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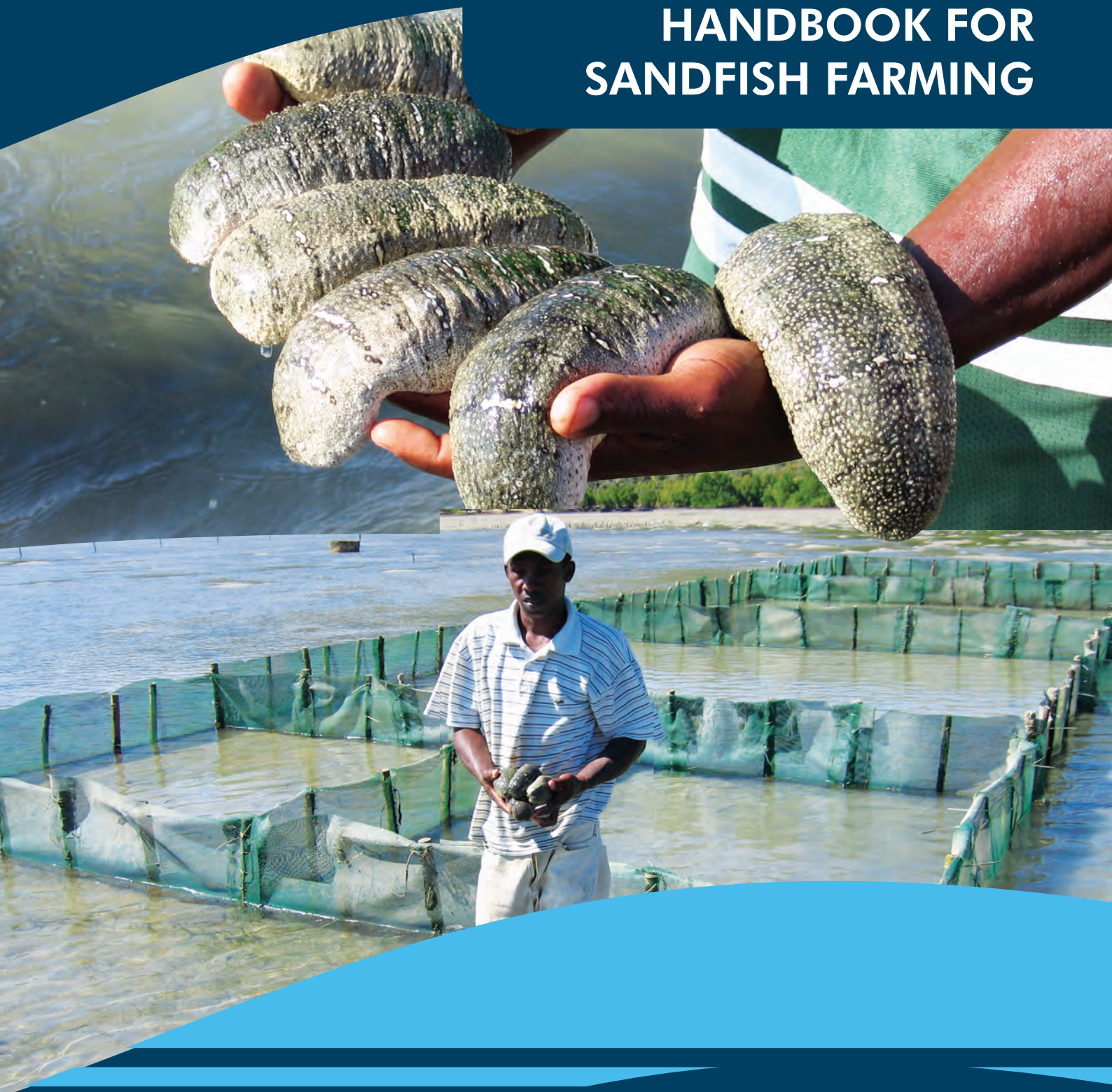
HANDBOOK FOR SANDFISH FARMING



HANDBOOK FOR SANDFISH FARMING

PREFACE

This handbook aims to disseminate the approach employed by project partners, in a ReCoMaP funded project, to develop sea cucumber farming as an alternative livelihood for vezo fishers, a marginalised coastal population, in south-west Madagascar. It is designed to raise awareness, among future stakeholders, of the factors that can affect the viability of the activity.

Background

In Madagascar, a technique for the in vitro reproduction of sandfish, Holothuria scabra, was developed during the pioneering work of the Aqua-Lab, a university cooperation project involving two Belgian universities (ULB and UMSH) and a Malagasy university (IH.SM). In 2009/2010, a small production unit (hatchery and nursery) allowed the spin-off company, Madagascar Holothurie SA (MH.SA), to utilise their patent-protected spawning technique to produce approximately 60,000 juveniles per year. At the time of writing, construction is underway for a 20-fold increase in production, which is expected to achieve significant economies of scale. Furthermore, a number of other countries are now interested in utilising this technology to develop sandfish farming along their coastlines.

For private companies, such as MH.SA, two options are available for the grow-out of hatchery-reared juveniles to market size. The first option is the development of private farms managed by the company or their business partners. The second option however, which is described in this handbook, is to work with coastal communities to develop sea cucumber farming as an alternative livelihood. In the case study of Madagascar, the private company sells sandfish juveniles to families, who rear them to market size in sea pens constructed in areas adjacent to their village. Once the sea cucumbers reach market size, they are harvested and sold back to the company for processing and export.

Two NGO's working in south-west Madagascar (Trans-Mad-Développement and Blue Ventures) received funding from the Regional Programme for the Sustainable Management of Coastal Zones of the Indian Ocean (IOC-EU-ReCoMaP) to develop sea cucumber farming as an alternative livelihood. Their role has been to develop and test effective mechanisms to support the creation of a network of small-scale mariculture units, which are both economically viable for farmers and productive enough to sustain a business partnership with the private company.

The manual is organised into three sections:

Section 1: A guide for operators including technical details and recommendations on:

A) The farming system promoted
B) The role of farmers and the tasks involved
C) The importance of technical and organisational support
D) The key steps to develop community-based mariculture

Section 2: Factsheets on key aspects of sea cucumber farming

Factsheet no. 1: Selection and validation of farming sites
Factsheet no. 2: Pen construction techniques
Factsheet no. 3: Production monitoring techniques
Factsheet no. 4: Methods to calculate optimal rearing densities
Factsheet no. 5: Strategies for control of predators
Factsheet no. 6: Strategies to prevent poaching: the case in Madagascar
Factsheet no. 7: Financial statement for one family owned pen (in US$)

Section 3: An illustrated cartoon for the extension of community-based sea cucumber farming

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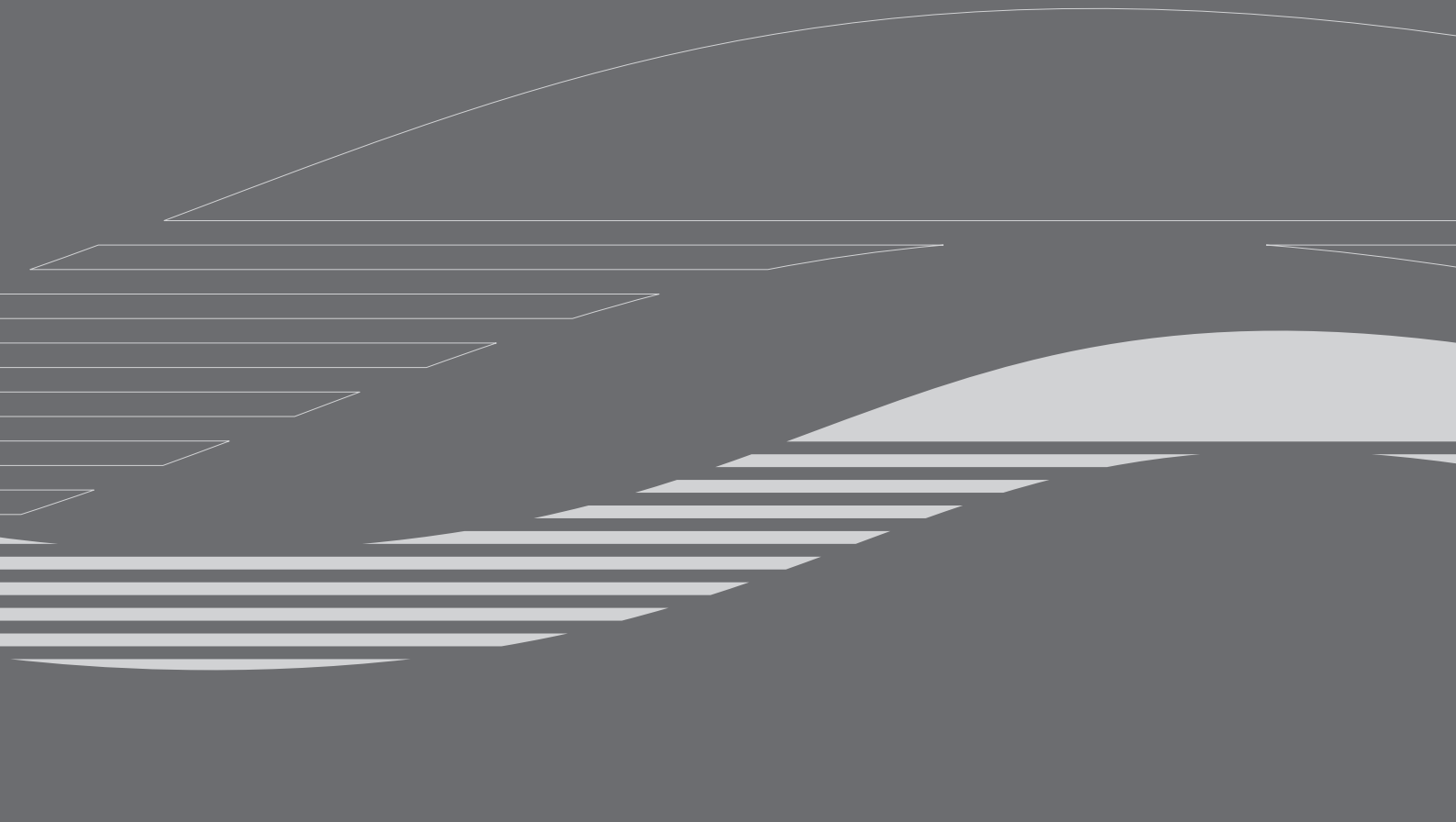
GUIDELINES AND RECOMMENDATIONS ON SEA CUCUMBER FARMING FOR SUPPORT ORGANISATIONS



The system developed in Madagascar for community-based sea cucumber farming involves three main stages, each requiring specific facilities:

- Spawning, larval rearing and settlement in tanks (hatchery)
- Rearing of juveniles in external ponds (nursery)
- Grow-out to market size in sea pens (farming)

As the first two stages are highly technical, hatchery and nursery production should be carried out by a public or private operator, who has access to appropriate technologies and sufficient financial and human resources. The final stage, however involving the grow-out of hatchery-reared juveniles in sea pens, can be undertaken by rural communities using simple and accessible technology. A pre-requisite for the development of community-based sea cucumber farming, is therefore an agreement or partnership between community farmers and a hatchery producing sandfish juveniles.

A) The farming system promoted:

- Sea cucumber farming is carried out in pens constructed from extruded plastic mesh in near shore coastal areas. It is prudent to start operations with medium sized pens (ca. 1000m2) in order to simultaneously minimise risk and generate significant revenues, until farmers have mastered the key parameters for successful farming. The future intensification and expansion of farms will depend on the performance of the farmers.

- Farmers buy batches of juveniles from a hatchery at an average size of 15 g. Again, it is necessary to stock medium sized batches of juveniles to limit risk and then progressively increase the size of the stock during subsequent deliveries. Juveniles can be sold on credit or a cash-basis, depending on the agreement with the commercial operator.

- During the first grow-out cycle, the initial biomass should be low and sea cucumbers should be stocked at less than one individual per square meter. 0.5 ind./m2 is a good starting point. Later on, once the carrying capacity of the site has been determined (see factsheet no 4) the stocking density can be increased.

- Juveniles can be stocked on a regular basis, ensuring that the carrying capacity of each site is not exceeded (otherwise the growth of sea cucumbers will slow or stop)

1) One option is to stock juveniles on a regular basis (e.g. quarterly) so that cohorts of different ages and sizes coexist simultaneously in the pen. This helps to maintain the total biomass as close to the carrying capacity of the site as possible. In this case, large sea cucumbers will always present and thus the pens will need to be permanently guarded at night to prevent theft.

2) Another option is to stock a large number of sea cucumbers (ideally at the start of the hot season to optimise the initial growth of juveniles) and wait until they are harvested before re-stocking the pens. This will avoid the need to guard the pens at night during the first months of grow-out as the market value of juveniles is virtually nil until they reach a size of 100-150g.

- Sandfish reared in sea pens can reach market size (350-400g) between five and twelve months later, as the length of the grow-out period varies between different sites and seasons. However, as the growth of sea cucumbers within each batch is not uniform, it is sensible to schedule the harvest and sale of a specific batch over a few months. Once a sufficient number of sea cucumbers exceed the agreed market size, the commercial operator should come to purchase the sea cucumbers. As they pay in cash, this is the ideal time for any financial transactions to take place between farmers and the operator, for example, re-payment of credit for juveniles and purchases of new batches of juveniles (the rates should be based on the value of the product sold).

Comment n°1: Once key parameters are known and understood (biomass / optimal density growth rates, predation levels, prevalence of theft ...), farmers may consider expanding the size of their operation by building new pens and increasing the number of juveniles stocked.

Comment n°2: It is possible that after several production cycles, farmers may notice the appearance of juvenile sea cucumbers in the vicinity of their pens. These are the offspring of their stock which have reproduced in the wild. If this happens, farmers can add increase their production by collecting the juveniles and stocking them in their pens for on-growing.

B) The role of farmers and the tasks involved

Control of theft

The sandfish, Holothuria scabra, is one of the most commercially valuable species of sea cucumber, forming the basis of a complex fishery and trade, involving a large number of operators along the value chain. Farming sites are likely to attract poachers, especially at night when the sea cucumbers emerge from the sediment and are more vulnerable. One of the key parameters for successful production is therefore the organisation of an effective surveillance system. Farmers will need to operate a rota (either within or between farming groups) to ensure that there is a permanent presence guarding the pens at night. This is the most important and time consuming activity for farmers.

Control of predation

If the pens are experiencing high rates of predation from crabs, farmers should organise regular searches for crabs at night (crabs are often more active at night). Two or three people per pen can easily carry out this task for about an hour during each spring tide. To be effective, it is essential to use a strong light (hurricane lantern) and other equipment to catch the crabs (nets, spears, gloves, etc.).

Two or three days prior to a delivery of juveniles, a more intensive search should be conducted both day and night to eliminate predators. Newly stocked juvenile sea cucumbers are the most vulnerable to predation during their first few weeks of grow-out.

Other maintenance tasks

Apart from the above nightly tasks, the remainder of the work to be done only requires a limited investment of time, so farmers are able to pursue other economic activities in addition to sea cucumber farming. Pen maintenance can be carried out by a single person in less than four hours per week (or during one or two spring low tides).

Maintenance tasks consist of:

-
- Brushing the sides of the pen to maintain adequate water exchange and make it easier to detect holes or tears in the mesh
- Repairing pens
- Controlling predators

These features make sea cucumber farming:

- a predominantly nocturnal activity in which men will play a key role!
- an activity that can rapidly achieve economies of scale once operations expand (as the burden of nightly surveillance does not increase)
- a moderate risk activity!

C) The importance of technical and organisational support

One of the roles of extension workers is to identify farmers who are motivated, professional, and efficient, with the ability to improve their standard of living significantly through mariculture. By engaging their interest, the achievements and success of these first farmers will act as a catalyst for the expansion and replication of farming villages, thus promoting the development of the sector.

The selection, training, and supervision of the first farmers is therefore of upmost importance. The extension process relies on having technicians permanently present in the villages, to regularly monitor production and facilitate consultation with local residents.

The role of training, monitoring and organisational support

From a technical and organisational point of view, the key message that is emerging for successful farming today, is that "it is the detail that counts." Whether it is preventing poaching or controlling predators, the farmers who are the most thorough and organised will generally fare better. Regular visits to the pens, combined with vigilance and hard work will yield results.

A key role for technicians is to assess the work of the farmers; therefore it is important to put tools for monitoring and evaluation in place. To encourage farmers to develop good practices, the focus should be on providing constructive advice and supporting famers in their work rather than compensating for their potential weaknesses.

If it is not possible to have technicians permanently in the field, then a representative from the village can support their role. This local intermediary must be your eyes and ears in the absence of technicians, especially for assessing the participation of famers in surveillance and predator control. They can also facilitate liaison between the commercial operator and farmers to schedule deliveries of juveniles, sales of market sized sea cucumbers and other necessary collective actions (building pens, monitoring production, meetings, etc).

Institutional support to create a secure operating environment

It should be noted that assuring 24/7 surveillance of their pens will be extremely difficult for farmers. There will always be unforeseen events which will occasionally leave the pens vulnerable to theft (such as unfavourable weather or sickness)

In addition to carrying out surveillance at night, farmers must work with you to establish a secure operating environment (legitimising the farms among local residents, deterring theft, mobilising public authorities, etc). This is the only way in which mariculture can develop harmoniously, especially during the early stages.

The development of mariculture-based activities should not be a source of conflict for the local community. Both farmers and extension workers need to give careful consideration to marine resource use issues and the wider political and economic implications of the activity, especially during the early stages of implementation (selection of farmers, designation of mariculture zones and spatial planning).

In summary, the role of extension workers is to:

- Initiate dialogue with the village, foster communication and relay relavent information
- Identify good farmers and train them in farming techniques.
- Supervise activities (site selection, pen construction, optimisation of spatial planning) and coordinate the smooth delivery and sale of sea cucumbers.
- Carry out monitoring of production at night with farmers
- Explain key parameters (density and survival) to farmers so they understand the principles of monitoring
- Monitor the economic performance of their farms in relation to their husbandry practices.

D) The key steps to establish community-based sea cucumber farming

1) Identification of potential sites

A sound approach in site selection is to utilise traditional ecological knowledge of fishers to identify sites which support, or previously supported, sandfish populations.

