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Montpellier

WATLAAR

AN EASTERN-INDONESIAN VILLAGE CAUGHT BETWEEN TRADITION AND MODERNITY

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INTRODUCTION

This work is the produce of an agreement between SEJATI and ORSTOM signed on the 8th of July 1996, the objectif being to supply a thematic report on traditional sea resource management known under the name of *sasi* by the village of Watlaar in Kei Besar. The publication was planned in two steps: a preliminary report at the end of the field work presenting the preliminary conclusions and a final report at the end of december 1997.

The research was implemented under the responsability of two scientists, a geographer, Isabelle Antunès from ORSTOM and a biologist, Sigit A.P. Dwiono from LIPI Ambon.
Field work was conducted full time from July 96 till March 97 in the village of Watlaar itself. It consisted first of all in mapping the village and the settlement. Mapping was then followed by a kinship census. Biological samplings were done during several weeks at three different times, before and after the opening of the sasi. Comparative biological samples were taken in two other villages : Banda Efaruan located north of Watlaar and Hollat located south of Watlaar. Banda Efaruan and Hollat were chosen on the criteria that Banda Efaruan was not seriously exploiting *Trochus* according to the *sasi* while Hollat had not opened the *sasi* for the past four years due to village disputes. The comparaison was an important element to bring forward both the strengths and weaknesses of *sasi* from a biological point of view in a perpective of viable development. Qualitative and quantitative information about villages both on land and on the sea were collected all throughout the time of the research.

The village of Watlaar is located in an area subject to fast development mainly sea orientated. Marine resource, namely *trochus niloticus*, locally known under the name of *lola*, represents for its people the most valuable commercial species. The exploitation of trochus according to the *sasi*, known as a traditional resource management system and a social equity community sharing-system has maintained a regular production and high profits. Nowadays, many constraints weigh heavy on the system and weaken it. Economic stakes and developing islands on the one hand and on the other hand customary authority which today is very contested by the local people themselves in a sense that traditional societies formely inter-related within a closed system and therefore favourable to many transformations and conflicts over power.

This report will first of all present the society and the life of the people of Watlaar. In the second part, it describes sea environment, marine exploitation and the trochus fishery. The third part argues that although from a biological point of view *sasi* is a positive management measure

in itself besides the point that it is difficult to assert that it is a traditional knowledge, *sasi* cannot be considered as a resource management in a perspective of sustainable development for social reasons which indeniably has negative effects on the ressource. Examples of other developping attempts in Watlaar bring out the same conclusion : customary autority is important in development projects but it must be continuous, solid and honest.

PARTI:THETERRESTRIALANDHUMANENVIRONMENT

A . THE TERRITORY

1 - The settings

Going to the island of Kei Besar is a real expedition. It takes about three days from Jakarta, stopping over night in Ambon, the capital of Maluku. From Ambon, small planes go to Tual, the capital of Kei Kecil. The trip can also be done by boat, in which case it takes about six days from Jakarta to reach Tual. From Tual, there are small passenger boats going back and forth twice a day to Elat, the main town on the island of Kei Besar. A mini bus then takes people on the east coast of the island. From that point, some long boats equiped with outboards will take passengers to their village.
Sea transport between Tual and Elat or along either side of the Kei Besar island is sometimes difficult and interupted due to bad weather or the seasons. For example, it is almost impossible to travel by boat on the east coast during the easterly wind season. People usually stay in the villages for three to four months and only reach Elat by foot if really necessary. The road system on the island is still very limited and mainly developed in the southern end of the island nearby Elat.

The village of Watlaar is located on the East coast of Kei Besar (6°28'N, 133°07'E), one of the islands in the regency of Maluku Tenggara. Watlaar is the seat of the traditional ruler, the head of the custom/adat [1] or Kepala Adat titled "*rat maur ohoi-wut*" named after the name of his province whose domain comprises Watlaar and nine other villages called in Kei language *utan*. An *utan* can gather several hamlets each managed by a headman (kepala soa/kepala dusun) all under the juridiction of the head of the village (orang kaya/kepala desa). The Kepala Adat is responsible to deal with any adat matter within the province.

The boarders that delimitate the frontier between an *utan* and another stipulates the autonomy of each village and its access to ownership both on the land and on the sea. In certain cases, an *utan* may be sub-divided among hamlets, in that case its boarder is called a *tavlat*. This delimitates the hamlet(s)'s boundaries to ownership. Thus, villagers will exploit the resources with respect to both land and sea limits/petuanan. This does not exclude the fact that they may also own a piece of land and/or sea in other villages.

In the case of Watlaar, the *utan* has been divided in two, separating Watlaar from two hamlets located a little south, Ohoiefaruan and Ohoifau. Since Watlaar is the seat of the

[1] All underlined words are written in Indonesian language and all words in italic are in Kei language

province Maur ohoi-wut but also in order to beneficiate from governmental village subsidies, it has been decided that Watlaar on the one side and Ohoiefaruan(Kepala dusun) and Ohoifau (Kepala Desa) on the other hand would have separate heads of the village.

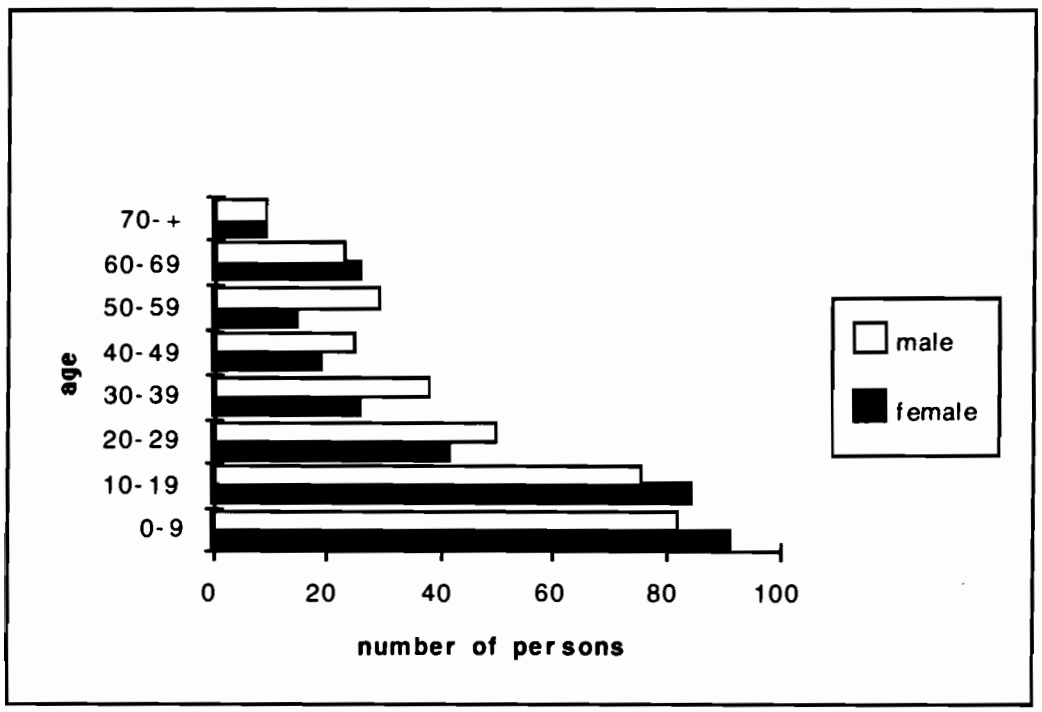
The General Map of Watlaar (Map 1, page 13) includes a map of the Maur Ohoi-Wut 's province and the distribution of villages, *utan* and *tavlat* along the coast. It intends to relocate Watlaar within its province and situate our ulterior points of comparaison. The position of *utan*, *tavlat* has been recorded with a GPS according villagers'informations. It must be mentionned that the distribution does not take into consideration recent new divisions of coastal areas between villagers nor areas of conflit claimed by several villages. Thus, we observe that Watlaar is located east of the *utan* Mun Ohoitel, south of the *utan* Wear Ohoitel. On the south, a *tavlat* separates the village of Watlaar from the villages Ohoiefaruan and Ohoifau. As far as the sea ownership is concerned, it goes from Sasaluk on the south until Wear Ngayaan in the north. The map also shows an area subject to conflict since it is claimed by both villages, Watlaar and Ohoifau. By march 1997, neither villages had come to a final agreement over boarders delimitations.

Administratively, the village of Watlaar belongs to the district of Kei Besar. Recently appointed by the Kepala Adat or head of the custom former Kepala Desa or head of the village the actual kepala desa, his son is on trial until august 1997. In reality, the Kepala Adat is in power. He holds village's matters with the help of the village deliberation council (LMD/Lembaga Masyarakat Desa) and the security council (LKMD/Lembaga Ketahanan Masyarakat Desa) who together look after the repartition of subsidies allocated by the government to meet any village needs. They also help coordinate the three years funded government plan to develop economic activities within the village known under the name of IDT(Intruksi Desa Tertinggal).

At the time of the study, November 1996, Watlaar counts some 643 persons for some 99 houses and about the same number of people living either in Tual, Ambon, Iryan Jaya or Jakarta. The majority of villagers are catholics with the exception of one household which is protestant.

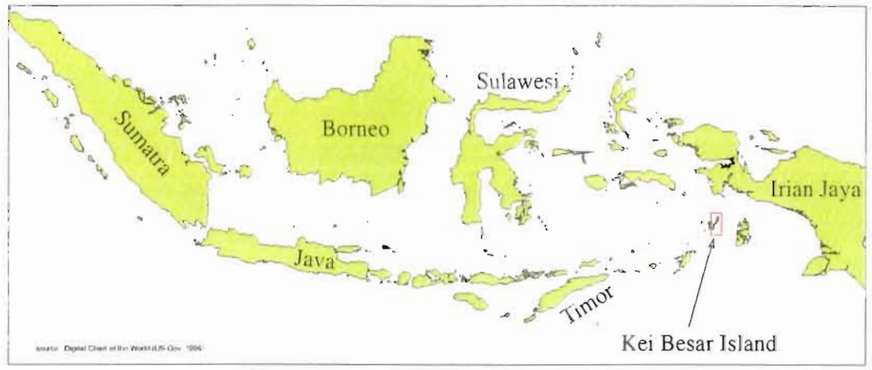
Figure 1 shows the distribution of the population of Watlaar according to its cohort of ten years and to its gender distribution. The majority of the population is young, about two third is under thirty years old. Most families count between four to six children each.

Figure 1 : Distribution of the population according to its cohort of ten years

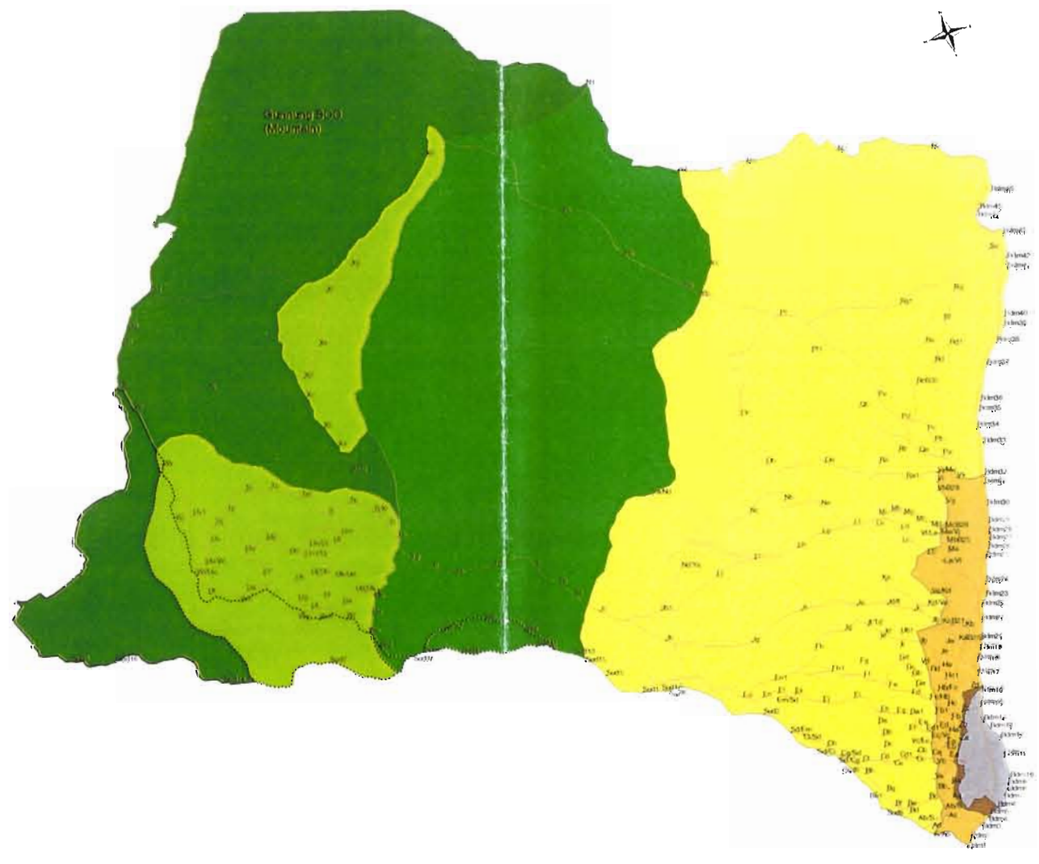


General map of the village of Watlaar - Kei Island, Eastern Indonesia

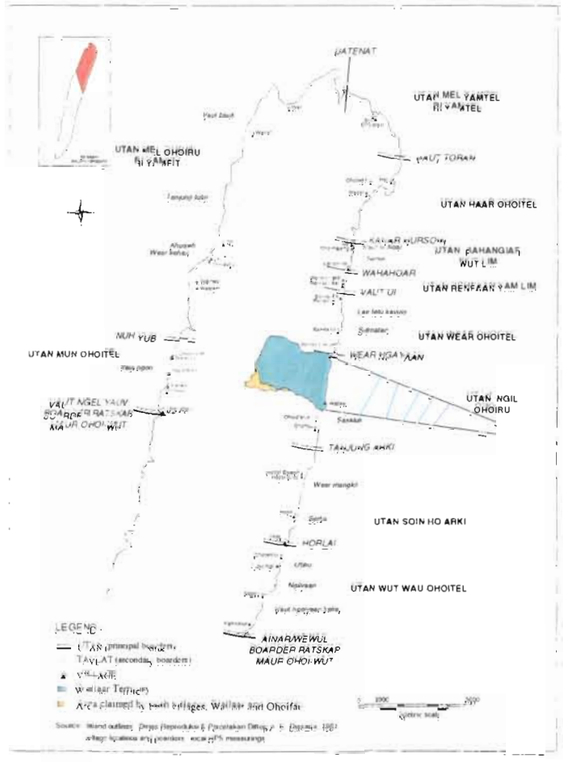
INDONESIA



WATLAAR TERRITORY



Villages and boarders in the province of MAUR OHOI -WUT



Land use :

- OHOI - Village
- OHOI MURIN - Village outskirt
- ROK - Permanent gardens
- RAIT - Recycled fields
- MEON - Sagu plantations
- VARAIN - Forest (hunting territory)
- VARAIN VAVEON - Primary forest

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2 . The landscape of Watlaar

The island of Kei Besar is an uplift horst of several calcareous terraces from 500 to 800 meters high cut by many creeks which drain rainfalls on both sides on the island. Due to the hot and wet climate, the erosion is very high. In most places, the soil is covered by big blocks of stones and many rocks. This is very constraining to agricultural activities.

The property of Watlaar roughly stretches along some 3,7 kilometers from south to north and by 6 kilometers from east to west. Its approximate total superficie (not including the area claimed by both villages, Watlaar and Ohoifau) is 1390 ha. It is a mountainous steep landscape that goes from sea level to an altitude of 793 meters (mountain Boo).

The General Map of Watlaar (Map 1, page 13) presentS the territory of Watlaar and describes the various land use. It also retraces the main paths across the forest and gardens people go through as well as the names of places people call out when refering to a particular area.

The village has been divided in seven distinct areas:

Ohoi : the settlement
Ohoi murin : the settlement's outskirt
Rok : permanent gardens
Kait : recycled field areas
Varain : forest and hunting area
Varain vaveon : primary forest
Meon : sago plantations

Some sections such as *Ohoi*, *Ohoi murin*, *Rok* and *kait* refer to a particular type of land use while the others, *Varain*, *Varain Vaveon* and *Meon* describe the natural vegetation. The boarders from one area to another can be divided in two categories : the domestic boundaries and the natural boundaries.

The domestic boundaries follow men physical and permanent appropriation of the land : the settlement and gardens.

Natural boundaries seem on the contrary to follow the landscape and the topography. However, it is difficult without a deep biological study to assert that natural boarders follow a change of vegetation. We do observe changes of vegetation and landscape but in the case of the boarder between *Kait* and *Varain*, it is the impact of men that has contributed to that change (recycled field areas).

The mapping of boarders separating one zone from another have been mapped following villagers informations and not from my own initiave depending on changes in the lanscape I could observe. Thus, I will describe the different zone starting from the coast and progressively moving inland.

2 .1. The different areas

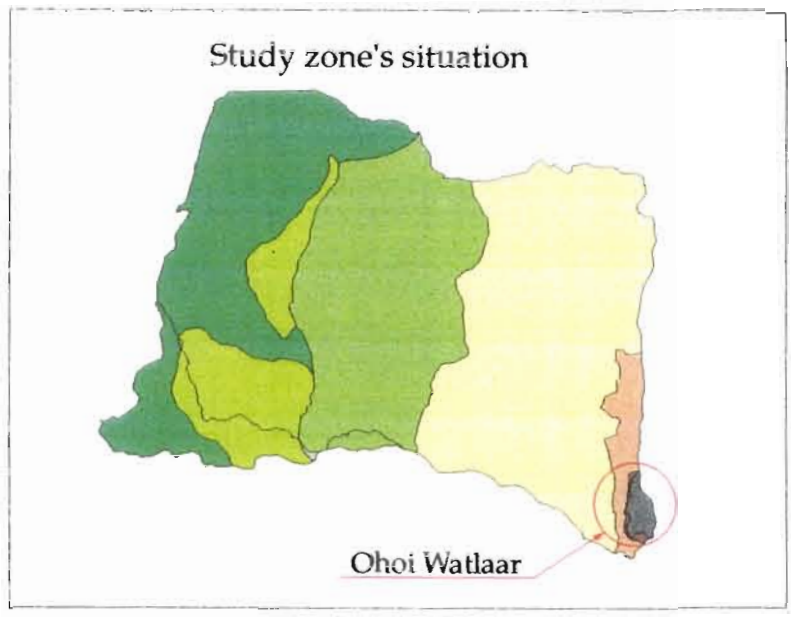
Ohoi

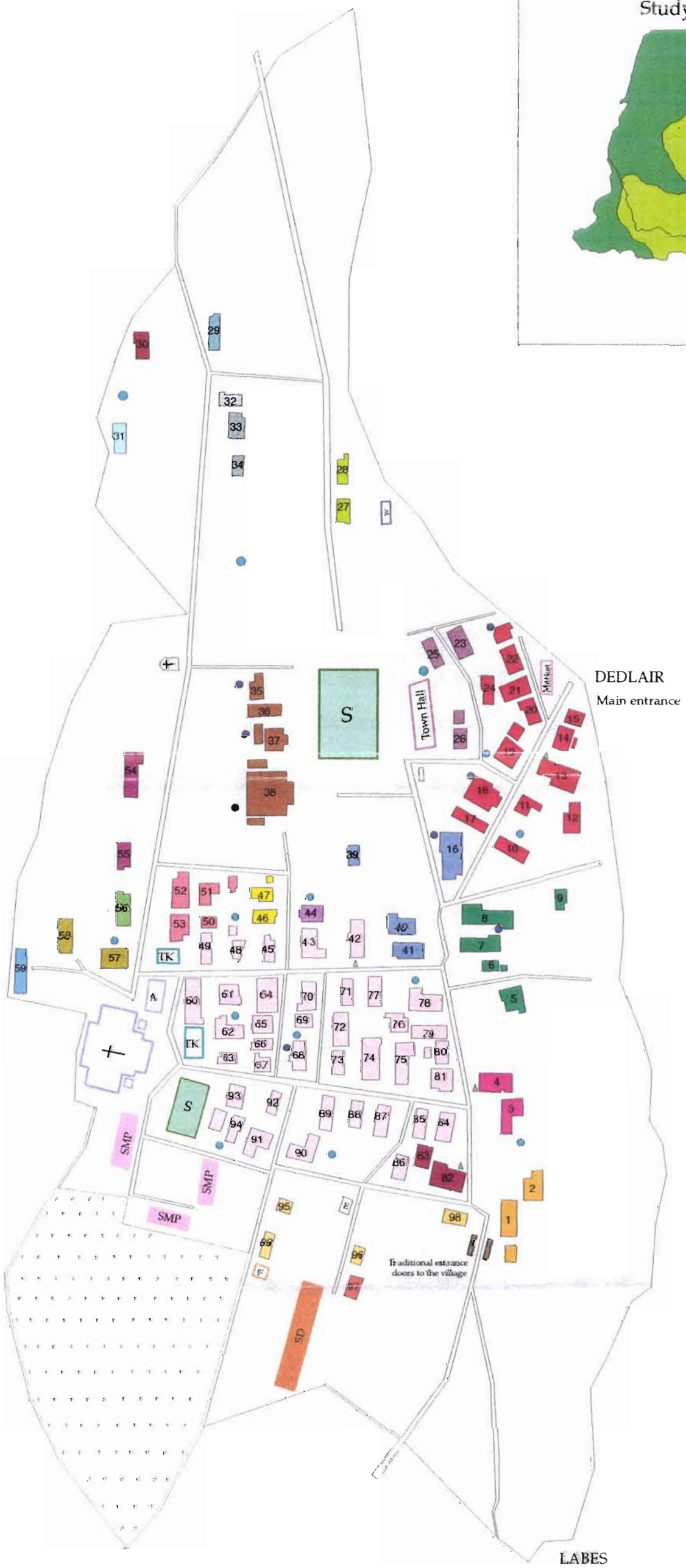
In Kei language, *Ohoi* means settlement or village. The settlement hangs on the hill against the gardens and forest that dresses up as a high wall.

The vegetation is green and colourful as every house has a front garden planted with fruits, vegetables and flowers. Houses are built either with permanent or non-permanent materials all neatly organized along the sides of stoned paved little streets. Different areas in the village have names and since there are no sharp boundaries, I distingued houses built on the area to differenciate the residential quaters (Map 2, page 16). The village is alimented in water by a pipeline system that fills in several water reservoirs spread around the village. Several houses have private water supplies. During the dry season, the water supplies are rare due to some misconception while setting the system up. The village also has a generator that periodically provides electricity for a couple of hours depending on the availability of fuel and on the special occasions. Watlaar has a kinder garden, a primary school and a junior high school that attracts children from neighbouring villages. It has a catholic church, a large townhall, a first aid clinic and offers sporting facilities such as a volley and football fields (Map 2, page 16).

OHOI WATLAAR

Map of the village (main center of habitation) according to residential quarters and facilities





LEGEND :

SD	Primary school
SMP	Junior high school
TK	Children play group
A	Priest house
E	Electric generator
F	First aid clinic
W	Workingshed
S	Sporting fields
	Public fresh water point
	Private fresh water pipe
	Kiosk
	Cimetery
	Church
15	Census number

Names of residential quarters

- Dedlair
- Dedmatan-ohoituvun
- Elrer
- Maturan-ohoi
- Ohoinewonraan
- Ohoinewonraan-murin-waf
- Ohoinewonraan-waf
- Uar-yah
- Uarfang
- Uarfang-ratan
- Uarfang-wavan
- Uarkamanbail-ni-moil
- Uarkamanbail-ratan
- Uarmasdium
- Uarmastom /Ohoinewonraan
- Uartevkemuin
- Vaut-buid
- Vduur-ratan
- Vduur-ratan-wawan
- Ve-be
- Vid-tuvan
- Wautmahwoar
- Wea mail
- Rauweliak
- Uar to
- Vid il
- Wearkasnau - tom

Realized with the participation of the Maison de la Télédétection, Montpellier (France).
This map gives account of field surveys conducted from july 1996 till march 1997. All measurements have been taken according to villagers informations.

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Ohoi Murin

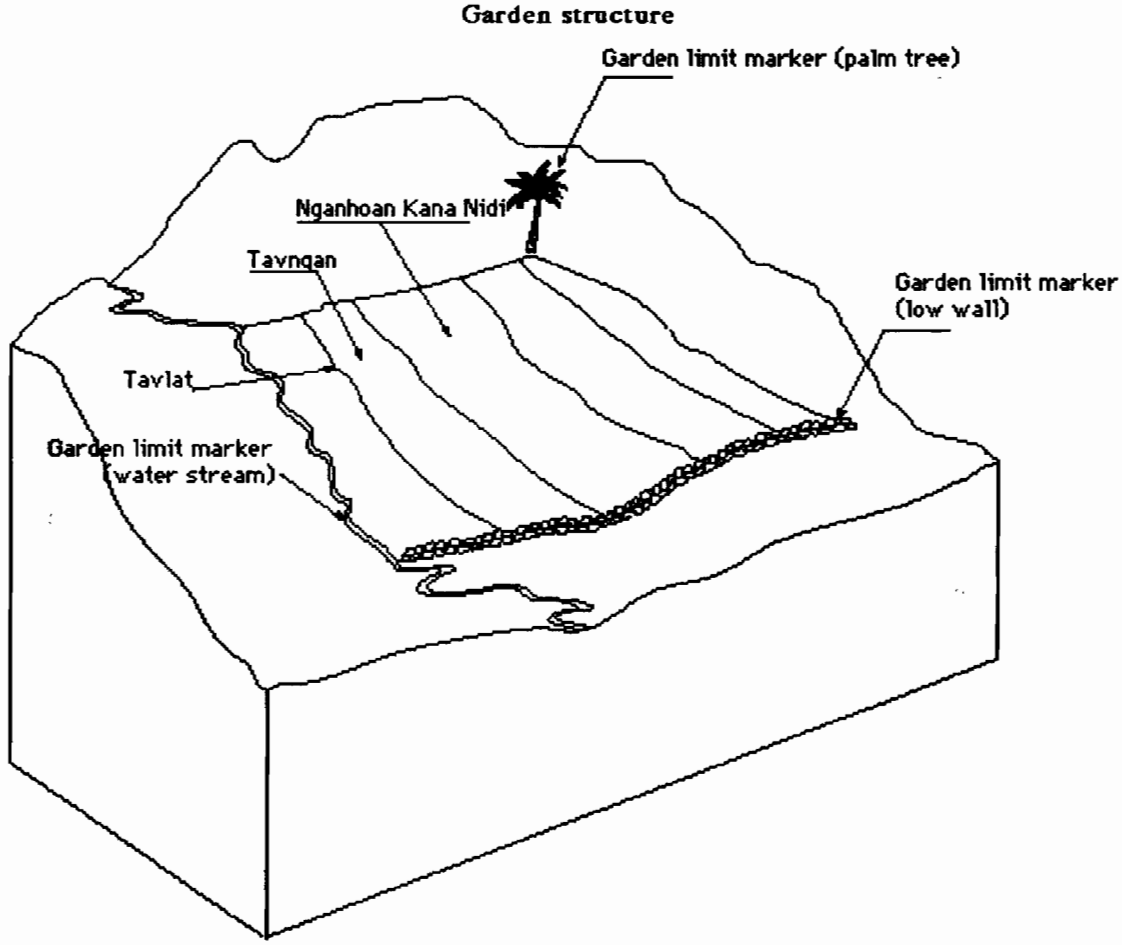
Ohoi Murin is the village outskirt, the transition area before entering the gardens and the forest. Its vegetation is quite dense with tall and very old trees, many fruit and coconut trees. There are several tiny gardens where people plant vegetables, tomato, peanuts, chili. *Ohoi Murin* is the place where villagers burn rubbishes. According to villagers, the area of *Ohoi Murin* used to be much larger but as people started to build new houses and to spread, *Ohoi* became bigger thus reducing *Ohoi Murin.*

Rok

Rok refers to the area where people have permanent gardens and coconut plantations. *Rok* lies along the coast, about half way to the north. It is an area which men have very much modified in that ruins of old settlements can be found, most gardens are enclosed or partly enclosed with low stone walls. In former days, people often moved from one place to another to escape from settlements in fire or deseases. And it seems that people opened permanent gardens then.
Rok is caracterized by being located on very steep slopes and only very few flat areas. Coconut trees are very dominant. The exploitation is not very homogenous. Permanent gardens which are exploited are more numerous close to the village whereas the northern part is is organized in coconut plantations. The size of the gardens vary from 500 to 1000 meters2. Villagers plant tuber and green vegetable for everyday needs.

The opening of a new garden

People usually open new the fields at two different time either in january and febuary or in august or september. These time correspond to the intermediate seasons before the complete revearsal of east-westerly winds. The month of febuary also sees the apparition of Neiris which predicts a few weeks of hot and good wheather during which those working the field can make the most to set the fire before planting the seeds. People from Watlaar usually work in two types of gardens which differ from one another in that one is permanent and that the second is a recycled field area. The permanent gardens are located in the area named Rok, close to the village itself while the recycled fields are located in the area called Kait, formal primary forest which has been exploited over the years. Each family owns several gardens in each area. Families have either inherited land from their father, grand-father or have got the gardens themselves since they were the first to ever work the fields. In some case, people may also have inherited a garden when they got married. The size and the number of gardens vary from one owner to another and from location to another (Rok and kait). People recognize the limits of their gardens from a water stream, a kind of tree, a rok, a low stone wall which was built. At the beginning, when people started to open new gardens, boarders were established depending on the superficy of the land that a particular person had worked. Since it is a forest with some very stony soil, people had to put some trees down and try to clear away some rocks in order to be able to plant. People usually worked and helped each other. They organized what they call in local language « masohi » or « gotong royong », a tradition in the Kei islands. Opening new field that way was also a mean to let everyone know of the boarders of gardens. The owner would sometimes plant some coconut or some kinds of trees to mark the limits. He would also build a stone wall to prevent the wild pigs from eating all the crops (see figure below).



Enbal (poisonous cassava) is one of the most important vegetable for the people of Watlaar. People usually prefer to plant it in the kait area which a fertile soil since the gardens are constantly recycled.
Regarding the seeds and cuttings and that for every species, people prefer to take them directly in ohoi murin, the village outskirt or from another of their gardens. They never take them from gardens which is not their as they believe that if they steal, their own crop will be eaten up by wild pigs.

Working the fields in Watlaar step by step.

1 - TAVRAGEN

This is the first thing people do when they want to work a field which they have left alone for a couple of year. It means opening a garden. The forest is very dense so people start to cut grass and to clean the area. This work requires a lot of people. both men and women are involved but on the first day. only the owner of the garden works so as to let the land kwnow that he is going to work it again. It is only on the second day that they start the « masohi », gathering up to two to ten persons depending on the size of the garden. usually members of the family. neighbours and in some cases the *mel* would ask the help of the *ren* and *iri* whom they are closely related to. Nowdays. each person gets paid for the work and receive about $US 1 for a day's work (equivalent in roupiah at the beginning of 1997) or chose to ask for the help of that garden owner in turn to work his own garden. Another could also receive some vegetable or some sagou in exchange of his day's work.
This work can take one or two days. People then just leave the field for two or three days for the grass and the leaves to dry depending on the weather so that later they can easily burn.

2 - ATIAN AI

The second step consists in cutting down trees to clear the field and let some light in. Some of the wood is then chopped and brought back home to be used in the kitchen. The rest is used to make « tavlat ».

Sweet potato plants

3 - TARUAK VE

Once the grass has been cut and let to dry. the trees have been chopped, farmers set the fire for a couple of days to really clean the area. After that. they gather together what is left of the wood after the fire, pieces here and there. They call it « tavkaloik » in local language. They set the fire to it to clean once and for all. This is called « tav avon » in local language.

4 - TAVLAT

Once the field is cleared. farmers divide their garden in smaller parcels using some of the trees they chopped down as illustrated above.
The number of « tavlat » is usually uneven and varies from 5. 7. 9 or 11 with all but the middle one mesuring the same size. The middle one is normally much larger being the center of the garden. Those « tavlat » help organize the garden and the species of vegetables. One « tavlat » can be only planted with yam, another with sweet potatoes and so on or various species of tubers can also be planted in one particular « tavlat » but because the planting will take place over several days. people will harvest successively one « tavlat » at the time and allow this way to have vegetables all year round.
« Nganhoan kana kidi » is considered to be the heart of the garden right in the center, usually marked or symbolized by a piece of wood « kayu kane » or by a particular banana tree (pisang din kaba because it is short but has many fruit. sometimes up to nine hands. can also use another specie locally called « dim teriwun ». It gives long and big fruits.). Thus. the owner of the garden brings all the cuttings he intends to plant and puts them in that particular place hoping that this will give him an excellent crop.

