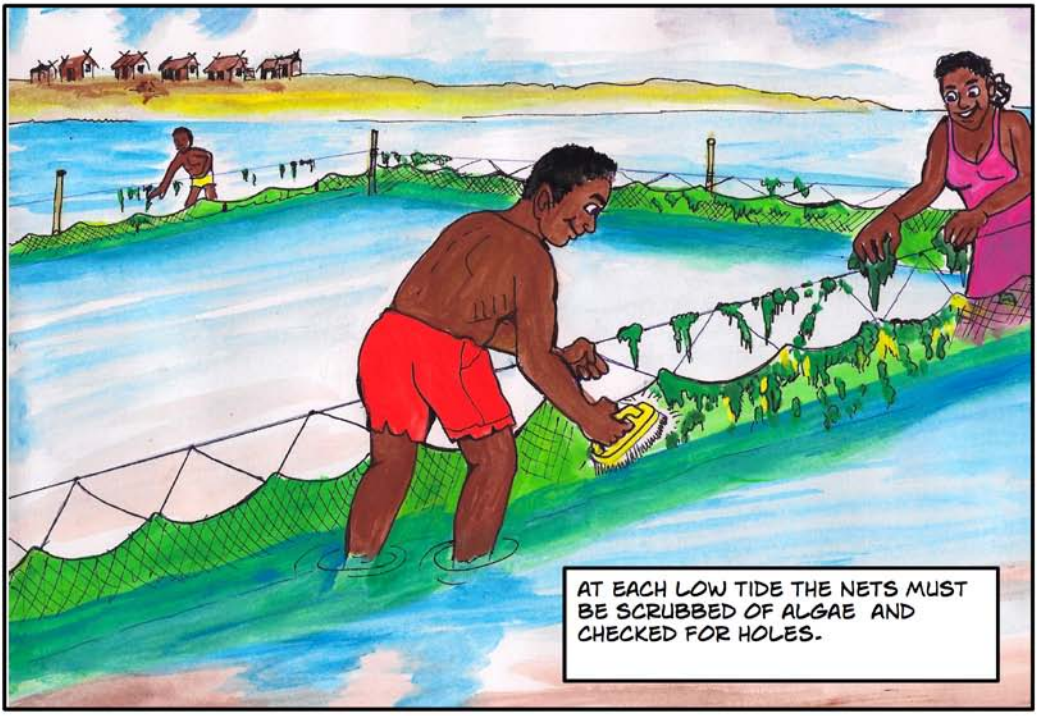
ADD SEA WATER EVERY 15 MINUTES UNTIL THE SEA CUCUMBERS REACH THE PENS.



GENTLY PLACE EACH SEA CUCUMBER IN THE PEN ONE BY ONE. BE SURE TO PLACE THEM ON THEIR STOMACHS AND TO SPREAD THEM OUT OVER THE AREA.



YOU'LL NEED TO SURVEY THE SEA CUCUMBERS EVERY NIGHT FOR THE FIRST WEEK TO MAKE SURE THEY ARE GROWING AND TO REMOVE ANY PREDATORS LIKE CRABS.



AT EACH LOW TIDE THE NETS MUST BE SCRUBBED OF ALGAE AND CHECKED FOR HOLES.

CRABS CAN EAT SEVERAL JUVENILES A DAY, CHECK FOR THEM OFTEN.

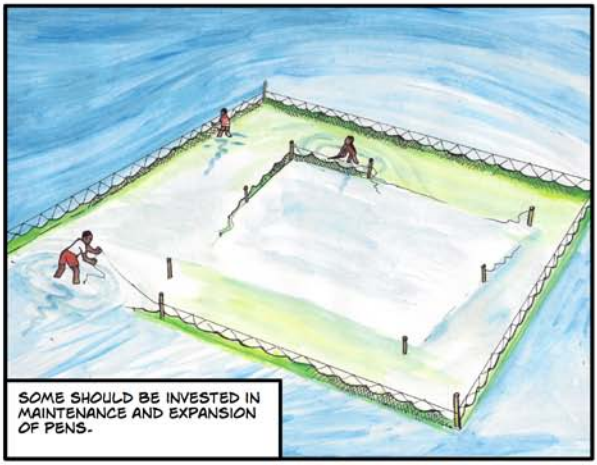
THEFT IS ALSO A MAJOR PROBLEM. A GUARD ROTATION SHOULD BE PUT IN PLACE FOR EVERY NIGHT AND A LOCAL LAW (*DINA*) SHOULD BE PASSED.