Ideally, before the development of farming activities, the suitability of the site can be assessed via the use of test plots to empirically evaluate growth rates and the carrying capacity of the site (see Fact Sheet No. 1)

Areas prone to influxes of fresh water, strong currents or waves should be avoided. The sediment should be deep enough (at least 40 cm) to allow the solid construction of pens. The substrate should never dry out completely, even during spring low tides. A good site will have a minimum water depth of 10 - 50 cm during the lowest tide. The site should be characterised by soft, sandy-muddy sediment, which is often (but not exclusively) found in close proximity to mangroves.

For security reasons, sites that are within sight of the village offer an advantage, as during the day, farmers can keep an eye on the pens and the daily traffic around them, without needing to be physically present.

2) The selection of villages for consultation

Small villages can offer a number of advantages. In general, solidarity is often stronger and conflicts are rarer or easier to resolve by the villagers. The risk of theft is therefore more manageable.

The development of community-based sea cucumber farming will inevitably lead to a change in marine resource use. For other resource users, the designation of areas for mariculture will translate into a net loss of access. It is therefore necessary that changes in land use are negotiated and accepted by all stakeholders in the area.

Different compensatory measures, whether symbolical or physical, (sacrifices, ceremonies, financial compensation - either upfront or in the form of local taxation, fees or land lease), can be implemented in collaboration with the first few farmers who enter into mariculture, for the benefit of the wider community. Above all, it is a case of legitimising changes in marine resource use, preventing any disagreements and avoiding the definitive and unequal ownership of the mariculture area. Although compensation should originate from the farmers, it should not so great that it affects the profitability of sea cucumber farming.

Caution! Territorial land use rights that come into play in the development of mariculture can be complex and interconnected among various groups of coastal residents! The development of compensatory measures must be taken into account. To avoid conflicts (manipulation by certain groups, imposition of illegitimate measures, etc.), it is more prudent to spend time consulting all

parties involved. It is not the role of an external operator to develop such measures, let alone to enforce them. It is up to the local authorities to make such decisions. Caution is therefore essential. Although it is advisable to involve local government in these processes, it does not necessarily guarantee legitimacy. Compensatory measures therefore do not have to be formal; they can simply be local agreements which lack legal recognition.

3) Selection of farmers

Preliminary screening

Farmers must be hardworking, dedicated people with an entrepreneurial sprit. Sea cucumber farming commits farmers to long cycles and requires an initial investment, regular expenses (purchase of juveniles) and income generation that is potentially significant but sporadic (for example every two or three months). To ensure that profits are generated regularly, the work must be carried out methodically, including a systematic nightly surveillance program.

These features contrast with the economic pattern that characterises most small-scale fisheries, in which income is generated almost daily and where fishing effort can be tailored to meet cash flow requirements. During the start-up phase, farmers cannot rely on a single activity to meet their needs. It is only after the first two or three farming cycles they can consider specialising in mariculture. It is preferable that each farming unit comprises several active members in a group (4-5 people), preferably from the same family, sharing the risks, workload (maintenance and surveillance) and the benefits.

It is essential that all candidates involved in the screening process are aware of these characteristics. It is therefore important to conduct selection interviews with all candidates to discuss these issues and evaluate their understanding of risk before they start farming. Scenario-based role playing is a useful tool to assess how people will react and cope with different situations.

It is very important to clarify the details of how the work will be carried out and how risk will be shared among the parties involved. Even the most dedicated and serious farmers should have some recourse to compensation in the event that their farms are affected by a natural disaster. However, they must also understand that they will be held responsible for theft, regardless of the reasons for a default in surveillance. Simplified contracts can be drawn up to formalise the roles and responsibilities of each party.

Creation of contracts

Once the selection process is complete, the creation of contracts with farmers will help to clarify the exact nature of the support given, define the duties and responsibilities, and in addition, regulate the commercial partnership with the hatchery supplying juveniles who may, in return, demand the exclusive right to buy back all production.

Formal contracts should be sufficient to justify the exclusion of "cheaters" who resell part of their production to other traders instead of the company supplying the juveniles. It is very important that the contract terms are understood and accepted before the start of the activity.

Secondary selection based on economic performance criteria

During the second farming cycle, it is advisable to implement measures based on performance criteria, through which farmers can either be incentivised or excluded. For example, at the end of the 2nd or 3rd grow-out cycle, farmers who have not reached minimum targets (e.g. harvesting and selling 50% of their sea cucumbers) can be excluded from the activity whereas farmers who have exceeded targets (e.g. who have sold 70% or more of their stock) can be incentivised to build a second pen (through prizes or donations of equipment).

The objective of this secondary 'triage' is to exclude, early on, any dishonest farmers who sell their production elsewhere or unproductive farmers, who occupy farming sites and utilise materials that other farmers could put to better use and absorb valuable inputs of juveniles in vain. On the other hand, performance-based criteria are necessary to avoid farmers wasting their time, or worse, falling into debt by persevering at an activity that they are unable to master.

On the other hand, it is in everyone's interest to support the best farmers to construct a second pen and increase their production. With an expansion of the farming area, the workload will only increase marginally and the economic success of these farmers will encourage others to achieve a similar level of results.

4) Monitoring production

To assess the performance of farms, regular monitoring is essential. It will allow problems to be identified early on, so that farmers can be helped to make the correct choices to resolve the problem.

Monitoring should be carried out every two weeks, during spring low tides. The technicians, accompanied by the farmers, should count all sea cucumbers in the pen and weigh a sample (e.g. 25% of the total) to determine the growth rate (factsheet no 3). As sandfish tend to burrow during the day, monitoring should be carried out at night when the sea cucumbers are active.

A decrease in the number of sea cucumbers during the first three months may indicate predation (probably by crabs) or escape/loss of sea cucumbers from the pens due to strong currents or damaged pens. Later on, once the average weight of sea cucumbers exceeds 100g, a reduction in the number of sea cucumbers almost certainly indicates that a theft has occurred (either from poaching or internal theft whereby the farmers have discretely sold their sea cucumbers to other traders). Once sea cucumbers attain a certain size they are able withstand predatory attacks from crabs and although occasional marks may be visible on the body wall, attacks rarely result in mortality.

5) Problem solving and adaptation of farming practices to local conditions

Adaptation of farming techniques

Depending on the problem encountered, if it increases costs for farmers and in turn affects the viability of their farms, certain practises may be unavoidable to resolve the problem.

Key problems	Potential solutions
Slow growth rates	• Sediment re-working (efficiency to be confirmed ?) • Sediment enrichment (techniques to validate ?)
High mortality rates (predation from crabs)	• Construction of a juvenile nursery (protected enclosure) • Organisation of predator control (day and night) • Use of crab traps
Theft of sea cucumbers	• Strong coordination at village level • Reinforcement of surveillance • Construction of an elevated guard platform • Systematically reporting thefts and requesting government assistance in investigations • Role of government: establishment of a system of traceability for farmed product (certificates of origin for wild sea cucumbers and inspections).

Adaptation of the farming model

Other adaptations of the farming model are possible based on different biophysical and socio-economic characteristics. They should be assessed on a case by case basis in consultation with farmers. Two standard models are available:

Farming model	Advantages	Disadvantages
1) Farming in consecutive cycles (extensive) : A new batch of juveniles are stocked after each harvest	• No surveillance needed for the first few months • Farmers can pursue other economic activities	• Limited profitability • Irregular income • Extensive model requires more space
2)Farming in continuous cycles (intensive) : Batches of juveniles are stocked at regular intervals throughout the year. Different cohorts grow simultaneously in the pen	• Optimisation of space • Increased profitability • Regular and evenly spread income	• Permanent surveillance required • More time consuming

Farming in consecutive cycles is a form of extensive mariculture. This model is suited to sites where growth rates are slow and/or the carrying capacity of the site is low or sites where a large area suitable for sea cucumber farming is available. Grow-out time to market size will be longer and sites will have a lower profitability per unit area than sites which can support an elevated biomass. In this case, sea cucumber farming can provide a complementary source of income. With longer grow-out periods (10-12 months) until sea cucumbers reach market size, farmers will be less likely to specialise in mariculture and income generation will be infrequent. In this scenario, it is desirable to stock sea cucumbers at the start of the hot season to optimise their growth during the first few months.

Farming in continuous cycles is preferable in order to optimise site potential, especially at sites where the available surface area for sea cucumber farming is limited. This method allows an intensification of production by maintaining the total biomass close to the carrying capacity of the site. Batches of juveniles are stocked regularly, as soon as market size sea cucumbers have been harvested. Although the workload is higher and more time consuming (nightly surveillance, predator control) the profitability is higher. Farmers will be more driven to specialise in mariculture

.The farming model however is not definitive and it is always possible to re-evaluate the choice of model employed, based on the capacity and performance of farmers. In addition, the models outlined here can undoubtedly be improved as sea cucumber farming practices evolve. Hybrid models can be considered, for example by scheduling juvenile inputs shortly before the harvest and sale of the previous cohort or by incorporating fallow periods into the farming system

.In conclusion, the strategy of the support organisation should take into account that :

- The growth rate of sea cucumbers is higher during the hot season than then the cold season.
- Production cycles are long and often do not correspond with the mentality of fishers
- The terms and conditions of a commercial partnership with a hatchery must clearly understood and respected. The sustainability of community-based sea cucumber farming depends on the existence of a functional hatchery, which may in turn depend on being able to buy back sea cucumbers for processing an export, in an exclusive partnership with communities.
- Pro-active prevention of theft and nightly surveillance are indispensable to the success of community-based sea cucumber farming
- Sea cucumber farming is an activity that can rapidly achieve economies of scale
- The size of mariculture units must take into account financial viability, social equity and marine resource use issues.
- Effective community involvement is essential to provide farmers with a degree of security and to legitimise the exploitation mariculture zones.

- The above also applies to government involvement
- Empowerment of farmers can only be achieved through an effective partnership with a hatchery in which the buy-back of sea cucumbers and re-supply of juveniles becomes routine.

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FACTSHEETS

Preliminary identification

1) Use traditional ecological knowledge for fishers to identify sites where wild Holothuria scabra are found (or were previously found).
2) Restrict site selection to areas where the sediment is soft and sufficiently deep, notably more than 40cm before a solid substratum is reached, so that the stakes and mesh can be solidly embedded (a crow-bar or iron bar can be used to test sediment depth).
3) Assess the compactness of the top layer of sediment in order to choose the softest areas.
4) Avoid areas exposed to waves, strong currents and influxes of fresh water.
5) Select sites closest to populated areas to facilitate surveillance during the day and at night

Empirical validation

Where possible, consider using replicated test plots to validate the suitability of selected sites based on their natural carrying capacity. This is done by:

1) Building a series of small 4m^2 pens covered with a protective top-net (like the nursery pens)
2) Stocking a batch of juveniles at a relatively high density (for example, 10 juveniles/m^2)
3) Weighing the sea cucumbers every seven days to monitor their growth
4) Calculating the carrying capacity of the site (see information sheet n°4)
5) Determining the optimal density for the culture system chosen (consecutive or continuous cycles)

Note: the method illustrated in the following example can be adapted to specific constraints (pen size, number of juveniles stocked, etc.) To ensure that the results are representative, a minimum of 5 test plots should be constructed per site.

Example: In a 4 m^2 test plot, 40 juvenile sea cucumbers with an average weight of 15g are stocked. The following results were recorded during monitoring:

T=0 => biomass = 40 ind. x 15 g / 4m^2 = 150 g/m^2
T=7 => biomass = 40 ind. x 18 g / 4m^2 = 180 g/m^2
T=14 => biomass = 40 ind. x 25 g / 4m^2 = 250 g/m^2
T=21 => biomass = 35 ind. x 32 g / 4m^2 = 280 g/m^2
T=28 => biomass = 35 ind. x 36 g / 4m^2 = 315 g/m^2
T=35 => biomass = 30 ind. x 44 g / 4m^2 = 330 g/m^2
T=42 => biomass = 30 ind. x 44 g / 4m^2 = 330 g/m^2

The above data shows that some sea cucumbers disappeared, maybe due to predation from crabs or due to mortality post-transfer. However, the exercise demonstrates that the total biomass does not increase beyond day 35, indicating that the natural carrying capacity of the site is 330g/m2. At this site, it should be possible to rear sea cucumbers at a density of 1 ind./m2 until they reach an average size of 330g utilising the consecutive stocking model. In order to grow sea cucumbers to a market size of 500g using this method, the density should be reduced to 0.66 ind./m2 (calculated as 330/500).

SPECIFICATION SHEET FOR FIELD TECHNICIAN

Assessment of the quality of potential sandfish farming sites

Based on sediment study done by Thomas Plotieau and Igor Eeckhaut (University of Mons Belgium)

To identify potential farming sites, three key parameters must be taken into consideration: **survival rates, growth rates** and **physical characteristics**. Some background information is given below for each factor to allow technicians to optimise the success of future farming operations by selecting the best grow-out sites.

Identify factors that promote survival:

- The most straightforward indicator is a knowledge of the previous or present existence of Holothuria scabra populations.
- It is essential that the site remains submerged even during the lowest spring tides
- Finally, the abundance of crabs (species such as Thalamita crenata) should alert technicians to increased risks of mortality due to predation (especially for juveniles).

Assess factors that promote growth:

1) Sites with a high proportion of fine sediments should be selected preferentially: the fraction of fine sediment can be measured with a 500 micron sieve and high precision electronic scales. In the absence of laboratory equipment, the technician can estimate the fineness of the sediment by releasing a handful of sediment at the water surface. For fine or muddy sediment, which are ideal for growth, it will disperse in a cloud; if not, the sediment is likely to be granular or sandy which is less favourable for sea cucumber farming. In addition:

- Well protected areas (such as bays and coves in large lagoon systems or areas close to mangroves) will generally be subject to natural sedimentation which is likely to promote growth, as opposed to areas that are subject to significant water movements (strong currents, reef flat areas inside a fringing reef, etc).
- The presence of certain species such as the black brittle star (Ophiocomina nigra) can indicate coarser sediments which are unfavourable for sandfish growth.
- The presence of seagrass beds and/or the sea urchin Tripneustes gratilla can indicator sediment that is favourable for sandfish growth.

2) Sediment with a high proportion of quartz appears to be very favourable for sandfish growth. If it is complicated and expensive to conduct tests to analyse the mineral composition of sediments, it is still assess the proportion of carbonate, which in general, is inversely proportional to the amount of quartz. Simply measure the difference in weight between a sample of dry sediment weighed before and after adding acid (e.g. vinegar). It is anticipated that carbonate dominated sediment (e.g. $>$ 80%) may result in slow growth.

Note : the colour of the sediment is not a relevant indicator.

Assess factors that will optimise farming efficiency:

- Pens should be built in areas with a soft sediment and a minimum depth of 30cm to ensure that the construction is sturdy.
- The accessibility and proximity of farming areas in order to encourage regular monitoring, maintenance and in particular, facilitate guarding of the pens.
- Assess the security of the site and minimise risk factors by investigating the potential for theft (pre-existing conflicts, economic alternatives, proximity to police stations, etc.) and concealment (presence of sea cucumber traders, quantities traded, etc).

Once favourable sites have been identified and farmers have been selected, two options can be considered to construct the pens: circular or square pens.

- Circular pens have the advantage that they are more resistant to currents and also they provide a larger surface area per linear metre of mesh used. They are therefore less expensive to construct than square pens.
- However, square pens are more advantageous when they are constructed in an adjoining fashion. With this type of construction, the area occupied by the pens is optimised and spatial planning is more straightforward.

Care should be taken at this stage to incorporate channels between groups of pens to allow access by canoes or boats.

Pen construction

The materials to construct pens should be prepared ashore. Plastic mesh with a minimum mesh size of 8mm should be cut to a minimum width of 75cm. Wooden stakes measuring 1m in length, (using wood that will not rot in seawater) are ideal however at sites where there is a hard substrate underlying the sediment, galvanised steel stakes can be used, although this is an expensive option. Pen construction should be carried out during spring low tides. Two or three days work is sufficient to build a pen with a team of people.

1- Using a measuring tape, rope and some stakes, hammer stakes into the 4 corners and use rope to outline the area of the pen
2- Use a narrow shovel to dig trenches at least 30 cm deep along the rope outlining the perimeter of the pen.
3- As the trench progresses, start to insert the mesh into the trench, ensuring that is pulled taut along its length.
4- As the mesh is rolled out along the trench, hammer in stakes at 1 metre intervals, alternating between the interior and exterior of the pen to support the mesh.
5- Use 2mm cord or cable ties to attach the mesh to the stakes. The mesh should be attached to the stakes at the base and the top and then stitched along the length of the stakes to secure it.
6- Backfill the trench and compact the sediment to ensure the mesh is well buried.

Construction of a nursery

At sites which suffer from high levels of predation, the construction of a covered enclosure to act as a nursery for juveniles is indispensable. To determine the correct area needed, the formula to calculate rearing density (factsheet no 4) is used by setting with the target weight at which juveniles should be transferred out of the nursery of the juveniles at 50g. Once sandfish reach this size, they are less vulnerable to predation by crabs.

The construction method for the nursery is similar to the main pen, with two main differences:

- The stakes should be inserted only along the interior of the pen and the stakes must be flush with the top of the net.
- A net with a mesh size of 1cm square should be used to cover the top of the nursery. Cord should be used to stitch the top net securely to the sides of the pen, ensuring that there

are no gaps for even small crabs to enter.

Whenever access to the nursery is needed, for example to capture crabs or count juveniles, the top net can be partially unstitched and pulled back, ensuring that it secured again once the work is completed.

The sandfish, Holothuria scabra, actively feed on the sediment surface at night, however during the day, they often remain buried. Therefore all activities such as counting, weighing and harvesting need to be carried out at night, during spring low tides. This is also an ideal opportunity to search for and capture any crabs.

The following equipment is needed to carry out monitoring at night: a hurricane lantern and extra torches, plastic containers to collect the sea cucumbers, weighing scales, writing materials (preferably waterproof) and a stable surface for weighing (a folding table is ideal).

Monitoring protocol :

1) Light the hurricane lantern, gather all the equipment and wade out to the pens, setting up the table in the centre of the pen.

2) Farmers should form a line and walk slowly upstream (to avoid stirring up the sediment and reducing visibility) using the hurricane lantern to illuminate the search area. An empty plastic bowl or bucket can used to collect and count of all of the sea cucumbers that are found.

3) Once placed in the containers, the sea cucumbers will release water held inside their bodies and 'deflate'. This water should be emptied out of the container periodically to that sea cucumbers are weighed once they have emptied out internal water to standardise the weighing procedure.

4) A representative sample (25%) of sea cucumbers are weighed one at a time, as quickly as possible, before being replaced in a separate container filled with water until the sample is complete. A clipboard can be used to record the data.