5 - AV VOAT

After having divided the field in smaller parcels. farmers begin to dig with a pick to take away some of the rocks and prepare small heaps of land where they will later plant the seeds. The rocks are piled up together and will be used later to make a surrounding fence.

6 - VOI

The actual planting takes place then. For example. when people plant either cassava or enbal. they usually put the cutting at an angle/slantwise. They can plant one to three pieces of cuttings on one heap depending how big they are.

7 - LUTUR

Once the planting is done. people start making a fence in stone all around the garden. It is a way to prevent wild pigs or other animals from destroying the crops and also a mean to mark the garden and differenciate the area which is planted from the area which isn't.

8 - SAIR

The next step consist in building a little shed where people can rest and live in for several days. The gardens are most of the time located quite far from the houses and people prefer to sleep over night rather than walking back and forth.

9 - TAVRAGEN BANAU RAN

This is usual step of weeding beginning when the crop starts to grow.

10 - AILAV YAU

Harvest time. Harvest time will vary depending on the species. Thus. enbal and cassava will be harvested after 8 to 12 months while sweet potatoes after 4 months. yam after 9 months to one year. kumbili and talas after one year. corn and rain rice after 4 months.

Kait

Kait is the recycled field area. The vegetation is not homogenous all over the zone. Villagers usually open several gardens for slash and burn agriculture which they exploit for two to three years depending on the soil fertility. After this time, they just leave those gardens to be and move on to other gardens they have not exploited for several years. The size of the gardens varies between 1000 m2 to 1 ha.Thus, the vegetation differs from that of *Rok*. The forest is not very dense since many trees have been cut down. Some areas are quite opened since they are exploited whereas others are left to become forest again. The landscape is more varied with its slopes, uplands, plains, valleys and overlooking views to the west of the primary forest.

The southern part is more exploited than the northern part due to the proximity to the village. Distances to the village are quite considerable. It requires several hours'walk to walk anywhere through steep landscape. Coconut and banana trees remain dominant but lessen as we go westward and higher in altitude.

Kait is furrowed by pathways, showing that men travel this zone up and down thus, pathways are more numerous in the south, closer to the village.

Garden Tools

To work the gardens, farmers use several kind of tools. Here is a list of them:

1 - HUAN

This is a locally hand made tool made of strong wood which has been sharped in one edge and to which has been added and tied with some rotan a wooden small plank in order to wedge a foot. Huan is used to dig out some of the rocks from the soil.

2 - TUMAN

Tuman is a claw which was introduced by the japanese. It is used to dig out rocks or plant banana trees. People seem to use claws more often than *huan* nowdays.

3 - PIG WEL

This is a pickaxe used to dig the soil, make little heaps and plant banana and tubers.

4 - NGER

This is a machete used for everything, cutting the wood, planting, getting out roots and vegetables.

5 - MENSADO

This is an axe used to chop down big threes.

6 - SUANG

Another locally hand made tool. It is a piece of wood, like a stick which has been sharpened at one end. It is used to dig out holes in the soil or in the heap to help introducing the cuttings.

Varain

Varain is the forest which has not been exploited by men in recycled field areas. *Varain* is probably was *Kait* formely was but this is only an assumption and further specialized studies would be necessary to prove this point. The boundaries between *Kait* and *Varain* is very sharp just by looking at the vegetation. It is much denser, thicker in *Varain*. Trees are taller, older. The diversity in species seems quite high. The relief is mountanous and rises.

It is quite clear that men has not yet transformed the landscape as he has in *Kait*. According to villagers informations, some species of trees have been already commercially exploited in the early 90ies, for example eagle wood or Kayu Gaharu which has very high commercial value. Exploitaton of the resources in this zone seem to follow the market.

While looking at the General Map of Watlaar (Map 1, page 13), we notice that there are hardly any pathways to the Meon area located on the north. This can be explained by the fact that this particular patch belonged to the village whereas the patch located in the south is families owned.

Meon

Meon is the natural sagou plantation. Here again the landscape differs from *Varain, Kait* and *Rok*. It is located in a valley. Water is very abundant, the soil very muddy and the atmosphere humid. The sagou is a palm which pith provides a yellow flour which is then cooked and represent the basis for every meals and is most important with enbal. Many different species are found. From a cultural point of view, sagou for the people of Watlaar is the equivalent to rice for the javanese. Men traversed *Meon* very frequently. Little sheds from place to place tell about men staying overnight, traditional filtering and decanting sagou machines stand along the rivers. *Meon* seems to be a world in its own, cut from the rest.

Varain Vaveon

Varain Vaveon is the primary forest, thick, tall humid and mysterious. The biodiversity seems very high. It stretches to the top of the mountain Boo and overlooks Mun, down to the west. Very few people ever go to *Varain Vaveon* or to the mountain Boo. *Varain Vaveon* is where men go hunting sometimes. But the mountain Boo is sacred to the people originated from the land.

Working the sagou - *Omfaor*

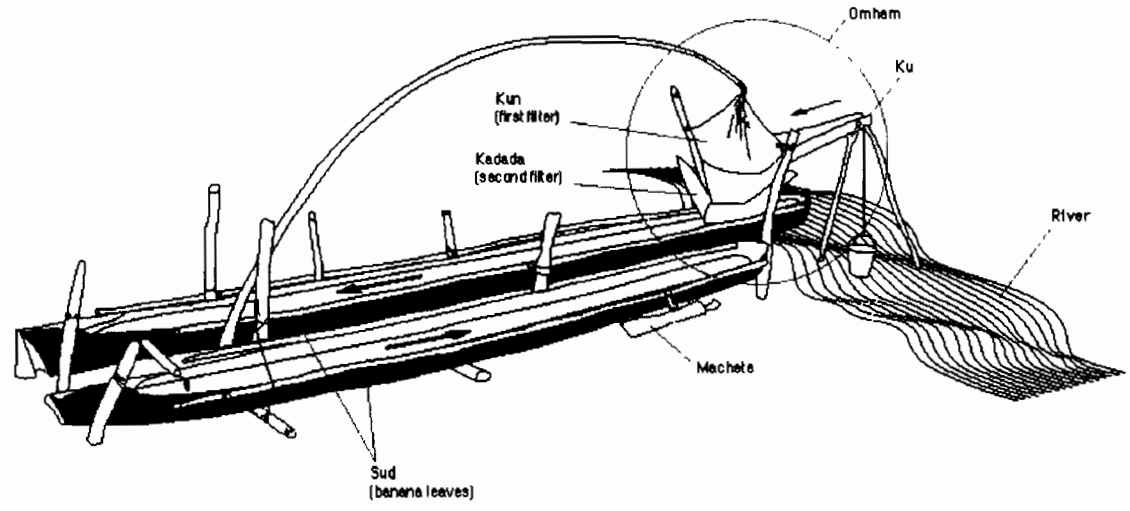
Besides working the fields, people from Watlaar also work the sagou.. The sagou is a palm which pith provides a yellow flour which is then cooked and represent the basis for every meals and is most important with embal.
The important thing is to choose the right tree since if it is too young, the inside will be too wet and if it is too old, its pith would be much too dry and therefore would not have much to offer. To tell whether it is time to harvest or not, people usually look at the leaves and look for a tree whose leaves are rather short and dry since if the leaves are too high and in flower, it is a sign that the tree is already too old.
Once a tree has been chosen, men clean its trunk and cut it at the bottom so as to make it fall. They then cut it in half in the middle from one end to the other. The inside can then be extracted with a pickaxe or *leb* just by digging it out. The pith is rather soft.
In Watlaar working the sagou is an activity reserved to men. It takes four to five person to work together. Each of them has a particular task described as follows :

Omfaor designs the two persons in charge of digging the pith out of the trunk;

Omham designs the action of pressing to filter the pith while the person doing it is called *mufram*;

Omvuar designs the person carrying the pith from the place it is extracted to the river where the traditional filtering and decanting machine has been built.

Traditional filtering and decanting of Sagou production



Once in the Meon area, distances to travel are never very far but sometimes considerable. But the use of the river or a water stream is very important since the filtering is done with water. Sagou trees are mostly found in the meon area, deep in the forest (Cf. General Map of Watlaar). Working a sagou tree usually takes a couple of days and since the meon location is far from the village, men tend to camp overnight. Another man usually accompanies them and is responsible for doing the cooking and looking after the camp and helping them.
The figure above illustrates the traditional filtering and decanting machine or *Sud*.. It is made from banana leaves in the shape of a canoe, from bambou, various barks and using plastic cloth for the filter.
A buket is used to take water from the river and as a measurement.
Each time the *omham* starts the filtering, he takes a couple of handfull of pith and puts it in the *ku*, the rear top end of the machine. He then empties three buckets of water and starts to press the pith giving out a dark red colour. He then repeats the operation using two buckets of water each time until the water coming out is clean and clear. He finishes using only one bucket of water and then throws away the dry sagou by the riverside taking some fresh one. And so one until both *Sud* are filled with decanted flour or *mangga*.
The *mangga* goes through the first filter or *kun*, through the second filter, *kadada* and slowly runs and sits at the rear of the upper *sud*. Only when it is full, does it start to run and sit in the front and in the lower *sud*. the water continously runs from the upper to the lower *sud* and falls out from the rear of the lower sud. People usually name the *mangga* which sits in the upper *sud*, the eldest since it sits there first while the *mangga* sitting in the lowest *sud* is considered as the youngest since it sits there last.
Once both *sud* are filled with *mangga*, the person in charge of *omham* unties the banana leaves making the *sud* to let the water run out, thus leaving only the *mangga* to be collected.
A sagou tree can fill up both *sud* several time and take several days. However, when collecting the mangga, people always leave the production located at the rear of the upper sud to be taken last. This *mangga* sits there untill the end.
At the end of the work, the whole production of *mangga* is equally divided among all the people involved except for that special part located at the rear end of the upper *sud* which goes to the person who did the pressing or *mufram*. He is the only one getting an extra share of the profit.

2 .2. The landscape and its perception

The territory is divided in two worlds, the domestic which men traverse every day, have got possesion of, transformed, organized and the wild world where few people go. The General Map of Watlaar (Map 1, page 13) shows that the whole territory is crossed by small walkaways that join the east to the west. The same map shows that the number of walkaways located west of the settlement is more important simply because people rather work recycled fields closer to the settlement. They also go through this way to get to the sago plantations. On the contrary, the north west part only shows few roads as the fields are located far from the settlement. In former times, there was two roads that linked the north to the south to allow people to cross the territory without entering the settlement. Today, long boats have solved the problem. The roads have been recovered by the vegetation and it was therefore impossible to measure them.

This wild world gives way to different beliefs and perception depending on whether people are originately natives or immigrants. Thus, natives say they are originated from the mountain Boo, it is their sacred world, the place of their ancestors (Map 1, page 13). To them, the mountain is their guardian with whom they continue to communicate via two water streams that have magical powers. While the natives refer to Boo as their identity, the immigrants consider the mountain as a hostile and dangerous place. Very few of them have ever been at the top and when they did, they were always accompanied by a native in charge to do the rituals for asking protection. The immigrants have their own sacred place called Labes, located on the coast of Watlaar. It is the place where they first landed. They believe their ancestors soul live here. Today, it is still considered as the entrance door to the village and as the heart of the settlement locally known under *woma*. Very symbolically, everytime someone important arrives for the first time, he or she has to go through that door and observe the rituals for it is the immigrants who have the right of speech and everything has to go through them.

Villagers refer to places by names that were given to rocks, trees, rivers, landscape which either relate some legends, describe the place or tell of a particular event (most names have been drawn on the map in correspondance to the initials). It is a way to localize a place. In the case of Watlaar, names are a reference to ownership, identity and myth. People know where they have gardens by refering to names of places while trees, rocks, water streams and more recently stone walls stand as markers of ownership and delimitate each owner's property. The system of ownership follows a pattern of division of the land according to families in order to share the resources. Further researches would allow a description and comprenhension of ownership in Watlaar.

B . The comtemporary social organization

People of Watlaar, like the Keieise, recognize social boundaries which divide their community in three endogamous segments, *mel, ren* and *iri*. In august 1996, the census indicates that there are 75 *ren* head of family 37 m*el* and 10 i*ri* head of family.

Most people live in separate houses althouh a house may count several households from the same segment and in some cases, some *ren* households may also live together with a *mel* household.

The differences between these groups refer to social stratification and hierarchy in which nowdays *mel* are considered as the upper class, *ren* as the middle class and *iri* as the lower class. In the Kei islands, local people often talk about castes to describe *mel, ren* and *iri* but as P.M. Laksono rightly wrote it « unlike caste system in India, this segmentation does not imply any division of labour based on the separation of pure and impure values. Each group in the Kei islands reject connubium but they accept convivium with the other groups. » (Laksono, 1990).

If the majority of *ren* and *iri* people in Watlaar agree today that the relation between *mel* and *ren* and *iri* is not like between upper and lower classes or are different to the relation between a master and servant but rather considered as a helping relationship, many *mel* do not see it that way and still keep to that order and show their authority.

Despite the three social categories, people belong to a House or *Rahanyam* often translated as a patrilineal kinship group related to the *mel*. But the House also accommodates for *ren* and *iri* even though they have no kinship links with the *mel*, they have other links inherited from their ancestors. In this case, *ren* and *iri* households are considered to be the youngest brothers and the *mel* the eldest brothers and *ren* and *iri* have no authority on their own. Moreover, the House revolves around those three levels of hierarchy. Depending on their importance, customary matters will be settled at a certain level. The hierarchy usually followed to organize any customary matter depends on whether it happens within the *Rahanyam* or whether it involves two *Rahanyam*. In the first case, people will refer to their *Yamar ar*, the head of the family from the same kinship group who will then inform the *Yamong duang*. The *Yamong dua* is the *mel* to whom *ren* and *iri* families are tied to. The latter will then either call the other *Yamar ar* if the matter to be settle happens within his own people, or adress the other *Yamong duang* if it involves a person within the same house. Depending on the importance of the matter, they may refer to the *Yamad duad*.

If the matter has to be settled between two *rahanyam*, then the information arrives to both *Yamad duad* who will arrange for the customary usuals. The sense of belonging to a House is

very strong for the people. The relations seemed to be mostly related to marriage alliance and to the notion of exchange.

An old man told me a very interesting story relating the meeting of two different groups of people, the natives and the immigrants. The immigrants were originated from the island Luang located in southern Maluccas while the natives came from the mountain Boo located within the boarders of Watlaar, about 5 kilometers inland to the west (Map 1, page 13). Soon, the head of the natives married a girl from the immigrants in exchange of some land. The natives overruled the land and village matters while the immigrants dealt outside problems such fights between villages for example.

The immigrants were named *mel* by the natives which meant in Kei language that they were the younger or *adik* since they were foreigners while those who had come with them were called Iri since which meant the one who is always told to go and do things. The natives called themselves *ren*, in other words, elder or *kakak* because they were originated from the land. The understanding was that younger/elder - *adik/kakak* were to live together and help each other.

It is not yet clear what was the relationship between the people of the same blood and between the natives and the immigrants at the time, but it seems that there were on the one side the natives and on the other the immigrants. The natives being the head of the village and the Lord of the Land or *Tuan Tan.*

Since the beginning of the nineteenth century, series of events began to change the course of history. The colonials looking for local chiefs certainly contributed to divide the society and organize a new hierarchy by which *mel* were considered as the upper class and *ren* and *iri* lower classes. Religion played its part too. In the forties, the native traditional Tuantan's family was estinguished. He was replaced by a family *mel* belonging to the house Ler-ler as it seemed natural that an upper-class should be responsible for that House. About the same time, the traditional number of families was divided in order to increase their number and therefore have more head of families that would elect the head of the custom or kepala adat so that the government stayed in Watlaar. And social boundaries continued to become even sharper and a mean of power. I will refer to the thesis written by P.M. Laksono, the most recent anthropological research on the Kei Islands, who presents the historical processes of the persistence of gift exchange and social segmentation in the Kei Islands, thus enabling comprehensive and new answers to these questions. I quote :

« The disagreement between mel-mel and ren-ren is basically concerned with the adaptation of their original social differences to specific historical contexts, especially the

changing distribution of power in the village. We can see this after the imposition of the territorial administration, which was going on under the Dutch colonial rule.[2] The Dutch introduced a new system of hierarchy based on a territorial administration by giving certain positions (rat, orangkaya, majoor and kapitan) to local collaborators, who were the holders of local administrative offices or mel-mel. the Dutch, while disregarding the office of *nuhu teran* (the lord of the land), claimed these title bearers were noble, granted them with cane knobs (rottingknoppen) as insignia of office, and issues them letters of appointment.[3] These new attributes became the standard references for understanding the term mel-mel during colonial times. So mel-mel individuals in the islands have become (in its translation) the nobles of the islands. Thus, Geurtjens (1921/189) said, that not seldom in a village the nobles constitue the preponderant part of a village. There is no evidence, however, that the autochonous inhabitants, i.e. the ren-ren, were once defeated by the immigrants. Even J.W. Admiraal (1939:22) reported, that they were still powerful, for they held the office tuantan (the lord of the land), while the immigrants, the mel-mel, had no territorial authority.[4] Admiraal (1939:22) wrote, that the formation of the territorial juridiction had started with their presence. This process was not finished until the establishment of Dutch administration in the islands (1882). Admiral even said that the territorial authority of the village was limited by what he called the middlestand (the ren-ren) who maintained their office tuantan (the guardian of land). In Kei Besar, for example, Admiraal (1939:29) found that the later immigrant noble was not successful in suppressing the stand in Kei Kecil. The middlestands still assumed as evenly prominent with the immigrants, and in the later formation of the kingdoms they acknowledged themselves as the kings of Yamtil and Ohoinangan.

The following matrixes might explain the differences between the two sets of classifications.

1. Their original set of social differences

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[2] The construction of the village map in 1927 was the basic procedure for imposing territorial over genealogical order. this imposition was clearly under the Dutch command. J.W. Admiraal (1939 : 20), a Dutch ex-officer in Tual reported : »Geleidelijk aan werden na 1911 de adat-hoofden steeds meer uitgeschakeld van het bestuur der raatschappen. Deze raatschappen dreigden zelfs tot volkomen verval te geraken, toen aan de dorpshoofden ook rottingknoppen werden uitgereikt, en nog later hun benoemings besluiten hen aanwezen als « regenten met den titel van Orangkaya » - Gradually after 1911 the adat- heads were excluded from the government of the kingdoms. these kingdoms even tented to decline, when the knobs were distributed to the village heads whose letters of appointment assigned them as « regents wih the title of orangkaya ».

[3] By doing so, the Dutch created an accumulation of power in the hand of the village administratrators. There has been no attempt to reconsider this issue. Even the newest Indonesian government regulations on the village administration of 1979, n°5, takes no account on it. In these regulations (17 :2), the village head becomes the only power holder in the village. He is, at the same time, the head of the village administration, and the chairman of the Lembaga Musyawarah Desa (the Institute of Village Council).

[4] See also Klerks (1939/ 19-20).

natives	immigrants	
	superior	inferior
ren-ren	mel-mel	iri-iri

2. The new set is contained in this set of relationships.

(superior)
mel-mel (the noble)
ren-ren (the middle class)
iri-iri (the slave)
(inferior)

The new set fails to explain adequately the differences between the mel-mel and the *ren-ren*; the translation of ren-ren into middle class seems to assume that the position of ren-ren is between the mel-mel and the iri-iri. However, the historical facts suggests that the ren-ren were neither under nor above the mel-mel; both basically agreed that they were supposed to live together in a relationship of equality, in which the ren-ren held office of *teran nuhu* and mel-mel held administrative office. »[5](Laksono, 1990).

The independance of Indonesia and government regulations increased the social stratification and hierarchy in that power had to be represented. According to the newest Indonesian government regulations on the village administration of 1979, n°5 (5:3), the village head must be democratically (secara langsung, umum, bebas dan rahasia) elected by the villagers. However, the head of local government in Elat (Bp. Camat) wrote in a report that the villages administration structure was modelled on the previous social organization established by the Dutch colony. Thus, the Bapak Raja had become the Kepala Desa in the village which was the seat of the Ratskap (kepala Ratskap); the orang kaya became the Kepala Desa in the village which had the status of Kayaskap while the Kepala Soa became the Kepala Desa of the village which had the status of Soa or dusun. The Kepala Adat or Bapak Raja kept his authority over

[5] Their relationship looks similar to the inter-moiety relationship, between the leo inak moiety and the leo anak moiety, in the island of Rote (see Fox 1977 and 1980). In Rote leo inak is believed to be the immigrant moiety, who holds the office of the kampong head; and the leo anak is believed to be the native moiety who holds the office of the tuan tanah (lord of the land). As in Rote, holding the control of the distribution of land alone did not raise the autochthonous group, in this respect the ren-ren, to the superior or dominant position in relation to immigrant group or the mel-mel. It is clear that in the earlier period hierarchical relations between these groups were unknown, and only later historical events imbued the relationship with the notion of noble mel and commoner ren.

the orang kaya and Kepala Soa within his province and had the support of the Bupati of Tual, local governor . (Berhitu, 1987).
Development also played its role since it created new needs among the people but nothing to obtain it apart from exchanging and being indepted to the ones who had wealth, thus creating dependency. Soon, the house Kbautib became too crowded and after the death of their father, the four brothers decided to create another house named Ler-ler, thus dividing the eldest from the youngest (*yaan dan warin*). Social status and ownership of people were handed over from generation to the next. And as inter-class mariages were prohibited, those who did not follow the rule automatically fell and belonged to the lower class.

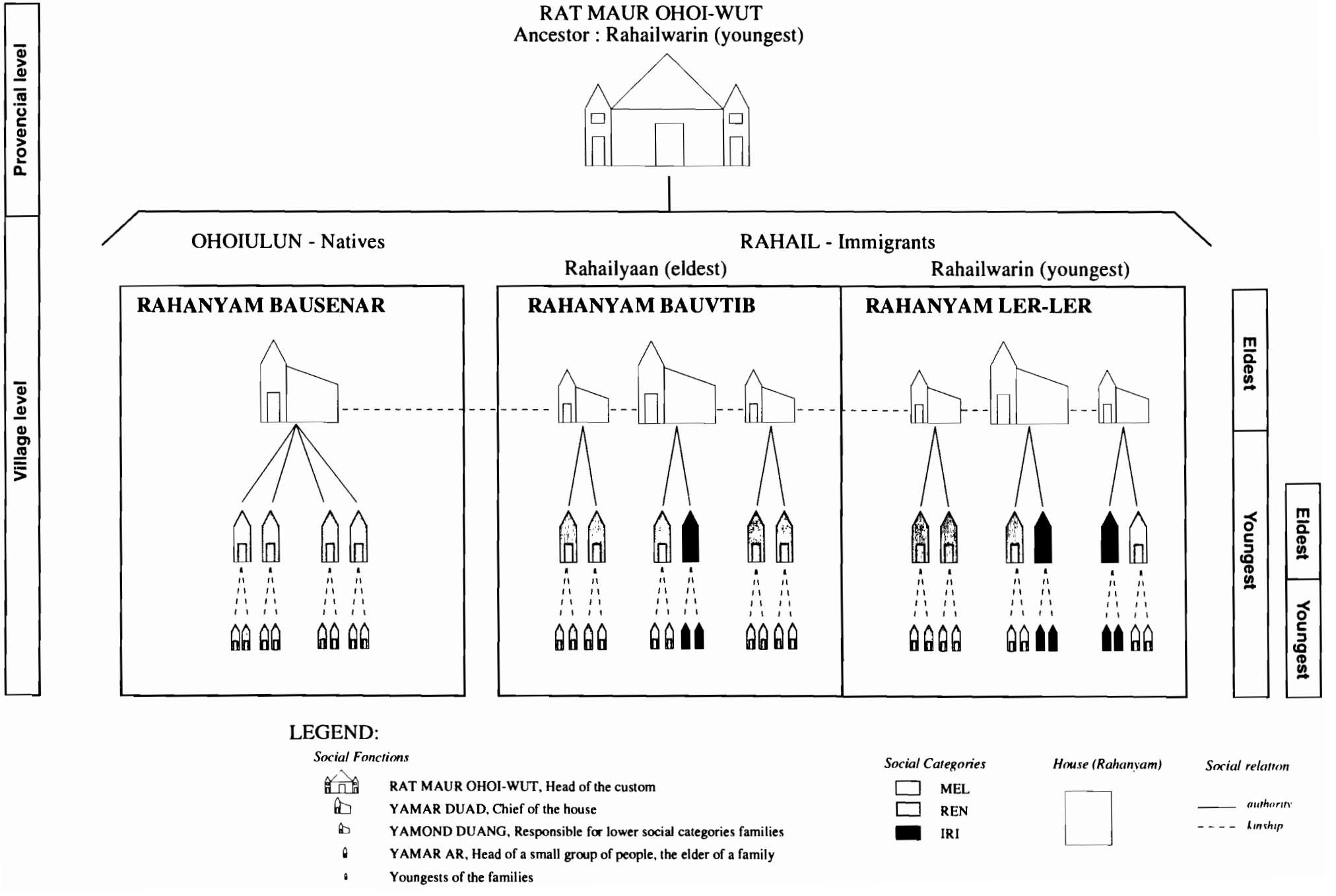
This, together with all the changes brought about by governmental new implementations drastically changed both the traditional social organization and the role of each key person within the village and within the province. So much so that the power that was applied to the whole province has been reduced to the size of the village thus increasing the function of the house no longer as an entity but as a property. Development and modernity have created new needs. Lower classes have become entangled in a dependant relationship with the upper class based on a former model that of helping each other with the difference that in the old days, the House Bawsenar functionned as an entity but that today we observe that the whole village is completely in the hands of one family, originally former immigrants. It is that dependant relationship that has been taken up as a sense of property mainly because the house is where all the wealth is kept and also because of the internal house structure.

It is very intersting with this background to look at the contemporary social organization in the village of Watlaar which somehow illustrates the original set of differences between people and the new set of relationships which Laksono described (Laksono, 1990).

The Figure 2 (page 30) presents the comtemporary social organization in Watlaar beginning at the provincial level with the Kepala Adat since Watlaar is the seat of the traditional ruler of the province Maur Ohoi-Wut and describing the organization at the village level.
The village of Watlaar counts three houses, one has for ancester the Tuantan's ancestor, whose name means the head of the village, while the two others come from the same ancestor, Rahail, the immigrant. It was only natural since the authority was in the hands of the *mel* to replace the *Tuantan* by a *mel*, thus overruling on both the land and juridical matters. It seemed that the internal structure of the Houses also change at the same time, taking away *ren* and *iri* prerogatives since they no longer had power over the land and that they were divided under the authority of the *mel*. Nowdays, intersocial categories in Watlaar show the authority of the *mel* and the dependency of the *ren* and *iri* as illustarted in Figure 2 (page 30). One or several *mel* housholds have complete authority over several Ren and Iri and are responsible for them. *Mel*

"own" lower classes in the sense that they can ask *ren* and *iri* to do things for them such as housework, working the fields, cutting wood and so on. In exchange of which they have to provide the customary wealth at the occasion of wedding and funerals or to reimburse a debt. According to the adat, weddings, funerals and any crime committed to the community or to an individual involves a price to be paid in gold, gongs and canons. Part of the wealth is given to the person concerned but most of it is given to the house the person belongs to. *Mel* may also help if someone is sick or in need. But it seems that while *ren* and *iri* are still caught today in that same investment, *mel* do not always keep up to their responsabilities.

COMTEMPORARY SOCIAL ORGANIZATION IN WATLAAR



Thus, lower classes are still tied to the upper class because of the adat ritual, the payments of crimes, their informal debts because the *mel* has helped them while they were ill for exemple but also and specially because their social status does not enable them to directly adress an upper class person nor to organize any matter by themselves. They have to follow the hierarchy presented in Figure 2 according to which they constantly depend on the *mel* and to ask a *mel* for something means that the *mel* can ask for something back in exchange.

Nowadays, the village counts few lower class families who have managed to be more independant. Those families have relatives living outside of Watlaar who have succeeded, thus were able to bring themselves their part of wealth at the adat occasion without asking material help to their *Yamong duang*. However, the majority of lower class families are still caught in thinking one day at the time. But in general, it clearly seems that wealth itself would not change the status of *ren* and *iri* status. Rather well-off families still have to go through this hierarchy system that maintains a social organization. The difference is that their *Yamong duang* perhaps measures his authority a little.

Table 1 shows that the repartition of castes varies from one house to another. This can be briefly explained because of the change of traditional social organization in the case of the house Kbautib. It should be mentioned that in the houses Kbautib and Ler-ler, *mel* also "own" *ren* and *iri* in neighbouring villages. The distribution of *ren* and *iri* for *mel* does not follow any specific pattern. A household *mel* may "have" between two to four households *ren* and/or *iri* while another might only "have" one or none at all. Partly because the *ren* and/or *iri* they formerly "had" did not have any descendants or because they stayed outside of Watlaar for many years and recently came back to the village to retire. In that case, they may ask help from *ren* and/or *iri* who usually work for their relatives. What is striking is that the majority of people are *ren*, counted all together 398 persons for some 157 *mel* and 62 *iri*, that is three quater of the population under the authority of one third.

Table 1: Repartition of people according to the distribution of caste and of house in november 1996.

BAWSENAR			KBAUTIB			LER-LER		
Mel	Ren	Iri	Mel	Ren	Iri	Mel	Ren	Iri
5	187	-	61	68	28	91	143	34

(Only the people originated from Watlaar figure in this distribution)

C . THE VILLAGE ECONOMY

The economy of the village of Watlaar is very little monetarized. Most families work essentially to support self-subsistence and, as families are dedicated to the same production, exchanges are rather low and occasional. Part of the exchanges happen within the village while exchanges with the outside serve to other and very specific purposes. Exchanges within the village concern food production and serve to regulate food and basic everyday needs deficits or any occasional surpluses between the families. Money is mainly needed to afford exchange with the exterior. Exchanges with the outside serve only to finance children education and to acquire manufactured products or other goods which are not produced in the village (sugar, tea, flour, spices, rice, petrol,..).

Both men and women's activities are either meant to maintain self-subsistence or to acquire money. We have tried to estimate the villagers self-subsistence needs by looking first of all at their diet and then look at the activities and working time necessary to ensure their subsistence.

1 - The diet according to the meals

30 children aged between 13 and 15 years old have been asked to write during two weeks exactly what they ate for breakfast, lunch and dinner. Children were from all the three social categories in order to see how belonging to a particular social category affected the villagers's diet. The sampling was done late february and beginning of march 1997 at the end of the westerly wind season.

Figure 3 shows the distribution of the number of intake in different food consumed by the villagers during a week. The food consumed either come from the garden and the meon (vegetables, sagou and tubers), from the sea or are bought (tea, rice, flour, supermie). It is very interesting to note that the only source of proteine come from the sea.[6] The percentage of meat (pork, chicken and other products from hunting) is very low. This might be explained by the fact that the sampling was done while the season was still favorable to sea activities. It may also be explained by the fact that pork and chicken represent an interesting source of income and that villager would rather trade those products. Most of the seafood is collected at low tide on the intertidal zone by women (small fishes, octopus, shells) since the village is located close to the

[6] People eat all day long products from the forest (coconut, canari nuts, fruits). This also has to be taken as a proteine intake.

shore. Hunting products caught in remote forest areas and fishes caught on the outer reef slope by men are rarer commodities.