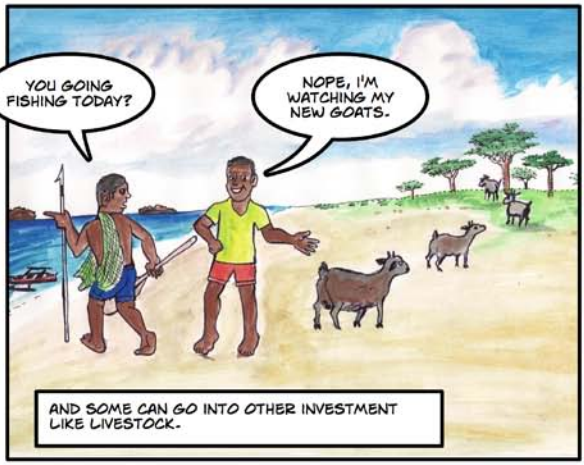
EVERYONE SHOULD TAKE PART IN THE NIGHT WATCH. ANYONE WHO FAILS TO PARTICIPATE SHOULD BE FINED. SEA CUCUMBERS ARE VALUABLE AND THE RISK OF THEFT SHOULD NOT BE UNDERESTIMATED.

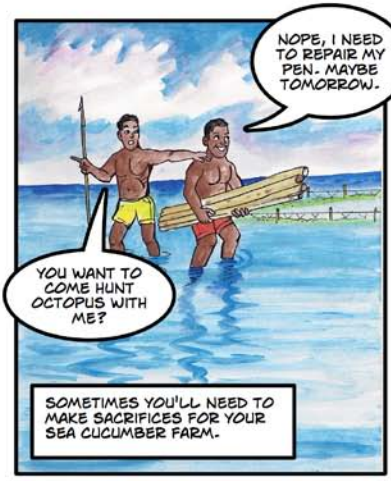
WHEN YOU CATCH SOMEONE, BE FAIR BUT ENFORCE THE FINE. IF YOU DON'T DETER THEFT, THE PROJECT WON'T SUCCEED.

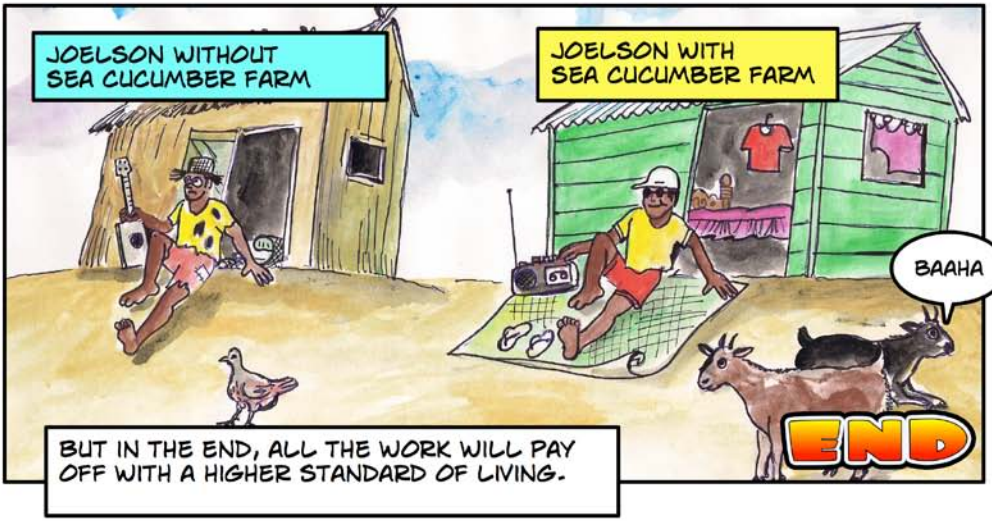
AFTER 9 – 12 MONTHS, DEPENDING ON CONDITIONS, YOU WILL BE READY TO SELL YOUR SEA CUCUMBERS. ALL CUCUMBERS OVER 350 GRAMS CAN BE SOLD.


YOU SHOULDN'T SPEND ALL THE MONEY IMMEDIATELY. YOU SHOULD INVEST SOME OF IT. EVERYONE SHOULD PARTICIPATE IN THE DECISION-MAKING.


SOME SHOULD BE INVESTED IN MAINTENANCE AND EXPANSION OF PENS.


YOU GOING FISHING TODAY?
NOPE, I'M WATCHING MY NEW GOATS.
AND SOME CAN GO INTO OTHER INVESTMENT LIKE LIVESTOCK.


NOPE, I NEED TO REPAIR MY PEN. MAYBE TOMORROW.
YOU WANT TO COME HUNT OCTOPUS WITH ME?
SOMETIMES YOU'LL NEED TO MAKE SACRIFICES FOR YOUR SEA CUCUMBER FARM.


JOELSON WITHOUT SEA CUCUMBER FARM
JOELSON WITH SEA CUCUMBER FARM
BAAHA
END
BUT IN THE END, ALL THE WORK WILL PAY OFF WITH A HIGHER STANDARD OF LIVING.

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