5) Once the monitoring is completed, the sea cucumbers can be returned to the pen :
a. Return them to the areas where they were found
b. Handle them gently - avoiding damaging their skin or throwing them back into the water.
c. Place them with their ventral (white) side face down
d. Take care not to group them all in one place

Note : to monitor juveniles in the nursery pen, the method is the same however great care should be taken not to step on or damage juveniles. Once monitoring is completed, the top net must be carefully replaced and stitched to prevent crabs from entering.

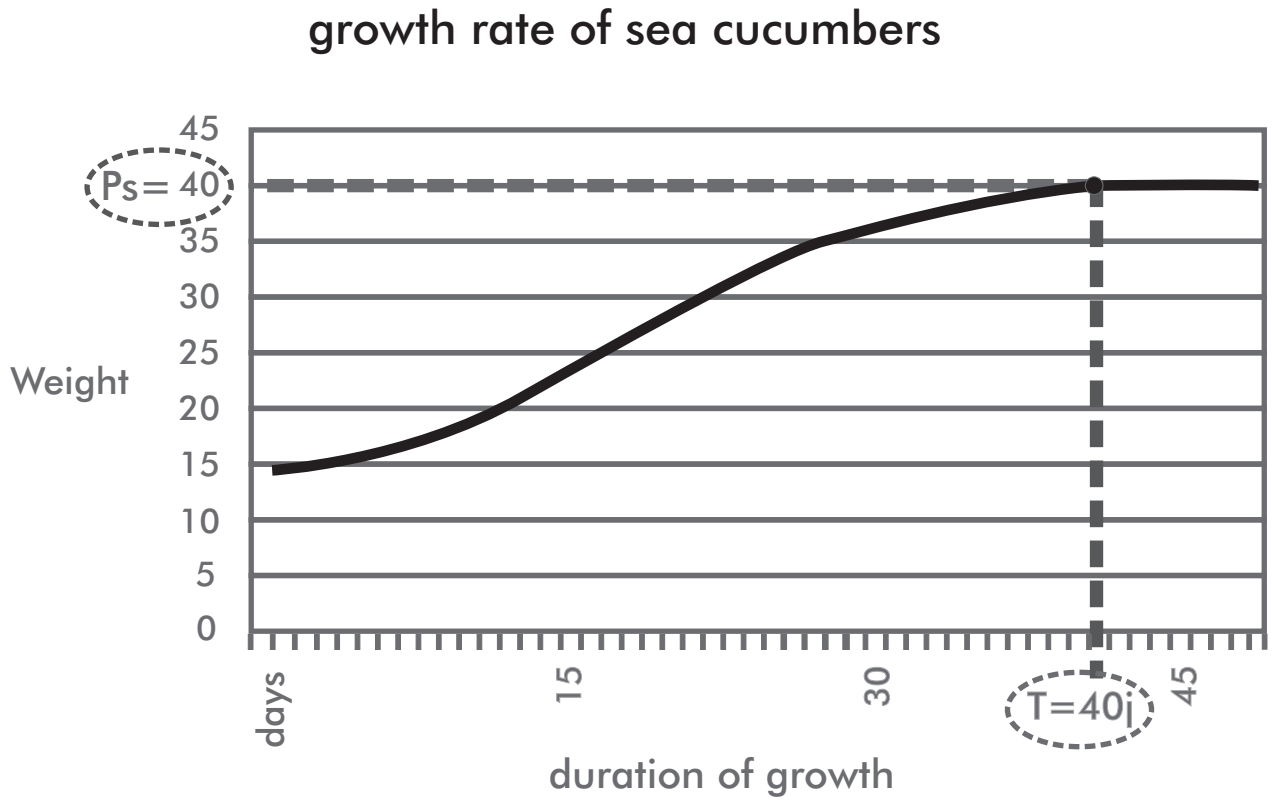
In order to calculate optimal rearing densities, the following variables need to be known:

- Surface area (S) = 4 m^2
- Number of sea cucumbers stocked (n) = 50
- Initial weight (Wi) = 15 g
- Target weight (Wt) = 350 g

(note: the target weight (Wt) can either be the market size of sea cucumbers or the size at which juveniles should be transferred out of the nursery).

By plotting growth rate data from the test plots, the curve of the graph will enable determination of:

- The maximum average weight (Wmax g) that the sea cucumbers attain before growth slows and stops due to density-dependant effects (illustrated by the point at which the graph starts to /level off)
- The time taken to reach the maximum weight (t in days)



1) Calculation of the carrying capacity of the site

To calculate the carrying capacity (Ccap) of the sediment at the farming sites, the following formula should be applied :
Ccap = Wmax x n / S

So for the above example
Ccap = 40g x 50 sea cucumbers / 4m^2 = 500 g/m

2) Calculation of the optimal stocking density for consecutive farming cycles

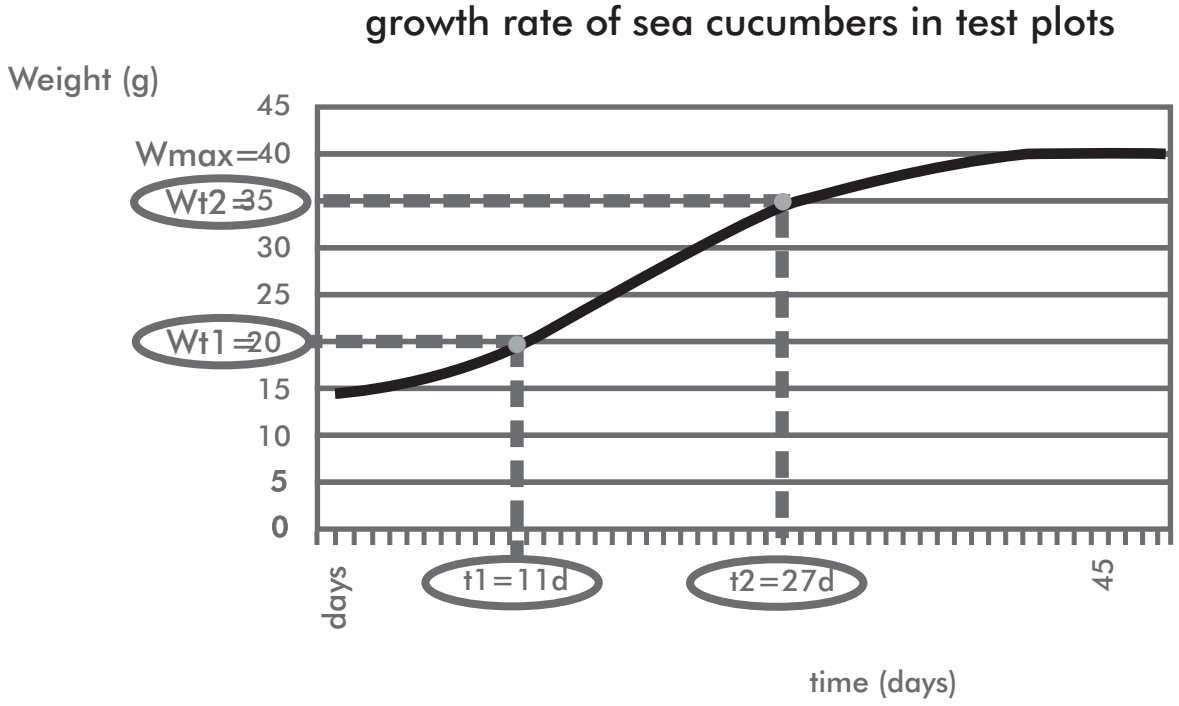
Therefore us, to determine the optimum stocking density (D) on the site tested previously, the critical biomass is divided by the target harvest weight (g) (or the average weight at which juveniles should be transferred from the nursery into the grow-out pen).

$D = Ccap / Wt$

Following on from the previous example: $D = 500\ g/m^2 / 350\ g = 1.43$ sea cucumber/m^2
Thus in a pen with a total surface area of 900 m^2, 1285 sea cucumbers per cycle could be reared to market size (in a consecutive farming model)

3) Calculation of growth rates : another key parameter

Growth rates will vary from site to site, even if the carrying capacities are identical. To calculate the growth rate at each site, you must again collect reliable data from initial test plots or from monitoring production during previous farming cycles.



$$Gr = (Wt2 - Wt1) / (t2 - t1)$$

Note : growth rates are independent of the carrying capacityof the site

4) The continuous stocking model : optimisation of production

Using information generated from the above parameters, it is possible to optimise production, by rearing different cohorts of sea cucumbers (different ages and sizes) in the same pen simultaneously. The following table gives an estimation of the numbers of sea cucumbers to stock, the frequency of stocking and the length of the grow-out period which can be used as a guideline to intensify production.

For a total biomass of 100kg per pen						
	Target market size = **350 g**			Target market size = **500 g**		
Growth rate	No. to stock	Frequency of deliveries	Grow-out period	No. to stock	Frequency of deliveries	Grow-out period
0,5 g/day	**118**	every 6 months	670 day	**85**	every 8 months	970 day
1 g/day	**118**	every 2 months	335 day	**85**	every 4 months	485 day
1,5 g/day	**118**	every 2 months	223 day	**85**	every 3 months	323 day
2 g/day	**145**	every 2 months	167 day	**104**	every 3 months	242 day
2.5 g/day	**164**	every 2 months	134 day	**121**	every 3 months	194 day
3 g/day	**160**	every 2 months	112 day	**104**	every 2 months	162 day

Comment : to support a total biomass of 100kg, a site with a carrying capacity of 100g/m2 would require 1000m2 whereas a site with a twice the carrying capacity (200g/m2) would require half the area (500m2) in order to support the same quantity.

Example :

A farmer with a 2500 m^2 pen has an average growth rate of 1.5 g/day and a carrying capacity of 300g/m^2. According to the table above, to grow sea cucumbers to an average market size of 500g in continuous cycles, he should ideally stock juveniles **every 3 months**.

The number of sea cucumber to be delivered will be determined as follows:

First calculation the total biomass (Btot) the pen can support

$$Btot = 300\ g/m^2 \times 2500\ m^2 = 750\,000\ g \text{ or } 750kg$$

The number of sea cucumber to be delivered every 3 months is calculated by referring to the table above

$$n = 85 \times (750\,000 / 100\,000) = 637$$ **juveniles per input**

(These instructions can be added as an appendix to the contracts signed by team leaders)

To do…regularly (every spring tide)

- **Brush the sides of the pen** to promote good water exchange and make it easier to see any holes in the net. At the same time check for and remove any crabs
- **Check the nursery pen** very carefully including the top and sides
- **Repair any holes**
  To adequately protect the juveniles from predation by crabs, the nursery should be completely closed and inaccessible to crabs for two months. A single crab can kill approximately 30 juveniles per month
- **Hunt for crabs in the pen at least once per tidal cycle** using a hurricane lantern with 1L fuel until the fuel runs out. **Use spears, gloves and crab nets**, carefully checking all sides of the pen.
  Bait can be positioned upstream, farmers start by moving downstream then after coming back against the current any crabs should be concentrated around the bait so they can be easily captured. Afterwards, the bait can be replaced in traps around the pens.
- **Bait the traps** and place them around the pens, for example every 3 metres.

To do… during the spring tide before a delivery of juveniles

- **Use a mask to search for and capture any crabs in the nursery and check the base of the net** then **re-secure the top net.** This should be done a few times during the tide during the day with a mask and at night with a lamp.
- **Carefully check all sides of the nursery** at low tide and at high tide with a mask…**repair any holes.**

To do…just before a juvenile delivery

- **Intensify the search for crabs**
- Open the nursery and re-work the surface layer of the sediment (this makes it easier for the juveniles to bury and helps to eliminate crabs and their burrows).

To do…the day of the delivery

- **Continue to check for crabs** (using a mask during the day and at lantern at night) making sure that crabs do not enter the nursery while the top net is pulled back
- **Regularly check the sides of the nursery pen and ensure the top net is securely fastened**
- **Monitor the juveniles** regularly without opening the top net. If the remains of juveniles are found beware! It is likely that crabs have been shut inside with the juveniles!

(These instructions can be added as an appendix to the contracts signed by team leaders)

In Madagascar, groups of farmers involved in sea cucumber mariculture have agreed to guard their pens against theft at night and are contractually bound to do this. Due to mistrust between different farming groups, it is not possible to organise a communal rota, instead each group sends at least one person every night to guard their pen. In the days leading up to a sale of sea cucumbers (when incidents of theft have been much higher) the pens must be guarded until daybreak. Normally, farmers guarding the pens are able to remain on the beach during the low tide and return to their houses once the tide covers the pens. However the risk of theft remains!

A/ Suggestions on reinforcing pro-active measures to combat theft :

(to implement and integrate into farmer contracts in villages where the level of security is not sufficient)

1) As soon as sea cucumbers reach an average weight of 150g it is imperative to guard the pens every night without fail!
2) Surveillance should be carried out at both low and high tide, throughout the night
3) Farmers who do not participate in the surveillance should pay a fine to the other farmers

Other suggestions:

- If a watchtower is constructed, two or three people must stay there each night. They can take it in turns to sleep, but not all at the same time.
- Three people from different teams can act as guards between two successive monitoring periods (when the sea cucumber are counted) and take responsibility for the stock during this period. After each count, the team of guards can rotate once the sea cucumbers are all accounted for and it is certain that no theft has occurred. The numbers of days that each person guards the pens should be recorded and balanced out over the year.
- If certain people are absent (for valid reasons) one of the three guards must remain there permanently throughout the cycle. He will be the guarantee for the team and the person responsible if a theft occurs.
- If the surveillance cannot be carried out for legitimate reasons (storms, heavy rain, force majeure) the sea cucumbers should be recounted as soon as the surveillance is resumed.

B/ Steps to follow is a theft is discovered

- If a theft is discovered or suspected…on a mandatory basis and as quickly as possible!:

1) Count all remaining sea cucumbers at night and compare the result to the previous count.
2) File a declaration of theft to the village authorities, the mayor and the district police (with their signature).
3) Carry out an investigation with people in the village who may have seen something (people that work at night, traders, transport companies, village security patrols, etc.).

- If the thieves were caught 'red-handed' or in possession of stolen sea cucumbers:
- Call as many witnesses as possible to corroborate the theft
- Make a written record of the incident with the village authorities in which the thief (or thieves) and witnesses are identified
- Apply local conventions or laws and ensure that the thieves reimburse the famers' loss, or
- If no consensus is reached, the case should be passed onto law enforcement officers…however a written account should be recorded at each stage of the investigation.
- If suspicions or information lead to the identification of a suspect, the following steps should be carried out in order:
- Hold a conflict resolution meeting in the village to shed more light on the affair: ask specific questions and record all statements in a transcript signed by all legal authorities and traditional leaders and the people involved in the case (victims, suspects, witnesses)
- In the situation that the matter is not resolved at the village level, the fine may be made to the municipality in the presence of the mayor and then proceed to court for unresolved cases (see theoretical procedures outlined in local agreements that were created at the start of the mariculture activity).
- If there are no suspicions or information which allow a suspect to be identified :

Caution : this indicates that there is a big problem with security and the organisation of the farmers. Their working methods should be reassessed and any future collaboration should be seriously considered!

Comments for the attention of support organisations and extension workers

The role of technical or project leadership should be to provide advice and support throughout the process. Technical support is not designed to replace the need for famers to manage these types of problems themselves. It is dangerous and counter-productive to do so!

If the procedures outlined above are not followed the project must make the famers in the village understand that they can no longer support them. It is the only leverage the project has to negotiate and put pressure on the famers to react to restore a safe operating environment and regain confidence with industry partners.

The type of advice that follows can be given by the project to ensure that the above procedures are carried out effectively:

-Alert the maximum number of official authorities (village, municipality/district, police, fisheries department, industry partners, etc) and create official documents.
-Record very precisely all statements made during meetings in signed minutes of the meeting so the information can be recalled at a later date.
-Treat suspects as 'innocent until proven guilty' rather than rely on evidence that may be deliberately misleading
-Follow procedures in local laws or conventions that have been established
Based on the procedures carried out by the farmers and meeting minutes recorded at each stage of the investigation, the support organisation can then help to mobilise government authorities so that they can take over the investigation. It is important that the regional fisheries department, the police and fisheries patrols are involved in treating cases of theft and furthermore show their presence on the ground.

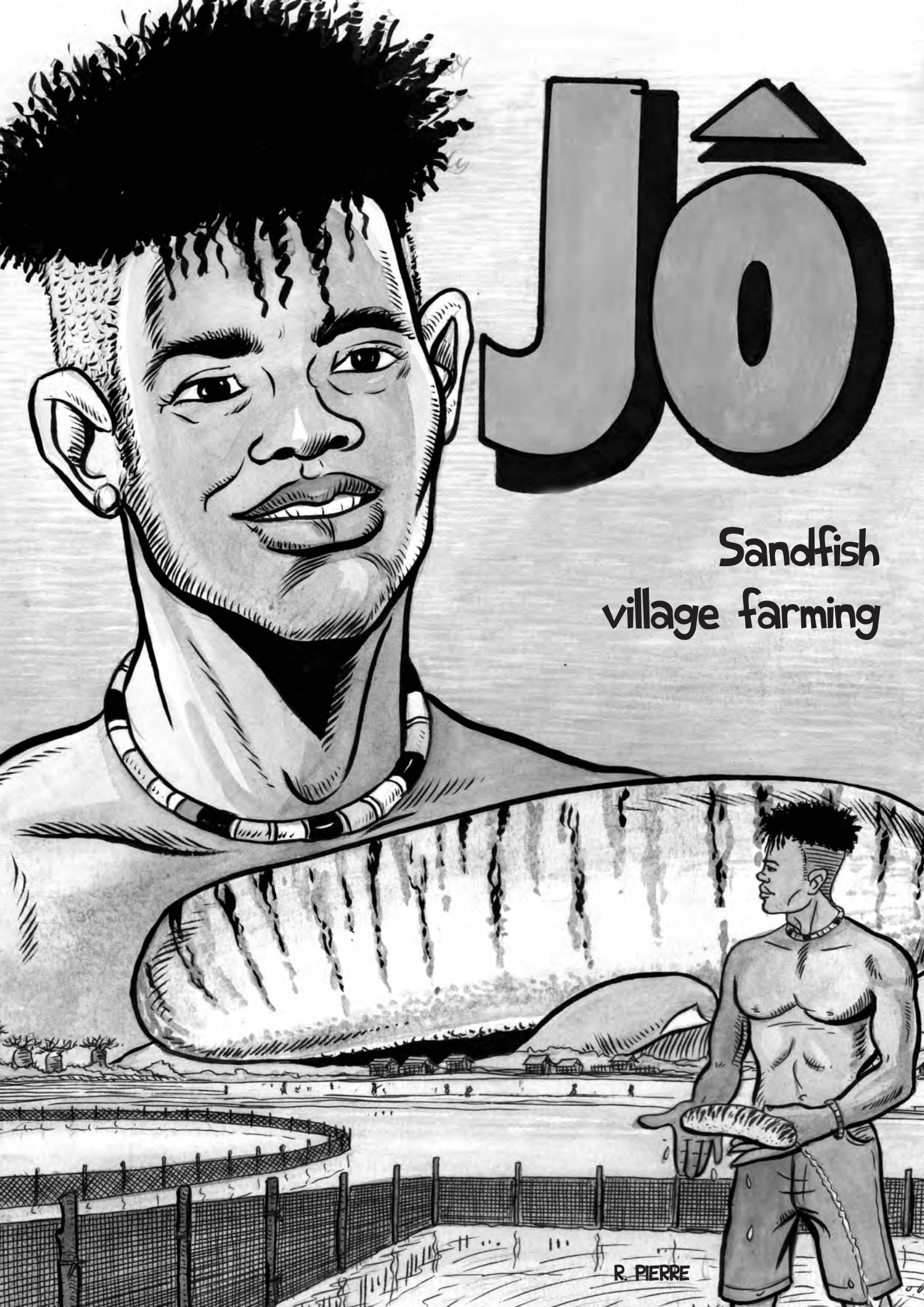
The following example is based on an experienced farmer who has already demonstrated positive results with a small mariculture unit and has decided to expand his farm to consist of a large 2500 m2 square pen and a 100m2 nursery pen. The financial statement is based on the following assumptions: the pen (including the plastic net and wooden stakes) costs approximately US$2.5 per linear metre, the juvenile price is US$0.20 and the sale price for market size sea cucumbers (400g) is US$ 1 (ex works).