Figure 3 : Frequency of food intake during the meal per week

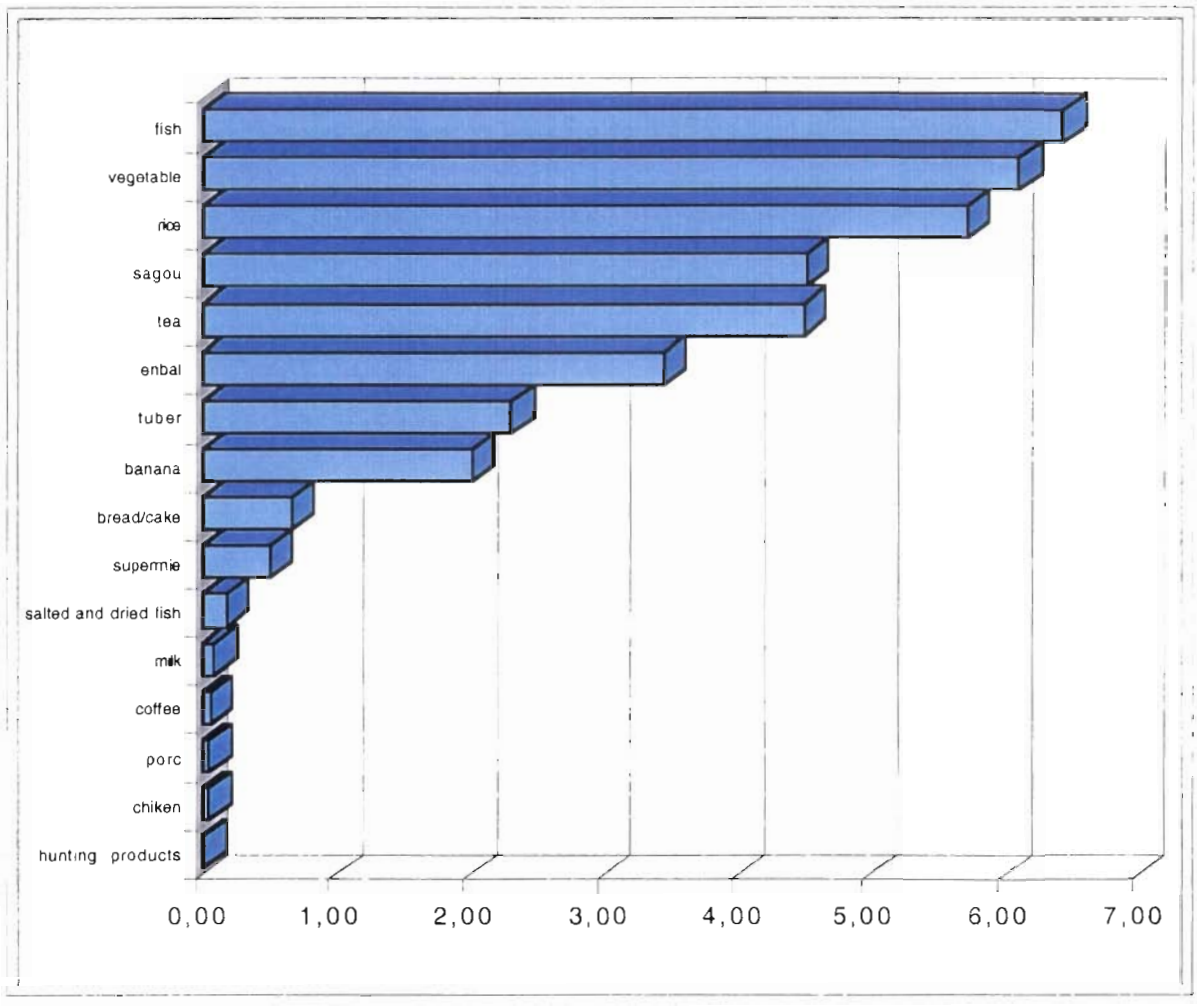


Figure 4, Figure 5 and Figure 6 show the distribution of the number of food intake per week according to the three social categories : *mel*, *ren* and *iri*.

The percentage of products extracted from the garden (enbal, tuber, vegetable, fruits, sagou) is much higher for the social categories *ren* and *iri* than it is for the *mel* who tend to buy food (rice) rather than produce it. The comparison of the three graphs brings out social differences in terms of purchasing power which leads us to question villagers basic needs in self-consumption and produces which must be bought, the time involved in producing and exchanges that can generate money.

Figure 4 : Distribution of food intake per week according to *mel* social category

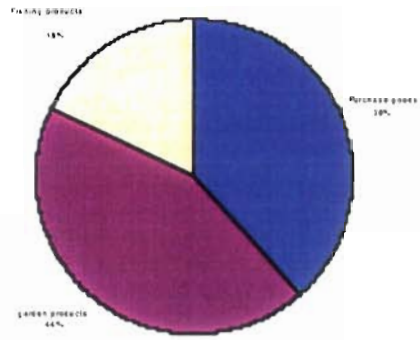


Figure 5 : Distribution of food intake per week according to *ren* social category

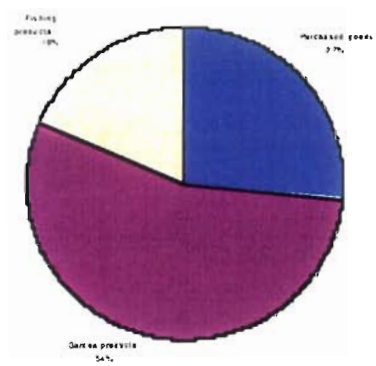


Figure 6 : Distribution of food intake per week according to *iri* social category

We can say that villagers activities's calendar is quite regulated. A week of work only counts four and a half days since on Monday, all men, head of family, must show up for weekly community meeting and community work and on Tuesday, they have to work for the *Rahanyam* within the IDT program. This time is not used to acquire money but to meet the Kepala Adat and the Kepala Desa's requirements which they must follow if they do not want to pay the Rp. 2000 fee for not showing up. Sunday morning is reserved to go to church. Women usually work for the church on Friday. Thus, community work conditions the production and the village economy.

The Table 2 presents a list of goods pertaining to the regular meal and produced by the village, the working time, the basic household need based on a weekly rate and the price it cost if it is not self-produced or the income those products can provide to a household if any surpluses are sold. It has to be note that sometimes dishes are also used as money exchange. This means that the village is little monetarized and that the goods coming from the exterior are rare.

Table 2 : Working and consumption of the main food food products in Watlaar

Resources	Time consuming	Household consumption	Price
Sagou	4 days of work to extract 3 baskets	minimum 1 basket weekly (on the basis of 6 intakes per week)	US$ 1,40 to 2 /basket
Enbal	2 days of work to process one basket	minimum 1 basket weekly (on the basis of 6 to 8 intakes per week)	US$0,40 /basket (unprocessed)
Tubers and vegetables	6 hours daily for the regular activities and five days a week	minimum 1 basket weekly (on the basis of 6 to 8 intakes per week)	US$0,40 /basket (unprocessed)
Sea products	average mean taking into account both men and women activities 2 to 3 hours daily and five days a week	The weekly fishing activities allow 6 to 8 seafood intakes in the meals per week	US$0,60 for about 10 small fishes or 2 bigger ones
oil	half a day of work to make 3 bottles of coconut oil	1 bottle per week	US$0,40 /bottle
Fruits	no time involved From the gardens	occasional, depending on the resource	from US$ 0,20 to 0,40

Exchange rate based on 1997 rate of US$ 1 = Rp. 2400

The work involved in producing self-consumption goods appears to be very high and especially time consuming. Both men and women are involved in those activities. While men will do hard and physical work like working the sagou, cutting trees, clearing rocks to organize the gardens, going sea fishing, women will ensure the maintenance of the gardens, the processing of enbal and oil, the housekeeping, and the collect of fishes and shells on the intertidal zone.

A minimum of 9 to 10 working days per week are needed to produce the very basic food consumed weekly by a family while only four and a half days are available to men and five days to women. This is without taking into consideration the time women spend in cooking and nursing. Other food products are needed to the diet but are not self-produced in the village. They are bought either at the Chinese shop or at the other stalls. Cash is then needed and part of the working calendar is used to make money.

2 . Household Food Expenditures

A list all the goods representing regularly villagers expenses attempts to evaluate people from Watlaar minimum cost of living as shown in Table 3.

Table 3 : Household expenditures per month

List of goods	Minimum estimated basic needs /month for a 6 pers. Household	Minimum estimated basic needs /year for a 6 pers. household
salt	from US$ 0,20 to 0,40	from US$ 2,40 to 4,80
sugar	from US$ 5 to 11,60	from US$ 60 to 139,20
bread/cake	from US$ 3,30 to 5,80	from US$ 39,60 to 69,60
tea	from US$ 0,20	from US$ 2,40
coffee	from US$ 0,20	from US$ 2,40
spices	from US$ 2	from US$ 24
washing powder	from US$ 2 to 3	from US$ 24 to 36
soap	from US$ 1	from US$ 12
cigarette/tabacco	from US$ 1	from US$ 12
fuel	from US$ 2	from US$ 24
Total low average mean	**US$ 17**	**US$ 204**
Total high average mean	**US$ 25**	**US$ 300**

Exchange rate based on 1997 rate of US$ 1 = Rp. 2400

From looking at Table 2 andTable 3 we quickly see that villagers are caught between spending time to meet self-consumption requirements and spending time to trade work for money.

3 . Household Education Expenditures

Besides the need to purchase goods, children education is an expense which must be taken into consideration in the household budget since the census showed that 94% of the children under 17 years old were going to school (on a total of 229 children under 17 years old living in Watlaar, 13 children aged between 13 to 17 years old do not go to school) . As mentioned

earlier in the report, Watlaar has three types of schools, TK which is a children playgroup for children under 6 years old, SD which is a primary school and SMP which is a junior high school.

School fees vary in function of the type of school as follow :

TK : US$ 5,20 per child/year

SD : US$ 15,40 per child/year

SMP : US$ 41,60 per child/year

Looking at the number of children per family according to the different social categories and the cost of schooling, we tried to estimate education expenses for a household.

The Table 4 presents the distribution of children according to schools and social categories and the cost per household.

Table 4 : Distribution of children according the different schools and the social categories and the cost per household in US$.

Type of school	Iri	Ren	Mel	Chinese	Total
TK	1	12	4	0	17
SD	8	82	41	4	131
SMP	7	27	29	0	63
Total scholar	16	121	74	4	215
Nb of households	7	44	22	1	74
Average Nb of scholar per household	2,3	2,7	3,2	4	2,9
Total cost	419,6	2448,4	1856,6	60,8	4487,4
Total cost per household	59,9	55,6	84,5	60,8	60,6

N.B. Nb of families who have children at school

The average education expenditure is US$60,6 per family per year. The education expenditures are much higher for mel households and less active persons per family.

Taking into consideration both living and schooling expenses, the annual expenses varies between **US$ 240 and 380 per year**. This figure does not include other expenses such as transport, clothes, basic household equipment and healthcare.

4 . The Workforce

From the 643 people permanently living in the village, there are 80 children aged under 4 years old, 215 children aged between 4 and 17 years old going to school and 348 working people[7]. In Watlaar, people work until 60 or 70 years old depending on their health but generally speaking they are still considered as active persons in the village.
Table 5 shows the number of working people by family according to social categories. We also mentionned active people aged over 63 years old and under 17 years old.

Table 5 : Distribution of active people according to gender and social categories

Social Categories	Nb of households	Total Nb of actives	Active Women		Active Men		Actives
				> 63 years		> 63 years	< 17 years
Mel	31	104	57	10	47	10	0
Ren	57	200	106	17	94	15	10
Iri	7	37	22	3	15	1	3
Chinese	2	3	1	0	2	0	0
Total	97	344	186	30	158	26	13

N.B. The total number of houses does not count two houses since they are not considered to belong to any of the three social categories above (people recently arrived in the village). Some ren belong and live in mel houses. They have been included in the mel social category.. Some iri married with ren and living in the same house have been considered as a ren with whom they live.

We corrected the number of active people by considering people over 63 as counting for half of an active person. The weekly working time has been calculated on the basis of 4 and a half days for men and 5 days for women. Table 5 shows that the average number of active person per family is 3,3 persons and that the average number of working days per family is about 15 days and a half.

[7] Out of 643 permanent residents in Watlaar, 4 persons are not originated from the village and will therefore not be further considered in the study.

Table 6 : Distribution of average number of active people and of working time per household and social categories.

Social categories	Nb of household	Nb of active person[8]	Nb of active per household	Working time per week[9] (day)	Working time per week and household (day)
Mel	31	93	3,1	449	15
Ren	57	184	3,2	876,7	15,10
Iri	7	35	5	164,7	23,5
Chinese	2	3	1,5	14	7
Village	97	317	3,3	1512,5	15,6

The necessary time to ensure the weekly supply of food produced in the village for a family has been estimated to 9 to 10 days. This does not take into account the time dedicated by women to nursing, cooking and other housekeeping. This estimation does not take into consideration the fact that some type of work, usually reserved to men, imply to be away from the village during 2 to 4 days (going to the sagou plantations or in the gardens located far away from the village). If we take these aspects into consideration, more working days would have to be considered. However, there is still time left during the week to do casual work for money.

Money exchanges are limited and occasional within the village. But some persons will concentrate in looking for money in specializing in various activities such as making canoe, cutting wood, making fishing pots, making sagero and have an income from those activities. Considering the time they spend doing this monetarized activity, they cannot ensure self-consumption. Thus, commercial activities are all reserved to some persons able to monetize a particular skill or to make profits from a particular equipment.

[8] Person above 63 years old were counted as 0,5 active person.
[9] Working time was calculated on the basis of 5 days/week for women and 4,5 for men.

5 . Monetary Earnings

Income varies from one household to another and from one month to another. But generally speaking, we can say villagers can get money from different sources:

Surplus food sold within the village
- occasional crop, fruits
- sea products
- coconut oil
- poultry

Casual jobs in the village
- house building
- working the garden
- cutting wood
- handmade baskets, rugs and fishing pots, furniture
- cooking bread

Rental facilities within the village
- coconut and enbal grader
- chain saw
- fishing net
- transport

Commercial products sold outside the village
- coprah
- poultry
- porc
- trochus

Working outside the village and financial transfer from family living outside the village.

The exploitation of trochus will be discussed in the second and third part of the report since it is a commodity which is subject to a certain type of management and a particular community sharing-system. It represents an important source of income for the village but only happens once every year or every two years. When the profits are shared among the villagers, a

household may receive between **US$ 50 to 70** every year or every two years. Trochus and coprah are the only trade source of income from the exterior.

Coprah is probably the most regular source of income for the villagers. A survey in the different households showed that most of them produced an average of 40 to 80 kilos of coprah per month during eight months a year since during the easterly winds season, transportation is impossible. Pofits from coprah represent an average from **US$ 17 to 33** per month or from **US$ 136 to 264 a year.**

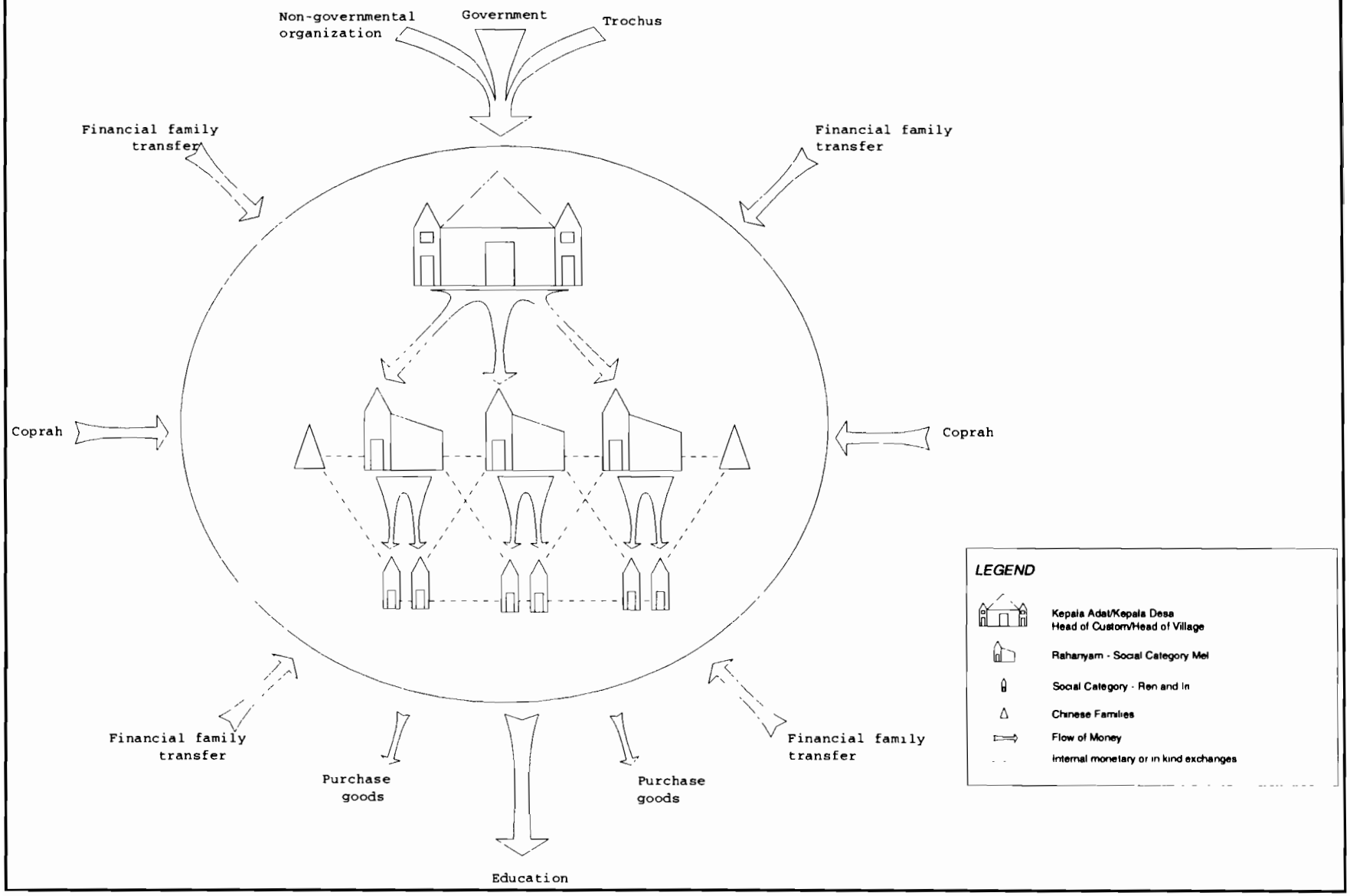
Coprah is sold to the Chinese local shopkeeper and to the two other *mel* shopkeepers. They drain the small production which they then sell to others traders in Elat, the capital of the Kei Besar island.

The comparison of the estimation of cash needed per household ranging from about US$ 250 to 380 per year and the money people can earn ranging from about US$ 180 to 350 shows the fragile balance they are confronted to. However, although these are rough estimations not taking into consideration the demographic differences between families, we can nevertheless say that monetary income and accomplished work can just meet everyday life needs. The accumulation or investment in tools or work facilities is very difficult. The very fact that dishes for example are used as money exchange, that many services or work be paid in kind shows the difficulty to get money. This is due to the very low productivity which obliges people from Watlaar to devote nearly 80% of their working time just to ensure their food.

6 . Village heritage and standard of living

The Figure 7 presents the monetary exchanges and financial floods from and with the outside. We can see that besides coprah and family financial transactions, others flow from either governmental or non-governmental sources also go through the hand of the head of the village or the Kepala Adat who also controls trochus trading. Watlaar is a village managed on a community sharing-system. The Kepala Adat and Kepala Desa are in charge to redistribute funds allocated to develop the village and to share the profits made from exploiting the resource. An analysis of the heritage and villagers'standard of living allows us to examinate whether this redistribution improves the well-being of the families.

Figure 7 : The flow of money in Watlaar



We first looked at the village facilities (fresh water points, toilets, schools, sporting field, first aid clinic, ...). We found that the water supply had not been built correctly and that during the dry season, fresh water was difficult. Much money had been spent in the town hall. The first aid clinic was closed during all the time of our stay that is for nine months.

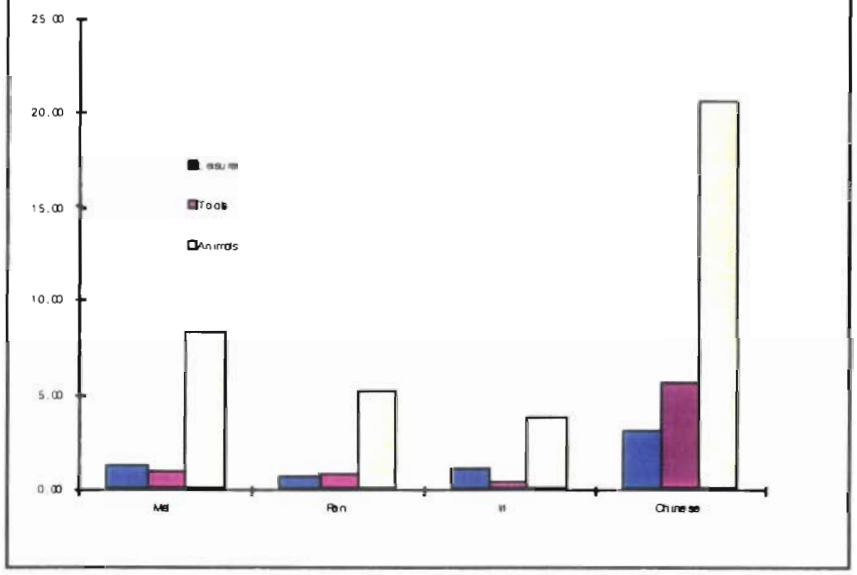
At the time of the survey in 1997, the IDT program had been going on for three years. The government subsidies allocated to each team was quite considerable each year. There was three different teams doing different activities. One was specialized in agriculture, another in making wooden furniture and a last one had opened a small kiosk. The group specialized in making furniture had invested in tools while the small kiosk had invested in goods which they intended to sell again. There was no signs of investment for the agriculture team. They had planted coffee. There was no signs of any development of activities or productions from either team. The furniture team sometimes made tables and chairs for the village but there was never enough work for all the members. And no cash to be made from the IDT program. It was more time consuming than anything else.

In order to describe the distribution of the standard of living in the village, a survey done in every houses recorded data on the type of house, whether it was permanent (all permanent building materials), semi-permanent (building materials from ciment but also wood and bambou) or non-permanent (wood, bambou), the sanitary, leisure equipments (TV, video player, radio, tape player), working equipments (canoe, fishing nets, sewing machine, ect...) and animals.

Figure 8 shows the repartition of leisure equipments, working equipments, sanitary and animals according to social categories.

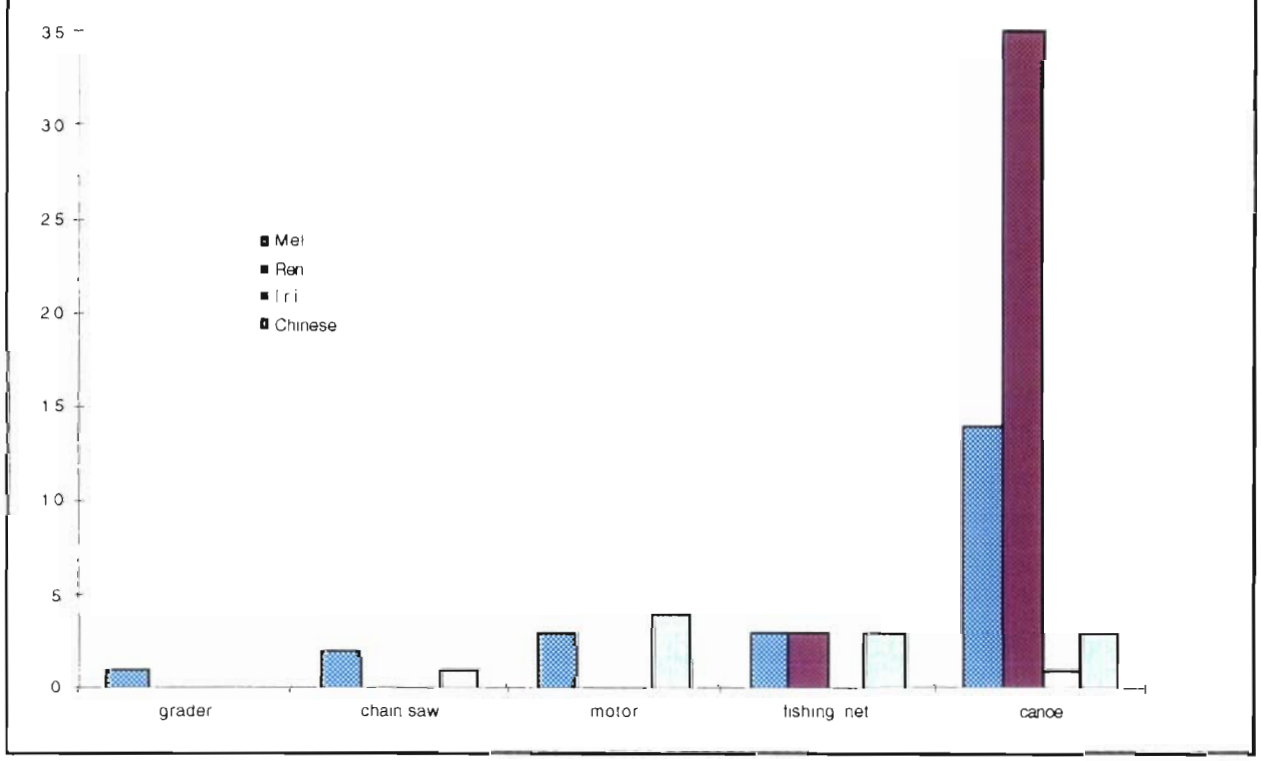
We observe that all working equipments, except for canoes are in the hands of either the Chinese families or *mel* families (Figure 9 : Distribution of working tools according to social categories). Those equipments are rented by their owners (transport, grater for coconut or enbal, chain-saw) and therefore generate an income for their owner.

Figure 8 : Distribution of leisure equipments, working tools and animals according to the social category



It is striking that Watlaar has only one coconut and enbal grater knowing the time it takes to do it manually and considering the fact that enbal is the basis of the people meals and coconut is a main source of monetary income.

Figure 9 : Distribution of working tools according to social categories



Chicken plays an important role within the village both for consumption but most probably as a trade. 80% belong to *ren* and *mel* families. Yet, if we compare the repartition taking into consideration the number of households, the Chinese families are the ones who have the most and destined to be sold (Figure 10). Dogs are mainly found in *ren* families and are used to go hunting. Porks are wild animals which have been caught alive and are destined to be sold (Figure 11).

Figure 10 : Distribution of animals per household according to social categories

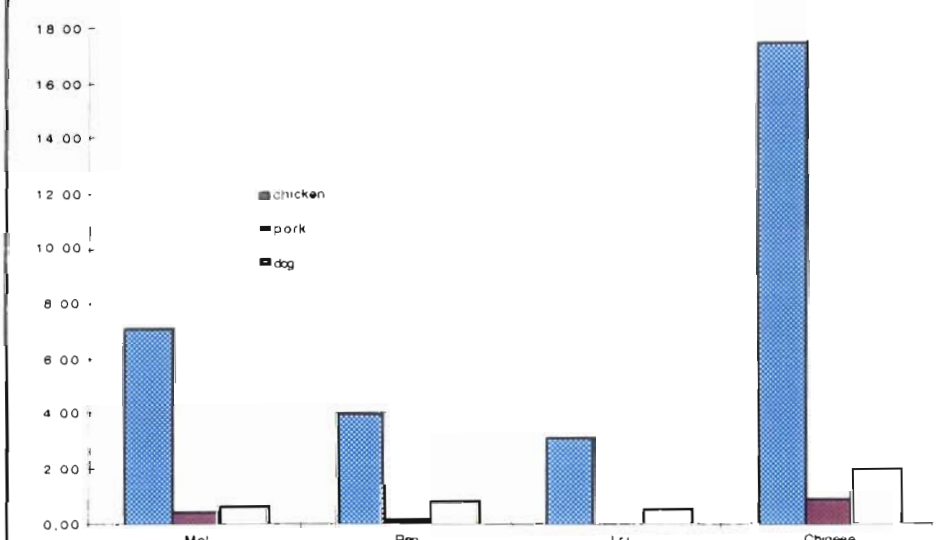
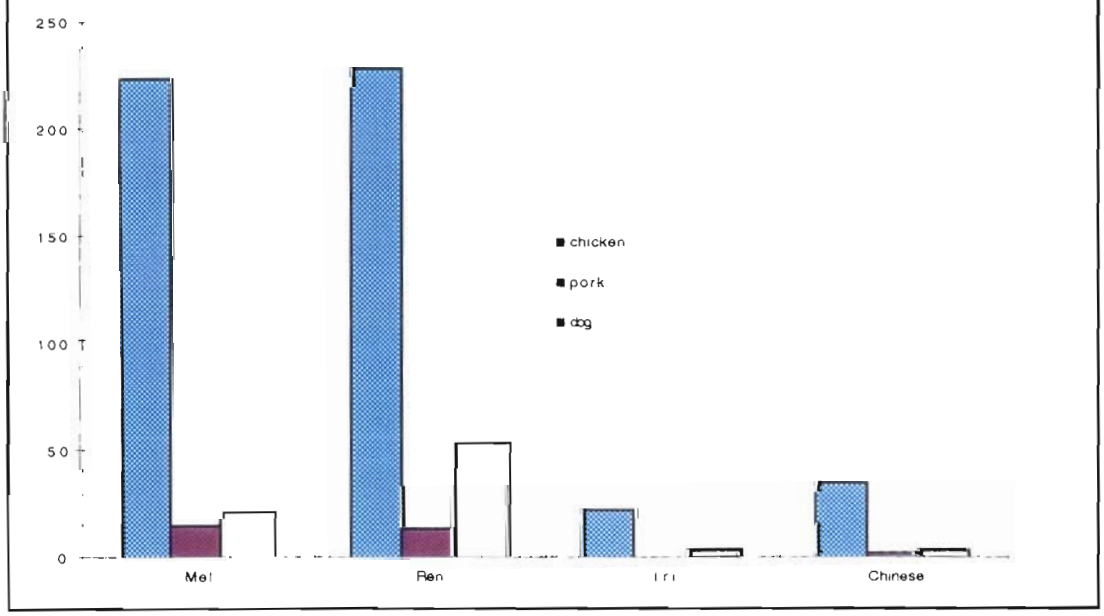


Figure 11 : Number of animals according to social categories



Leisure equipments are more evenly distributed among the different categories when compared to working equipments (Figure 12). However, it must be noted that only the *mel* families own expensive equipments such as television, video players, parabola, which they can hardly ever use since electricity only runs very occasionally. Those equipments are considered as prestigious.

Table 7 shows that the majority of people live in semi-permanent type of houses.

Figure 12 : Distribution of leisure equipments per household according to social categories

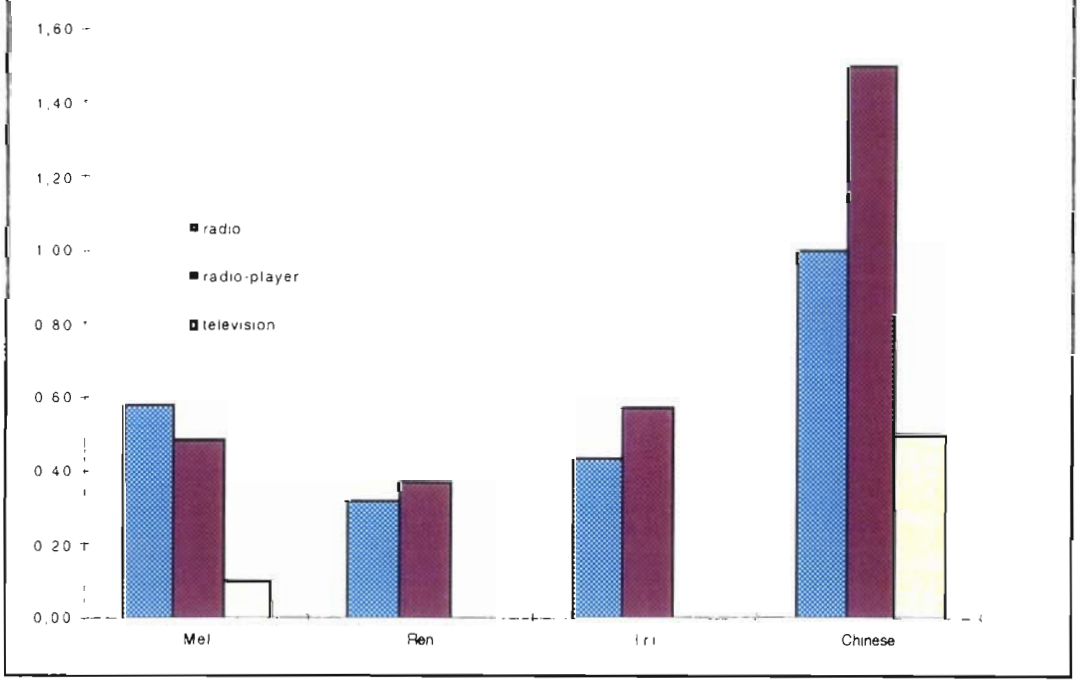


Table 7 : Distribution of type of houses according to social categories

Type of house	Iri	Ren	Mel	chinese	total
permanent	-	2	4	2	8
semi-permanent	7	47	23	-	77
non-permanent	-	6	6	-	12
total	7	55	35	2	97

These figures do not include two houses inhabited by foreigners.