Conservative assumptions for growth rate and survival are employed. The grow-out period for 15g juveniles to reach market size is 400g is 8 month, at a site with a carrying capacity of 600g/m2. The example is based on 3 deliveries of 1200 juveniles per year. The overall survival rate, after taking into account mortality from predation and minor thefts is 75%, which translates into the sale of 900 market sized sae cucumbers per input.

The following balance sheet illustrates the example of an expanding sea cucumber farm.
Attention the first year the farmer has to disburse 1,035 $ at the beginning and a second pack of juvenile for 240 $, before any profit. This has to be sorted it out with a loan, donors support ..

Items	**Price per unit**	**Per cycle (8 months)**	**TOTAL**
	$	**$**	**$**
Operational costs			
Juvenile purchase (1 200 juveniles)	0,20 $/piece	240	
Kerosene and maintenance (hurricance lamp)	2,5 $/month	20	**260**
Sales revenue			
Sale of 900 sea cucumbers	1 $/piece	900	**900**
Gross profit			**640**
Depreciation (over 1 cycle)			
Pen 50x50m (5yr lifespan, i.e. 14 cycles)	500 $	36	
Nursery pen 5x20m (3yr lifespan, i.e. 8 cycles)	200 $	25	
Hurricane lantern (2yr lifespan, i.e. 5 cycles)	35 $	7	
Equipment (masks, traps, crab nets, etc) (2 yr lifespan, i.e. 5 cycles)	40 $	8	**76**
Net profit for 1 cycle			**564**
Net profit per month (with sales every 4 months)			**138**

	Month	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5	Cycle 6
Year 1	1	-1,035					
	2						
	3						
	4						
	5		-240				
	6						
	7						
	8	900					
	9			-240			
	10						
	11						
	12		900	Profit Yr 1= 285			
Year 2	1				-240		
	2						
	3						
	4			900			
	5					-240	
	6						
	7						
	8				900		
	9						-240
	10						
	11						
	12					900	Profit Yr 2=2,265


Jô
Sandfish
village farming
R. PIERRE

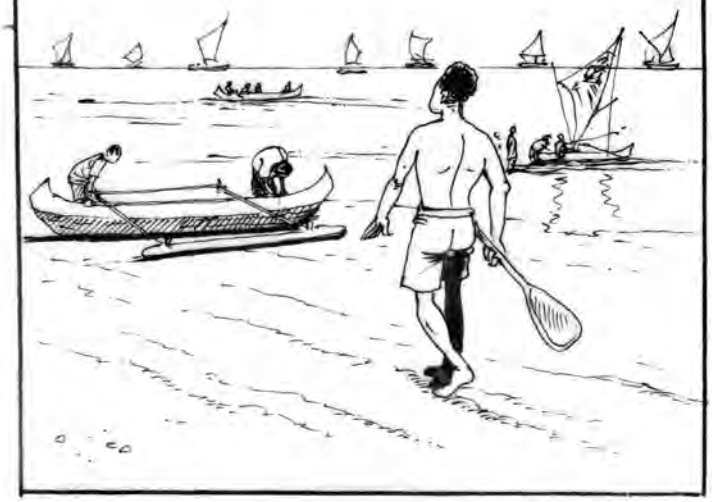
ZANGASOA,

A COASTAL VILLAGE IN SOUTH-WEST MADAGASCAR. FISHING IS THE MAIN ACTIVITY FOR THE PEOPLE IN THIS SMALL VILLAGE.

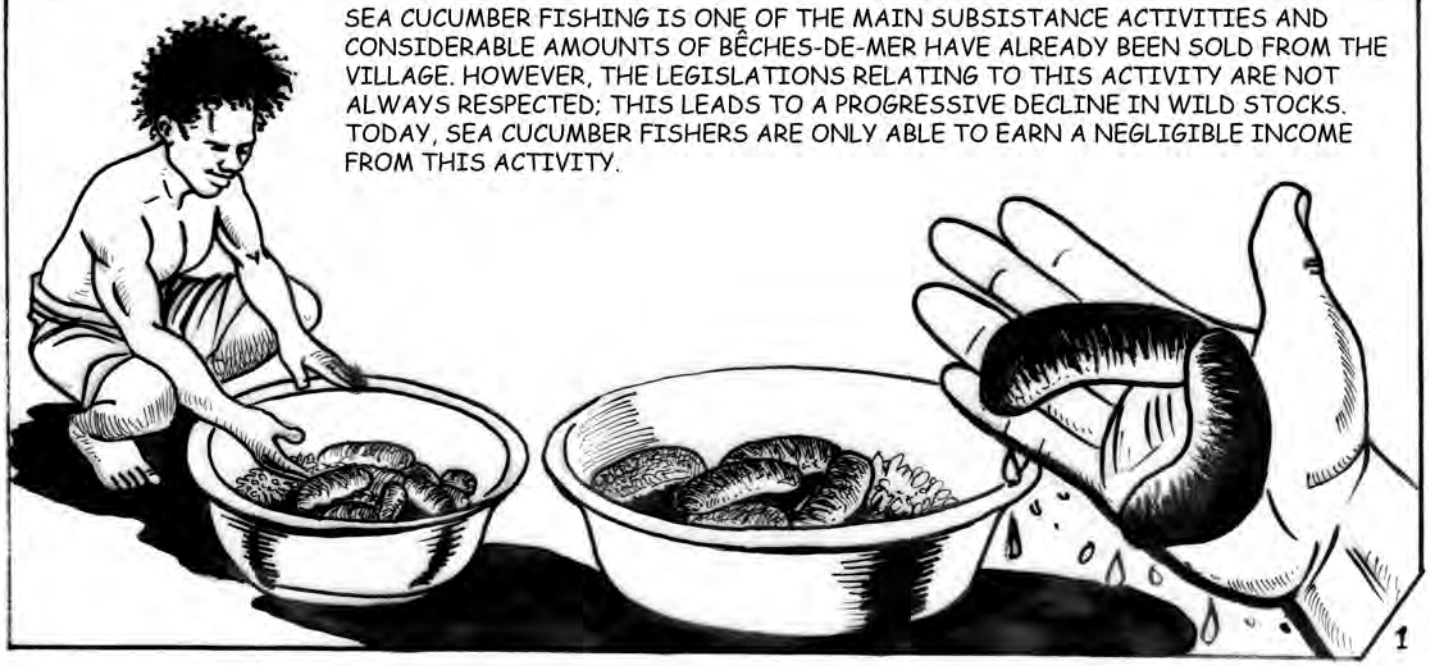
RESEARCH, TEXT AND ILLUSTRATIONS BY :
RAJAONARISON PIERRE / 2010

LIFE IS HARD FOR THE VILLAGERS AS AT EVERY BIG TIDE THE WOMEN AND CHILDREN GO REEF GLEANING TO CATCH OCTOPUS, FISH, SHELLFISH AND URCHINS.

... WHILE THE MEN, WHO HAVE DUGOUT CANOES, FISH WITH A NET OR DIVE FOR SEA CUCUMBERS...



SEA CUCUMBER FISHING IS ONE OF THE MAIN SUBSISTANCE ACTIVITIES AND CONSIDERABLE AMOUNTS OF BÊCHES-DE-MER HAVE ALREADY BEEN SOLD FROM THE VILLAGE. HOWEVER, THE LEGISLATIONS RELATING TO THIS ACTIVITY ARE NOT ALWAYS RESPECTED; THIS LEADS TO A PROGRESSIVE DECLINE IN WILD STOCKS. TODAY, SEA CUCUMBER FISHERS ARE ONLY ABLE TO EARN A NEGLIGIBLE INCOME FROM THIS ACTIVITY.



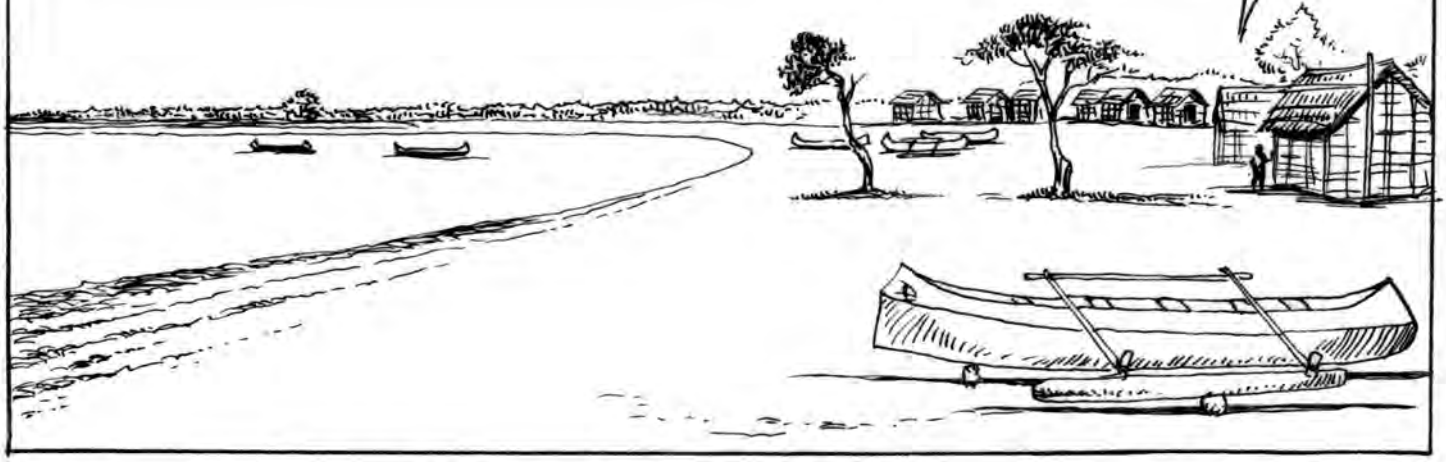

AMONG THESE FISHERS, JO IS ONE OF THE BEST
BUT NOW HE IS WORRIED...
THERE ARE FEWER AND FEWER SEA CUCUMBERS AROUND HERE, WHAT CAN I DO TO EARN MONEY ? IF THIS CONTINUES IT WILL BE THE END FOR ME AND MY FAMILY... FISH ARE ALSO BECOMING RARE !
SEAWEED FARMING IS NOT ENOUGH... MY WIFE ALSO HAS PROBLEMS.
I'M GOING TO TALK TO MAHATANTE
HAVE YOU GOT NOTHING BETTER TO DO THAN HANG AROUND HERE ?
AH ! JO ?
HEY JO, WHERE WERE YOU ? IT'S BEEN A LONG TIME SINCE WE SAW YOU.
IT'S REALLY TOUGH, I CAN'T STOP THINKING ABOUT A WAY TO GET SOME MONEY
WE'RE NOT FINDING SEA CUCUMBERS OR FISH ANY MORE ... I DON'T KNOW WHAT TO DO!
TRUE ! SOON WE'LL BE IN A REALLY BAD SITUATION IF THIS CONTINUES


WHAT ARE WE GOING TO DO THEN ?
WE WERE WRONG TO HAVE CAUGHT EVEN THE YOUNG SEA CUCUMBERS
WE TOOK EVERY THING AND NOW I'M WORRIED THAT THE STOCKS WILL NO LONGER REGENERATE
I FEEL REALLY BAD
SHHH ... JUST DROP IT, WE'LL FIND ANOTHER WAY OUT
YEAH, THAT'S MAINLY WHAT'S WORRYING ME
ONCE, I MET A FRIEND OF MINE FROM SARODRANO, I DON'T KNOW IF WHAT HE SAID IS TRUE BUT HE TOLD ME THAT THEY LIVE ON SEA CUCUMBER FARMING
WOW ! FARM SEA CUCUMBERS ? YOU CAN DO THAT, FARM SEA CUCUMBERS ?
FARMING ?
DELPHIN
OUR ANCESTORS NEVER DID THAT, YOU'LL MAKE THEM ANGRY IF YOU DO THAT GUYS!
SHUT UP MANAHIRA, LISTEN TO WHAT HE'S SAYING FIRST !
HA HA, I DON'T THINK THERE'S ANY TRUTH IN THIS STORY


HE JUST SAID THEY WERE FARMING SEA CUCUMBERS AND THAT SOMEONE WAS HELPING THEM DO IT
AND HOW DO YOU FARM SEA CUCUMBERS ?
I DON'T KNOW BUT I WAS THINKING OF GOING THERE SOON TO SEE !
I'M COMING TOO !
YOU'RE LAZY GUYS, IF YOU DIVE DEEPER, YOU STILL FIND ENOUGH SEA CUCUMBERS ... IT IS AGAINST NATURE TO FARM SEA CUCUMBERS !
JUST SHUT UP!
THE NEXT MORNING AT SARODRANO
ARE YOU READY TO GET STARTED IN AQUACULTURE ?
YES, WE'D REALLY LIKE TO LEARN. WHAT DO WE NEED TO DO MAMONJY ?
IT IS A COMPLICATED BUSINESS. YOU NEED TO BE BRAVE, PATIENT AND PART OF A TEAM BECAUSE THIS REQUIRES TEAMWORK
HEY, YOU KNOW MAMONJY, WE'RE REALLY KEEN TO DO THIS
OK, COME WITH ME. I'LL INTRODUCE YOU TO OUR VILLAGE LIASON OFFICER, HE REPRESENTS THE TECHNICIANS IN THE VILLAGE
OK ! COOL ! LETS GO !
WITH THE VILLAGE LIASON OFFICER
I UNDERSTAND WHAT YOU WANT TO DO. I'LL TELL THE TECHNICIAN WHEN HE COMES TOMORROW MORNING. HE'LL KNOW WHAT TO DO.
THANKS, WE'RE LOOKING FORWARD TO IT.
4

FOLLOWING THE DISCUSSION, THE TECHNICIAN WENT TO THE VILLAGE OF ZANGASOA

WE HAVE RECEIVED YOUR REQUEST. I AM HERE TO DISCUSS THE DIFFERENT FARMING OPTIONS WITH YOU.



THANK YOU FOR COMING TO SEE US. OUR LIFE HERE IS BECOMING DIFFICULT

HMM, THEY SAY THAT SANDFISH IS VERY EXPENSIVE AND THERE IS STRONG DEMAND

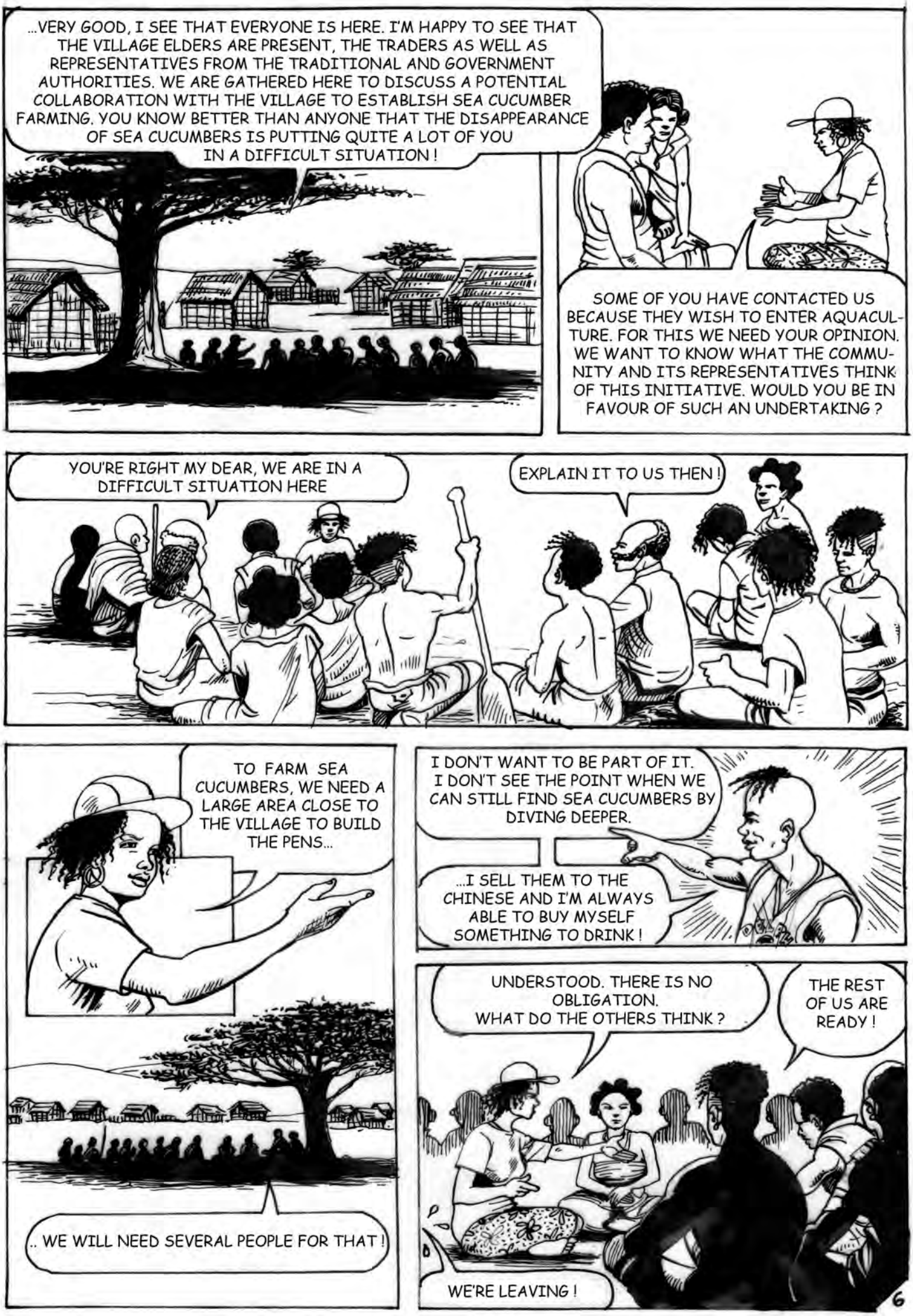
FIRST OF ALL, WE'LL HAVE TO MEET WITH THE VILLAGERS AND THE LOCAL AUTHORITIES....WHEN CAN WE DO THAT ?

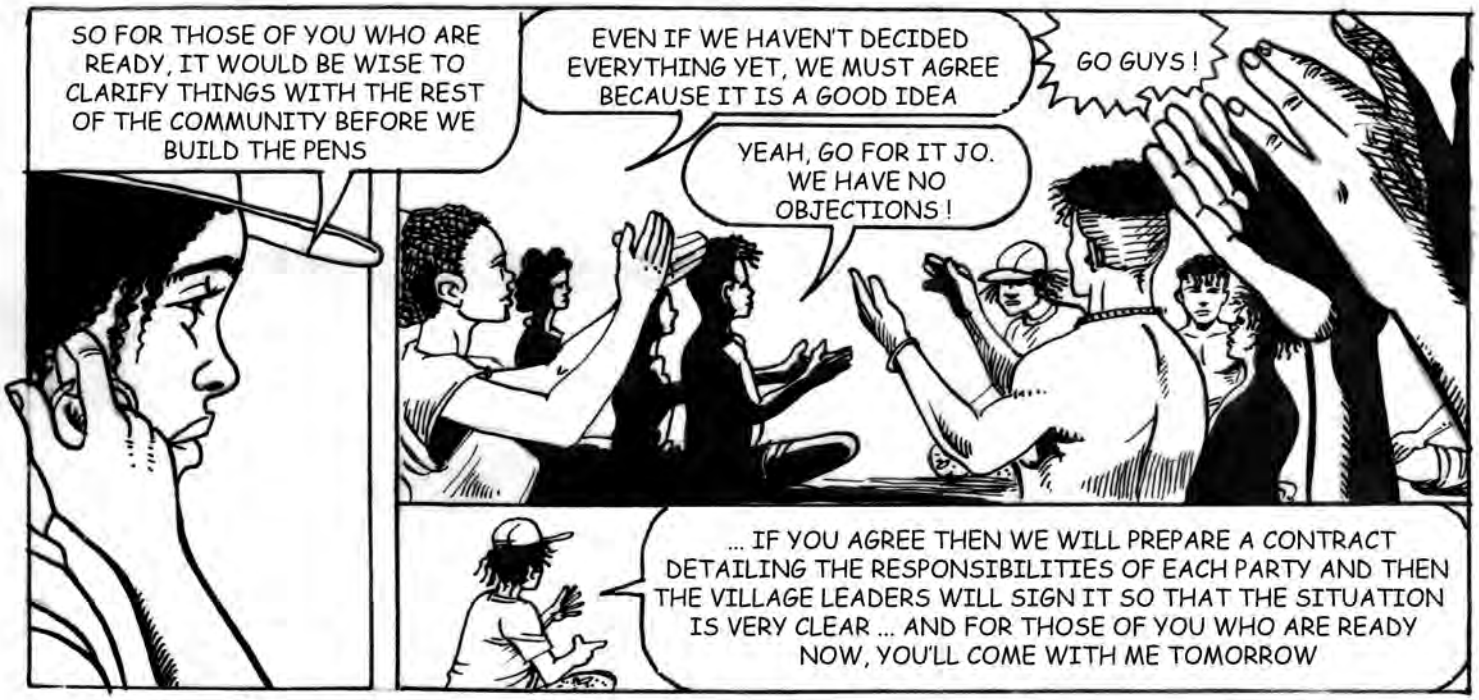
AND IF WE DO THAT STRAIGHTAWAY, WILL IT BE OK ?

IT'S UP TO YOU, WE'RE READY TO WORK WITH YOU.

WE'LL LOOK FOR THE VILLAGE LEADER TO EXPLAIN THE PROJECT. HE CAN ORGANISE A MEETING TO DISCUSS THE POSSIBILITY OF FARMING SEA CUCUMBERS IN PENS HERE IN ZANGASOA...

DEAR FRIENDS, WE HAVE A GUEST WHO BRINGS ENCOURAGING NEWS FOR THE VILLAGE

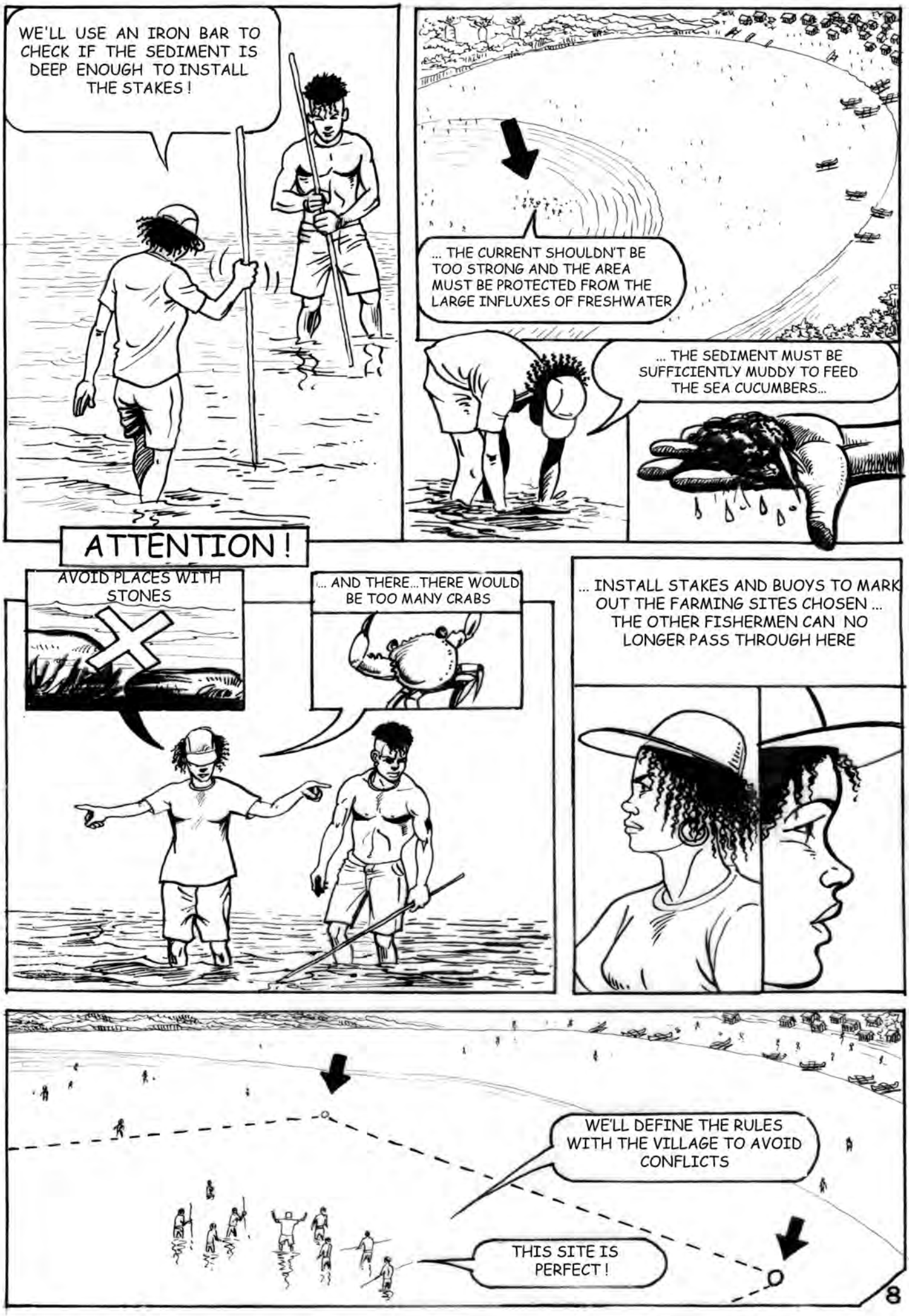

...VERY GOOD, I SEE THAT EVERYONE IS HERE. I'M HAPPY TO SEE THAT THE VILLAGE ELDERS ARE PRESENT, THE TRADERS AS WELL AS REPRESENTATIVES FROM THE TRADITIONAL AND GOVERNMENT AUTHORITIES. WE ARE GATHERED HERE TO DISCUSS A POTENTIAL COLLABORATION WITH THE VILLAGE TO ESTABLISH SEA CUCUMBER FARMING. YOU KNOW BETTER THAN ANYONE THAT THE DISAPPEARANCE OF SEA CUCUMBERS IS PUTTING QUITE A LOT OF YOU IN A DIFFICULT SITUATION !
SOME OF YOU HAVE CONTACTED US BECAUSE THEY WISH TO ENTER AQUACULTURE. FOR THIS WE NEED YOUR OPINION. WE WANT TO KNOW WHAT THE COMMUNITY AND ITS REPRESENTATIVES THINK OF THIS INITIATIVE. WOULD YOU BE IN FAVOUR OF SUCH AN UNDERTAKING ?
YOU'RE RIGHT MY DEAR, WE ARE IN A DIFFICULT SITUATION HERE
EXPLAIN IT TO US THEN !
TO FARM SEA CUCUMBERS, WE NEED A LARGE AREA CLOSE TO THE VILLAGE TO BUILD THE PENS...
.. WE WILL NEED SEVERAL PEOPLE FOR THAT !
I DON'T WANT TO BE PART OF IT. I DON'T SEE THE POINT WHEN WE CAN STILL FIND SEA CUCUMBERS BY DIVING DEEPER.
...I SELL THEM TO THE CHINESE AND I'M ALWAYS ABLE TO BUY MYSELF SOMETHING TO DRINK !
UNDERSTOOD. THERE IS NO OBLIGATION. WHAT DO THE OTHERS THINK ?
THE REST OF US ARE READY !
WE'RE LEAVING !


SO FOR THOSE OF YOU WHO ARE READY, IT WOULD BE WISE TO CLARIFY THINGS WITH THE REST OF THE COMMUNITY BEFORE WE BUILD THE PENS
EVEN IF WE HAVEN'T DECIDED EVERYTHING YET, WE MUST AGREE BECAUSE IT IS A GOOD IDEA
GO GUYS !
YEAH, GO FOR IT JO. WE HAVE NO OBJECTIONS !
... IF YOU AGREE THEN WE WILL PREPARE A CONTRACT DETAILING THE RESPONSIBILITIES OF EACH PARTY AND THEN THE VILLAGE LEADERS WILL SIGN IT SO THAT THE SITUATION IS VERY CLEAR ... AND FOR THOSE OF YOU WHO ARE READY NOW, YOU'LL COME WITH ME TOMORROW


THE NEXT MORNING...
YOU ARE GOING TO HELP ME IDENTIFY AREAS SUITABLE FOR YOUR FARMS


... AT SPRING LOW TIDE, SITE SELECTION...
HERE SHOULD BE A GOOD SITE BECAUSE THERE USED TO BE LOTS OF SEA CUCUMBERS...


THE WATER LEVEL NEEDS TO BE BETWEEN 10 AND 75CM AT SPRING LOW TIDES. ABOVE ALL, THE SEDIMENT SHOULD NEVER DRY OUT
SELECT AN AREA WHERE THERE IS SOME SEAGRASS...
HERE THERE SEEMS TO BE ENOUGH SPACE TO BUILD SEVERAL PENS


WE'LL USE AN IRON BAR TO CHECK IF THE SEDIMENT IS DEEP ENOUGH TO INSTALL THE STAKES !
... THE CURRENT SHOULDN'T BE TOO STRONG AND THE AREA MUST BE PROTECTED FROM THE LARGE INFLUXES OF FRESHWATER
... THE SEDIMENT MUST BE SUFFICIENTLY MUDDY TO FEED THE SEA CUCUMBERS...
ATTENTION !
AVOID PLACES WITH STONES
... AND THERE...THERE WOULD BE TOO MANY CRABS
... INSTALL STAKES AND BUOYS TO MARK OUT THE FARMING SITES CHOSEN ... THE OTHER FISHERMEN CAN NO LONGER PASS THROUGH HERE
WE'LL DEFINE THE RULES WITH THE VILLAGE TO AVOID CONFLICTS
THIS SITE IS PERFECT !

NO WAY ! I OBJECT ! CHOOSE ANOTHER PLACE BECAUSE THAT IS WHERE MY WIFE USUALLY COLLECTS SHELLS

YOU ARE ALWAYS IN BAD FAITH MANAHIRA. YOU KNOW VERY WELL THAT YOUR WIFE CAN GO LOOKING FOR SHELLS ELSEWHERE

DON'T YOU SEE THAT YOU ARE VERY CLOSE TO MY HOUSE AND THAT IT IS MY PATH TO COME BACK IN MY CANOE ? SORRY OLD MAN, BUT I REFUSE THAT YOU BUILD YOUR PENS HERE ... IT'S TOO MUCH HASSLE FOR ME. GO SOMEWHERE ELSE IF YOU DON'T WANT AN ARGUMENT !

JUST FORGET ABOUT IT, WE'LL GO AND CHOOSE ANOTHER SITE !

SSS...

DELPHIN

PREPARATION OF THE EQUIPMENT BEGINS

HERE IS THE REPRESENTATIVE OF THE COMPANY PRODUCING THE JUVENILE SEA CUCUMBERS. THEY CAN HELP YOU TO START FARMING BY PROVIDING THE MATERIALS AND THE FIRST BATCHES OF JUVENILES ON CREDIT. YOU PAY THEM BACK WHEN YOU SELL THE FIRST SEA CUCUMBERS... !

TO BENEFIT FROM OUR INITIAL SUPPORT AND DELIVERY OF JUVENILES, I SUGGEST YOU SIGN A CONTRACT GUARANTEEING THAT WE WILL BE THE ONLY ONES TO BUY BACK YOUR SEA CUCUMBERS WHEN THEY REACH A WEIGHT OF 350g.

OF COURSE! THAT SEEMS FAIR !

EVERYTHING IS CLEAR! COME ON, LET US CARRY ON WORKING ...

HERE IS THE NECESSARY EQUIPMENT

0,75m
or
1,5m

... FOR THE PEN, A NET THAT IS 75 CM - 1M WIDE... ... PLASTIC MESH IS GOOD BECAUSE IT LASTS FOR A LONG TIME...

N° 2 NYLON ROPE

2mm

... THIS STRING IS USED TO ATTACH THE NET TO THE STAKES ...

HARDWOOD STAKES ... 410 STAKES PER PEN SHOULD BE ENOUGH

1m

...SOME SHOVELS TO DIG THE SEDIMENT

THERE ARE TWO POSSIBLE TYPES OF PENS FOR YOUR FARM .....

..... BOTH ARE GOOD BUT THE CHOICE DEPENDS MAINLY ON THE CHARACTERISTICS OF THE AREA !

THE FIRST TYPE IS A SQUARE PEN... WE PUT STAKES IN THE FOUR CORNERS

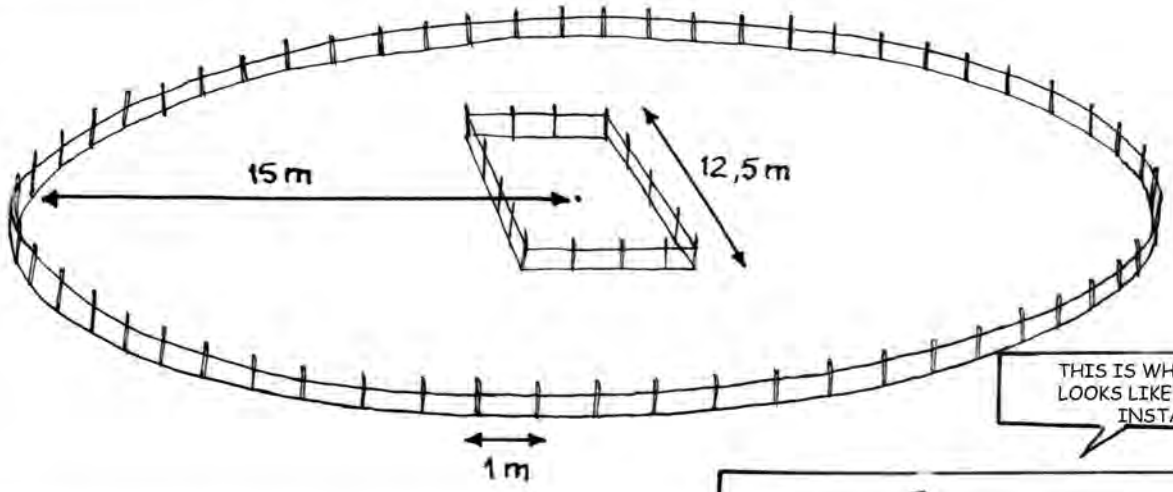
1,25m
Sea
sediment
20-30 cm

... THEN YOU RUN ROPES BETWEEN THEM TO GUIDE THE ALIGNMENT OF PEN WALLS ...