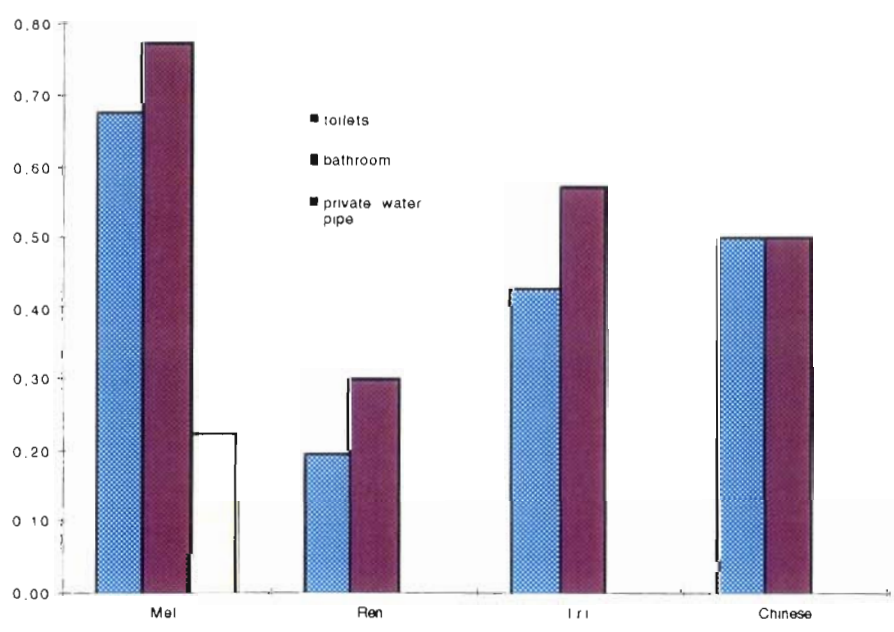
Table 8 shows the repartition of sanitary equipmentst according to social categories. Out of 97 houses in the village, 37 are equipped with a toilet, 47 with a bathroom and only seven have private water supply. Other houses help themselves to public water points (Map 1, page 13). The houses equiped with private water pipes are *mel* families who have strong authority in the village.

Table 8 : Distribution of sanitary equipment according to social categories

sanitary equipments	Iri	Ren	Mel	Chinese	total
private water supply	-	-	7	-	7
bathroom	4	16	24	1	47
toilet	3	11	21	1	37

Taking into consideration the whole village it is first the family of the Kepala Adat which has the better standard of living. Follows then the Chinese families who are the best equiped and offer a good standard of living. Looking at the Figure 13 which takes into consideration the number of households in the different social categories, *ren* are the less well equiped. *Iri* families seem to beneficiate from financial flood from relatives living outside the village.

Figure 13 : Distribution of sanitary facilities per household according to social categories



From all these observations, it appears that some families and the social category *mel* play special economic roles.

The Chinese families have a special position within the village since they hold production means in their hands and offer a link with the exterior in term of trading (coprah). Villagers can have a privilege relationship with them since nothing but trading and exchanges tie them together. On the contrary, *mel* from their status within the social organization represent the authority and the persons to whom r*en* and *iri* and dependent to. *Mel* will rarely pay *ren* or *Iri* people for their work or their time but will be the garant for bringing the customary usuals for at the weddings, death or birth for example. So *ren* will rarely trade with the *mel*. However, the *mel* concentrate tools and equipments from which they can produce things which *ren* and *iri* will need to buy, for example, bread. Only *mel* families own oven and have enough money to buy necessary ingredients. Thus, *mel* and Chinese families hold all production equipments which they use to develop commercial activities over which they have the monopoly of. But, unlike the *mel*, the Chinese do not invest in prestige but in equipments and products which can be sold. *mel* families are caught in prestige thus freezing capitals rather than reinvesting them within the system and make it go round. Moreover *mel* have the authority over production tools, governmental subsidies and non-governmental fundings. Money goes through them since they represent the authority and they are the one who then redistribute or are at the head of development projects. But by looking at some details in their standard of living for example, it seems that most of the money coming from the exterior to help develop the village is more often used to ensure their authority and prestige.

PART II : MARINE ENVIRONMENT AND THE FISHING ACTIVITY

A. DESCRIPTION OF MARINE ENVIRONMENT

1. The physical environment

1.1 Hydroclimate

The Kei island is dominated by equatorial monsoon regime. Southeastern (boreal summer) monsoon occurs from April to August, while northeastern (austral summer) runs from November till February. Between those seasons there are two transitional seasons. Independantly of reversal of wind direction, current always flows southward along eastern side of Kei island. Strengthened by the prevailing winds the flux in southern monsoon is higher than northwest monsoon.

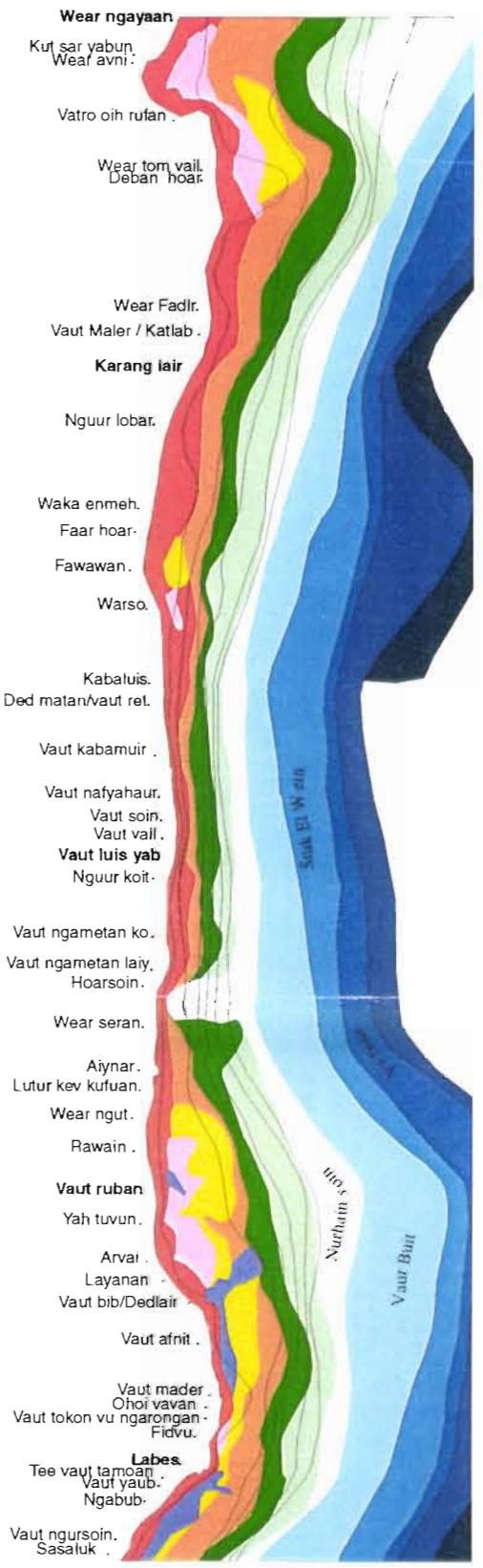
In Watlaar, whose coastline formed an angle of 15 ¡ to the magnetic north, during the incoming tide in October (northeast monsoon) both wave and tidal current on the reef flat came from south. Although tidal waves from both the Pacific and Indian Oceans reach Aru islands, the tides in this region are more strongly influenced by wave coming from the Indian Ocean (Hatayama *et al.*, 1994). In these regions, the type of tide is mixed semi-diurnal. This means that in approximately 24 hours period there is two successives tides where one tide is higher than the following one. The tidal range varies from 1 to 2 meter. The annual seawater salinity varies from 33 to 35 ppt, the surface seawater temperature varies from 26 to 30 ¡ C. The water is quite clear and visibility can attain 30 m depth.

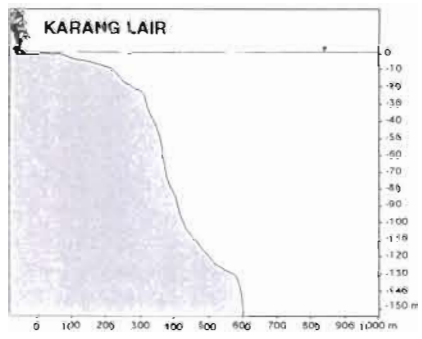
1.2. Bathymetry

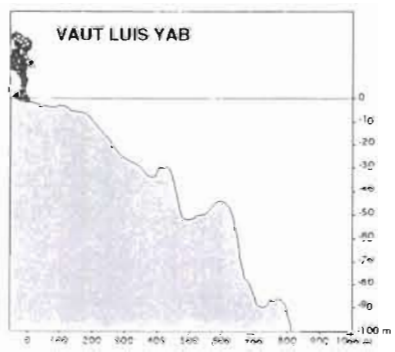
The result of bathymetry studies is presented in Map 3. The profile of Watlaar coastal area is not homogeneous along the coastline. Norhern and southern areas are less steep comparing to the central area where the extent of the reef flat is reduced. Above 900 meters from the sea shore, the slope falls very sharply to deep sea bottom.

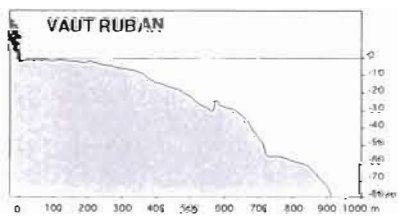
SEA MAP OF WATLAAR

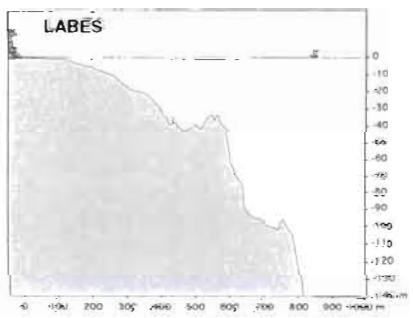
Fishing zones and bathymetry











0 250 500 750 1000

Metric scale

Profiles : In reference to names of places in bold along the coast.

Fishing areas named after the fishermen
(corresponding to the topography and the biotopes)

- Faar Soin : beginning of intertidal zone
- Ngaan Raan : small pool which captures water at low tide. Water can go out
- Tuvun : small pool which captures water at low tide. Water cannot go out
- Nut : little dune at low tide
- Yafat : intertidal zone
- Hanger : area with stones and coral rubble
- Hanger Soin : coral reef

Bathymetry (meters)

- 1 to 20
- 20 to 40
- 40 to 60
- 60 to 80
- 80 to 100
- 100 to 120

Nurhain Soin : sand area
Vaut Buit : color of the water is white/blurry
Stuk el Wein : color of the water is blue
Faruan : outer reef slope

Realized with the participation of the Maison de la Télédétection, Montpellier (France)
This map gives account of field surveys conducted from july 1996 till march 1997. All measurements have been taken according to villagers' informations.

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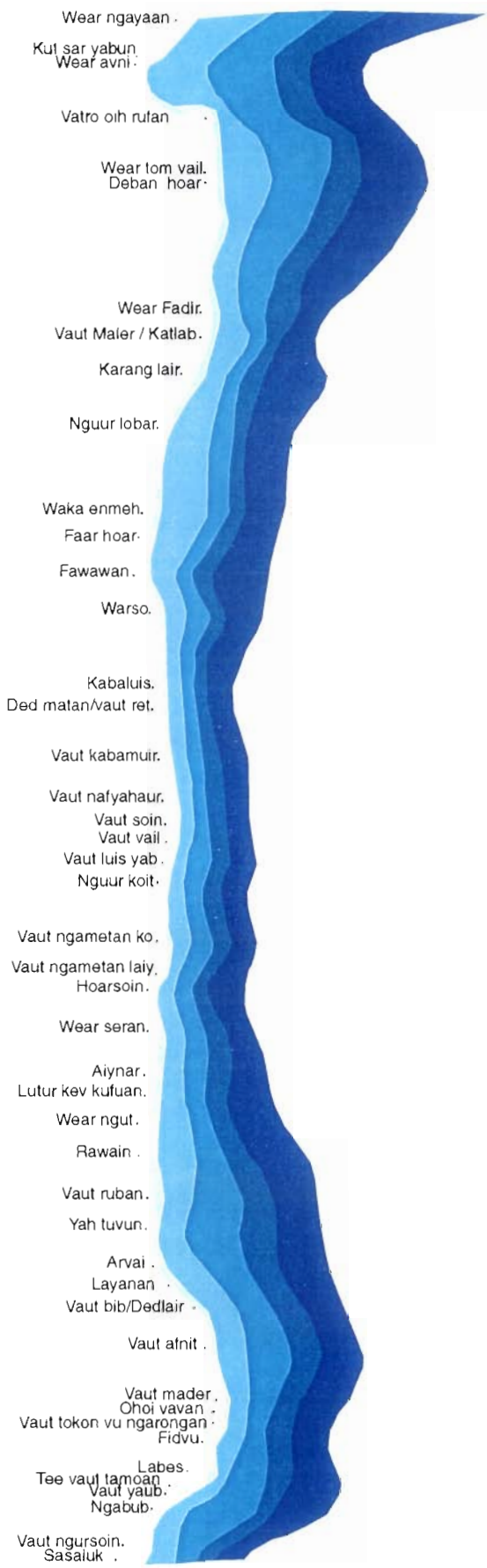
Vertical zonation and marine environment in Watlaar waters



LEGEND :

- Middle intertidal
- Lower intertidal
- Upper substidal
- Middle substidal
- Lower sustidal

0 250 500 750 1000

Metric Scale

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Realization : Sigit A.P. DWIONO with the participation of the Maison de la Télédétection, Montpellier (France).
This map gives account of field surveys conducted from july 1996 till march 1997

1.3. Spatial Distribution of Marine Substrate

The study of benthic community was done from 0 to approximately 20 m. Coastal water can be divided in 2 major zones i.e. intertidal and subtidal area. The intertidal area could be further sub-divided in 3 zones, i.e. upper intertidal, middle intertidal, and lower intertidal (Castro & Huber, 1997). In the same manner, the subtidal can be sub-divided in upper subtidal, middle subtidal and lower subtidal (Map 4) .

The brief description of each zone is presented below :

- Upper intertidal : Upper zone of marine environment on the beach. This area is under constant emersion and received only seawater splash during high tides.
- Middle intertidal : The emersion time in this zone is much longer than submersion time. The depth of this area varies between 0.2 to 0.4 m below high tide.
- Lower intertidal : This zone is emerged and submerged periodically according the tide cycle. This zone is usually considered as veritable intertidal area and includes areas of 0.4 to 2.0 m depth.
- Upper subtidal : This zone covers area with depth ranged from 2.0 to 3.0 m. During ordinary low tides, this zone is submerged and emersed only during exceptional low tides.
- Middle subtidal : This zone is always submerged even during exceptional low tides. The depth of this zone varies from approximately 3.0 to 8.0 m.
- Lower subtidal : The area covered by this zone is extended from 8.0 m countour down to 20 m.

In marine environment, the main physical components are water body and bottom. The bottom is built by substrates, either hard or soft, which determine the community of benthic animal and vegetal. In Watlaar waters, the bottom is consisted of different type of substrates including mud, sand, stone, rock, coral boulder, coral rubble and limestone flat. These various substrates are not distributed homogenously along the coast and the combinations of two or more substrate are frequently found. The following table summerizes the existing substrate types and substrate combinations in the coastal area of Watlaar (Table 9).

In order to visualize the distribution of different substrates within Watlaar marine area, a geographical information system (GIS) has been done using Arc info Softwear. For the sake of cleariness, the existing subtrate types and substrate combinations are divided in two category, the dominant (or primary) substrate, and complementary (or secondary) substrate. Primary substrate is defined as main subtrates forming the bottom or seafloor, while secondary or complementary substrates are those found among and/or on the primary substrates. For primary

subtrates, a numerical code was used for existing substrate types or their combinations; while alphabetical code was used to for secondary substrate. The result of the visualization technique is presented in Map 5 which includes zonation, primary and socondary subtrates. Since the first sub-zone (upper intertidal zone) is very narrow and hardly visible in the given figure scale, this sub-zone is not presented. The Map 5 shows that neither the primary substrate nor the secondary substrate are not distributed homogeneously along the coast, as well as along the different zones.

Table 9: Substrate types and their combinations found in coastal waters of Watlaar.

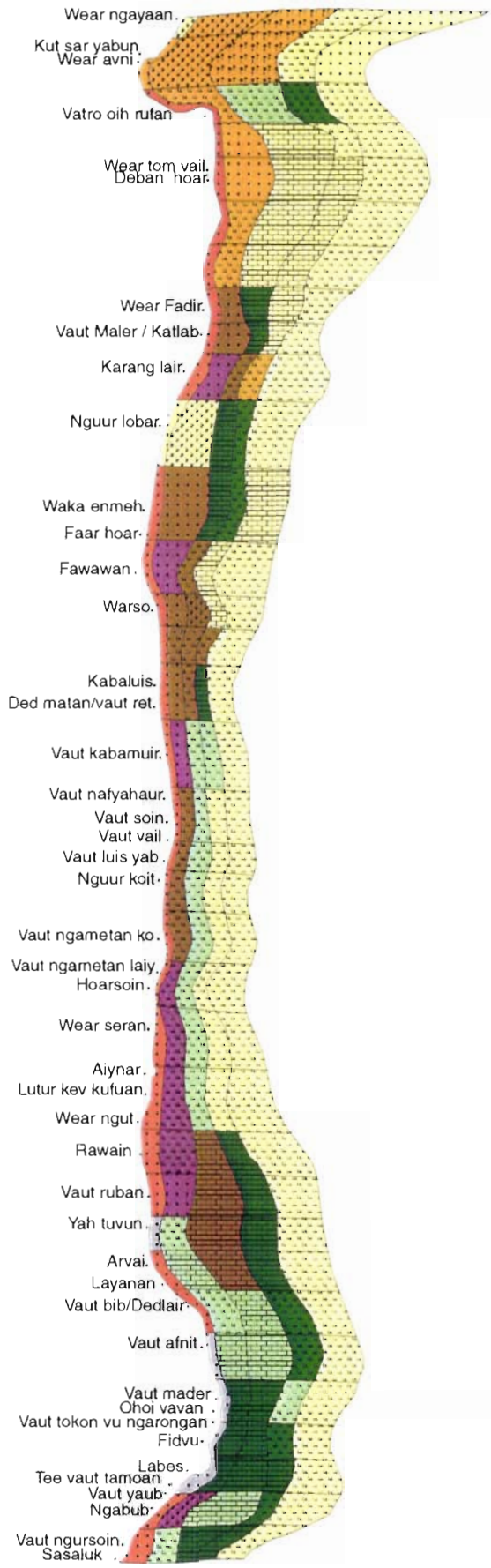
Zone	Intertidal			Subtidal		
Subzone	Upper	Middle	Lower	Upper	Middle	Lower
Depth (m)	0.0 - 0.2	0.2 - 0.4	0.4 - 2.0	2.0 - 3.0	3.0 - 6.0	6.0 - 20.0
Substrate types* and combination	Sa Sa, Mu Ro St Sa, St	Sa Sa, Mu Ro St Sa, St	Sa, St Sa, St, Lm Sa, Cr Sa, St, Mu Sa, St, Dc Sa, St, Cr Sa, St, Dc, Cr Sa, St, Lm, Dc Sa, St, Lm, Cr St, Lm Lm, Dc, Cr	Sa, St, Mu, Dc Sa, Dc, Cr Sa, Lm, Dc Sa, Lm, Dc, Cr St, Lm, Dc St, Lm, Cr St, Lm, Dc, Cr Lm, Dc, Cr	Sa, St, Dc Sa, Dc Sa, Dc, Cr Sa, Lm, Dc St, Lm, Dc Lm, Dc Lm, Dc, Cr	Sa Sa, Dc Sa, Dc, Cr

* Cr = Coral rubble; Dc = dead coral; Lm = Limestone flat; Ro = rock; Mu = mud; Sa = Sand, St = stone.

Of 8 main (primary) substrates, sand is the most dominant at all zones of Watlaar coastal area. The first zone (middle intertidal zone) is constituted by rock, stone, sand or mixture of sand and stone. The second (lower intertidal) zone is formed mainly by limestone or its mixture with sand and stone, excepted at Nguurlobar (in local dialect, *nguurlobar* means fine sand) and at the northernmost part (Wear Avni to Wearngayaan) where sand and stone are dominant. As well as the second zone, the bottom of the third (upper subtidal) zone is composed mainly by limestone and sand or their combinations with other substrate types. The fourth (midle subtidal) zone bottom is constituted especially by sand or limestone, while the fifth (lower subtidal) zone bottom is formed exclusively by sand.

From Map 5, an estimation of surface area covered by each type of primary substrate or its combinations was made (Table 10). As dominant substrate, the surface area covered by sand attains approximately 43.15 ha. Sand-contituted bottom was observed mainly on the lower subtidal zone (29.94 ha) and middle subtidal zone (7.27 ha). The combination of sand and limestone reef flat is the second important subtrate, and covers aproximately 10 ha of intertidal and subtidal area. Limestone reef flat and its combination with other substrates occupy almost 30 ha of intertidal and subtidal area. These type of substrate, as we will see later, is known to be the preferential habitat of trochus.

Primary and secondary substrate distribution according to vertical zonation in Watlaar waters



LEGEND :

Primary Substrate

- Sand
- Stone
- Sand, Stone
- Rock/Boulders
- Limestone
- Sand, Limestone
- Stone, Limestone
- Sa, St, Ls

Secondary Substrate

- No Substrate
- Mud
- Dead Coral, Mud
- Dead Coral
- Dead Coral, Coral Rubble

0 250 500 750 1000

Metric Scale

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Realization . Sigit A.P. DWIONO with the participation of the Maison de la Télédétection, Montpellier (France).
This map gives account of field surveys conducted from july 1996 till march 1997.

Table 10: Surface area (in ha) of primary substrate coverage according to vertical zonation.

Primary	Inter	tidal		Sub	tidal	Total
Substrate	Middle	Lower	Upper	Middle	Lower	area
Sand (Sa)	0.43	1.40	4.12	7.27	29.94	43.15
Stone (St)	4.98					4.98
Sa, St	0.06	4.79	1.70	0.43		6.98
Rock/boulders	1.08			7.88		8.96
Limestone (Ls)		1.27	3.84	1.36		6.48
Sa, Ls		3.23	6.76	0.26		10.25
St, Ls		4.55	4.59			9.13
Sa, St, Ls		4.78				4.78
Total	6.56	20.02	21.01	17.19	29.94	94.71

The secondary substrates include mud, dead coral, and coral rubble. On certain zones, especially on the first (middle intertidal) and second (lower intertidal) zones, no secondary substrate is found. Mud is only present among the primary substrates in Wear Avni and Wear Ngayaan, both on the first, second and third tidal zones. Among secondary substrates, dead coral is the most frequently found in Watlaar marine environment. This substrate alone or in combination with coral rubble, is found on the most of lower intertidal, upper, middle and lower subtidal zones. The estimated surface area covered by the secondary substrates is presented in Table 11.

Table 11 : Surface area (in ha) of secondary substrate coverage according to vertical zonation.

Secondary	Inter	tidal		Sub	tidal	Total
Substrate	Midle	Lower	Upper	Middle	Lower	area
No substrate	6.43	6.87			1.78	15.08
Mud (Mu)	0.13	1.88				2.01
Dead coral (Dc)		6.20	5.06	10.97	26.89	49.11
Coral rubble		1.90	0.31			2.21
(Cr)						
Dc, Mu			1.70			1.70
Dc, Cr		3.16	13.94	6.22	1.28	24.60
Total	6.56	20.02	21.01	17.19	29.94	94.71

The table shows that almost one sixth of Watlaar marine area bottom is devoid of secondary substrate. This bare area was observed mainly on the intertidal zone, both middle and lower sub-zones. Mud and its combination with dead coral cover 3.71 ha of the bottom. These secondary substrates and sand (primary substrate) constitute the bottom of seagrass beds which are found mostly at Wear Avni and Wear Ngayaan. Dead coral, coral rubble and their combinations occupy more than 75 ha of bottom area. These secondary substrate are suitable for grazing animals including *Trochus niloticus*. Unfortunately, some of this area is found on lower intertidal which is exposed at low tide, and lower subtidal where various coral species grow. Therefore, this suitable substrate is only available on approximately 37.5 ha of bottom area.

2. Marine flora and Fauna

2.1. Marine Flora distribution

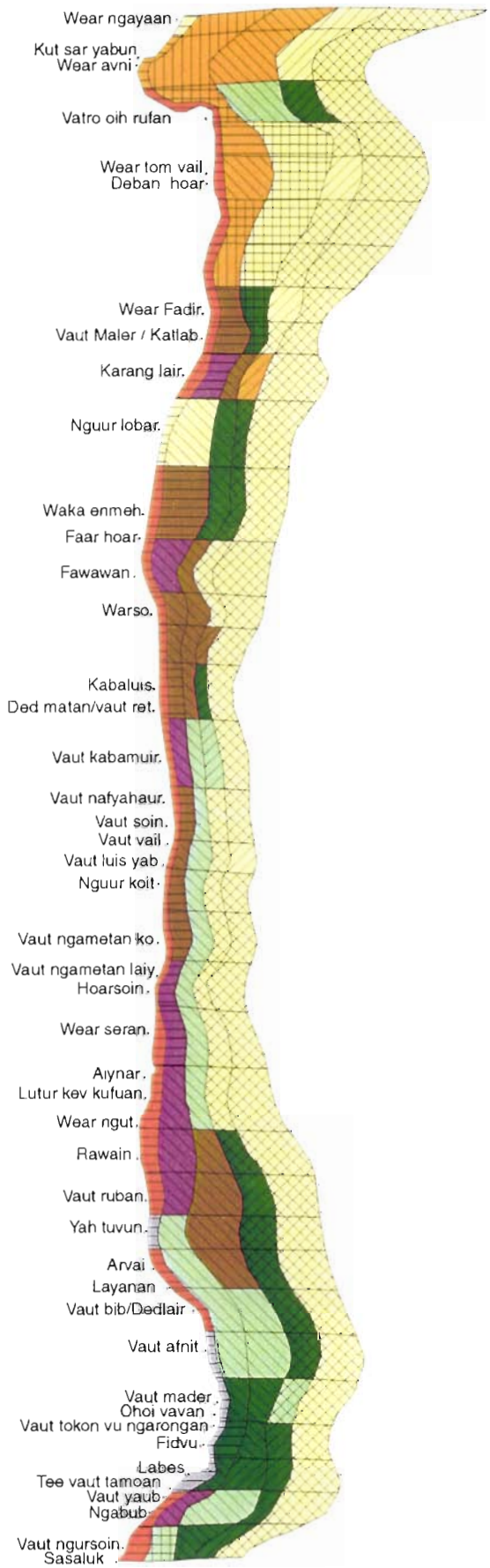
The distribution of flora in Watlaar is presented in Map 6. In this report, only sessile plants are considered. These marine plants include microalgae, macroalgae, seagrasses and calcareous algae. Microalgae can be found everywhere in marine environment of Watlaar and grow on almost every kind of substrate such as stone, rock, dead coral, coral rubble, limestone and even on macroalgae and seagrass, as epiphytic organism. Although no specific study was made on these microalgae, but their presence is verified (Table 12 : Surface area (in ha) occupied by benthic flora according to vertical zonation.he subtrates on all middle intertidal and some lower intertidal zones are covered with microalgae where grazing animals, especially

marine gastropod, obtain their food. Although the biomass of these microalgae are small, but their productivity is known to be important.

Table 12 : Surface area (in ha) occupied by benthic flora according to vertical zonation.

Benthic	Inter	tidal		Sub	tidal	Total
Flora	Middle	Lower	Upper	Middle	Lower	area
Microalgae (Ma)	6.56	6.12				12.68
Ma, Seagrass (Sg)		2.39				2.39
Ma, Macroalga (A)		10.71	15.65			26.36
Ma, Calc algae (Ca)			0.74	6.68	0.38	7.80
Ma, Sg, A		0.80	4.63			5.42
Ma, A, Ca				10.51	29.56	40.07
Total	6.56	20.02	21.01	17.19	29.94	94.71

Primary substrate and benthic flora distribution according to vertical zonation in Watlaar waters



LEGEND :

Primary Substrate

- Sand
- Stone
- Sand, Stone
- Rock/Boulders
- Limestone
- Sand, Limestone
- Stone, Limestone
- Sa, St, Ls

Benthic flora

- Microalgae
- Ma, Seagrass
- Ma, Macroalgae
- Ma, Calcareus algae
- Ma, Sg, MA
- Ma, MA, Ca

0 250 500 750 1000

Metric Scale

Realization : Sigit A.P. DWIONO with the participation of the Maison de la Télédétection, Montpellier (France).

This map gives account of field surveys conducted from july 1996 till march 1997.

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Seagrass and its combination with microalgae and macroalgae were observed mostly at northern part of Watlaar coastal area. This vegetation type is found at the lower intertidal and upper subtidal zones and covers almost 8 ha of surface area (Table 12). In lower intertidal zone, seagrass is observed at northern part of Wear Fadir and from Vatro Oih Rufan to Wearngayaan, while in the south it is found at Sasaluk. In upper subtidal zones, seagrass is observed on the area extended from Vaut Maler to about 75 m south Vatro Oih Rufan. There are at least two species of seagrasses living on these area, *Enhalus* sp. and *Thalassia hemprichii*. The result obtained on this ecosystem will be discussed further in the following part.

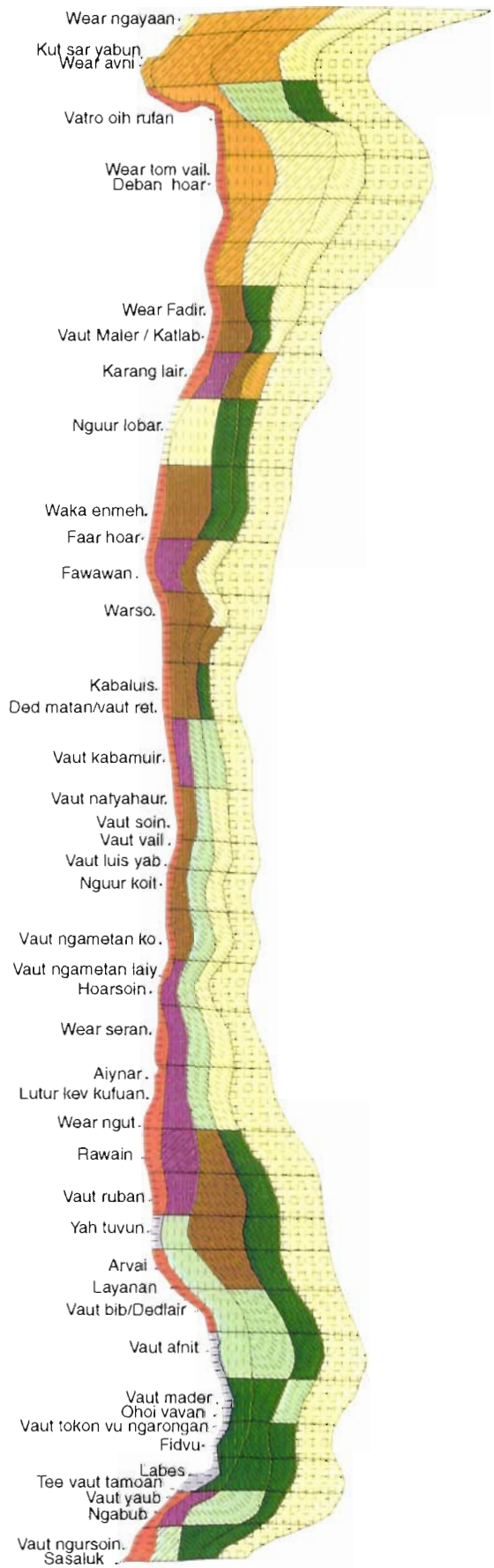
Macroalgae and its combination with calcareous algae were observed in most of lower intertidal zone and all of subtidal zones. Among the macroalgae species, some of them are distributed widely such as *Caulerpa* sp., *Halimeda* sp., *Gracillaria* sp., *Padina* sp., *Sargassum* sp. and *Turbinaria* sp., while *Amphiroa* sp. is one of the calcareous algae observed.

2.2. Fauna distribution

The distribution of benthic fauna is presented in Map 7 .There are two categories of intertidal fauna, the fauna of sandy bottom area and the fauna of limestone reef flat area. The first category was found on middle or lower intertidal zone, and upper subtidal zone. This category of animals include Annelid polychaeta, some pelecypoda (Arcidae, Cardiidae, Lucinidae, Mytilidae), some gastopod molluscs (Buccinidae, Bullidae, Cerithidae, Conidae, Nassariidae, Naticidae), and echinoderm (Ophiuridae). On limestone reef-flat, some characteristic animals are found including some species of Conidae, Cypraeidae, Echinometridae, Haliotidae, Mitridae, Ophidiasteridae, Portunidae, Trochidae and Turbinidae. The member of the last two families may be found in deeper water as well.

Subtidal area is inhabited mainly by Muricidae (Drupa spp., *Morula* spp. and *Muricodrupa fenestrata),* Pteridae (Pinctada *margaritifera),* Strombidae (Lambis spp. and *Strombus* sp.), Trochidae (Euchelus *atratus, Jujubinus* sp., *Tectus* spp., and *Trochus* spp.), and Turbinidae (Angaria *delphinus, Astraea calcar* and *Turbo* spp.). In coral reef area, the common species are *Cassis cornuta* (Cassidae), *Charonia tritons* and *Gyrenium gyrinium* (Cymatiidae), and *Tridacna squamosa* (Tridacnidae). A small number of Trochidae and Turbinidae was observed.