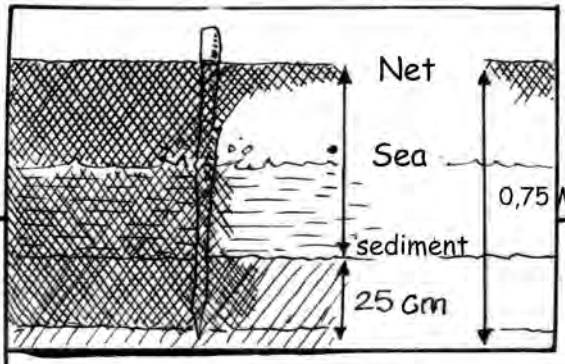
FINALY, WE BUILD EACH SIDE ONE BY ONE


WE FOLLOW THE DIRECTION OF THE ROPE TO MAKE SURE THAT THE NET GOES IN STRAIGHT AND PLACE THE STAKES ONTO WHICH THE NET WILL BE FIXED.
WHAT WE ARE DOING IS FOR US... SO DO IT WELL AND TAKE IT SERIOUSLY EVERYONE.
...AND, PAY ATTENTION TO ADVICE FROM TECHNICIANS. THEY ARE THERE TO GUIDE US!
WE DIG A STRAIGHT TRENCH OF AT LEAST 25CM DEEP IN THE SEDIMENT.
BIT BY BIT, WE INSTALL THE PLASTIC NET AND THE STAKES, MAKING SURE THAT THE FENCE IS KEPT TAUGHT.
THEN WE ATTACH THE NET TO THE STAKES WITH THE CORD N°2
25CM
WHEN IT IS DONE, WE CAN ALWAYS ADD MORE STAKES IF WE NEED TO REINFORCE THE PEN...
... ESPECIALLY AT THE CORNERS TO TENSION THE PEN.

THE SECOND TYPE IS A ROUND PEN WITH A 15M RADIUS.



THIS IS WHAT THE PEN LOOKS LIKE ONCE IT IS INSTALLED



... WE ALSO BUILD A SMALL 25m² PEN IN THE INTERIOR TO STOCK THE JUVENILES.

DEAR FRIENDS,
WE ARE GOING TO START A NEW ACTIVITY THAT OUR ANCESTORS DIDN'T KNOW. I WILL CARRY OUT A SMALL CEREMONY TO SEEK THEIR BLESSINGS AND MAKE SURE OUR FUTURE HARVESTS ARE GOOD ...

GOOD THINKING WISE MAN!

AND THEN, TO THANK THE VILLAGE FOR AGREEING TO LET US USE THIS SPACE, I PROPOSE THAT WE SACRIFICE A COW ...

... WE WILL TAKE THE OPPORTUNITY TO ESTABLISH A VILLAGE AGREEMENT TO PREVENT POACHING AND MAINTAIN A HEALTHY COLLABORATION AMONG EVERYONE, VILLAGERS, SEA CUCUMBER FARMERS, GOVERNMENT, SEA CUCUMBER TRADERS AND ANYONE ELSE .....

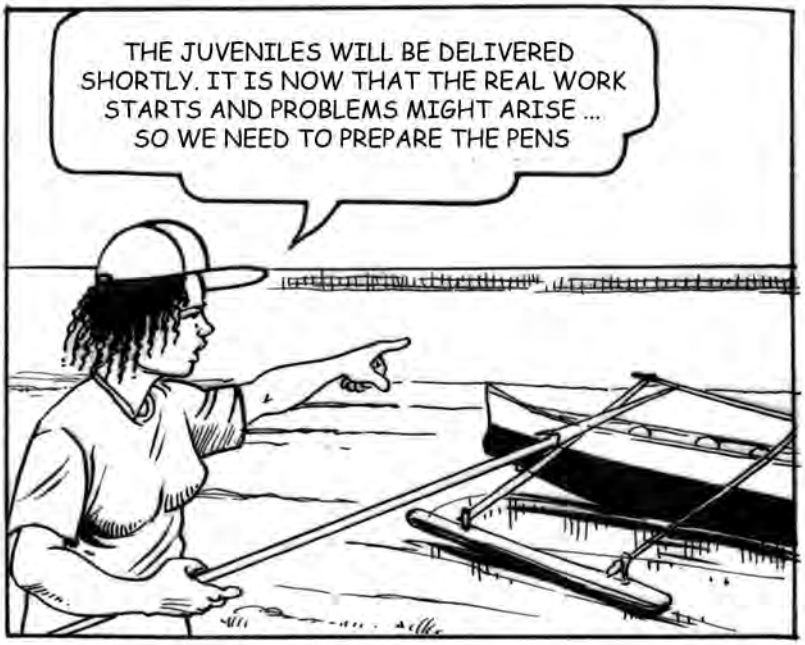
SO LET'S CHIP IN TO BUY A COW!

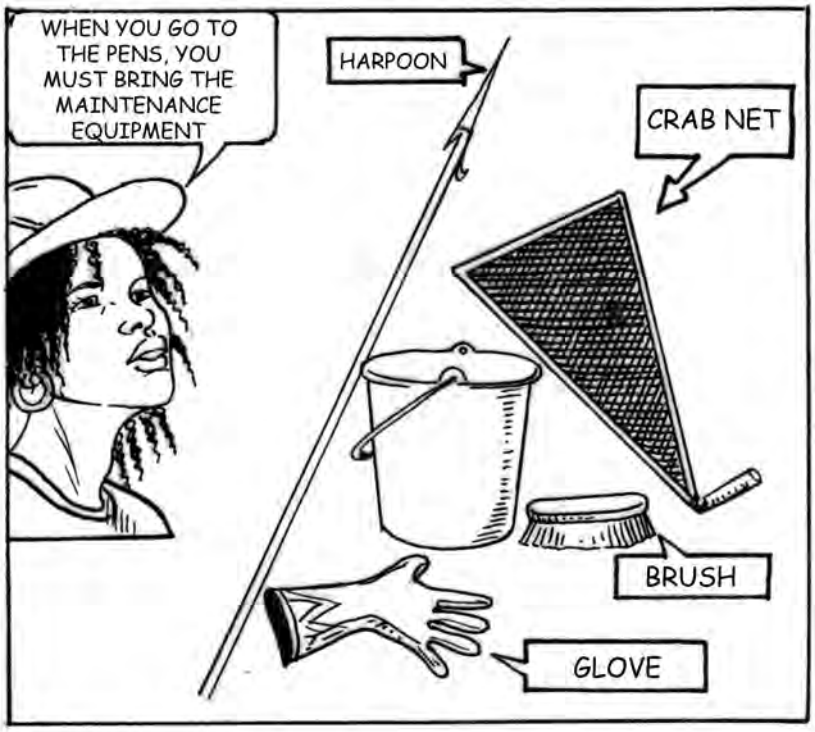
DURING THE BLESSING CEREMONY
IN THE VILLAGE OF ZANGASOA

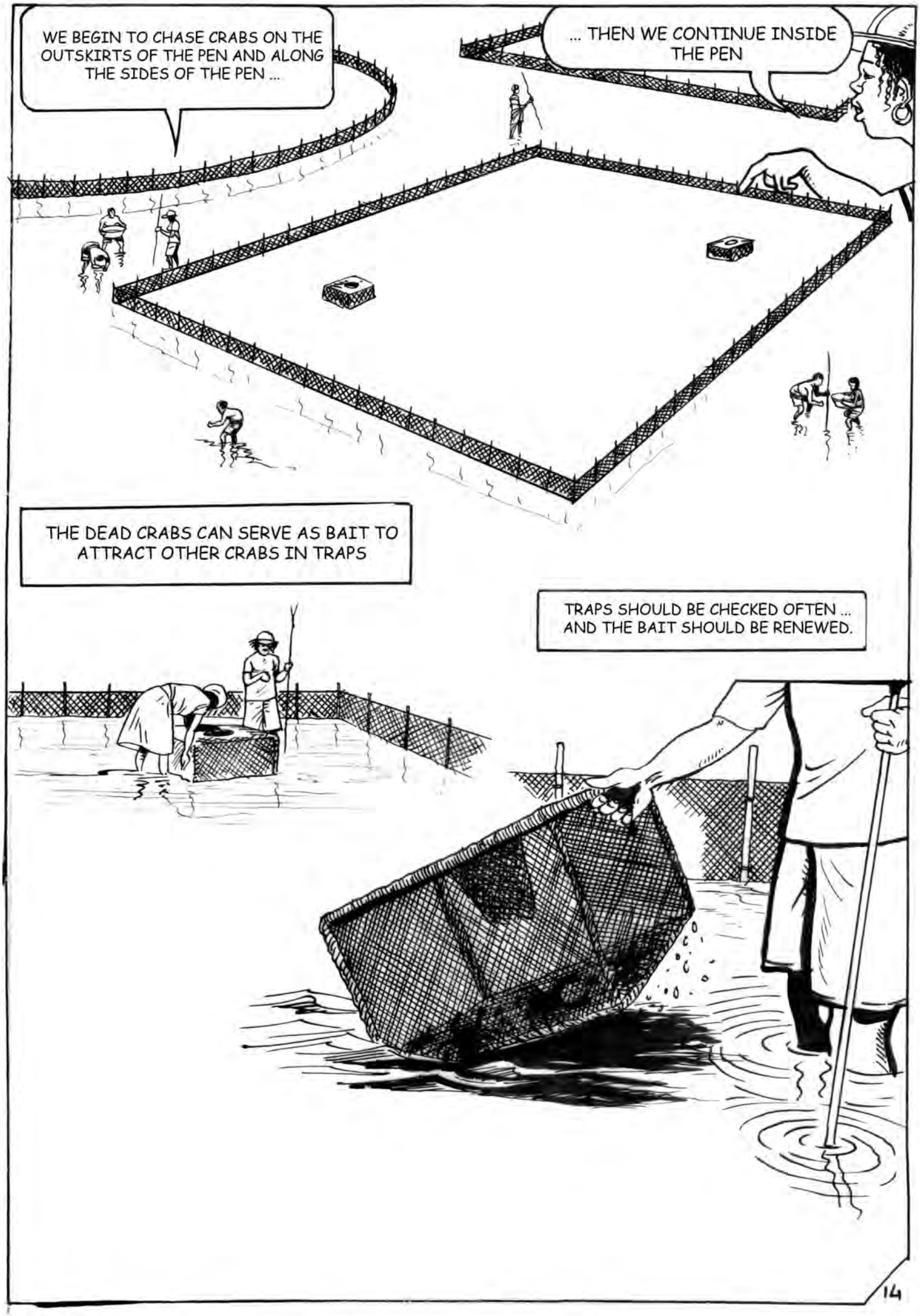
... THOSE WHO EAT THIS COW WILL BE PUNISHED BY GOD AND THE ANCESTORS IF THEY STEAL OR VANDALISE THE FARMS, BUT BLESS THEM IF THEY COMPLY. WE HOPE THAT SEA CUCUMBER FARMING DEVELOPS AND PROVIDES WELLBEING AND PROSPERITY TO THE WHOLE VILLAGE!

A FEW DAYS AFTER THE INSTALLATION OF PENS, EACH TEAM IS READY -

THE SPRING TIDE ARRIVES






WE BEGIN TO CHASE CRABS ON THE OUTSKIRTS OF THE PEN AND ALONG THE SIDES OF THE PEN ...
... THEN WE CONTINUE INSIDE THE PEN
THE DEAD CRABS CAN SERVE AS BAIT TO ATTRACT OTHER CRABS IN TRAPS
TRAPS SHOULD BE CHECKED OFTEN ... AND THE BAIT SHOULD BE RENEWED.

IT IS NECESSARY TO REMOVE SEAWEED AND MUD CLINGING TO THE SIDES OF THE PEN TO ENSURE GOOD WATER EXCHANGE.

WARNING

WE USE A SCRUBBING BRUSH

... CLUMPS OF SEAWEED THAT ACCUMULATE IN THE PEN MUST BE THROWN OUT SO THAT THEY DON'T INTERFERE WITH THE GROWTH OF SEA CUCUMBERS

IF THE CRABS ARE TOO ABUNDANT, WE MUST INTENSIFY THE HUNT TO ELIMINATE THEM ALL ...

YOU NEED TO SWIM ALONG THE EDGE OF THE PEN WITH A MASK

USING A CRAB NET TO TRAP THE CRABS

CAREFULLY CHECK THE BASE OF THE NET

YOU MUST BE VERY THOROUGH IN THE SEARCH FOR CRABS

... WE CAN ALSO BUILD A NURSERY: A SMALL ENCLOSURE COVERED WITH A NET TO PROTECT THE JUVENILES

... IT STOPS THE CRABS FROM ATTACKING THE JUVENILES

WE MUST KILL EVEN THE SMALL CRABS, ESPECIALLY WITHIN THE NURSERY WHERE THE JUVENILES ARE STILL SMALL AND VULNERABLE

BE CAREFUL, THERE ARE STILL MORE !

A THOROUGH ELIMINATION OF CRABS IS ESSENTIAL BEFORE STOCKING THE JUVENILES...

THE NEXT MORNING AT LOW TIDE, THE JUVENILES ARE DELIVERED BY THE TECHNICIANS

WE MUST ENSURE THAT JUVENILES ARE IN GOOD HEALTH. IT MAY BE THAT:

...SOME ARRIVE EVISCERATED...

...AND OTHERS ARE INJURED.

INSPECT THEM CAREFULLY !

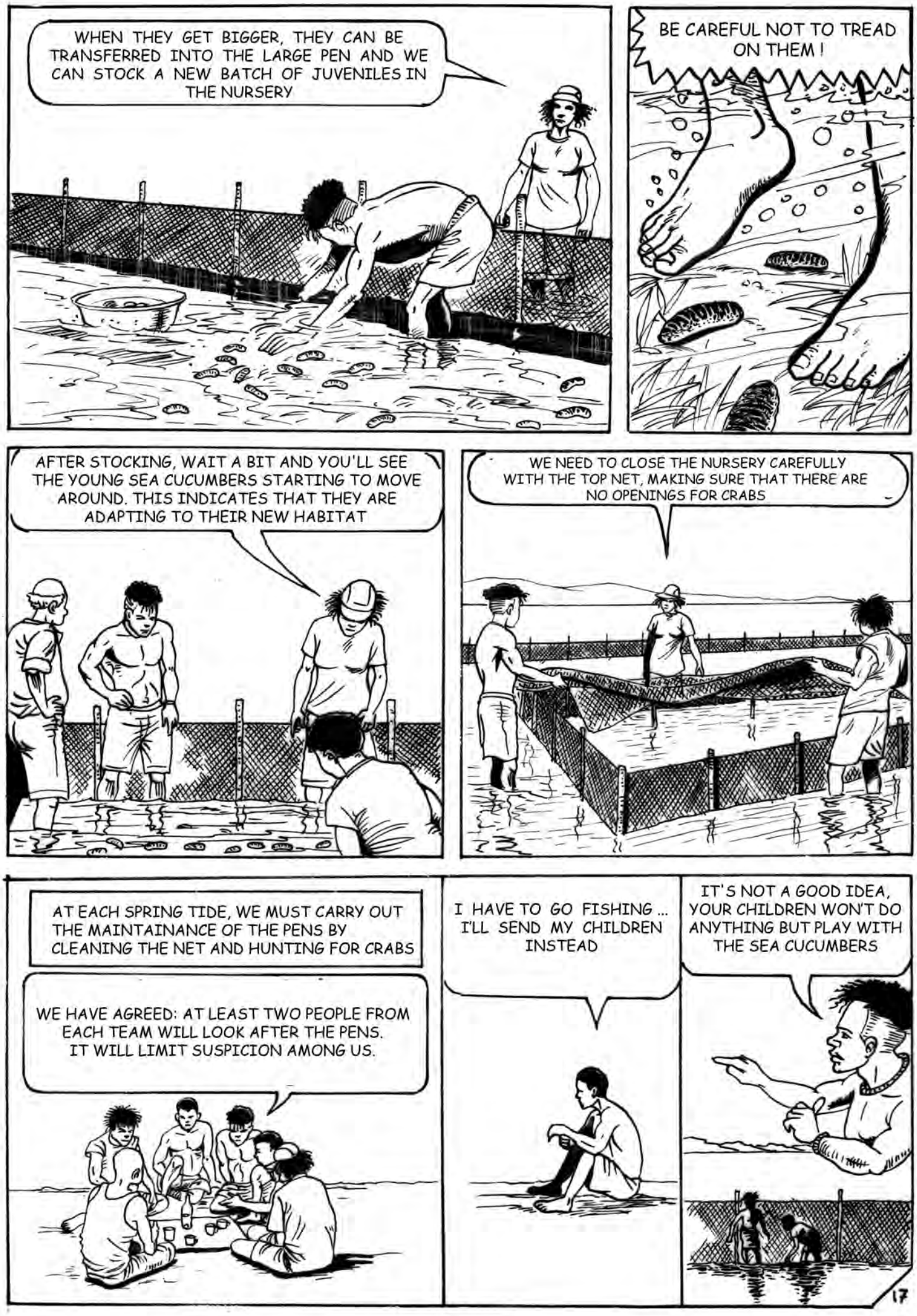
THE TRANSPORT CAN DAMAGE SOME JUVENILES

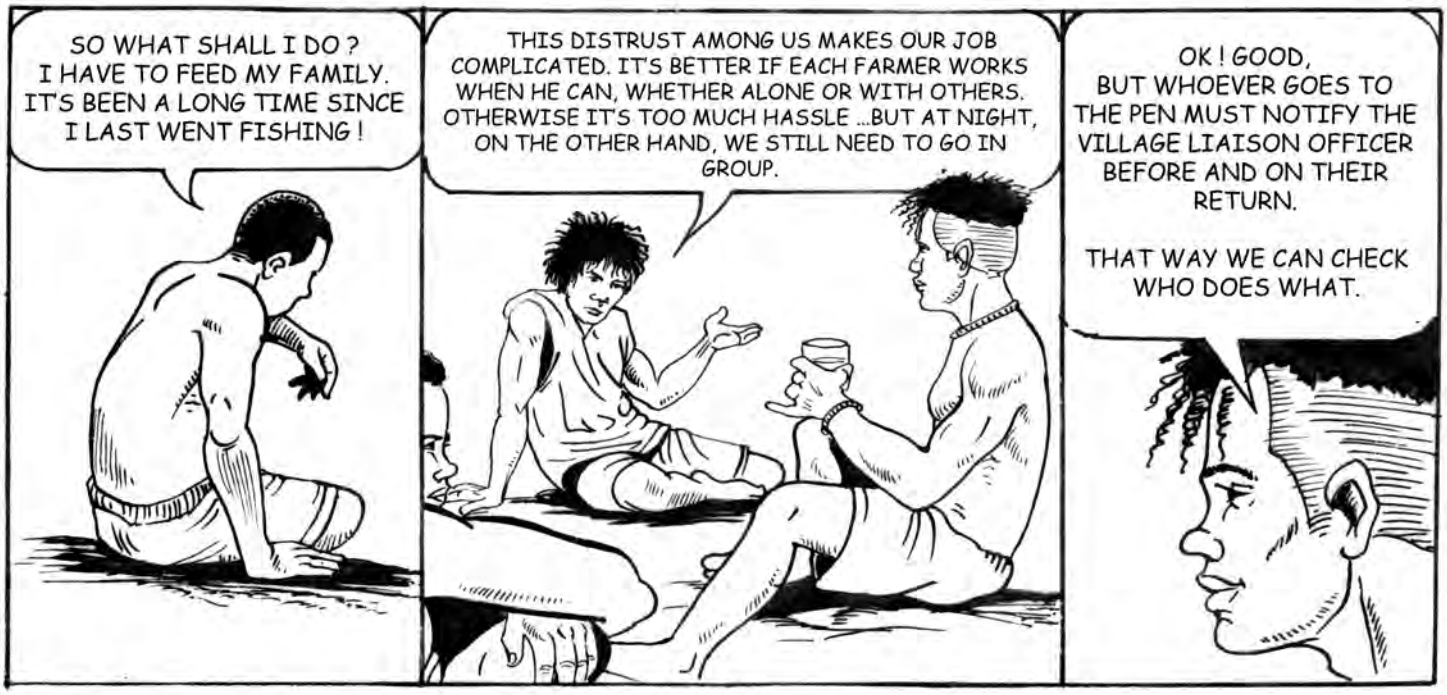
WHEN SOME SEA CUCUMBERS ARRIVE IN POOR CONDITION, MAKE A WRITTEN STATEMENT WITH THE TECHNICIAN RESPONSIBLE FOR THE DELIVERY

IT IS ALSO NECESSARY TO RECOUNT THE JUVENILES TO ENSURE YOUR ORDER IS COMPLETE

THE JUVENILES ARE STOCKED IN THE NURSERY...