Primary substrate and benthic fauna distribution according to vertical zonation in Watlaar waters



LEGEND :

Primary Substrate

- Sand
- Stone
- Sand, Stone
- Rock/Boulders
- Limestone
- Sand, Limestone
- Stone, Limestone
- Sa, St, Ls

Benthic Fauna

- Supratidal fauna
- Intertidal, sandy bottom fauna
- Intertidal, reef flat fauna
- Subtidal fauna
- Coral reef flat fauna

0 250 500 750 1000

Metric Scale

Realization : Sigit A.P. DWIONO with the participation of the Maison de la Télédétection, Montpellier (France).
This map gives account of field surveys conducted from july 1996 till march 1997.

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This figure shows that the middle intertidal area, extended from Sesaluk up to Vaut Afnit, are inhabited by supratidal fauna such as barnacles and certain molluscs. This group of animals can support long emersion period because of their particular behaviour or anatomy. Barnacles and mussels minimize water loss by enclosing themselves in their shells during emersion period (Castro & Huber, 1997). In Watlaar, some gastropod inhabit this middle intertidal zone, such as family Patellidae and Littorinidae.

There are two categories of intertidal fauna, the fauna of sandy bottom area and the fauna of limestone reef flat area. The first category was found on middle or lower intertidal zone, and upper subtidal zone. This category of animals include Annelid polychaeta, some pelecypoda (Arcidae, Cardiidae, Lucinidae, Mytilidae), some gastopod molluscs (Buccinidae, Bullidae, Cerithidae, Conidae, Nassariidae, Naticidae), and echinoderm (Ophiuridae). On limestone reef-flat, some characteristic animals are found including some species of Conidae, Cypraeidae, Echinometridae, Haliotidae, Mitridae, Ophidiasteridae, Portunidae, Trochidae and Turbinidae. The member of the last two families may be found in deeper water as well.

Subtidal area is inhabited mainly by Muricidae (*Drupa* spp., *Morula* spp. and *Muricodrupa fenestrata*), Pteridae (*Pinctada margaritifera*), Strombidae (*Lambis* spp. and *Strombus* sp.), Trochidae (*Euchelus atratus*, *Jujubinus* sp., *Tectus* spp., and *Trochus* spp.), and Turbinidae (*Angaria delphinus*, *Astraea calcar* and *Turbo* spp.). In coral reef area, the common species are *Cassis cornuta* (Cassidae), *Charonia tritons* and *Gyrenium gyrinium* (Cymatiidae), and *Tridacna squamosa* (Tridacnidae). A small number of Trochidae and Turbinidae was observed.

The surface area occupied by each fauna type is presented in Table 13. The fourth fauna type (subtidal fauna) is distributed in largest area (31.87 ha), followed by coral reef fauna (29.94 ha) and intertidal reef flat fauna (16.14 ha). Intertidal with sandy bottom fauna and supratidal fauna occupied 10.39 ha and 6.37 ha, respectively.

Table 13 : Surface area (in ha) occupied by benthic fauna according to vertical zonation.

Benthic	Inter	tidal		Sub	tidal	Total
Fauna	Middle	Lower	Upper	Middle	Lower	area
Supratidal fauna	6.37					6.37
Intertidal, sandy bottom fauna	0.19	3.87	6.33			10.39
Intertidal, reef flat fauna		16.14				16.14
Subtidal fauna			14.69	17.19		31.87
Coral reef flat fauna					29.94	29.94
Total	6.56	20.02	21.01	17.19	29.94	94.71

3. Main habitats and ecosystems

There are three main habitat or ecosystem in Watlaar coastal area, i.e. Seagrass bed, Limestone reef flat and coral reef ecosystem. These three main habitat and ecosystems will be presented successively.

3.1. Seagrass bed

Seagrass ecosystem in Watlaar is found mainly in the northern part. The total area of this ecosystem is estimated at 8 ha. The bottom is composed by sand, or the mixture of sand and mud which form a soft-compacted substrate. The main flora growing in this substrate are *Enhalus* sp. and *Thalassia hemprichii*. Some micro and macroalgae are found living attached in the bottom, small pieces of dead coral or stones. Macroalgal species observed in this ecosystem include *Caulerpa* sp., *Halimeda* sp., *Gracillaria* sp. and *Padina* sp. During the low tide, this area is partially exposed, while at high tide it may attain 2 meter depth or more.

Around the mouth of Wear Afnit and Wear Ngayaan (in local dialect, *wear means* small river), the coastline forms a small bay and the water is relatively calm comparing to the remaining area of Watlaar. In this area, seagrass bed is more developed. The habitants of the seagrass bed of Watlaar include various fishes, molluscs, echinoderms and crustaceans. The seagrass bed fishes include *Abudefduf* spp., *Apogon* spp., *Gerres* sp., *Halichoeres* spp., *Lethrinus* spp., *Mulloides vanicolensis*, *Parupeneus* spp., *Parapercis barberinos*, *Plotosus anguilaris*, *Pomacentrus* spp., and *Siganus* spp. In seagrass area, the species of fishes can be grouped as whole life resident, seasonal resident and occasional resident. *Halichoeres*, *Gerres*, *Lethrinus* and *Parapercis* are the fish genera categorized as whole life resident in seagrass bed of Kotania bay, West Ceram (Peristiwady, 1994).

Among benthic organisms, molluscs is well represented in seagrass bed of Watlaar coastal area. *Anadara antiquata*, *Barbatia* sp., *Fragum* spp., *Codakia* spp., *Tellina* sp., and *Tapes* sp. are main species of pelecypod mollusc inhabiting sandy bottom of seagrass bed. *Engina* spp., *Bulla* sp., *Cerithium* sp., *Conus* spp., *Nassarius* spp., *Natica* spp. and *Polineces* spp. are small size gastropod mollusc that constitute the seagrass community. Other benthic animals inhabiting seagrass bed of Watlaar include *Ophioplocus imbricatus* (Echinodermata : Ophiuroidea) and *Portunus pelagicus* (Crustacea : Portunidae).

3.2. Limestone reef flat

This reef flat is constituted mainly by limestone. Secondary substrate such as sand, stone/boulder, dead coral and coral rubble are found scattered on the limestone bottom. Surface area of this type of habitat in Watlaar is estimated at 37.5 ha and extends from lower intertidal to middle subtidal zones. During high tide the depth of this area varies between 0.4 to 6.0 m, while during low tide, the bottom is partially exposed.

The hard substrates such as limestone, boulder, dead coral and coral rubble support the development of various benthic microalga. These microalgae are used by various benthic animals as food. Therefore, this area is the preferential habitat of herbivorous animals such as Turbinidae and Trochidae which are found in high density. Some other molluscs inhabit this habitat as well, including Angariidae, Cerithidae, Cypraeidae, Conidae, Haliotidae, Pteridae Muricidae and Strombidae. *Linckia laevigata* and *Echinometra mathaei* are common echinoderm species in this area, while crustaceans species are represented by *Thalamita* sp. and *Portunus* sp.

Macroalgae are common in this habitat. The species observed including *Caulerpa* sp., *Halimeda* sp., *Padina* sp., *Sargassum* sp., and *Turbinaria* sp. The last two species (*Sargassum* sp. and *Turbinaria* sp.) are well developed and distributed widely. The good development of

these two macroalgae is due mainly to their strong attachment to the substrate and good resistant to the current and waves.

3.3. Coral Reef

Of 11 sites studied in Watlaar, seven sites are in good condition while the others are in moderate condition (Table 14). During the study, 141 species of coral belonging to 49 genus and 16 family were identified (Appendix 1).

The characteristic of each site is given below :

- Wear Ngayaan : This site is situated at northernmost part of Watlaar, at the border between this village and Banda Efaruan. Coral area at this site extends up to 138 m wide to the slope, but reaches only the depth of 12 m. Colonies of stony corals are found scattered among sandy bottom which dominated this coral reef area. Hard coral is dominant biotic component and is represented especially by branching coral, such as *Porites nigrescens*, *Porites cylindrica* and *Seriatopora hystrix*, while sub-massive and massive coral are represented successively by *Galaxea fascicularis* and *Porites lutea*. The highest coverage is showed by abiotic component (50.49 %), followed by hard coral (42.72 %), Algae (4.13 %) and other fauna (2.22 %). According to coral reef stability criteria (Sukarno, 1985), this coral reef is categorized as moderate.

- Wertom Veil : This area is situated approximately 385 m from Wear Ngayaan. The bottom is dominated by dead coral and sand. The width of the reef is about 122 m to the slope where the depth attains 20 m. The dominant hard coral growths and species observed are as follow : tabulate form (*Acropora cythera*), massive form (*Porites lutea*) and encrusting form (*Montipora* spp.). The highest coverage percentage is showed by hard corals (48.17 %), followed by algae (45.82 %), other fauna (3.72 %) and abiotic component (2.29 %). This coral reef flat is categorized as moderate.

- Karang Lair : The substrates of the bottom are similar to that of Wertom Veil with narrow coral reef (120 m) to the slope and maximum depth 12 m. Hard corals found in this site differs from other sites. At 3 m depth, the hard coral is dominated by foliose form (*Montipora foliosa*, *M. aequiturbeculata*) and branching coral (*M. digitata*), while at 5 to 12 m depth the coral is dominated by massive form (*Porites lutea*), and branching coral (*P. nigrescens* and *P. cylindrica*). Hard coral dominates this site by 57.24 % of coverage, followed by algae (32.45 %), other fauna (4.79 %) and abiotic component (5.52 %). This coral reef flat is categorized as good in term of stability.

- Waka Enmeh : This site possess a narrow coral reef flat (75 m) to the slope with maximum depth of 12 m. The bottom is dominated by dead coral and sand. *Heliopora coerulea* (hard coral) is dominant at 3 m depth, while at 5 to 12 m the reef flat is dominated by *Porites cylindrica* and *Porites nigrescens*. In this site, dead coral covered with green algae (turf) were found. This suggests that coral destruction was occured some time ago. Therefore, the dominant component of this coral reef is turf algae (64.69 %) followed by hard coral (27.50 %), other fauna (3.51 %), and abiotic component (4.31 %). According to coral stability criteria, this site is categorized as moderate reef.

Table 14 : Percentage of coverage of coral reef at eleven sites in Watlaar, Kei island, Southeastern Maluku

No.	Site	Benthic Life Form (%)					Category
		Hard Coral	Dead Coral	Algae	Other Fauna	Abiotic Component	
1.	Wear Ngayaan	42.72	-	4.13	2.22	50.93	Moderate
2.	Wertom Veil	48.17	-	45.82	3.72	2.29	Moderate
3.	Karang Lair	57.24	-	32.45	4.79	5.52	Good
4.	Waka Enmeh	27.50	-	64.69	3.51	4.31	Moderate
5.	Warso	61.97	-	33.34	2.27	2.41	Good
6.	Kabaluis	70.22	-	23.58	5.15	1.05	Good
7.	Vaut Luis Yab	69.02	-	19.58	6.60	4.80	Good
8.	Wear Seran	45.30	-	24.11	23.24	7.36	Moderate
9.	Dedlair	65.69	-	17.60	11.00	5.71	Good
10.	Vaut Afnit	64.22	-	28.99	6.48	0.31	Good
11.	Sasaluk	55.91	-	30.89	5.66	7.54	Good

- Warso : The site has similar dominance of substrate to previous sites, i.e. dead coral and sand. The coral reef is very narrow (about 70 m width) to the slope but attains 15 m depth. The three meter depth is dominated by hard coral (*Heliopora coerulea*), while area between 5 and 15 meter depth is dominated by branching coral (*Porites cylindrica* and *P. nigrescens*). The most dense area with large colonies is observed at 6 meter depth. This highest value of coverage is shown by hard coral (61.97 %), followed by algae (33.34 %), abiotic component (2.41 %) and other fauna (2.28 %). This coral reef is categorized as good.

- Kabaluis : This site has narrow coral reef growth (60 m to the slope). The coral grows down to 12 m depth contour. The bottom is consisted mostly by dead coral and sand. The coral reef is dominated by branching and massive corals of the genus *Porites*, i.e. *P. nigrescens*, *P. cylindrica* and *P. lutea*. Despite of narrow growth, this coral reef shows the highest coverage percentage of hard coral comparing to other studied sites in Watlaar. The value of

coverage percentage for hard coral is 70.22 %, followed by algae (23.58 %), other fauna (5.15 %), and abiotic component (1.05 %). According to coral reef stability, this site is categorized as good.

- Vaut Luis Yab : Vaut Luis Yab possess the narrowest coral reef (50 m to the slope) comparing to other studied sites in Watlaar. Coral growth attains 12 m depth with dead coral and sand as dominant substrates. The dominant species of coral is similar to Kabalus site, i.e. *Porites nigrescens*, *P. cylindrica* and *P. lutea*. Hard corals dominates the reef by 69.02 % of coverage percentage, followed by algae (19.58 %), other fauna (6.60 %), and abiotic component (4.80 %). This coral reef is categorized as good.

- Wear Seran : The width of this coral reef is about 75 m and extends down to 12 m depth. The dominant substrates are dead coral and sand. Branching coral of *Porites nigrescens* and *P. cylindrica*, and massive coral of *Porites lutea* are dominant hard corals. From transect study, the highest coverage observed is hard corals (45.30 %). Algae and other fauna components show similar coverage percentage, i.e. 24.11 % and 23.24 %, respectively, while abiotic component has 7.36 of coverage percentage. This reef is therefore categorized as moderate.

- Dedlair : This site possess a small bay which serves as the harbour of Watlaar. In this site, the coral reef attains 125 m width and 15 m depth. The three meter depth contour is dominated by sub-massive acropora coral (*Acropora palifera*); while tabulate acropora (*Acropora cytherea*), branching non-acropora (*Porites nigrescens, P. cylindrica*), and massive non-acropora species (*P. lutea*) dominate the 5 to 15 meter depth. Highest value of coverage percentage is shown by hard coral 65.69 %, folllowed by algae (17.60 %), other fauna (11.00 %) and abiotic component (5.71 %). According to hard coral coverage percentage, this site is categorized as having good stability of coral community.

- Vaut Afnit : The width of this coral reef site is about 70 m and attains 12 m depth. The bottom is consisted mostly by dead coral and sand. The most dense coral community is observed at 6 m depth. The dominant species are *Acropora palifera* (sub-massive acropora), *A. cytherea* (tabulate acropora), *Porites nigrescens* and *P. cylindrica* (branching non-acropora), *P. lutea* (massive non-acropora) and *Montipora* spp (encrusting non-acropora). Coverage percentage for each components is as follows : hard coral (64.22 %), algae (28.99 %), other fauna (6.48 %) and abiotic (0.31 %). This site is considered as good.

- Sasaluk : Salsaluk is the southern part of Watlaar village at the border of this village and Ohoi Efaruan. In this site the coral reef attains 100 m width and 15 m depth with dead coral and sand as dominant substrates. At 6 m depth, the reef is dominated by branching coral of

Porites (*P. cylindrica* and *P. nigrescens*). At three meter depth contour, *Heliopora coerula* is dominant. Highest value of coverage percentage is shown by hard coral 55.91 %, folllowed by algae (33.17 %), other fauna (4.90 %) and abiotic component (7.54 %). According to hard coral coverage percentage, this site is categorized as having good stability of coral community.

The surface area of coral reef ecosystem is estimated at 29.94 ha. In this ecosystem various animal are observed including *Cassis cornuta*, *Charonia tritons*, *Gyrenium gyrinium* and *Tridacna squamosa*. Macroalgae (*Turbinaria* sp. and *Sargassum* sp.) and calcareus algae (*Amphiroa* sp.) are found as well.

B. Marine Resources

Watlaar coastal area possess various marine resources including fishes, molluscs, seaweed, crustaceans, and echinoderms. The abundance and diversity of some groups are high while the remaining group has low abundance and diversity. This difference in abundance and diversity is mainly due to the physical factors such as wave, current and wind. The following part will describe the diversity of each phyllum successively.

1. Fishes

A total of 104 species of fish was inventoried (Appendix 2). Among these species, fifty species are categorized as ornamental fishes, while the remaining is edible species for consumption. Ornamental fishes are usually of small size and have colorful skin. In contrast, the fishes for food usually have bigger size with or without beautiful coloration of the body. However, it must be mentionned that villagers eat ornamental fish species of very small size.

Edible fish species include *Acanthurus* spp., *Auxis thazard*, *Caesio cuning*, *Caranx* sp., *Cephalopolis* spp., *Cheilinos* spp., *Ctenochaetus* spp., *Epinephelus* spp., *Lethrinus* spp., *Lutjanus* spp., *Sardinella* sp., *Sargocentron* spp., *Scarus* spp., *Siganus* spp., and *Thalassoma* spp.

Ornamental species inhabit either coral reef or seagrass ecosystem. Some genera of ornamental fishes are well represented, such as *Abudefduf*, *Apogon*, *Arothron*, *Chaetodon*, *Chilio*, *Chromis*, *Chrysiptera*, *Helichoeres*, *Plotosus*, *Pomacentrus* and *Scorpaenopsis*. Athough *Helichoeres* spp. are small in body size, the villagers of Watlaar catch these fishes for daily consumption. The various fishing techniques used to catch the fishes will be presented in the folowing part.

2. Molluscs

The list of molluscs collected from line transect or specimen collection is presented in Appendix 3 and 4. A total of 136 species of gastropod belonging to 81 genera and 43 family was identified, while among pelecypod molluscs, only 17 species belonging to 15 genera and 10 families were collected. Among gastropod molluscs, some species are edible i.e. *Cassis cornuta* (Cassidae), *Cerithium nodulosum* (Cerithiidae), *Conus coronatus*, *C. sponsalis* and *C. vitulinus* (Conidae), *Haliotis asinina* (Haliotidae), *Patella* sp. (Patellidae), *Lambis lambis*, *L. chiragra*, *Strombus luhuanus* (Strombidae), *Trochus niloticus*, *T. maculatus*, *Tectus pyramis*, *T. fenestratus* (Trochidae), *Turbo marmoratus*, *T. chrysostomus* (Turbinidae), and *Cymbiola vespertilio* (Volutidae). Some of these gastropod are highly prized molluscs including *Trochus niloticus* and *Turbo marmoratus*. *Trochus niloticus* is abundant in Watlaar coastal area and is subjected to traditional management (sasi). The status of trochus fishery, its exploitation and management will be developed in the following chapter.

The transect of benthic animals has been done at three sites, i.e. Sasaluk, Ruwain and Wear Ngayaan. Transect lengths in Salsaluk, Ruwain and Wear Ngayaan were 160 m, 150 m and 160 m respectively. All transects were done perpendicular to coastline. The results of transect of gastropod mollusc is presented in

Table 15. Sasaluk showed higher number of species comparing to other sites. In Sasaluk, Conidae, Melampidae and Nassariidae are more abundant. In Ruwain, Buccinidae, Conidae, Nassaridae and Triphoridae are the most presented, while Nassariidae is the most dominant family in Wear Ngayaan.

Among gastropod molluscs found during transect, only some species are edible. In Selsaluk only two species are edible (*Conus sponsalis* and *C. coronatus*), while in Ruwain six species are edible : *Conus mustelinus* and *C. vitulinus* (Conidae), *Strombus luhuanus* (Strombidae), *Tectus fenestratus*, *Trochus maculatus* and *T. niloticus* (Trochidae). In Wear Ngayaan, three species are edible, i.e. *Patella* sp. (Patellidae), *Trochus maculatus* (Trochidae), and *Cymbiola vespertilio* (Volutidae). In all case, the abundance of each edible species is very low (less than 1 individuals in 10 square meter). This suggests that these group of gastropod is harvested continuously.

Table 15 : Number of species and abundance (ind./100 m2) of gastropod mollusc in Sasaluk, Ruwain and Wear Ngayaan.

Family	Sasaluk		Ruwain		Wear Ngayaan	
	No. Spec	Abund	No. Spec	Abund	No. Spec	Abund
Angariidae	-	-	1	7	-	-
Architectonidae	1	6	2	13	-	-
Buccinidae	3	31	2	47	1	6
Bullidae	-	-	1	7	1	13
Cerithidae	3	19	1	7	2	25
Columbellidae	-	-	1	1	1	6
Conidae	8	113	7	67	2	13
Costellariidae	1	38	1	7	2	44
Cymatiidae	-	-	1	7	-	-
Cypraeidae	2	19	1	13	2	25
Fasciolariidae	1	13	-	-	-	-
Fissurellidae	-	-	1	7	-	-
Marginellidae	1	50	-	-	-	-
Melampidae	2	169	1	7	1	6
Melanellidae	1	6	-	-	-	-
Mitridae	3	50	2	20	1	13
Muricidae	2	19	2	13	4	38
Nassariidae	5	144	2	67	7	88
Naticidae	4	38	2	13	4	38
Neritidae	1	19	1	7	-	-
Patellidae	-	-	-	-	1	6
Pyramidellidae	4	31	-	-	-	-
Rissoinidae	1	6	1	1	1	13
Scaphanderidae	1	44	1	13	1	6
Strombidae	1	6	2	20	2	25
Terebridae	1	6	1	7	1	6
Tonnidae	1	6	1	1	1	6
Triphoridae	2	25	5	40	4	31
Triviidae	2	50	4	27	2	31
Trochidae	2	25	-	-	2	13
Turbinidae	1	13	-	-	1	6

Most of pelecypod molluscs, such as *Anadara antiquata*, *Barbatia* sp., *Codakia tigerina*, *Fragum* spp. (Cardiidae), *Septifer bilocularis* (Mytilidae), *Tellina* sp. (Tellinidae), *Tapes* sp. (Veneridae) *Hippopus hippopus* and *Tridacna squamosa* (Tridacnidae) are edible species. These species inhabit seagrass bed or coral reef flat.

The result of benthic animal transect of pelecypod molluscs is presented in Table 16. The table shows that all edible species have a low density excepted *Tellina* sp. which was found at density of 25 individuals in 100 square meters. This species inhabit in sandy bottom of intertidal area. Therefore, ones have to dig the bottom in order to harvest this species. It is probably due to the important effort furnished to harvest that this species is still in high abundance.

Gastropod and pelecypod mollusc are two taxonomical group which inhabit coastal area as benthic organism. Their movement is very limited. As other sessile or benthic organisms, the capture of these molluscs is easy. The ease of capture and the value of this marine resource, either as commercial comodities or food, have caused the depletion of their natural population. In order to minimize the depletion (and extinction) rate of their natural population, the government of Indonesia has declared the protection of some marine molluscs species. According to the decree of the Ministry of Forestry no. 12/Kpts-11/1987, the list of protected molluscs species includes giant clam (*Tridacna gigas*), Southern clam (*Tridacna derasa*), China clam (*Hippopus porcellanus*), Saffron coloured clam (*Tridacna crocea*), Scaly clam (*Tridacna squamosa*), Bear paw clam (*Hippopus hippopus*) Triton's trumpet (*Charonia tritons*), Giant helmet shell (*Cassis cornuta*), Mother of pearl/top shell (*Trochus niloticus*), Green snail (*Turbo marmoratus*) and Chambered nautilus (*Nautilus pompillius*). Some of these species are found in Watlaar, such as *Cassis cornuta*, *Charonia tritons*, *Hippopus hippopus*, *Tridacna squamosa*, *Trochus niloticus* and *Turbo marmoratus*. Watlaar villagers, unaware of this prohibition, continue to collect those species for their daily subsistance excepted *Trochus niloticus* which is under traditional or village management regime (sasi).

Table 16 : Number of species and abundance (ind./100 m2) pelecypod mollusc in Sasaluk, Ruwain and Wear Ngayaan.

Family	Sasaluk		Ruwain		Wear Ngayaan	
	No. Species	Abundance	No. Species	Abundance	No. Species	Abundance
Cardiidae	-	-	2	13	-	-
Lucinidae	2	13	1	13	1	6
Mytilidae	1	6	1	7	1	6
Pteriidae	-	-	1	7	2	13
Tellinidae	-	25	1	7	-	-
Trapezidae	-	6	-	-	-	-

3. Echinoderms

Echinoderm are not common in Watlaar. Some species are found, i.e. *Gomophia egyptica*, *Linckia laevigata*, *Echinometra mathaei* and *Ophioplocus imbricatus*. No commercial or edible echinoderm was found during the field work.

4. Algae

Some macroalgae are found during the study. *Sargassum* sp and *Turbinaria* sp. are the most common. Other species such as *Caulerpa* sp., *Gracillaria* sp., *Halimeda* sp. and *Padina* sp. are found scattered in small quantity.

5. Crustacea

Crustacea were rarely found in Watlaar. The species observed includes *Thalamita* sp., *Portunus pelagicus*, *Portunus* sp., *Kraussia* sp., and *Oreoporus* sp.

C. DESCRIPTION OF THE FISHING SYSTEM

Fishing activities in Watlaar are very numerous, some are reserved to men and others to women. However, they are highly conditionned by the weather as Watlaar is located directly on the east coast exposed to the prevailing winds. The high fishing season goes from october till march, that is while the westerly winds blow. The technics are still traditional and there are no fishing boats for the moment. Villagers only use their *kole-kole* or canoe. There are three main type of fishing activities, marine activities at low tide fishing traps and sea fishing.

1 Marine activities at low tide in the intertidal zone

Mostly women and children collect shells and small fishes almost everyday from the intertidal zone or *meti* . Two times a month at the occasion of big tides, men also go down. The moon is a reference to know when the best time to go down the beach is. The language is an indication of the importance of the *meti* for the people of Watlaar since they have an expression to tell about either the size of the meti or when it occurs during the day. Thus, people know the caracteristics, time and size of the tides according to two aspects. They plan fishing activities according to the caracteristics of the tide which are the length of the low tide and the intensity of tidal range. According to them, these parameters are closely linked to the lunar cycle seasons, winds and wawes.

1.1. The moon cycle

The moon cycle corresponds to a season which is caracterized by the direction and the speed of the wind. People tend to associate both parameters as being inter-related as shown in the following description :

People from Watlaar refer to the moon calendar by looking at the position of the moon in relation both to the land and to the sea when it rises. It is quite ingenious when we come to think that Watlaar is located on the east coast of the island and that the moon rotates east-west. Thus, they know the day of the circle from the first day they see it on the east side, on their side and according to whether the moon comes out at night or very early in the morning. The position of the moon then determines the size of the tide and they have given names to the tides which are considered as good because they are long and big or to the one which is not good at all:

- *Met baren* is the name given to the tide occuring at dawn, from the 9th till the 13th day according to the villagers calendars. It is considered to be an excellent time to go fishing;

- *Met hamer* occurs from october till december. The tide is long and big and takes place during the day;

- *Met dedan* occurs from march till may. This tide occurs during the night. It is long and big about the same as the *Met hamer* which occurs during the day with the difference that the wind and the seas are strong.

- *Metru* describes a kind of tide when it has come up but not to its full height and yet goes out again.

1.2. The season, the winds, the waves and the tides

There are two main seasons, the westerly wind season and the easterly wind season. People describe the tide during the easterly wind as being short (meti pendek) during which they can only look for shells and fish eggs. On the contrary, the tides are big and often long during the westerly winds. People will be more inclined to collect only shells during the easterly wind season and try to catch small fishes, squid and larger shells during the westerly wind season simply because the sea and tide conditions are more favorable. Usually, the head of the village imposes an interdiction called *sasi meti* for several months during august and september in a certain area of the beach in order to maximize the catches in october. Sometimes, he will also close the beach located directly near the main centre of habitation from the month of march till june in order to open it again in the middle of the easterly wind season, thus making it easier for the villagers to find seafood within walking distance even though the seas are rough.

Moreover they have given name to two distinctive tides which are known to be big tides:

- *meti lawar* which occurs in febuary or march which corresponds to the apparition of neireis,

meti kei, occuring each year in october and which is known to be the longest biggest tide of the year in the Kei Islands.

Those two particular tides see all the villagers on the beach. *Meti Kei* is a real event in Watlaar because villagers are allowed to collect shells and seafood again in the area which was formely closed. That day is called buka *sasi meti* in other words, the interdiction is lifted. Once the tide starts to go down, someone from the head of the head of village's house gives out

the signal banging on the gong that they are free to go down the beach. Every body goes down and even the school closes for a day.

Women and children collect every species of shells apart from the species which are subject to *sasi.* They gather the shells in a little basket called *ngel* which they usually hang on their shoulders in a way that it falls on their back (Photo 1). Women use a special basket in a V shape to catch fishes. It is called *saluv* (Photo 2). The idea is to put it near a rock in very shallow water so that when the woman lifts the rocks, the fishes afraid directly go in the *saluv.* Women also use the *sangiar* (Photo 2), a little pot measuring 25 by 15 centimeters made of bambou. They first catch little crabs which they then mash up to use as bait inside the *sangiar. The sangiar* is then placed in shallow water and checked now and then while looking for fishes in other places. Men would rather use the harpon or *hoho* and dive with the fishing gun or *sbaengiar* to try to catch fish and octupus.

Marine activities at low tide also involve a particular technic known as *karau*, a momentarily permanent fishing technic to trap fish. *Karau* are made from coconut leaves, rocks and small fishing pots as presented on Figure 14. These karau involve a lot of work, thus, men usually work in group, one family for example or helping each other *masohi* . This activity takes place during the months of december and january, while the currents and the sea are still rather calm and will therefore keep the *karau* in place. The *karau* is covered at high tide. When the tide goes out, fishes are captured and enter the little traps following the direction of the water. The catches are then shared among the people who helped make the *karau*..

Sometimes, fishermen also make another intertidal fishing trap known as *sero* to catch fish. Figure 15 describes the shape of that fishing trap. It is a leading trap net with multiple wings anchored in the subtrate. The *sero* is placed in about one to two meters depth of water at low tide. It is made of bambou and of coconut leaves. Here, fishermen will have to go and dive in the *sero* to get the fish caught.

2. Sea Fishing traps

Fishing traps or *wuv* are very popular in the village. No bait is use inside sea fishing trap to attract the fishes. There is only one model bambou trap made in three different size to be used in different water depth:

- *Wuv flerak* : this trap mesures 40 by 20 by 70 centimeters. It is hidden in 2 to 3 meters depth of water by rocks. Fishermen dive regularly to check if any fishes have been caught.