...SPREADING THEM OUT EVENLY SO AS NOT TO SLOW THEIR GROWTH


WHEN THEY GET BIGGER, THEY CAN BE TRANSFERRED INTO THE LARGE PEN AND WE CAN STOCK A NEW BATCH OF JUVENILES IN THE NURSERY
BE CAREFUL NOT TO TREAD ON THEM !
AFTER STOCKING, WAIT A BIT AND YOU'LL SEE THE YOUNG SEA CUCUMBERS STARTING TO MOVE AROUND. THIS INDICATES THAT THEY ARE ADAPTING TO THEIR NEW HABITAT
WE NEED TO CLOSE THE NURSERY CAREFULLY WITH THE TOP NET, MAKING SURE THAT THERE ARE NO OPENINGS FOR CRABS
AT EACH SPRING TIDE, WE MUST CARRY OUT THE MAINTAINANCE OF THE PENS BY CLEANING THE NET AND HUNTING FOR CRABS
WE HAVE AGREED: AT LEAST TWO PEOPLE FROM EACH TEAM WILL LOOK AFTER THE PENS. IT WILL LIMIT SUSPICION AMONG US.
I HAVE TO GO FISHING ... I'LL SEND MY CHILDREN INSTEAD
IT'S NOT A GOOD IDEA, YOUR CHILDREN WON'T DO ANYTHING BUT PLAY WITH THE SEA CUCUMBERS


SO WHAT SHALL I DO ? I HAVE TO FEED MY FAMILY. IT'S BEEN A LONG TIME SINCE I LAST WENT FISHING !
THIS DISTRUST AMONG US MAKES OUR JOB COMPLICATED. IT'S BETTER IF EACH FARMER WORKS WHEN HE CAN, WHETHER ALONE OR WITH OTHERS. OTHERWISE IT'S TOO MUCH HASSLE ...BUT AT NIGHT, ON THE OTHER HAND, WE STILL NEED TO GO IN GROUP.
OK ! GOOD, BUT WHOEVER GOES TO THE PEN MUST NOTIFY THE VILLAGE LIAISON OFFICER BEFORE AND ON THEIR RETURN.
THAT WAY WE CAN CHECK WHO DOES WHAT.


AT EACH SPRING TIDE, IT IS NECESSARY TO CONTINUE TO CHECK THE PEN AND KILL THE CRABS DURING THE DAY AND AT NIGHT.
NIGHT FALLS ....
THE FARMERS GO TO THE PENS WITH THEIR EQUIPMENT
I AM REASSURED BY THE RESULT OF THE COUNT. IN OUR PENS, WE FOUND 400 SEA CUCUMBERS
IN OURS, LOTS ARE MISSING. WE DON'T KNOW WHERE THEY'VE GONE.


IT MAKES SENSE THAT YOU STILL HAVE 400. YOU HAVE HUNTED THE CRABS VERY EFFECTIVELY !
ON THE OTHER HAND, I HAVE THE IMPRESSION THAT THE REST OF YOU HAVE BEEN LESS THOROUGH AND THAT'S WHY YOU ARE MISSING SOME.
HEY ! STOP PLAYING WITH THE SEA CUCUMBERS. YOU'LL STRESS THEM AND STUNT THEIR GROWTH !


IT IS ALSO BEST TO AVOID MOVING THE SEA CUCUMBERS THAT YOU FIND. IF THEY ARE IN ONE PLACE, IT'S BECAUSE THEY ARE CONTENT AND FINDING ENOUGH FOOD.
BE CAREFUL NOT TO HURT THE SEA CUCUMBERS WHEN YOU SPEAR CRABS ! EACH CUCUMBER THAT DIES MEANS LESS PROFIT !
WHEN SEA CUCUMBERS ARE FOUND ALONG THE SIDES OF THE PEN, WE CAN PUT THEM IN THE MIDDLE OF THE PEN.
TIME PASSES AND SEA CUCUMBERS GROW ... IT'S THE NIGHT TO MONITOR THE STOCKS ...
FOLLOW THE INSTRUCTIONS THAT I GIVE YOU ...
WE MUST MOVE SLOWLY UPSTREAM TO AVOID DISTURBING THE WATER ... WE WALK IN A LINE BESIDE THE PERSON HOLDING THE HURRICANE LANTERN.
IT'S GOOD TO HAVE A FEW PEOPLE FOR THAT

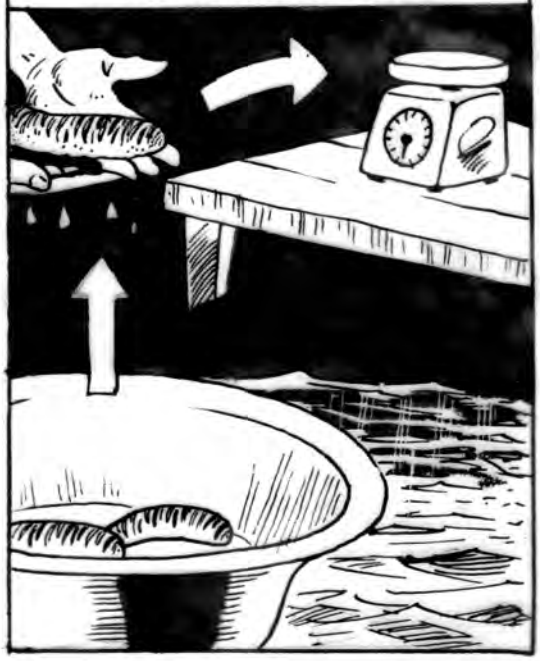
IT SHOULD BE DONE SLOWLY SO AS NOT TO MISS ANY...

DON'T PUT WATER IN THE CONTAINER, OTHERWISE THE SEA CUCUMBERS WILL FILL UP WITH WATER WHICH WILL LEAD TO ERRORS IN THE WEIGHING

TORCHES CAN BE USED IF THERE IS NOT ENOUGH LIGHT

AFTER THE FIRST SEARCH, IF SEA CUCUMBERS ARE STILL MISSING THE PEN CAN BE SEARCHED A SECOND TIME AFTER WAITING A FEW MINUTES FOR THE WATER TO SETTLE AND BECOME CLEAR

THE SEA CUCUMBERS ARE WEIGHED AS YOU GO ALONG... FAIRLY QUICKLY TO PREVENT THEM FROM EVISCERATING



THE WEIGHING SCALES ARE SET UP ON A TABLE AND THEY ARE WEIGHED ONE BY ONE...

... AND AFTER BEING WEIGHED THEY ARE PUT IN ANOTHER CONTAINER FILLED WITH SEAWATER

WE RECORD ALL THE WEIGHTS TO EVALUATE THE GROWTH RATE AND THE NUMBER OF SEA CUCUMBERS THAT ARE READY TO SELL.

... ONCE THAT'S ALL DONE, WE PUT THE SEA CUCUMBERS BACK IN THEIR PLACE

BE CAREFUL
NOT TO EMPTY THE BOWL ALL AT ONE GO OTHERWISE THE SEA CUCUMBERS WILL ALL BE GROUPED IN THE SAME PLACE !

BE CAREFUL NOT TO THROW THEM

.. PLACE THEM GENTLY IN THE WATER AND SPREAD THEM OUT A BIT !

COUNTING AND WEIGHING IS CARRIED OUT ONCE A MONTH TO CHECK THE GROWTH, SURVIVAL AND POTENTIAL THEFT FROM EACH PEN

AFTER COUNTING THE JUVENILES IN THE NURSERY, THE TOP NET MUST BE STITCHED BACK ON CAREFULLY TO PREVENT CRABS FROM ENTERING

YOU NEED TO CHECK YOUR PENS AND KILL CRABS VERY FREQUENTLY, PARTICULARLY IN THE NURSERY.

FOR EXAMPLE, IF YOU SEE TEARS IN THE NET YOU NEED TO MEND THEM AS SOON AS POSSIBLE

WALK AROUND YOUR PENS TO SEE IF THE NETS ARE DAMAGED OR THE STAKES BROKEN.

IT IS ALSO GOOD TO TAKE A LOOK OUTSIDE THE PEN TO CHECK IF ANY SEA CUCUMBERS HAVE ESCAPED

3m

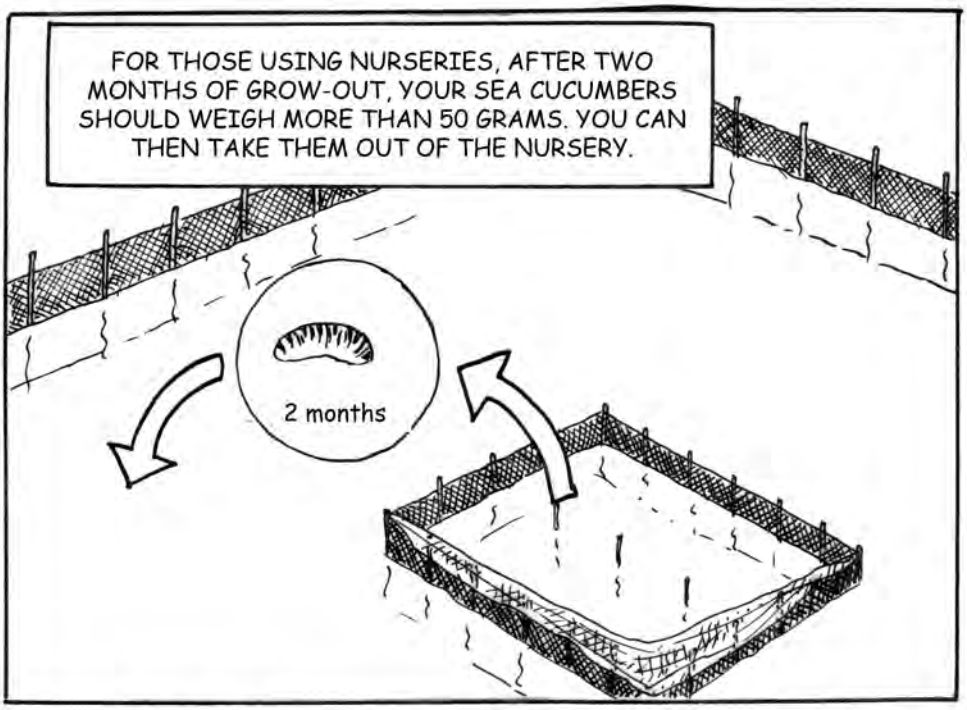
IF SHELLS BECOME ATTACHED TO THE STAKES, REMOVE THEM WITH A KNIFE. THIS WILL AVOID THEM DAMAGING THE NET OR SOMEONE GETTING HURT

WE ALSO CHECK THE CRAB TRAPS, WHETHER IT'S TRAPS OR BAITED BUCKETS PLACED IN HOLES.

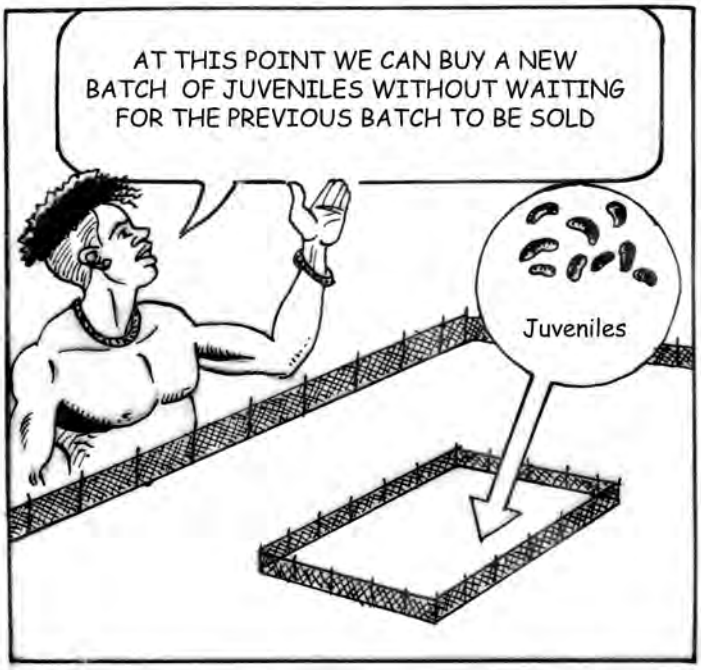
THE CAPTURED CRABS MUST BE KILLED. BREAKING OFF THEIR PINCERS IS NOT ENOUGH BECAUSE THEY CAN REGROW

THE DEAD CRABS ARE TAKEN BACK TO THE VILLAGE OR USED AS BAIT IN THE TRAPS

FOR THOSE USING NURSERIES, AFTER TWO MONTHS OF GROW-OUT, YOUR SEA CUCUMBERS SHOULD WEIGH MORE THAN 50 GRAMS. YOU CAN THEN TAKE THEM OUT OF THE NURSERY.



AT THIS POINT WE CAN BUY A NEW BATCH OF JUVENILES WITHOUT WAITING FOR THE PREVIOUS BATCH TO BE SOLD



AFTER EIGHT MONTHS

THERE WE ARE, MANY SEA CUCUMBERS WEIGH OVER 350 GRAMS. WE WILL TELL OUR BUYER TO COME TO COLLECT THEM !

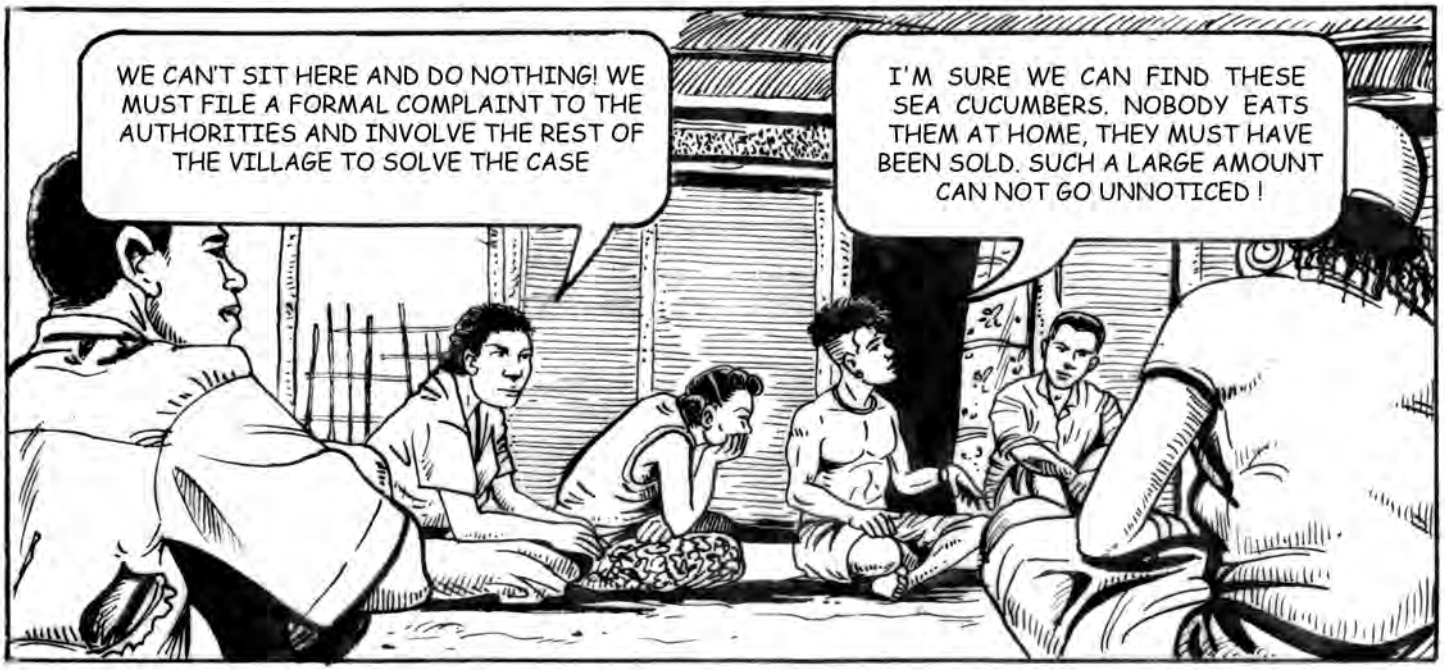
WE MUST BE VERY VIGILANT WITH OUR SEA CUCUMBERS MAHATANTE BECAUSE THERE WILL ALWAYS BE PEOPLE WHO WILL TRY TO STEAL FROM US

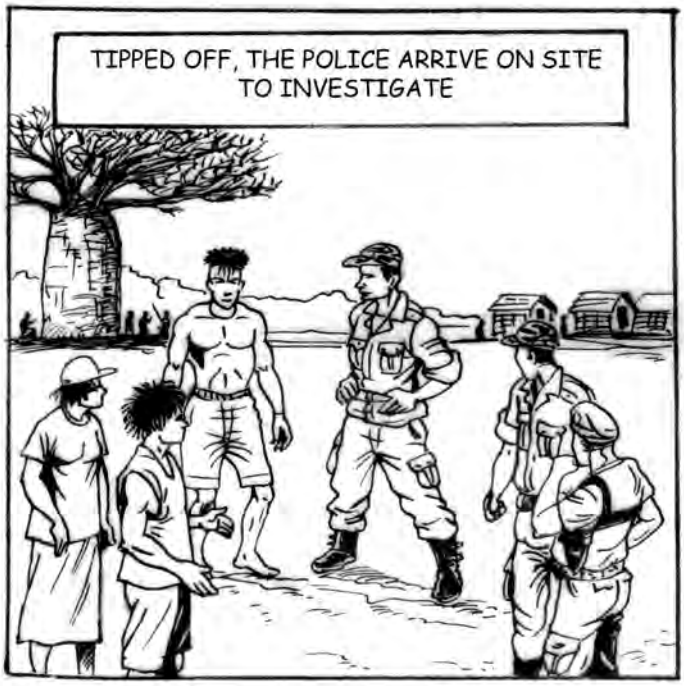
SURE !
WE MUST ORGANISE A ROTA TO GUARD THE PENS, WHATEVER THE TIDE OR THE WEATHER !