Photo 1 : Woman catching fish at low tide

Photo 2 : Saluv and Sangiar

Figure 14 : Karau : Traditional fishing technique in the Kei Islands - Maluku Tenggara

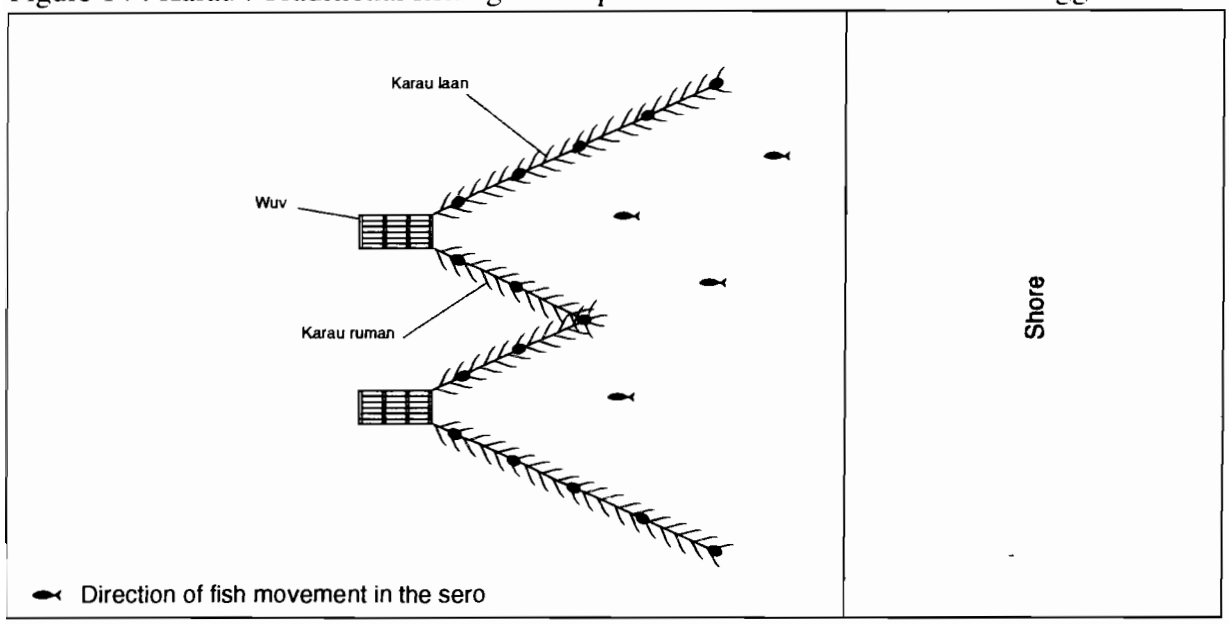
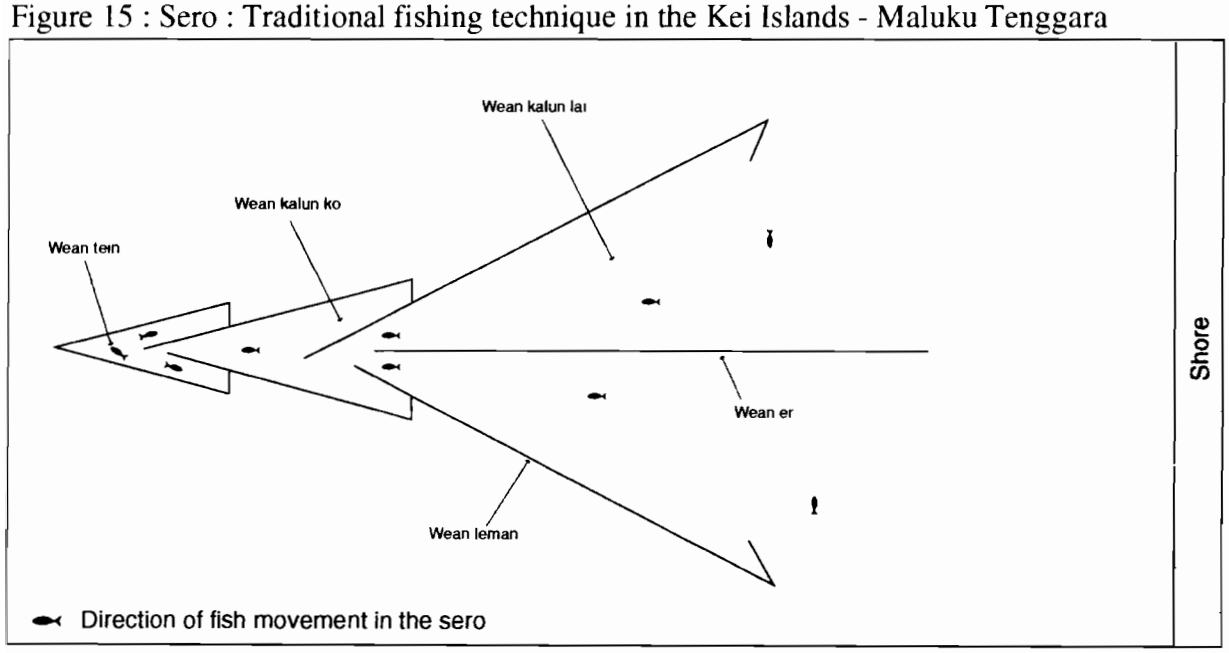


Figure 15 : Sero : Traditional fishing technique in the Kei Islands - Maluku Tenggara



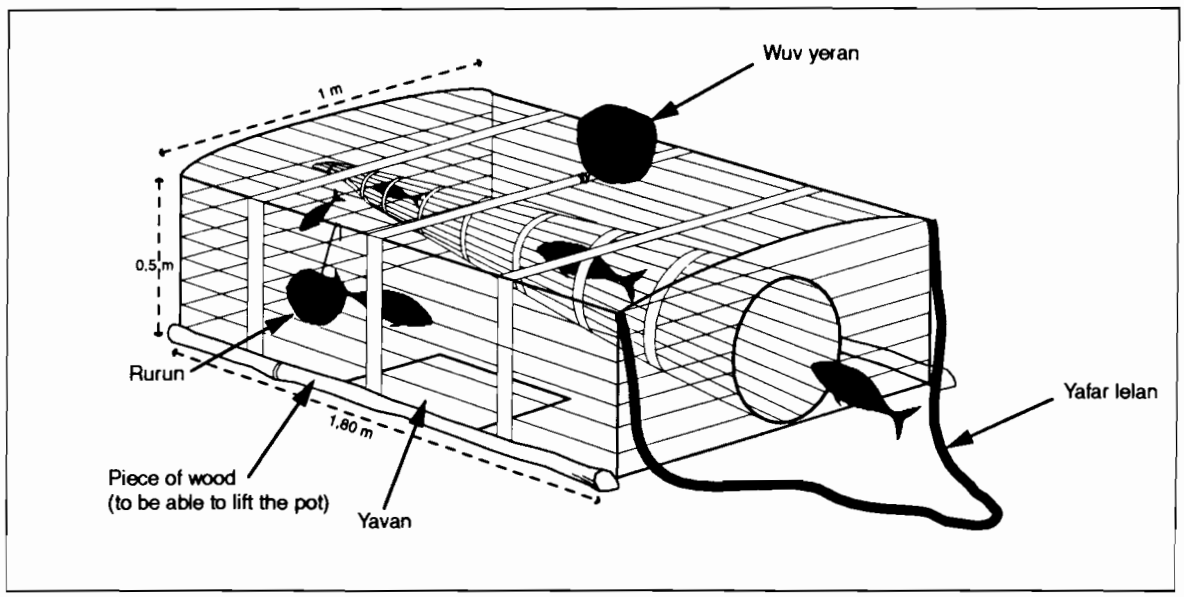
- *Wuv Relan* : this trap is the intermediate size and mesures 50 by 30 by 120 centimeters. The wuv relan is maintained in 7 to 10 meters of water by few rocks directly tied to the trap. To the difference of the *wuv flerak*, it has a rotan handle measuring 1,2 meter. This will enable the fisherman to lift the pot when he wants to check if any fish have been caught.

Both of these traps are placed during the westerly wind season, from october till march, the seas being to rough to maintain them in one place and not also making it difficult for the fishermen to find it again and catch fish.

-*Wuv roa* : it is the sea fishing trap measuring 1 by 0,50 by 1,8 meter. The *wuv roa* sits in 25 to 35 meter depth (Figure 16). It is maintained in the water by rocks tied on the trap itself. After a week, the trap is heavy enough from being wet and usually stays in place. It has a handle like the *wuv relan* with the only difference that it is tied back by a rotan rope to about 10 to 15 meters depth to make it easier for the fishermen to find it and bring it back to the surface. The rotan rope can mesure between 30 to 100 *depa*, local mesure which is equivalent to 50 to 150 meters.

Rurun is a permanent stone tide to the trap with some rotan rope. *Wuv Yeran* is a bigger stone tied with some vegetable rope and not some rotan rope simply because rotan rope is not digradable. The *Wuv Yeran* helps to maintain the trap in the water for the first week when the trap has just been made from fresh bambou. The trap is still much too light. Thus, the *Wuv yeran* will stay in place just the time for the trap to be wet enough and therefore heavier. It will fall out naturally once the fishermen lift the trap up to see if they have caught any fishes. From then on, fishermen usually visit their traps every two to three days. When they do so, they add bambou poles on both side their canoe to stabilize their enterprise as they lift the pot.

Figure 16 : Wuv Roa : Traditional fishing trap in the Kei Islands - Maluku Tenggara



While on the field, we observed fishermen doing rituals when they were to put the *Wuv Roa* in the sea for the first time. The ritual consisted in offering some betel nut and slaked lime wrapped in some leaves together with a bit of tabacco. Part of it was given to the ancesters, in which case the fisherman put the offering at the bottom of a tree some that « *they could have their share* » he explain. When asked whether he had to put it in a particular place, fishermen answered that it did not matter as long as ancesters were given some, as long as they were told. The other half was placed in the *Wuv Roa* together with some encens burning in an old coconut shell. The fisherman would move around the encens so that the smoke who go eveywhere. While doing so the fisherman would sofly speak out the usuals. People are very quite about this. They say that they do it for chance and protection. They did not do this ritual for other types of traps or fishing technics.

What the fishermen who went fishing quite a way off shore at night during the full moon did was to always leave some fishes on their little pirogue when they came back ashore. Villagers believe that there are spirits along the coast that keep an eyes on the fishermen and that if they do not give them some of their catch, the spirits will push them away and make it difficuft to come back ashore. But if instead the spirits are given some fish, they will help the fishermen carry back their pirogue on dry land. These spirits are called « *wahat* » in kei language. According to the villagers, they do not always distub people and one never knows when they will disturb.

3. Other fishing activities

Other fishing activities revolve around handfishing. There are several different ways to handfish, that is from the shore at low tide or off shore from the canoe.

At low tide, fishermen will stand near by the reef with a bambou line or just a line equiped with a small hook, some feathers and some bait. This type of handfishing is called in Kei Language « *taswaur* ». The bambou line is called « *wawor* ».

Fishing from a canoe, while holding a line is called « *tastuk* ». Fishermen throw their line which has a fishing hook with either some feathers or some bait near the bottom of the sea. The line sinks thanks to a little weight. When they do not have a fishing weight, they make one from a little stone which they tie with a coconut leaf. This simple fishing equipment is now made of nylon for the nylon and steel for the hooks and the weight. In former times, before people had nylon, they used rotan which they cut in very thin lines.

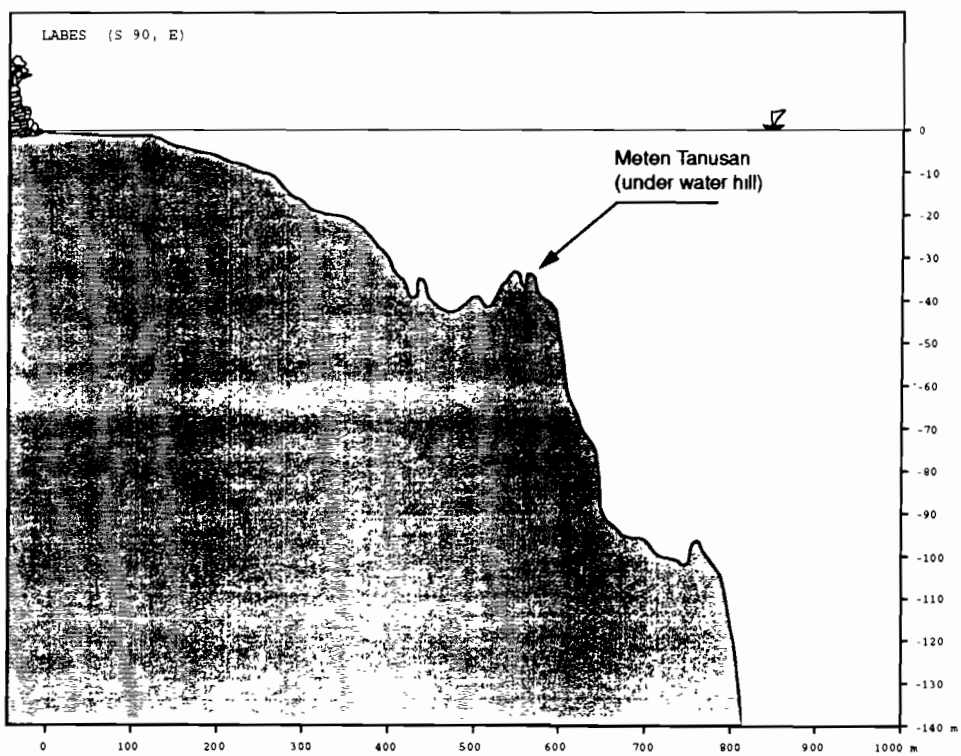
Fishermen prefer to go at sea during the new moon, the full moon. They also go at night in which case they will go quite a way off shore with their canoe and oil lamp in order to catch squids which will be used as bait later in the night while handline fishing closer to the shore. They often fish within 25 to 40 meters water depth in the area where they placed Wuv Roa but also where in that same depth they know there is some under water hill which they call « *meten tanusan* » as illustrated in Figure 17.

Very few fishermen use a fishing net. There is only one type known as the gill net. Fishermen usually use it either early in the morning during certain tides or in the late afternoon. Two or three canoes go out together, one large canoe where the net is and smaller canoes. There are several men. Some stay on board the large canoe in order to throw the gill net parallel to the coast line in about two to three meters water depth. In the meantime, the other men leave their canoes and swin quite strongly to frighten the fishes in the direction of the gill net. The fishes will then be caught in the net. The men on board the boat will slowly bring it up while the men in the water will grab the fishes caught and prevent some other ones from escaping. Some fishermen also set the net late in the afternoon and go back at night to get the fishes.

The total of fish caught is never very important and only sometimes is there any surpluses of fish to be sold. Most of the time the catches are enough for family consumption. During the easterly wind season, fishermen hardly ever go at sea as the seas are too rough. Only the brave ones go handline fishing when they see a log drifting from the east which seems

to be the sign that many pelagic fish like to play around. Apart from collecting shells and fish on the *meti*, fishermen collect fish eggs that float along on the alguae. From june to august, it is an important source of protein for the villagers who either eat it row, boiled and dried than fried.

Figure 17 : Local name given to an underwater hill



4. Spatialisation of fishing activity and sea ownership

4.1. The fishing space

Like on the land, people of Watlaar have learnt, organised and named their marine environment. Each topographic caracteristic both on the intertidal zone and in the sea has a name and the sea has been divided in sections. Thus, a heap or dune is called *nut*, a pool that captures water at low tide is called *tuvun* while *ngaan ran* refers to a pool where water stays at low tide but which can slowly go out. Further off shore, villagers also name some caracteristics of the underwater: *Nam* is a deep sandy pool. The map of the sea of Watlaar (Map 3, page53) presents the general topographic caracteristics and zonation from the shore to about 120 meters water depth.

Thus, the different sections refer to either the marine ecosystem or to the distance from the shore. Thus,

Yafat refers to the intertidal zone,

Hanger refers to an area of rocks and dead corals,

Hanger soin describes the coral reef,

Nurhain soin tells of the beginning of the sand,

Vaut buit means white sea to describe that area where we suddenly cannot see the bottom of the sea anymore, the colour is somewhat white because of the sand,

Stuk el wein means blue sea, as the water gets deeper,

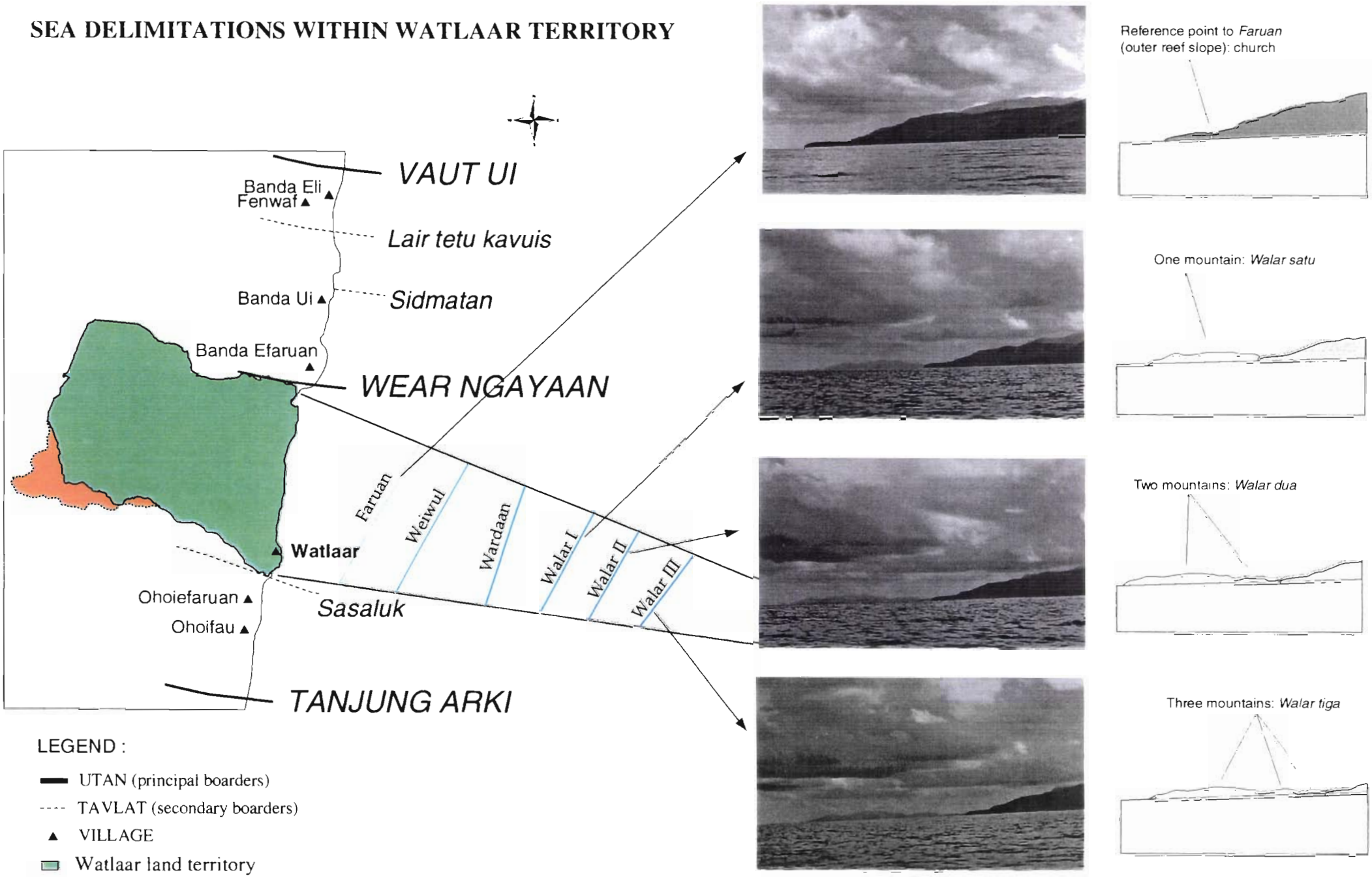
Faruan is half way to the ocean and corresponds to the underwater cliff deep drop of more than 100 meters.

From *faruan*, the different areas refer to a point of reference on the land, and as the fisherman goes east, landscape slowly unfolds. He has named the different sections after each new scenery that appears. Thus, the reference points that delimitate the frontier from one to another are either natural or physical, natural because they describe the milieu, physical because they refer to a land mark that itself tell of a distance from the shore. On Map 8 a serie of photos gives an example of the change of landscape which determine a new area in the sea.

The upper photo shows the starting point, *faruan* or the middle of the sea which corresponds to the rupture with the land and the beginning of the high seas. The reference point on the shore appears as soon as the fishermen see the church on the coast. The three other photos clearly show the differences as the coastline unfolds. Walar I is named after the first mountain, Walar II is named after the second mountain and Walar III is named after the aparition of the third mountain.

While on the field, we attempted to take some GPS points in order to estimate the distance from one area to another. We operated in two ways. First, we chose eight different latitudes as starting point from which we started the transects. Every time we came across a new area, the villagers who accompanied us told us and we recording both the longitude and the name of the area. Secondly, we started to run from the top end north of Watlaar - Wear Ngayaan along the boarder line separating the waters between Watlaar and Banda Efaruan. The elder men kept giving signals in the right direction while we recorded every few minutes the position on the GPS. Finaly we did the same things starting from the south end of Watlaar - Sasaluk.

SEA DELIMITATIONS WITHIN WATLAAR TERRITORY



LEGEND :

- UTAN (principal boarders)
- TAVLAT (secondary boarders)
- ▲ VILLAGE
- Watlaar land territory
- Area claimed by both villages, Watlaar and Ohoiru
- Watlaar marine territory

0 1000 5000

METERS

The Map 8 illustrates the results giving only approximate idea of the mapping which would required very performant equipment and reliable informants. It seems that only some elder men still know this different areas and their reference point on the coast. The angle of the northern and southern frontiers of the sea, that belongs to the people of Watlaar according to them, follows a perpective angle which proves that the references taken are on the shore and within the limits of eye sight.

The marine exploitation mostly takes place from the shore to *faruan*. The Figure 18 shows how villagers use their marine environment and how their fishing technics are suited to meet sea profile and maximise the catches.

We observe that each fishing device corresponds to an area, such as the *karau* is placed in the shortest area of the intertidal zone, *sero* has its place in *yafat* which corresponds to the intertidal zone while really big tides. In normal times, at low tide, the water depth goes as deep as a meter, a meter and a half. The fishing trap *flerak* sits at the boarder between the furtherst intertidal zone limit and the rocky, dead corals area where fish like to play. Another trap, the *relan* also sits at the frontier between the coral reef and the sandy bottom, another edge fishes fancy. Finally, a larger fishing trap, the *wuv roa* has its place in deeper water, between 25 to 35 meters depth. We notice that it is tied back to *nurhain soin,* the beginning of the sandy sea bottom in order to easily find it and bring it back to the surface.

4.2. The system of ownership

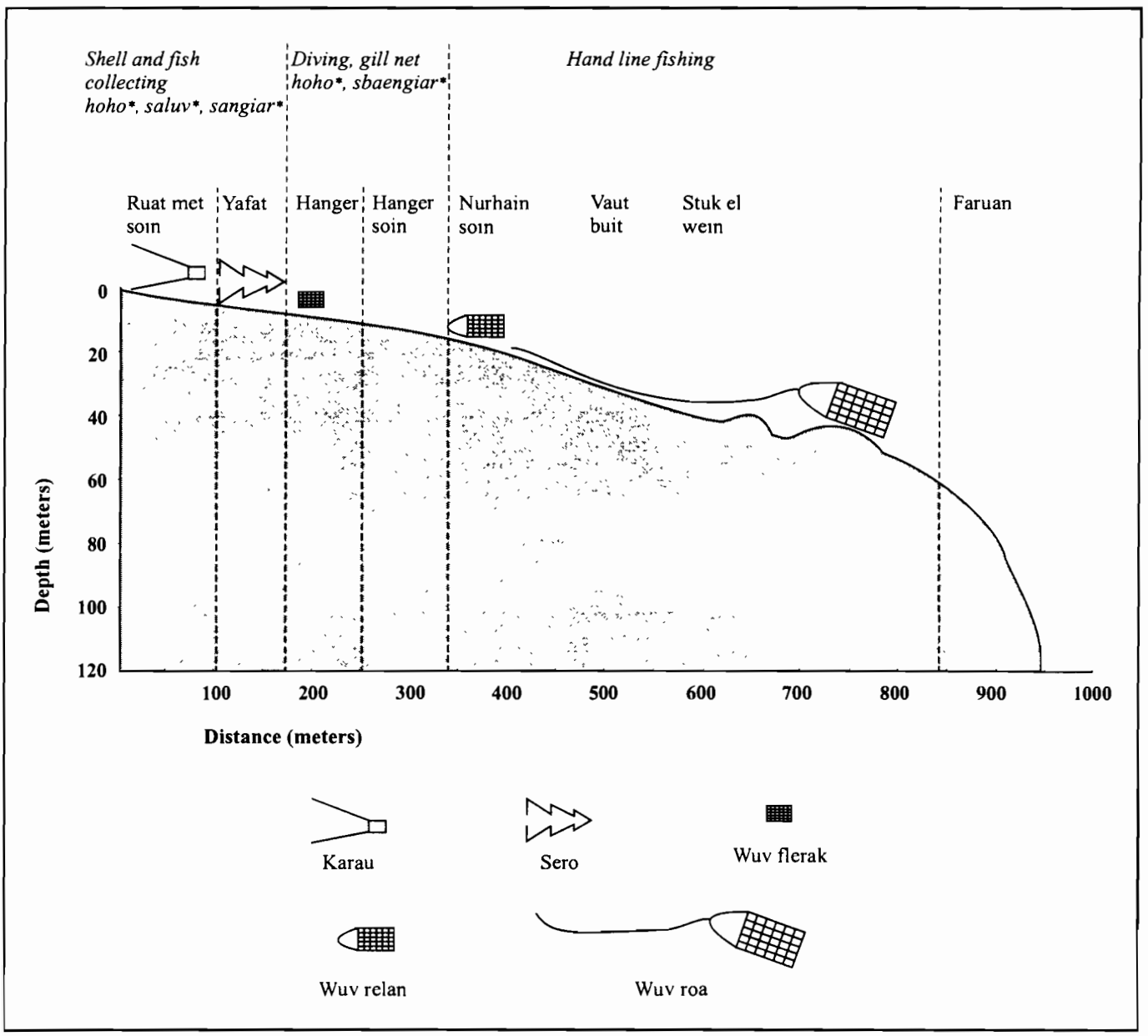
The village sea ownership goes from Sasaluk in the south to Wear Ngayaan in the north (Map 1, page 13). And within the village, some areas have been divided between the families to allow them to set up *karau, sero and wuv roa.* Probably so because those fishing technics require temporary permanent use of the space. In Watlaar, the whole section that goes from the shore to *yafat* is shared among owners to make *karau,* the section that goes from *yafat* to *hanger* is divided to make *sero* finally, the *rutan* and the area between 25 to 35 meters water depth is subject to ownership for putting fishing traps.

Ownership is delimitated by reference points on the shore (places with names as seen on Map 1) which coordinate with the section according to the fishing device used, for exemple *yafat* for the use of *sero* and so on.

Each area has specific owners and the actual system of ownership does not follow a regular pattern in that for exemple with reference to the preliminary general map of Watlaar, a person that owns a place for *karau* from Sasaluk to Labes, does not necessarily own a place for

sero here. He may own it further north and may not have one at all. It depends on the family and the social status. Some pools on the intertidal zone are also the propriety of some families. However, it should be stressed that the ownership of a piece of sea is only valid for the purpose of using either *karau, sero* or *wuv roa* but does not entitle villagers to own everything that is found in that place. Shells and fishes remain the village's property. Nor does it mean that nobody else but the owner can use that particular place. As long as the one who has the intention to use it previously informes its owner, there is no problem.

Figure 18 : Schematic representation of spatialisation of exploitation according to fishing methods



Nowadays, people seems to use less and less traditional fishing technic, that is *karau* and *sero*. Only the *wuv roa* is still quite popular. However, traditional family ownership still prevails.

D. Trochus Fishery Study

1. Biology of Trochus

The topshell (*Trochus niloticus*), known in Maluku as *lola* or *bia susu bundar*, is a tropical marine gastropod which belong to the family Trochidae and order Archaeogastropoda. According to Hedley, cited by Shokita *et al.* (1991), the natural distribution of *T. niloticus* extends from Ceylan to Samoa (from west to east), and from Ryukyus islands to wetern Australia (south to north). This gastropod lives on reef flat at depth ranged from 1 to 10 m with limited movement. This nocturnal animal is active at night and feed on encrusted algae growing on the hard substrate.

The maximum basal diameter is 16,0 cm. Male and female animals are indistinguishable externally. The first maturity is achieved at 5.5 – 6.0 cm of basal shell diameter (Pradina & Dwiono, 1994; Pradina *et al.*, 1997). The main spawning season in Banda islands (Central Maluku) occurred from March to June which coincided with transitional season from northwest monsoon to souteast monsoon (Arifin & Pradina, 1993; Pradina *et al.*, 1997). Spawning occurs usually at night during the new moon period and fertilization is external between dark green eggs and whitish sperms (Pradina *et al.*, 1996). The eggs hatched as swimming trochophore 9 to 10 hr post-fertilization and settled on suitable substrate 48 to 60hr post-fertilization (Heslinga, 1980; Nash, 1985; Dwiono, 1997). The growth rate during the first three years was varied between 25 – 30 mm per year (Moorhouse, 1932; Rao, 1936; Dwiono, unpubl. data)

Trochus niloticus possess a high commercial value because of its valuable mother of pearl shell. In local market, the empty unprocessed shell price varied between Rp. 10.000,- to Rp. 15.000,- (US$ 4.0 – US$ 6.0) per kilogram. The perly shells, used as high fashion button industry, paint industry and craft work are exported mainly to Japan, Singapore, Germany and Italy (Usher, 1984). Beside its valuable shell, the meat of this animal is used locally as protein source. Indonesia, as one of the main producer of trochus shell, has exported more than 1500 mt of dry shell in 1978. The production from Indonesia was maintained at this level until 1985 when more than 2000 mt was exported. Since 1988, the production decreased drastically and reached its lowest production in 1990 where only 195 mt of trochus shell was produced.

Similar tendency of production decline was observed in Maluku Province as one of Indonesian shell producer (Table 17).

Table 17 : Trochus production for Maluku and other provinces of Indonesia (From Dwiono, 1996)

Year	Maluku (kg)	Other Provinces (kg)	Total Production (kg)	Value (US $)
1978	249,000	1,339,511	1,588,511	714,391
1979	254,901	1,617,724	1,872,625	837,084
1980	281,140	1,174,962	1,456,102	994,479
1981	71,800	1,148,987	1,220,787	810,465
1982	139,500	1,361,745	1,501,245	1,278,238
1983	147,200	1,438,160	1,585,360	1,183,686
1984	101,500	1,805,513	1,907,013	1,227,445
1985	206,662	1,924,911	2,131,573	3,292,277
1986	85,800	1,482,134	1,567,934	3,808,320
1987	134,400	1,682,496	1,816,896	6,005,425
1988	201,100	6,86,130	887,230	3,928,280
1989	97,000	363,631	460,631	2,386,954
1990	17,500	177,540	195,040	1,364,370

The decline in trochus production observed throughout Indonesian territory has pushed Indonesian authority to declare a protection of trochus and several other marine molluscs. In 1987, Ministry of Forestry announced a ministerial decree No. 12/KPTS – 11 /1987 which prohibits any form of exploitation and trade of trochus and another eleven species. Although fishing is a daily activity of peoples living in coastal area of Maluku, the capture of most fishermen is only sufficient to meet their need in protein. For these peoples, the marine resource of commercial value, such as *Trochus niloticus*, is the sole possibility to get cash money. The need of fishermen of a valuable marine resource and of government policy to protect this species has created a conflict of interest. To solve this conflict, the Directorate General of Forest Protection and Nature Conservation (PHPA) – Ministry of Forestry decreed No. 07/KPTS/DJ-VI/1988 mentioning that protected species may be exploited and traded if they are produced from culture. This decree has a double aims, firstly, to protect the resource from extinction, and secondly, to enhance the sustainable production of this commercial commodity.

The village of Watlaar, as well as most of southeastern Maluku villages, is still applied the traditional resource management called '*sasi*' which provides the regulation of closing and opening of fishing period. While aquaculture activity is out of consideration for these traditional villages since aquaculture requires a lot of investment and skills, the regional authority wish to enable in considering *sasi* system as a comparable alternative of aquaculture activity. Therefore, the traditional resource management system has to fulfil the above double aims. In order to judge weather these aims were fulfilled or not, the evaluation on the strength and weakness of this traditional resource management in Watlaar will be presented.

2. Trochus repartition and abundance

The trochus density was estimated by transect method which was performed at 11 sites. At each site, the transect was done beginning from coast laine to the sandy area where no more trochus was found. Depending on the topography of the bottom, the length of the transect may vary from 150 m to 560 m.

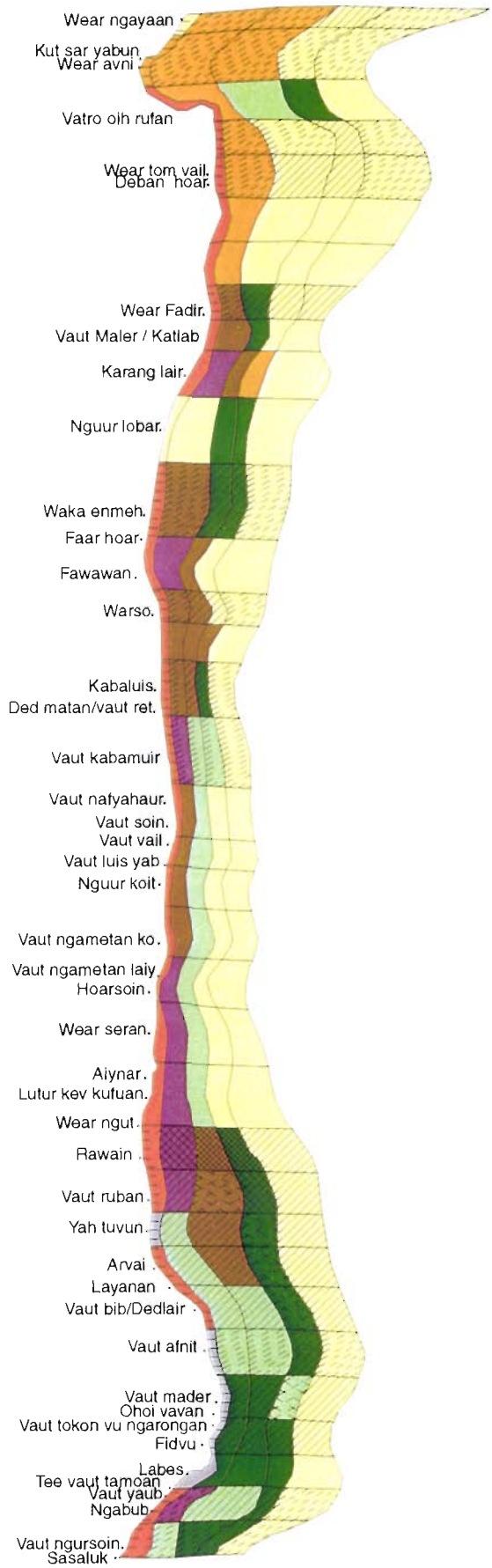
The density was calculated for each zone of the sites, and plotted against primary (dominant) substrate distribution. Map 6 shows that only the density of 11 out 35 sites were calculated. The high value of trochus density (> 21 individuals per 100 sq. m) was found only at middle subtidal zone of Vaut Ruban, while in Rawain it was observed both at lower intertidal, upper and middle subtidal zones. Moderate value of trochus density (between 1 and 20 individuals per sq. m) was found both at lower intertidal, upper, middle and lower subtidal zones of all sites observed. The low trochus density (< 1 individual per 100 sq. m) was found both lower intertidal, upper and lower subtidal zones, especially in northern coast of Watllaar (Wear Avni to Wear Ngayaan) and Wertom Vail.