ABSOLUTELY, IT SEEMS CRITICAL !

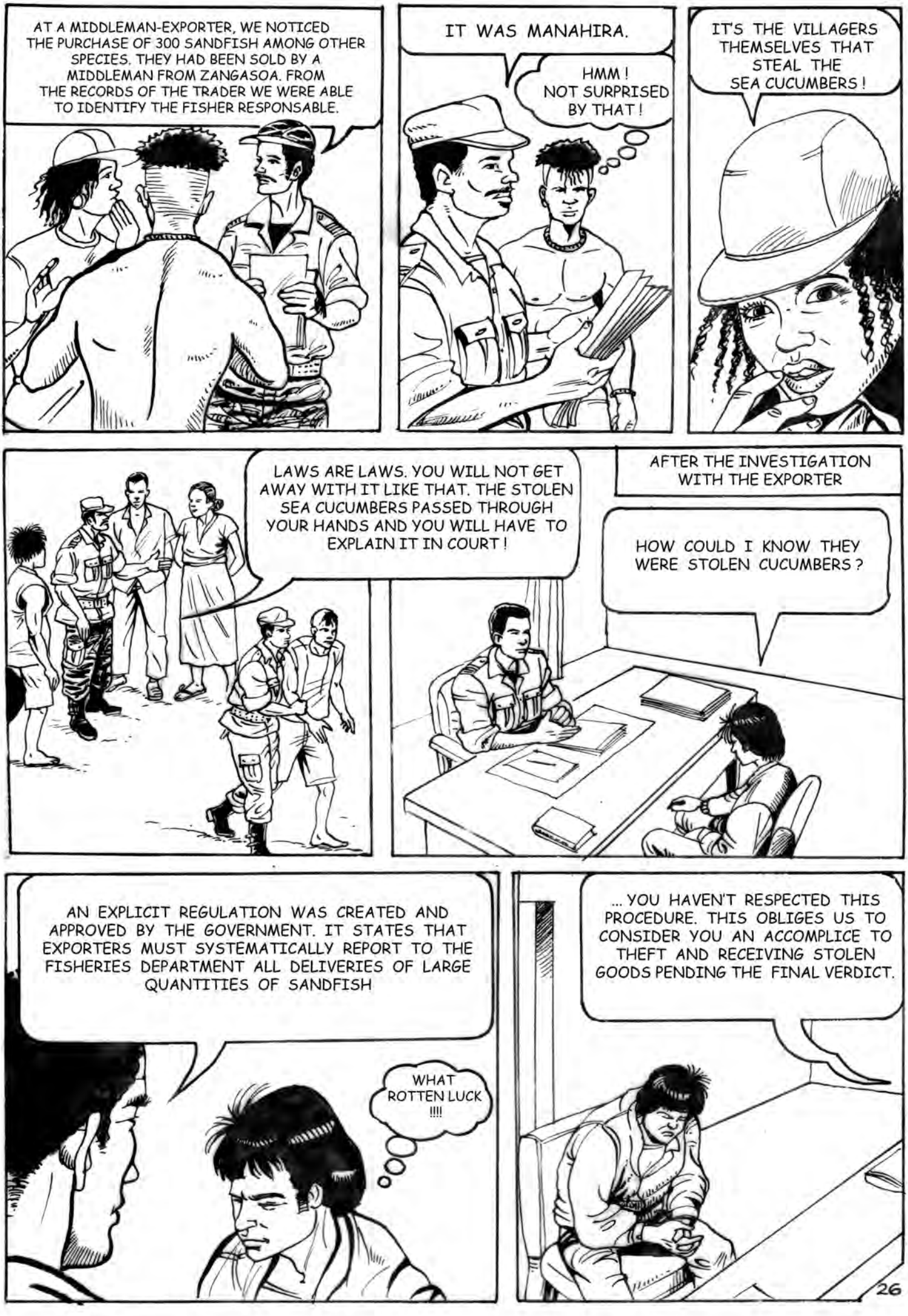

THE TIME HAS COME TO SELL THE SEA CUCUMBERS THAT HAVE REACHED COMMERCIAL SIZE
ALL THE TEAMS ARE BUSY COLLECTING THEIR SEA CUCUMBERS
?!
YIKES ?!! COME AND SEE JO !
I'M MISSING LOADS ! WHERE HAVE THEY GONE ? WE'VE BEEN ROBBED !
WHO WAS IN CHARGE OF THE SURVEILLANCE LAST NIGHT ?
WOAH ! I NEVER THOUGHT THAT THEY WOULD BE STOLEN !
IT WAS ZEAVISOA'S FATHER WHO GUARDED THE PENS LAST NIGHT !
ALL THAT EFFORT IN VAIN ! I REALLY NEEDED THAT MONEY !
HEY OLD MAN, WAS IT NOT YOUR TURN TO KEEP GUARD LAST NIGHT ? WHY HAVE MAHATANTY'S SEA CUCUMBERS DISAPPEARED ?
I WAS EXHAUSTED ...
... THERE WASN'T ANOTHER TEAM MEMBER SO I WENT TO BED
WHAT SHALL WE DO ?


THE FOLLOWING MORNING, THE FARMERS IN ZANGASOA HOLD A MEETING
WE MUST CARRY OUT AN INVESTIGATION TO FIND THE CULPRITS AND PUNISH THEM.
WE HAVE TO FIND ANOTHER SYSTEM TO GUARD THE PENS. ALL BECAUSE OF A SLACKER !
HEY SAMBAHITA ! NOBODY CAME TO SELL YOU A LARGE AMOUNT OF SANDFISH ?
NO, NO-ONE


WE CAN'T SIT HERE AND DO NOTHING! WE MUST FILE A FORMAL COMPLAINT TO THE AUTHORITIES AND INVOLVE THE REST OF THE VILLAGE TO SOLVE THE CASE
I'M SURE WE CAN FIND THESE SEA CUCUMBERS. NOBODY EATS THEM AT HOME, THEY MUST HAVE BEEN SOLD. SUCH A LARGE AMOUNT CAN NOT GO UNNOTICED !


TIPPED OFF, THE POLICE ARRIVE ON SITE TO INVESTIGATE


A VILLAGE MEETING WAS HELD. THE MINUTES OF THE MEETING ARE RECORDED
FROM OUR INVESTIGATION AND ACCESS TO DIFFERENT PAPERS REGARDING THE MARKETING OF SEA CUCUMBERS, WE HAVE IDENTIFIED AN ACCOMPLICE IN THE VILLAGE. WE WILL ARREST THEM, INTERROGATE THEM AND TAKE THEM TO COURT


AT A MIDDLEMAN-EXPORTER, WE NOTICED THE PURCHASE OF 300 SANDFISH AMONG OTHER SPECIES. THEY HAD BEEN SOLD BY A MIDDLEMAN FROM ZANGASOA. FROM THE RECORDS OF THE TRADER WE WERE ABLE TO IDENTIFY THE FISHER RESPONSABLE.
IT WAS MANAHIRA.
HMM ! NOT SURPRISED BY THAT !
IT'S THE VILLAGERS THEMSELVES THAT STEAL THE SEA CUCUMBERS !
LAWS ARE LAWS. YOU WILL NOT GET AWAY WITH IT LIKE THAT. THE STOLEN SEA CUCUMBERS PASSED THROUGH YOUR HANDS AND YOU WILL HAVE TO EXPLAIN IT IN COURT !
AFTER THE INVESTIGATION WITH THE EXPORTER
HOW COULD I KNOW THEY WERE STOLEN CUCUMBERS ?
AN EXPLICIT REGULATION WAS CREATED AND APPROVED BY THE GOVERNMENT. IT STATES THAT EXPORTERS MUST SYSTEMATICALLY REPORT TO THE FISHERIES DEPARTMENT ALL DELIVERIES OF LARGE QUANTITIES OF SANDFISH
WHAT ROTTEN LUCK !!!!
... YOU HAVEN'T RESPECTED THIS PROCEDURE. THIS OBLIGES US TO CONSIDER YOU AN ACCOMPLICE TO THEFT AND RECEIVING STOLEN GOODS PENDING THE FINAL VERDICT.

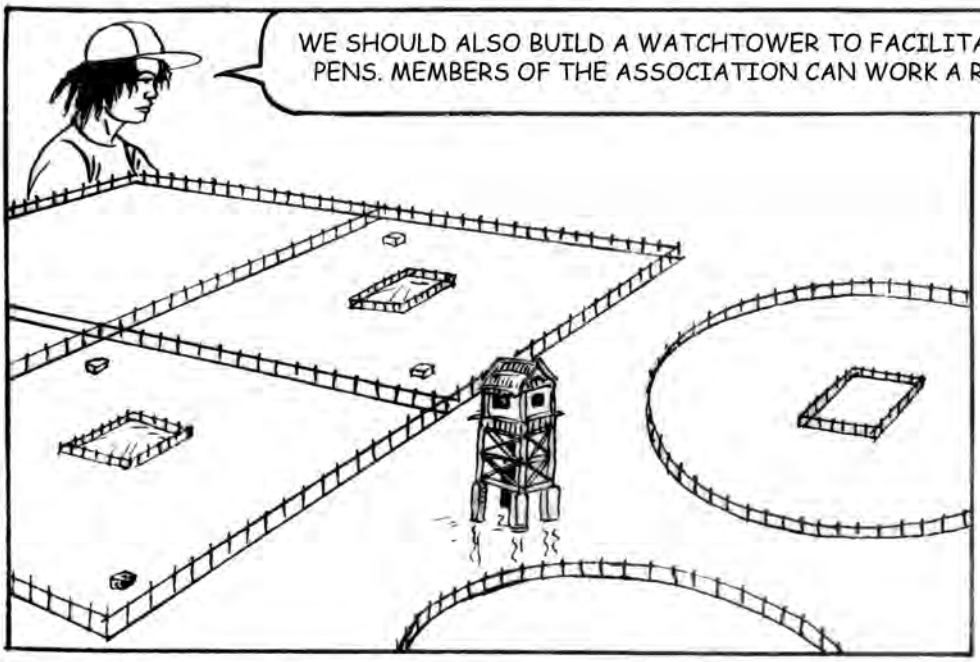

WHY DID YOU STEAL THOSE SEA CUCUMBERS MANAHIRA !
I HAD MONEY PROBLEMS !
WHY DIDN'T YOU DO THE SAME AS THE OTHERS INSTEAD OF STEALING ?
IT WAS LEBA'S MOTHER WHO CONVINVED ME BY OFFERING A GOOD PRICE !
AS THE BUYER YOU WON'T GET AWAY WITH THIS !
WHAT A MESS I'M IN ! SNIFF !
LUCKILY THE GOVERNMENT INTERVENED. WE WERE ABLE TO GET BACK THE MONEY WE LOST !
I'M STILL SURPRISED THEY DIDN'T FIND THE PRODUCT SOONER AT THE ROADSIDE CHECKS !
WE NEED TO REMAIN VIGILANT DESPITE THE GOVERNMENT AND ENSURE THAT EVERYONE CARRIES OUT THEIR RESPONSIBILITIES !
IT WOULD BE BEST TO CREATE A FORMAL ASSOCIATION OF FARMERS AND REMAIN IN CONTACT WITH THE GOVERNMENT TO MOBILISE THEM WHEN NECESSARY. IT WILL CARRY MORE WEIGHT THAT WAY. AND THEN, IT WOULD BE EASIER TO ACCESS TECHNICAL AND FINANCIAL SUPPORT ON BEHALF OF THE ASSOCIATION.

NOW WE KNOW HOW TO FARM SEA CUCUMBERS. WE CAN APPLY TO A MICRO-FINANCE INSTITUTION FOR CREDIT TO BUY MORE JUVENILES AND EXPAND OUR PENS. WE WILL ARRANGE WITH THE SUPPLIER TO DELIVER THE SEA CUCUMBERS AND RE-SELL THEM WHEN THEY ARE LARGE.

THAT WOULD BE PERFECT! THAT'S OUR GOAL, WE WILL CONTINUE TO FOLLOW YOU AND TO SUPPORT YOU TECHNICALLY UNTIL YOU NO LONGER NEED US ...

AND THROUGH YOUR ASSOCIATION, WE COULD ALSO PROVIDE TRAINING ABOUT HOW TO MANAGE YOUR MONEY AND INCREASE PROFITS!

WE SHOULD ALSO BUILD A WATCHTOWER TO FACILITATE SURVEILLANCE OF THE PENS. MEMBERS OF THE ASSOCIATION CAN WORK A ROTA TO PREVENT THEFT...



ONCE THAT'S DONE, WE SHOULDN'T HAVE ANY MORE PROBLEMS. ESPECIALLY AS MANAHIRA AND LEBA'S MOTHER SHOULD HAVE LEARNT THEIR LESSON DURING THEIR STAY IN PRISON ... OTHER FARMS SHOULD BE CREATED.

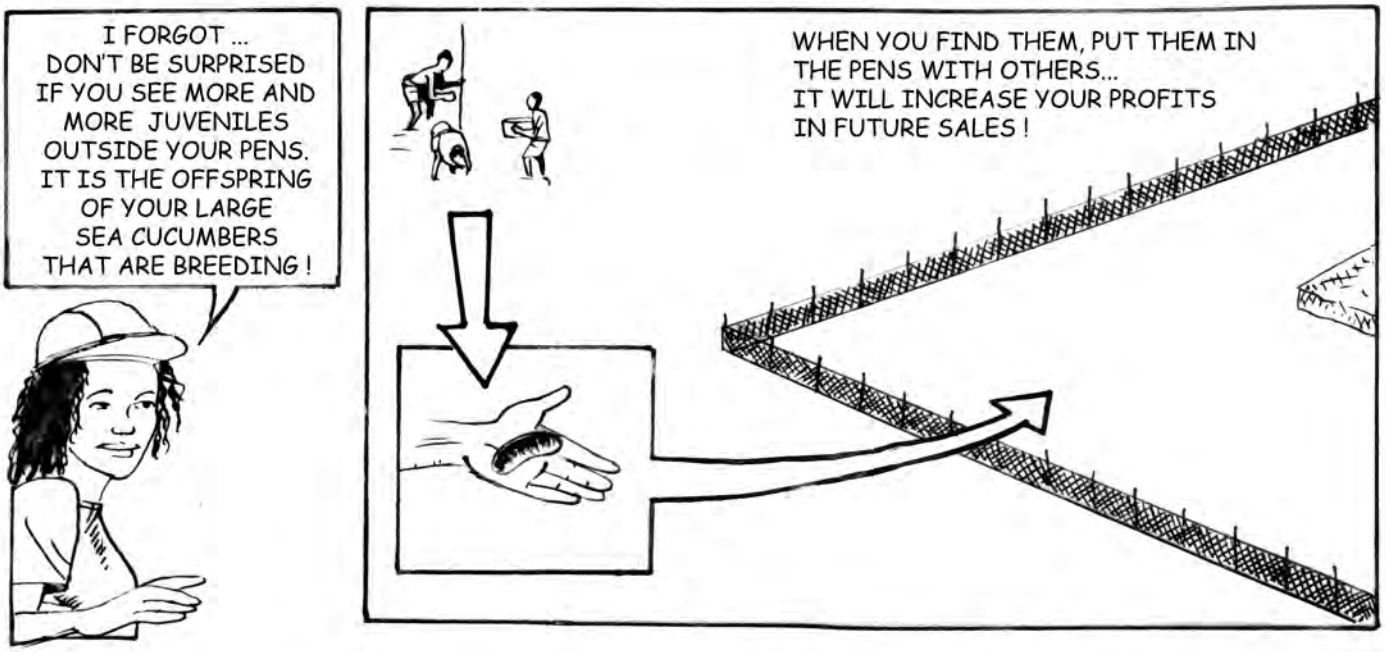
WITH MY EXPERIENCE AND THE MONEY I EARNED, I THINK I'LL INVEST IN BUILDING A SECOND PEN AND BUY MORE JUVENILES

IN ZANGASOA, SINCE MORE AND MORE OF THE POPULATION HAVE EMBARKED ON SEA CUCUMBER FARMING, THE APPEARANCE OF THE VILLAGE HAS CHANGED AND IMPROVED LIVING CONDITIONS ARE OBVIOUS ...

THE END

THE SEA CUCUMBER FARMERS STILL HAVE TIME TO GO FISHING. BUT TODAY, IT IS NO LONGER FOR SURVIVAL BUT BECAUSE IT IS THEIR PASSION!

AUTHOR AND ILLUSTRATOR : RAJAONARISON PIERRE / 2010


I FORGOT ...
DON'T BE SURPRISED IF YOU SEE MORE AND MORE JUVENILES OUTSIDE YOUR PENS. IT IS THE OFFSPRING OF YOUR LARGE SEA CUCUMBERS THAT ARE BREEDING !
WHEN YOU FIND THEM, PUT THEM IN THE PENS WITH OTHERS... IT WILL INCREASE YOUR PROFITS IN FUTURE SALES !


THAT'S THE PART OF THE WORK I LIKE THE BEST !


THE GOOD ATMOSPHERE AND THE BEAUTY OF THE PLACE OFTEN MAKE THE NIGHTLY SURVEILLANCE AN ENJOYABLE TIME FOR THE FARMERS !