Although the primary and secondary substrates of upper subtidal zone of Kabanuir is similar to those found in Arvai, Yah Tuvun, Vaut Ruban and Rawain, trochus density in Kabanuir is lower than in the other sites (Map 3 & Map 9). Similarly, the bottom of middle subtidal zones of Waka Enmeh, Dedlair, Vaut Afnit, Fidvu and Ngabub are constituted of limestone and dead coral, but trochus density in Waka Enmeh and Vaut Afnit, Fidvu, and Ngabub is lower than Dedlair. Similar tendency of variation in trochus density for same bottom composants was observed as well at middle intertidal, middle and lower subtidal. Since the depth (vertical zonation) and bottom composants (primary and secondary substrates) are similar

in those compared sites, the variation of trochus density might be due to other factors, such as wave, current, etc.

In order to obtain the density of the remaining 24 sites, an estimation was made. From the figure above, the relation of trocus density and primary substrates or their combinations were not clear. Therefore, a contingency table containing depth (vertical zonation), bottom composants (primary and secondary substrates), and trochus density was performed.

Primary substrate and trochus density distribution according to vertical zonation in Watlaar waters



LEGEND :

Primary Substrate

- Sand
- Stone
- Sand, Stone
- Rock/Boulders
- Limestone
- Sand, Limestone
- Stone, Limestone
- Sa, St, Ls

Trochus Density (No. ind. per 100m2)

- No trochus
- <1
- 1-10
- 11-20
- 21-30
- 31-40
- No information

0 250 500 750 1000

Metric Scale

ORSTOM

L'Institut français de recherche scientifique pour le développement en coopération

Realization : Sigit A.P. DWIONO with the participation of the Maison de la Télédétection, Montpellier (France).
This map gives account of field surveys conducted from july 1996 till march 1997

This contingency table (Appendix 5) shows a better correlation of trochus density with depth and bottom composant. For a given combination of these last two factors, an estimated value of trochus density was obtained.

The estimation of density, based on the depth (vertical zonation) and the substrate composition, permits to calculate the surface area occupied by different trochus density (Table 18). The table shows that no trochus was found at middle intertidal zone which attains 6.56 ha and small part of lower intertidal zone (0.37 ha). The surface area with trochus at density less than 10 individuals per 100 square meters extends up to 79.84 ha. This poor and moderate trochus habitat was found mainly at low intertidal, upper, middle and lower subtidal zones. The good and very good trochus habitat attains 6.69 ha and distributed only at lower intertidal, upper and middle subtidal zones. The 'excellent' habitat with trochus density more than 31 indivduals per 100 square meters was found only at upper and middle subtidal zones.

Table 18 : Surface area (in ha) occupied by trochus at different density according to vertical zonation.

Trochus Density	Inter	tidal		Sub	tidal	Total
(in 100 m2)	Middle	Lower	Upper	Middle	Lower	Area
No Trochus	6.56	0.37				6.92
Poor (< 1)		10.91	10.84	1.24	8.96	31.94
Moderate (1 – 10)		6.54	8.68	11.70	20.98	47.90
Good (11 – 20)		1.28	0.83	2.84		4.96
Very good (21 – 30)		0.92		0.81		1.73
Excellent (31 – 40)			0.66	0.60		1.26
Total area	6.56	20.02	21.01	17.19	29.94	94.71

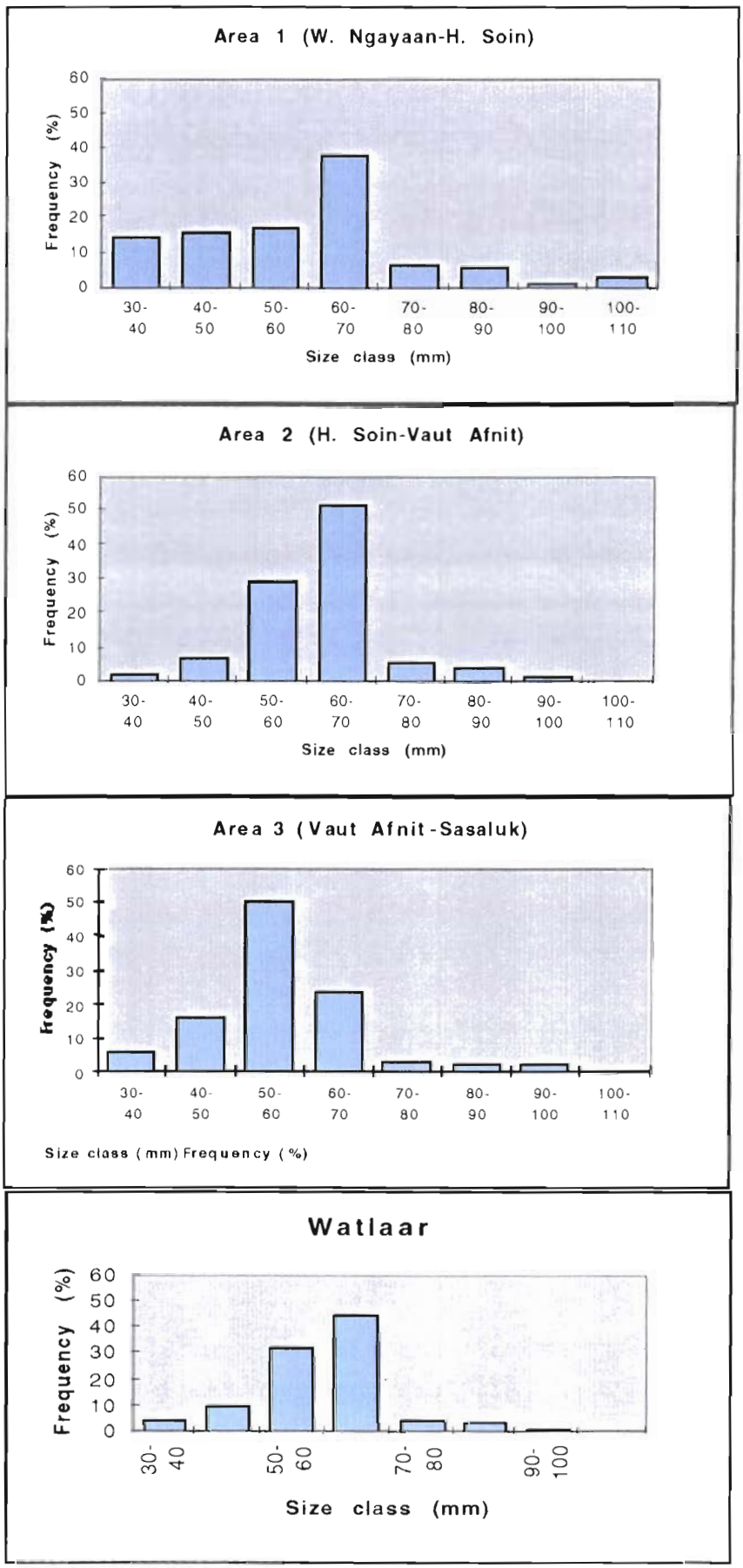
3. Population structure and Biomass estimation before harvest

The trochus transects at 11 sites made before the harvest permit to evaluate the population structure. For this purpose, the coastal area were divided in three sub-areas, i.e. from Wear Ngayaan to Hoar Soin (sub-area 1), from Hoar Soin to Vaut Afnit (sub-area 2) and from Vaut Afnit to Salsaluk (sub-area 3). The result is presented in form of histogramme (Figure 19).

The Figure 19 shows that the population structures of the sub-areas are slightly different. Sub-area 1 is dominated by small size (< 60 mm) individuals with approximately similar number of the first three class (30–40, 40-50 and 50-60). Sub-area 2 possess a high number of marketable size class (60-70), while the percentage of lower size classes are very limited. Sub-area 3 shows lower median which is situated under the marketable size (50-60 mm). The overall histogramme of trochus in Watlaar shows an equilibrium population structure with a median at marketable size class. The low percentage of trochus having basal diameter larger than legal marketable size (> 60 mm) at all sub-areas and overall population suggests that the trochus population has experienced an important fishing pression (Nash, 1993).

As mentionned previously, the Watlaar marine environment includes approximately 3.7 km long of coastal area. The main habitation extends from Fidvu to Arvai. There is a possibility that marine resources at sites near the main habitation is better controlled against illegal fishing than other sites. Therefore, two types of trochus biomass estimation was performed. The first type of estimation used only the data of trochus density obtained in sites near the main habitation (Fidvu to Arvai), while second type of biomass estimation was made using data of trochus density obtained from all (11) studied sites. The first estimation type gave a higher values and was considered as representing the trochus potency, while the second type, which visibly gave a lower density of trochus, was considered as representing the actual standing stock of trochus in Watlaar coastal area.

Figure 19 : Population structure of trochus in Watlaar before harvest



The calculation was made for each vertical zone and site by multiplying the width by the length with the estimated density. The result of the estimations was presented in Table 19. This table shows that the biomass of trochus, both potency and standing stock are not homogeneously distributed along the coastal waters of Watlaar. In northern part (from Wear Ngayaan to Vaut Maler), the number of individuals is less than central or southern part. Near the main habitation (from Fidvu to Arvai), the number of trochus is very high.

The standing stock of trochus in Watlaar coastal waters is estimated at 32,487 individuals, while the potency (or carrying capacity) of the area is estimated to at least 37,601 individuals. These estimations concerned only the individuals with basal shell diameter superior to 30 mm. If these estimations are correct, the present trochus standing stock is slightly under the optimum carrying capacity level and the actual resource management regime is sufficiently effective to ensure the sustainable production of this marine resource.

Table 19 : Standing stock and Potency estimations for Watlaar coastal area

Estimation of standing stock (Abundance # 1) and potency (Abundance # 2)

No	Sites	Width of zone (m)	Length of each zone observed (m)				Standing stock (individuals)					Potency (individuals)				
			Low Intertidal	Upper Subtidal	Middle Subtidal	Lower Subtidal	Low Intertidal	Upper Subtidal	Middle Subtidal	Lower Subtidal	Total	Low Intertidal	Upper Subtidal	Middle Subtidal	Lower Subtidal	Total
1	Sesaluk	20	83,0	50,0	45,0	70,0	0	4	16	0	20	0	4	16	0	20
2	Ngabub	100	50,0	70,0	72,0	32,0	0	120	220	0	340	0	120	220	0	340
3	Labes	100	20,0	74,0	47,0	89,0	45	61	305	252	662	59	559	1038	454	2110
4	Fidvu	100	52,7	36,3	80,0	60,0	80	260	520	180	1040	80	260	520	180	1040
5	Vaut Mader	160	34,0	45,0	50,0	80,0	181	544	992	352	2049	161	544	992	352	2049
6	Vaut Afnit	160	55,4	84,0	61,0	70,0	64	128	672	64	928	64	128	672	64	928
7	Dedlair	125	82,6	63,0	64,0	105,0	175	650	1050	276	2151	175	650	1050	276	2151
8	Arvai	115	87,5	72,0	59,0	96,0	207	828	920	460	2416	207	828	920	460	2416
9	Yath Tuvun	80	54,0	104,0	70,0	90,0	208	624	704	240	1775	208	624	704	240	1775
10	Vaut Ruban	85	57,1	98,0	65,0	100,0	289	1411	1309	697	3706	289	1411	1309	697	3706
11	Ruwain	115	80,1	57,0	53,0	110,0	1173	2231	2346	1841	7590	1173	2231	2346	1841	7590
12	Lutur Kev Kufuan	130	43,3	35,0	40,0	100,0	717	32	54	388	1170	717	32	54	663	1465
13	Wear Seran	115	33,0	40,0	40,0	55,0	483	33	47	65	628	483	33	47	323	886
14	Hoar Soin	100	34,2	30,0	25,0	70,0	435	21	26	198	881	435	21	26	357	839
15	Vaut Ngameten Ko	120	35,7	40,0	30,0	50,0	30	34	37	170	271	30	34	37	306	408
16	Nguurkoit	90	28,6	36,5	30,0	50,0	39	49	59	269	415	39	49	59	485	631
17	Vaut Luis Yab	75	34,9	43,0	35,0	50,0	19	23	27	106	175	19	23	27	191	260
18	Vaut Soin	130	23,0	22,9	40,1	42,0	21	21	54	155	251	21	21	54	278	375
19	Vaut Kabanuir	160	27,0	28,0	35,0	50,0	0	32	32	0	84	0	32	32	0	64
20	Kabalus	120	31,1	21,0	21,0	50,0	0	72	48	48	168	0	72	48	48	168
21	Kab/Warso	85	27,6	25,0	30,0	86,0	17	61	604	159	840	17	61	604	286	968
22	Warso	85	46,4	37,0	29,5	70,0	0	119	51	51	221	0	119	51	51	221
23	Fauwawan	115	56,9	28,5	39,4	70,0	195	94	70	228	587	389	94	70	411	964
24	Wak Enmeh	170	98,0	43,0	32,0	75,0	0	170	68	34	273	0	170	68	34	273
25	Nguur Lobar	170	82,3	40,0	30,0	85,0	144	304	331	409	1188	144	514	511	737	1906
26	Karang Lair	115	44,0	29,0	37,0	140,0	151	95	276	456	978	151	95	276	821	1343
27	Vaut Maler	60	61,2	35,0	30,0	55,0	0	94	28	93	215	0	159	28	168	355
28	Wear Fadir	65	40,5	46,2	50,0	50,0	0	104	65	39	208	0	104	65	39	208
29	100mN W Fadir	100	50,5	72,2	55,0	120,0	23	29	55	221	329	23	29	55	398	506
30	200mN W.Fadir	100	43,9	103,1	50,0	120,0	20	42	50	221	333	20	42	50	398	510
31	D.Hoar/W Veil	115	88,1	95,0	65,0	120,0	0	161	48	46	252	0	161	46	46	252
32	Vatro Ohoi Rufan	100	71,6	127,1	45,0	95,0	0	20	60	40	120	0	20	60	40	120
33	75mN VOR	80	28,8	105,0	65,0	110,0	16	52	84	136	269	16	52	64	449	582
34	Wear Afni	90	123,0	128,0	75,0	102,0	0	18	36	18	73	0	18	36	18	73
35	Wear Ngayaan	50	154,9	110,0	98,0	172,0	0	40	60	0	100	0	40	60	0	100
Total		3700					4712	8581	11304	7890	32487	4921	9355	12216	11110	37601

Standing stock (Estimation # 1) = 32487 individuals
Potency (Estimation # 2) = 37601 individuals

4. Harvest/Production

4.1.Harvest time

In Watlaar, like in many other villages in Maluku, commercial exploitation of trochus comes under a certain type of management, a traditional momentary interdiction known under the name of *sasi*. It means that for a certain period, people are not allowed to collect any trochus. The interdiction is implemented by the Bapak Raja and the head of the village. After one or two years, the interdiction is lifted for only two or three days and then implemented again. The harvest only officially takes place within those couple of days. The length of the interdiction either depend on the village financial needs, at the occasion of a special event, the construction of a church or on the estimation by the head of the village that there are enough trochus in the sea.

The lifting of the interdiction always takes place from october to march but more often around december. This time of the year corresponds to the westernly wind season which brings calm weather on the east coast of the island thus facilitating the harvest and transportation. The harvest only lasts two to three days in order to gather all the people at the same time which will collect all the trochus they can find within this particular time.

Sasi is an interdiction which is not only applied on trochus but applied on any natural resources in order to manage the stocks in the perpective of a viable exploitation both on the land and on the sea. In Watlaar, people refer to *sasi darat* and to *sasi laut*, that is the sasi applied on the land and the *sasi* applied on the sea. *Sasi darat* is usually applied to coconut for about three months every year and comes in viguor usually just before the easterly season. *Sasi laut* refers to the *sasi lola* and to the *sasi meti* whereby some area of the beach is closed for a few months.

It is interesting to notice that only *sasi lola*, a high valued shell, gives way to a ceremony gathering all the villagers whereas the other interdictions are simply implementated orally. The ceremony for *sasi lola* is a way to enforce the law both within the village but also to let neighbouring villages that the *sasi* is on. Thus, *sasi* is caracterized by a certain sign (Photo 3). The shape of the *sasi* sign corresponds to the importance of the punishment involved if someone trespasses the interdiction. In a way, *sasi* acts a role of police and its symbol marks down the territory that belongs to each village and within the limits of which people own and exploit the resources.

Photo 3 : The *sasi* marker

4.2. Harvest technic

The harvest is very much organized by the head of the village and the Deliberation Council LMD. They meet in order to decide on the harvest date, on how they will divide up the harvest and on how the profits will be divided.

Regarding the harvest date, they will be careful of the tide and plan it for the days when the tide is quite big and rather long. If they decide that the harvest will take place during three days, they will point out three areas along the shore and within the sea boarders of Watlaar that will correspond the three successive days. For example, in 1996, with reference at the name of places, the first day of harvest took place from Hoarsoin to Wear Ngayaan. The second day people collected trochus from Salsaluk to Vaut Afnit. Finally, on the third day, they harvest the area located in front of the village from Vaut Afnit to Hoarsoin. They had decided that the harvest from first day would be kept at the town hall so that its profit would go to the village to buy fuel for running the electric generator. The harvest from the second and third days would first of all be stored at the house of each respective head of *rahanyam* each diver belonged to so that the profit could then be divided up.

The sound of a gong would call out the villagers for the harvest. A first signal would tell the villagers that the havest would soon begin. A second bell would gather all the people on the beach and get them ready on their canoes. The third and last bell would lauch the start of the harvest. The start is given in relation to the tide because people would begin to dive as the tide goes out in order to facilitate the harvest. It would be too difficult to collect shell in deep water since men free dive to collect the trochus. They only have wooden handmade diving-glasses. Their chidren usually sit on their canoe following their father who slowly fills it up as he dives and brings back trochus each time he comes up to the surface. While the men were diving, women were collecting shells by the shore.

People usually pay attention to the size of the trochus they collect which is determined by the market. The size limit for the high price is 6 centimeters (three fingers) and above while shells under this size will be bought for about one third of the high price.

The day's havest usually finishes when the tide is high again or when there are no more trochus. The head of the village and the head of the each Rahanyam were usually waiting on the beach to count how many shells had been collected by each person but most of the time, people would only give account of their catch once there have taken out the meat from the shells since they went back to their house from another way and thus did not meet their chief.

At the end of each day, housewives will boil the shell in order to extract the meat which the family will eat. The head the family will then bring his catch to the town hall on the first day and on the following days to the head of his *rahanyam* who would then write down the number of shells each particular person has collected each day.

4.3. Selling the trochus

Trochus nowdays is a very expensive marine resource. Its commercial exploitation in Maluku goes back to the 1950ies. In those days, traders based in Ambon and in Banda begin to travel the other islands to buy the shells from the fishermen, then considered as the poorest people. Since exploitation of trochus has developped and has turned into a real business involving traders at all level of the circuit. In 1988, the total of exportation triped with some 80 000 Kg in 1987 and a little over 256 000 Kg in 1988. 7,5 tons were collected on the island of Kei Besar in 1989 ans sold for US$ 65 000 (Abrahamsz, 1991).

The Figure 20 page 106 shows that villagers sell the trochus to traders originated either from the same village or from neighbouring villages who then sell the shells to traders in Elat who themselves sell them again to on trader in Tual who finally ships everything to Surabaya. Along the chain, each trader will take a margin which is proportional to the price they will sell the trochus again taking into account transport and other expenses. Moreover, it is important to mention that the first traders who buy from the village is usually able to buy trochus because they borrowed capital from the second buyer in Elat.

After the three days diving and once all the trochus shells had been gathered at the town hall and at each respective *rahanyam*, the head of the village gathered all the married men at the town hall to speak about the selling of the trochus. It is always a very sensitive issue because of the price of the trochus and on the choice of the buyer.

Traders who intend to buy from the village must first of all do the usuals known locally as *siri pinang* that is giving some money and some tabacco to the head of the village who will divide everything between the members of the Deliberation Council. This custom gives the right to the traders to participate to the negociation but does not guaranty him that he will get to buy the trochus. In 1996, three buyers, all originated from Watlaar took part in the negociation which involved both the head of the village and all the members of the Deliberation Council. Each buyer offered its best price that is Rp. 12 500 (US$5,70) per kilo of trochus 6 centimeters and above and Rp. 2000 (US$ 0,90) per kilo of under size shells. These prices were adjusted according to the price that they would sell them again in Elat. The head of the village offered to

buy the trochus Rp. 13 000/kilo (US$ 5,90) of large size and Rp. 3000/kilo (US$ for the smaller size thus winning the buy since the other traders could not offer a better price. The villagers were happy to be able to sell the trochus at high price.

4.4. Sharing the profits

In 1996 the production of trochus attains 1939 kg in 1996 giving an income of Rp 14.727.000,- (eq. 6100 US$) to the village. As planned, the profit from the first day went to the village while the profits from the following days were divided up between the members of each Rahanyam depending on how much they had caught as a whole. The dividing up between the members differed from one Rahanyam to another and seemed unclear most of the time (Table 20).

Table 20 : profit allocated to the village and the Rahanyams

Total	Village	Rahanyam A	Rahanyam B	Rahanyam C
roupiah	1 123 000	3 497 000	5 190 000	4 923 000
US$	469	1457	2163	2051

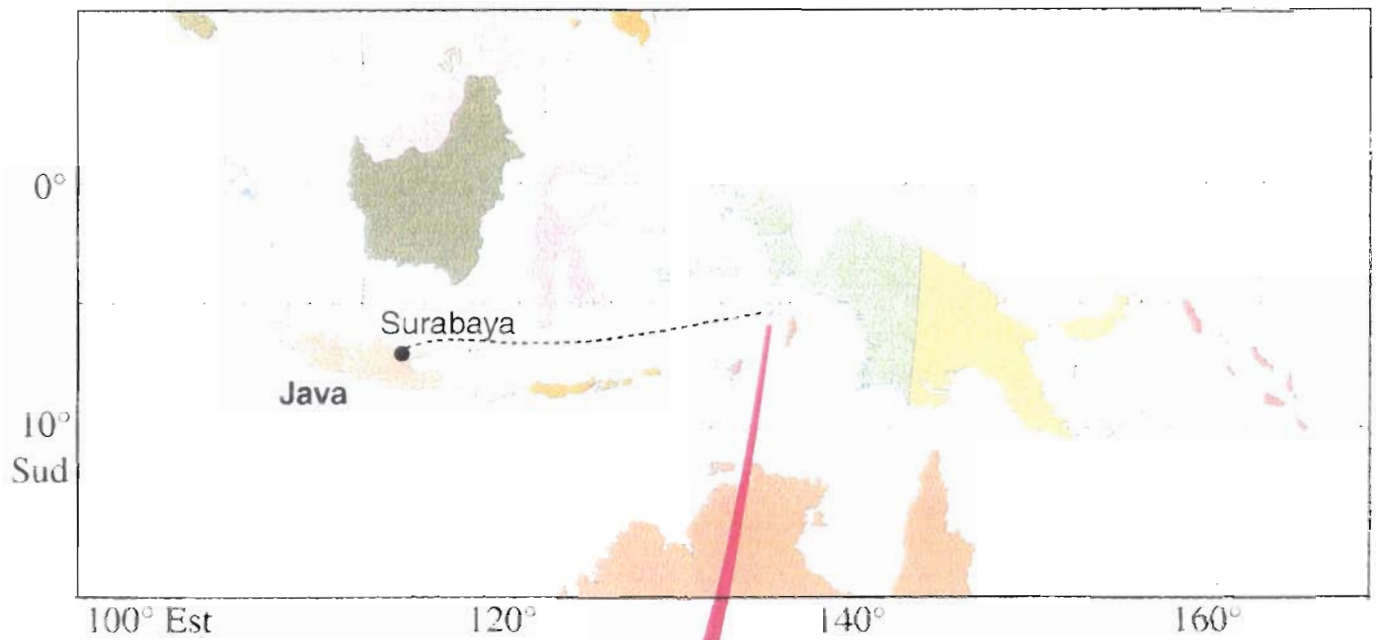
The profits were divided between the households taking into account the marital status, the number of children, whether the children went to school and their level of education. Some money was also given to some people who lived outside of Watlaar. It also gave a bonus to the divers who collected most shells but roughly speaking if profits from trochus were relatively important as a whole, 15 millions of rupiah, it was insignificant once divided up between the households who each get between 50 000 to 100 000 roupiah once every two to three years regardless on whether people dived or not.

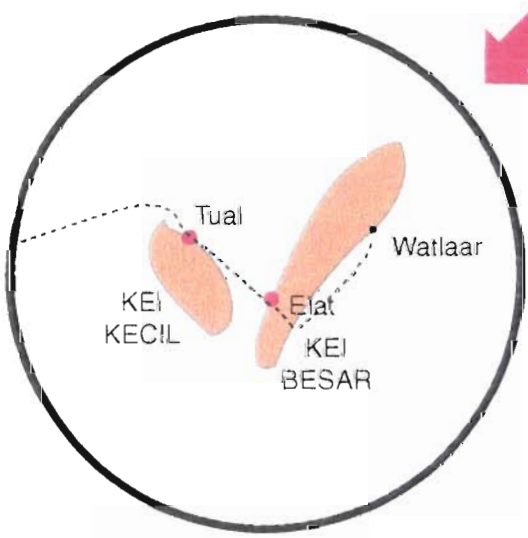
4.5. Trochus harvest evolution in Watlaar until 1996

The data of trochus harvest in Watlaar from 1981 to 1996 is presented in Table 21, page 107. The table shows that the interval of time between two successive harvest is not constant. It varies from one to almost four years, while the harvest period varied from two to 4 days. For Watlaar which includes 3.7 km long of coastal area, 3 days of harvest is sufficient for the villagers to collect the majority of trochus of legal market size (> 6.0 cm). One supplementary day may means the collect of almost all marketable trochus.

TROCHUS MARKETING NETWORK

IN THE KEI ISLANDS - INDONESIA





Kei Islands

Village

Traders originated from the village and/or from other villages

Traders based in Elat (capital city of Kei Besar island)

Trader based in Tual (capital city of the Kei islands) trading monopoly

Surabaya (Java island)

Processing industries

Table 21 : Evolution of Trochus harvest (in kg) in Watlaar since 1981.

Year	Date	Size > 6.0 cm	Size < 6.0 cm	Total	Remark
1981	March 3 – 5	5,204	0	5,204	After 3 years
1982	December 2 – 4	1,057	32	1,089	
1983	January 27 – 29	967	152	1,119	
1985	January 24 – 26	754	115	869	
1989	November, 22 – 24	1,236	115	1,351	
1991	April, 1 – 3	831	0	831	
1992	April, 1 – 2	989	40	1,029	
1993	March, 12 – 13	902	0	902	
1994	December, 14 - 17	1,895	0	1,895	
1996	December, 16 - 18	891	1,048	1,939	

In 1981, trochus harvest was made after three years of closing period and resulted the highest capture (5,204 kg). The following years, the capture of large size class (> 6.0 cm) while the number of small size class (< 6.0). Within similar harvest period (3 days), the increase of small size capture and the decrease of large size capture might indicate the over fishing. In this case, the over fishing has occurred in 1981 harvest.

The impact of over fishing in 1981 seemed to affect the 1985 harvest where only 754 kgs of of large and 115 kgs of small trochus were captured. In 1989, almost 4 years of closing period, the capture increased to 1,236 kgs of large and 115 kgs of small trochus. From 1991 to 1993 the harvest intervals were maintained to 1 year and the captures varied from 0,8 to 1,0 mt. In 1994 (after 21 months of closing period) the capture increased to 1,895 kgs, while in 1996 it attained 1,939 kgs of trochus. During this last harvest, most of the trochus (1,048 kgs) were below the legal marketable size of 6.0 cm.

4.6. Trochus harvest in 1996

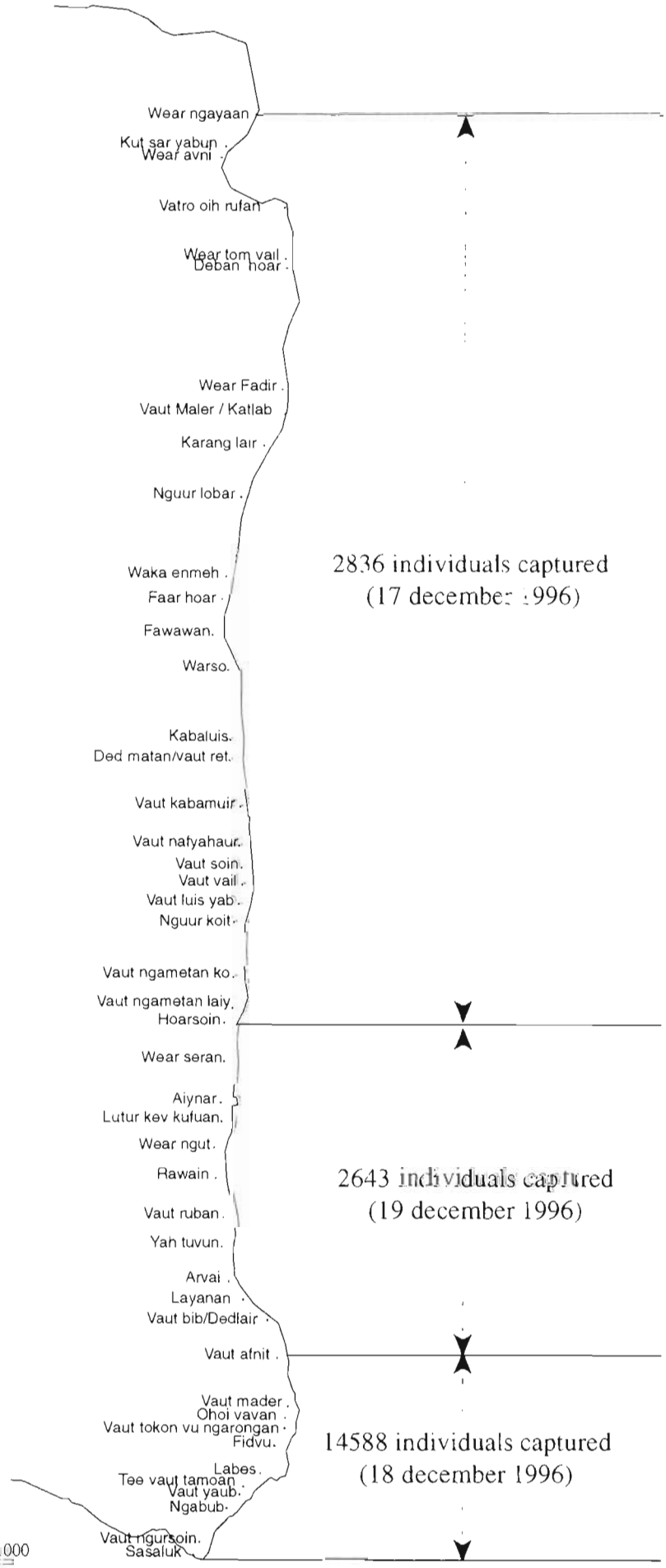
The opening of fishing for trochus or harvest period in 1996 was held from December 16th to 18th . For this purpose, the coastal area were divided in three sub-areas, i.e. from Wear Ngayaan to Hoar Soin (sub-area 1), from Hoar Soin to Vaut Afnit (sub-area 2) and from Vaut Afnit to Salsaluk (sub-area 3), as shown on Map 10. The first, second and third day of harvest were done at sub-area 1, sub-area 3 and sub-area 2, respectively. The data of this harvest is presented in Table 22.

This Table 22 shows that the harvest for the number of trochus caught at different sub-areas is varied. The highest capture was observed at sub-area 2, following by sub-area 1 and 3. The sub-area 2 is found on the main habitation of Watlaar village. The total capture for the three harvesting period is 20,067 individuals.

The Table 23 shows as well that the number of habitant participated in harvest is varied. The fishermen on the third day harvest at sub-area 2 is numerous. This value is higher in sub-area 2 (88.4 trochus individuals per fisherman), following by sub-area 3 and 1. The catch per unit effort may indicate the pression experienced by a given area. In this context, the sub-area 1 and 3 have experienced a lower fishing pression.

In watlaar, there is 3 Houses or *rahanyam*, Kbautib, Bausenar and Ler-Ler. The trochus capture obtained by each *rahanyam* during the 3 days of fishing is presented in Table 23. The members of *rahanyam* Bausenar participated in this harvest was more numerous than the *rahanyam* Kbautib and Ler-Ler.

Comparison of three troca-fishing zones



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Realized with the participation of the Maison de la Télédétection, Montpellier (France).
This map gives account of field surveys conducted from july 1996 till march 1997. All measurements have been taken according to villagers informations.

Table 22 : Trochus harvest in Watlaar in 1996 according to sub-areas.

Sub-area	1	2	3	Total
Date (December 1996)	16th	18th	17th	
Catch (Trochus individuals)	2,836	14,588	2,643	20,067
Effort (fisherman-day dive)	119	165	105	389
Catch per unit effort (CPUE)	23.8	88.4	25.2	51.6

The Table 23 shows that visibly, the *rahanyam* Ler-Ler's members are better divers than two other *rahanyam*. The mean capture of *rahanyam* Ler-Ler was 4.7 kgs of trochus per person, while *rahanyam* Bausenar and Kbautib obtained 4.0 kgs and 3.6 kgs per person respectively. Furthermore, the *rahanyam* Ler-Lercaptured a higher percentage of large size trochus comparing to other *rahanyam*.

Table 23 : The harvest of trochus in 1996 according to main families in Watlaar.

rahanyam	Kbautib	Bausenar	Ler-Ler	Total
Harvest (kgs)				
Large size (> 6.0 cm)	247	307	403	957
Small size (< 6.0 cm)	223	433	326	982
Total	470	740	729	1939
No. of fisherman	130	184	155	469
Catch per unit effort (kg)	3.6	4.0	4.7	4.1

4.7. Impact of harvest to trochus population in Watlaar

During the present study, two successive transects have been made at the same 19 sites before and after the harvest. Each transect was started from the coastline to the sandy area where no more trochus was found. The number of individuals encountered within 5 m wide transect is presented in Table 24. The table shows that the length of transect lines is not homogenous along the coastline of Watlaar. The longest transect (560 m) was at Wear Ngayaan, while the shortest (150 m) was at Vaut Kabanuir. The number of trochus found within the transect varied from 2 individuals in Vaut Kabanuir to 330 individuals in Ruwain. As mentioned previously, the bottom constituants of Watlaar coastal area is not homogenous. It is suggested that the difference of abundance is due to the existence of suitable substrates, such as

limestone, dead coral and coral rubble. The abundance of trochus around main habitation is visibly higher.

Table 24 : Length of transect and number of trochus encountered within 5 meter wide line transect before and after trochus harvest in Watlaar in December 1996.

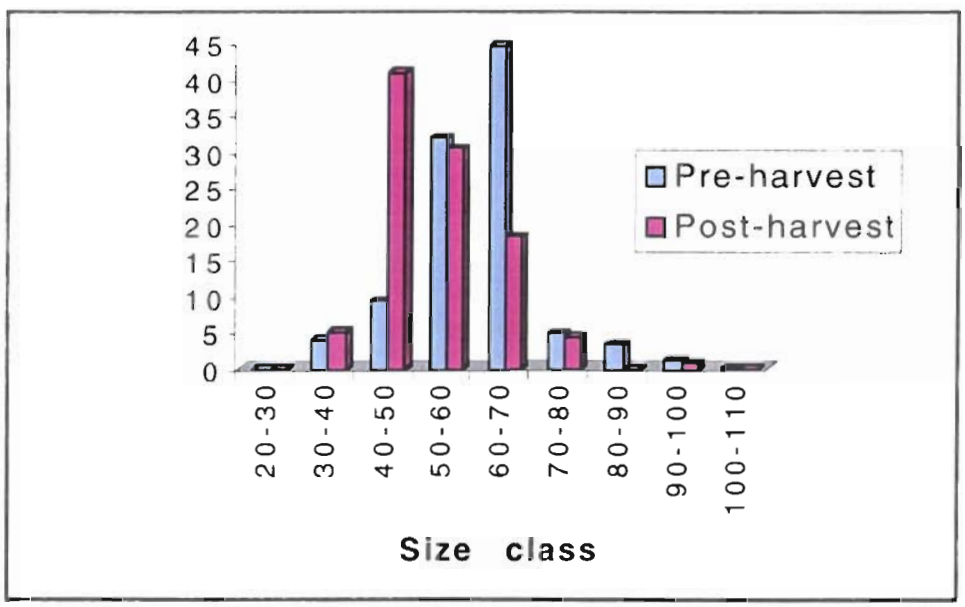
No	Site	Length of transect (m)	Before	After
1	Wear Ngayaan	560	10	4
2	Wear Avni	435	4	2
3	Vatro Oih Rufan	320	5	3
4	Deban Hoar	385	11	5
5	Wear Fadir	215	17	7
6	Waka Enmeh	270	8	5
7	Warso	200	13	4
8	Kabalus	160	7	4
9	Vaut Kabanuir	150	2	1
10	Ruwain	330	330	11
11	Vaut Ruban	350	218	9
12	Yah Tuvun	340	111	10
13	Arvai	340	105	12
14	Dedlair	315	86	9
15	Vaut Afnit	285	29	8
16	Vaut Mader	220	64	6
17	Fidvu	220	52	3
18	Ngabub	244	17	8
19	Vaut Nguursoin	275	5	4
	Total		1094	115

Trochus transect performed one day after harvest showed that the number of trochus encountered at the same sites are very low. The abundance varied from 1 individual (at Vaut Kabanuir) to 12 individuals (at Arvai). Limited number of trochus encountered and the diversity of bottom composants (habitat) did not permit the etimation of trochus density after the harvest.

The impact of fishing on the natural population can be evaluated by the change in the population structure. The size class distribution of trochus before and after harvest is presented in Figure 21. The figure shows that the harvest change the median from size class 60-70 mm to size class 50-60 mm, followed by size class 40-50 mm. The displacement of median to the left

in histogramme of frequency is usual. However, the fact that most of trochus (77 %) have a basal shell diameter less than 60 mm indicates that the remove of marketable trochus occurred very efficiently.

Figure 21 : Size class distribution of Trochus niloticus before and after harvest in Watlaar in December 1996



PART III : DISCUSSION

Trochus is a gastropod mollusc living on coral reefs which plays an important role in coastal fishery sectors in a large area of the pacific (Melanesia,Micronesia and Polynesia) and in Indonesia (Maluku and et Iryan Jaya). Trochus has an aragonite shell which provides raw material to make pearly button, cosmetic articles and pieces of marquetery . Its meat is eatable. It is generally cooked, tried and in some case canned (Clarkes R.P. et Ianelli J.N., 1996). The world annual demand for trochus shell varies between 3000 et 5000 tons (Bour, 1990). Most of the raw material is sent to transformers in Japon, South Corea and to Tawain. In 1996, Indonesia is the first worldwide producer of trochus.

However, the main problem in a perpective of sustainable development is to manage the exploitation of the stocks. The classical approach is to determine and impose a size limit at a national scale but then arises the problem of the respect of the law. This problem slowly gave way to a new approach in management no longer at a national level but at a regional one based on traditional village resource management systems. *Sasi* is one those traditional resource management system which raise much interest in the scientific community and among NGO as a conservative and social equity sharing-system which maintains the cultural diversity and the biodiversity.

In a perpective of sustainable development the focus should be made both on the resources and on human beings in order to take in consideration the complexity of the interaction between both sides. Usually, studies are either conducted by natural scientists or by human scientists which only consider their own field of interest. In the case study of Watlaar, we put the emphazise on the collaboration between a marine biologist and a cultural geographer. In the present discussion, we will alternatively show human sciences and biological point of view and raise the following questions:

Is *sasi* an efficient resource management system? And what are other alternatives in Watlaar ? .

Is *sasi* a sustainable management?

A . Is *sasi* an efficient resource management system?

1 . The *sasi* for the trochus management

The comparative study of the exploitation of trochus in Watlaar and in two other neighbouring villages chosen on the criteria that one did not manage trochus with *sasi* whereas the another one had not lifted the interdiction for more than three years is certainly one of the more objective way to show the efficiency of sasi.

The first village named Banda Efaruan is located right on the north of Watlaar. Its population is originated from the island of Banda. Their language, culture and cultural beliefs strongly differ from the community of Watlaar. Although they are known to be the best fishermen in the area, they are also known not take into consideration *sasi* neither any other resource management system. People from Watlaar often say they come in conflict with this population who according to them do not respect the rules and often take resources from their territory.

The second village named Hollat is located a little south of Watlaar, on the east coast of the island part of the Maur Ohoi-Wut province. Hollat is divided in two settlements. Its population and social organisation is the same as that of Watlaar. Since 1993, the villagers did not harvest trochus due to some domestic village dispute in 1995 which started between two persons originated from both settlements, one accusing the other of collecting trochus before the opening of sasi, thus leading to violent fights between the villagers and to the burning of houses. Many people were severely injured and several died in the fight (cf. Tual Court Report/Laporan Peristiwa Perkelahiaan antara Hollat atas dan Hollat Bawah (Hollat Solair) pada tgl. 20-21 januari 1995 dan tgl. 10-11 febuary 1995). The case is still not closed and trochus remains a very sensitive issue. Sampling managed to be done after long and complicated negociations with the head of the village of Hollat since he did not guaranty the reaction of his villagers. The team beneficiated from the help of Bapak Raja and was allowed to do work only two transects.

The sampling in Watlaar was done about one week before the opening of *sasi* which occurs after an interdiction period of two years and was done again right after the three days diving in order to estimate the impact of *sasi* on the trochus stock.

Both in Banda Efaruan and in Hollat, two trochus transects were performed in similar way as in Watlaar. The length of transects in Banda Efaruan were 380 m and 420 m, while in Hollath they were 320 and 380 m. In Watlaar, the total length for 19 transects was of 4230 m.

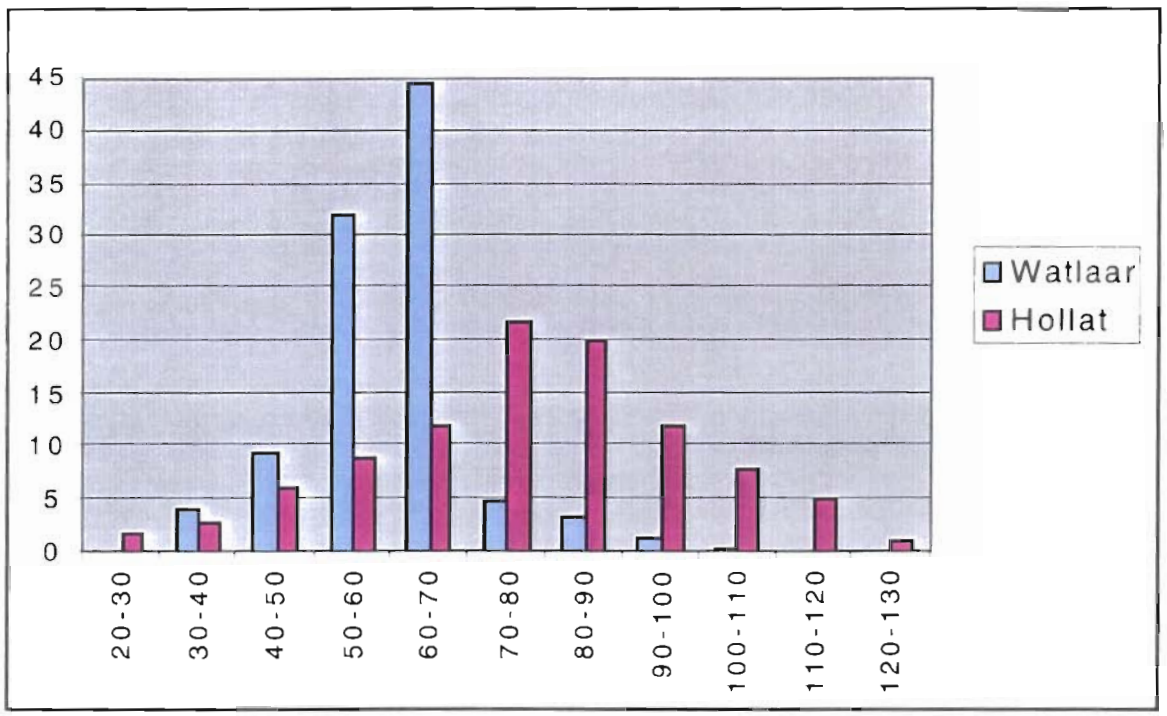
Table 25 shows that the number of trochus encoutered in Banda Efaruan is very low compared to Watlaar and Hollat where there is an interdiction of harvest for several years. Trochus capture could be considered as non-profitable activity in this village and did not interest the villagers. This is supported by the fact that the size of trochus is above marketable size. The example of Banda Efaruan shows that when there is no management system, the stock is overexploited, thus depriving villagers from an important economic source of income.

When comparing Banda Efaruan on one side and Watlaar and Hollat on the other side, we are convinced of the efficiency of baning the fishing activity during several years. The density of trochus in Watlaar and Hollat is 50 times higher than in Banda Efaruan.

When comparing Watlaar and Hollat, the difference in density is quite low (7%). The mean shell basal diameter of trochus in Watlaar is very small comparing to that from Hollath, and is under legal marketable size of 60 mm. This small mean diameter is probably due to the length of interdiction which is year shorter compared to Hollat. Size class distribution of trochus population is another way to show the impact of fishing activity in Watlaar.

Figure 22 shows that both trochus populations in Hollath and in Watlaar are normally distributed. But, the size class distribution of trochus population in Watlaar is flattened with median lies at 60-70 mm size class as in Hollath is flattened with median lies at 70-80 mm size class. Less flattened distribution in watlaar is caused by the elimination of the large size classes during the previous *sasi* opening and the fact that the length of the actual sasi, two years is too short to regenerate the complete stock.

Figure 22 : Size class distribution of Trochus niloticus population in Watlaar and Hollat



Looking at the results from Hollat, it appears then that three years of fishing interdiction would be more profitable. However, without detailed study which would show that the substrate compositions in Hollat and Watlaar is the same, it is hazardous to assume that three years interdiction period is better than two years. However, if we consider the history of *sasi* in Watlaar, we may assess the optimal harvest interval for a maximum efficiency.

Table 25 : Comparison of trochus number and size (mm) in Watlaar, Banda Efaruan and Hollath.

No	Locality	Total length of transect(m)	No. Trochus collected	Density trochus/ha	Maximum	Minimum	Mean
1.	Watlaar	4230	1094	517	107.81	30.55	59.96
2.	Banda Efaruan	800	4	10	96.60	64.00	74.33
3.	Hollath	700	195	557	120.00	25.60	86.53

Table 26 presents the successive exploitation since 1981, the quantity of trochus harvested according to the sizes, the price it was sold at and how were the profits divided. The table shows that people have harvested trochus after a period of time going from 8 to 24 months with one exception between 1985 and 1989 which cannot be explained apart from supposing that the informant forgot to mention a time of harvest between those years, that something happened in which case the information has been kept secret or that there really was not fishing during 59 months which seems unlikely looking at the quantity of trochus harvested in 1989. The figures in that case would certainly have been higher.

Table 26: Total of trochus harvested (in kg)in Watlaar since 1981

(Source: *Kepala adat* - Head of the Custom - Province Maur Ohoi-Wut, Kei Besar, Maluku Tenggara, 1997)

Opening date of *sasi*	Length of sasi	Size 6 cm and +	production growth 6cm+/year	Price	Size - than 6 cm	Price	TOTAL (roupiahs)	TOTAL (US$)	Use of profits
3-5/03/1981		5204		Rp.600/kg	-		3 122.400	4905	*sasi* gereja
2-4/12/1982	8 months	1057		Rp.600/kg	32	Rp.150/kg	639. 000	959	*sasi* umum dan *sasi* pribadi
27-29/01/1983	12 months	967	-8%	Rp.800/kg	152	Rp.200/kg	824.000	921	*sasi* umum dan *sasi* pribadi
24-26/01/1985	24 months	754	-11%	Rp.1.250/kg	115	Rp.700/kg	1.023.000	918	*sasi* pribadi
22-24/11/1989	59 months	1236	+13%	Rp.10 000/kg	115	Rp.2000/kg	12.590.000	7104	*sasi* pribadi
1-3/04/1991	16 months	831	-24%	Rp.13 000/kg	-		10.803.000	5518	*sasi* pribadi
1-2/04/1992	12 months	989	+19%	Rp. 9 000/kg	40	Rp.2 500/kg	9.001.000	4418	*sasi* umum
12-13/03/1993	12 months	902	-8%	Rp. 9 000/kg	-		8.118.000	3873	*sasi* pribadi
14-17/12/1994	20 months	1895	+53%	Rp.10 500/kg	-		19.897.000	9167	*sasi* umm
16-18/12/1996	24 months	891	-24%	Rp.13 000/kg	1048	Rp. 3 000/kg	14.727.000	6287	*sasi* umum dan *sasi* pribadi

When looking at the quantity harvested, we notice a drastical change from 1981 and the following years which seem to mark the beginning of a regular exploitation from the renewal of smaller trocus since the quantity of shell undersized is very low until 1996 which is higher than that of the quantity of commercial size. However, if we compare the catches from one opening of the *sasi* to another, we notice that the rate of growth of the stock of trochus is very badly corroleted to the length of the sasi. For example, after one year of sasi, the number of trochus collected in 1992 is 19% higher than in 1991 but between 1992 and 1993, we observe a decrease of 8%. Strangely, after two years of sasi, the harvest continues to show a decrease (less 11% between 1983 and 1985 and less 24% between 1994 and 1995 but between 1993 and 1994 the production increased of 53%).

The comparison between Hollat and Watlaar indicated that the longer the length of *sasi* is, the better the stock recovers, which seems to be logical. The results of historical trochus production since 1981 in Watlaar would almost contradict this assumption if we were sure that the information collected was reliable, which seems not be the case as show the bad correlations observed in table between the harvest interval and the rate of growth of the trochus production.

The biological study conducted in 1996 allow us to assess the effect of the fishing activity following the opening the *sasi* on the abundance of the trochus stock . In the two closer areas to the village, the 3 days harvest bring out a considerable decrease of the previous stock, respectively less 72 % and less 58 %. After such a disturbance, it is difficult for the stock to recover, as confirmed the size class distribution which is centered at 60-70 mm, while trochus may attained a maximum size of 160 mm. Apparently in 1996 after two years of interdiction of harvest, the trochus stock have not recovered completely after the previous opening of sassi in 1994 (Table 1), since the growth rate of trochus in natural habitat usually ranged between 25 – 30 mm per year (see Nash, 1993 for further information). After 1996 harvest, the median of size class distribution lies at 50 – 60 size class and the remaining stock (trochus > 35 mm) is limited (Table 27). It is predicted that the next year harvest will be less than in 1996.

Table 27 : Comparison of number of trochus and size (mm) before and after harvest according to the division of the area during harvest in Watlaar in 1996.

Sub-area	1	2	3	Overall
Estimated Potency (individuals)	10,704	20,873	6,024	37,601
Before Harvest				
Estimated biomass (individuals)	7,669	20,241	4,576	32,486
Mean shell diameter (mm)	58.94	61.54	50.78	59.96
Minimum shell diameter (mm)	30.55	35.92	35.00	30.55
Maximum shell diameter (mm)	107.81	99.19	65.50	107.81
Harvest Time				
Trochus captured (individuals)	2,836	14,588	2,643	20,067
Catch ratio (%)	37.0	72.1	57.8	61.8
After Harvest				
Predicted stock (individuals)	4,833	5,653	1,933	12,419
Mean shell diameter (mm)	49.31	52.68	57.04	53.01
Minimum shell diameter (mm)	35.90	38.60	40.20	35.90
Maximum shell diameter (mm)	67.60	73.30	93.40	93.40

As shown in the Table 27, there is a difference of actual standing stock and the potency estimations of Watlaar coastal area. The potency estimation indicate the number of trochus that can be supported by the Watlaar coastal area. Total potency is estimated at 37,601 individuals while the standing stock is estimated at 32,486. This suggest that the biomass of trochus is under the optimum carrying capacity and the standing stock may be increased.

Beside the general effect of the opening of *sasi* on the trochus stock, the other striking information of the Table 27 is the heterogenity of the catch ratio betwenn the areas 2 and 3 in one hand and the area 1 on the other hand. In this area 1, which is the remote to Watlaar village, the harvest does not reach 40 % of the stock. This result may be explained by a lower fishing effort or simply by the fact that the data is not reliable, one part of the harvest has not been declared. The geographical study shows that the second hypothesis proved to be true. Remote areas to the main centre of habitation seem to be a factor encouraging poaching. However, it seems that in all three areas, production has been underestimated even though we agree that these under estimations are higher in area 1 which most remote to the village. The

poor quality of formal data in 1996 helps explain bad correlations observed previous years (Table 26) between the length of *sasi* and the growth of trochus stock population.
In 1996, this underestimation encouraged us to reckeck the results presented in Table 27 and to estimate a higher pressure on the resource. It can be notices on Table 26 that it is the first time since 1981 that such a high quantity of undersized trochus were harvested and sold. This harvest of sexually immature trochus added to the high quantity of mature trochus collected of 6 centimeters and above foreshadows serious problems to come in the future in terms of the sustainability of sasi. *Sasi* would then have to be implemented over a longer period of time for the stock to recover and renew itself but the look on previous situations show that the opening of *sasi* does not depend on biological caracteristics but on human apraisal.

Recent studies on the reproduction cycle of trochus in Maluku showed that the first maturity of young individuals occurred at 5.5 – 6.0 cm of basal shell diameter and the main spawning season occurred from March to June (Arifin & Pradina, 1993; Pradina & Dwiono, 1994; Pradina *et al.*, 1997). The harvests in Watlaar were done at different moments of the year. In 1981 and 1993, the harvest was opened in March, while in 1991 and 1992 it was in April.

These harvest time coincided with the beginning of main spawning season of trochus. The elimination by capture of adult individuals in their spawning season will decrease the fecundity of the population and will cause the decrease of next recruitment. It is worsened when the number of adult is limited and when most of the marketable individuals have just attain their first sexual maturity. These phenomena were occurred in 1996, where most of captured individuals have a mean basal diameter between 5.0 to 6.0 cm.

The decision to open the fishing prohibition during northwestern monsoon in Watlaar is clear and comprehensible, since it provides long low tide and calm fishing season. However, it will be beneficial if the harvest is delayed for another year to permit young individuals to spawn or total allowable catch (quota system) is applied. The last system is consisted to estimate, based on the actual biomass, the maximum number of trochus that fishermen allowed to catch.

2 . Managing other marine ressources with sasi

As described previously, Watlaar marine area possess various marine resources including benthic and pelagic organisms. Among these two groups of organisms, the resource management of pelagic organism is more complex and require a larger scale of management since pelagic organisms have a larger range of movement during their life cycle. In contrast, the movement of benthic organisms are more restricted excepted during their larval stages which are usually pelagic.

Among benthic organisms inventoried during the study, several taxonomic groups were observed and evaluated. Molluscs is the most represented taxonomic group both by number of species and abundance. Gastropod mollusc is presented by 136 species, among which 17 species are edible while several others have commercial value, while most of pelecypod mollusc are edible species. At present the abundance of these species in Watlaar is very low as shown by benthic study. This low density is due to the constant high pression of fishing to the natural population.

According to the local fishermen, the Kepala Desa apply occasionally a fishing prohibition of intertidal fauna *sasi meti*. It seemed that the prohibition duration is very limited to approximately two months (this prohibition does not concern *Trochus niloticus*). This period of fishing prohibition is visibly insufficient to protect and maintain the optimum production of these marine resource. In fact, the sole purpose of this prohibition is to maintain the equal sharing of intertidal resource among the villagers. In this context, the prohibition was lifted when appropriate low tides were occuring. During these long low tides, almost all the villagers may benefit these resources. For time being, it is difficult to suggest any appropriate duration of fishing prohibition because of the diversity of the resource further studies are required.
The species diversity of other benthic organisms in Watlaar, such as echinoderms and crustaceans are very low. Among the species encountered, no species is edible nor of commercial value. Some macroalgal species found in the area possess commercial value, but it seems that their abundance is not sufficiently important to support any commercial activity. In any cases, two months of fishing interdiction is not sufficient and cannot be considered as an efficient resource management for molluscs, crustacea and fishes on the reef. If there was no overexploitation, the exploitable biomass would be much higher than it is actually. Taking into consideration the importance of these resources for households's consumption, it would be wise to improve this management so as to increase food-producing. The opening of sanctuaries such as shifting or revolving reserves would offer an interesting solution for managing the resource on the *meti*.

3 . And what are other alternatives in Watlaar for trochus management ?

In his article on the topshell, Nash (1993) has discussed the status of trochus biology, fisheries and management. On the fisheries development and management of this tropical gastropod, he has suggested several management tools including size limits, total allowable

catch (TAC), limited entry, limited fishing season, sanctuaries and stock replenishment. The following part will deal with the feasibility of those proposed management tools for Watlaar trochus management.

3.1. Size limit

This resource management option is appropriate for most of southeastern villages possessing trochus resource. In this context, the low size limit actually adopted need to be increased. It is suggested that the legal fishing size is increased from three adult fingers-wide (ca. 6.0 cm) to 7.5 or 8.0 cm to permit the new recruits to spawn, at least once, before being captured. However, this system has to be applicated carefully since the fecundity is related to the size of parents (Heslinga, 198l, Nash, 985; 1993). As an example, a 8.0 cm adult may produce 859,000 eggs, while 6.0 cm individual produce only 270.000 eggs. Usually, the fishermen refused to admit new regulation either because this will decrease thir income or simply because they are not used to this size limit. To facilitate the adoption of new size limit, a simple angled wooden stalk will help. In other hand, the new regulation has to be completed by punishment or sanction system.

3.2. Total Allowable Catch

This management tool should complement the size limit option as suggested by Nash (1993). This system will ensure and enhance the recovery of trochus population after endured an overfishing pression.

3.3. Limited entry

This type of management system is incompatible with traditional resource management (sasi) in southeastern Maluku. *Sasi* system implies that all the villagers are property of the resource, therefore the protection and the harvest of the resource have to be respected by all villagers. In this context, one can not prohibit the villagers to participate in harvest once the *sasi* is lifted.

3.4. Sanctuaries

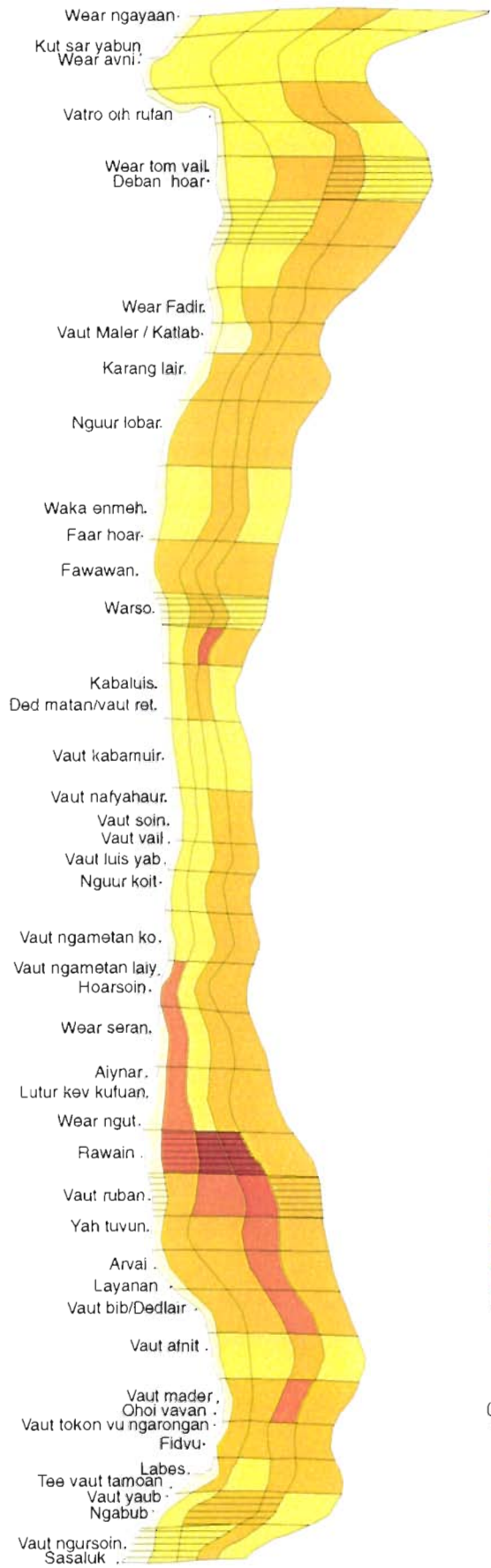
The establishment of sanctuaries or protected areas is an interesting resource management option. Meanwhile, the application of this option is usually difficult. This is true especially when the protected resource is valuable and the control enforcement is limited. This option may work in Watlaar where *sasi* system is still working and the villagers respect the traditional values (habit and regulation). In this context, several area have been recommended as sanctuary areas (Map 11). This recommendation is based on the fact that Watlaar coastal area includes a vast marine property. Since the recommened areas possess suitable habitat for trochus, it is expected that interspaced sanctuary areas recommended will accommodate sufficient population size which will furnish young trochus on the sourrounding areas.

3.5. Stock replenishment

Stock replenishment by juveniles produced in hatcheries or by adult from other areas is an interesting development option since most of Indonesian areas have endured more or less fishing pression. The hatchery or aquaculture technique for trochus juveniles production is now availabe in eastern Indonesia (Dwiono et al., 1997). Although still in semi-mass production, the technique trialed has shown promising result.

Since trochus population in Watlaar has endured a long fishing pression and the actual population showed unhealthy structure, it is suggested that stock replenishment program may be conducted to enhance its recovery.

Sanctuaries and trochus potential



LEGEND :

Potency of Trochus (No. ind. per 100 m2)

- No trochus
- < 1
- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- Sanctuary

0 250 500 750 1000

Metric Scale

Realization : Sigit A.P. DWIONO with the participation of the Maison de la Télédétection, Montpellier (France).
This map gives account of field surveys conducted from july 1996 till march 1997.

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B . IS *SASI* A SUSTAINABLE MANAGEMENT?

In former days, according to the old men, the opening of the *sasi* used to take place just after the apparition of the neiries, depending on the lunar calendar around febuary and march. Information collected on the field showing trochus exploitation since 1981 show that the opening of the *sasi* takes place from november to april. This period of time corresponds to the calm season thus allowing the diving and transportation. However, the opening does not depend on any particular traditional knowledge of the resource biological cycle but is strongly market orientated. The opening of *sasi* closely depends on the villagers' needs in terms of cash flow either to develop village facilities such as buying an electric generator, building a new church, changing the roof made from leaves with metal sheet or to meet households needs.
The respect of the size appears to be dictated by the price of the commercial size trochus and not by concern of short term profits.

The indication of the price in Table 26: Total of trochus harvested (in kg)in Watlaar since 1981119 clearly shows the difference between commercial size shells which are equivalent to 6 centimeters and above and the undersize shells which price corresponds to about one quarter of the high price. People usually refer to to three type of profit-sharing. *Sasi* umum which means that the profits will to the village and spent for the good of the community in which case people will dive for the village. *Sasi* gereja means that the profits will go towards the church. Finally, *sasi* pribadi which means that the profits will be divided between the people.

Nowdays, much too many constraints weigh heavy and weaken the system. On the one hand, economic stakes and small islands development and on the other hand an adat or custom autority which is contested by the people no matter their social category in a sense that traditional societies formely inter-related within a closed system and therefore favorable to many changes.
Development inevitably brings modernity in villages of the Kei islands and increase villagers needs (school, health, transport, ect...). As mentionned in the first part of the report, economic activities on the island are limited. Agriculture and fishing remain at a self-subsistence economy level and conditionned by insularity and geographic conditions. Coprah represents a regular but low economic income and profits really depend on household work imput and usually serve to pay the children education fees and to purchase necessary goods. Trochus represent another source of income for the villagers, although puntual since the exploitation only takes place once a year or every couple of years but profits are very high : a household may earn between US$50 to 80 in a year. There is not much labour involved compared to working coprah since no processing is required. In areas where incomes derive directly and only from natural

resources, it is understandable that some people be tempted not to respect customary laws and *sasi* or try to find a way to make most profit out of it.

Sasi presumes a strong autority and custom. *Sasi* plays a kind of police role between villages and within a village. Some villages with people from a cultural background such as Banda Efaruan do not know sasi. We cannot really assert that they poach in Watlaar waters but there are some strong indications that suggest it might be the case. While on the field, one person originated from that village was caught taking shell along the coast belonging to Watlaar. That person had to appear in a customary court audience after having been beaten up by the villagers. The adat court then dicided that all his belongings and his canoe were to be kept until the man came back to pay a certain amount of money, some gold and a gong. Moreover, he was not allowed to go back to his own village by the sea but had to walk through the forest.

This example shows how important the notion of territory is to a village and by extention how the resources that are found on that territory belong to all the villagers. This where other constraints arise because of the buying and the selling of trochus and the notion of sharing-system. *Sasi* embodies everything at once, managing stocks of trochus, introducing security between villages and ensuring that each village can exploit its resources. Furthermore, since the resource belongs to all the community it gives way to community sharing-system.
Authority and custom are important to manage the stocks but they must be honest and solid when it comes to sharing profits. Yet, observations on the field revealed that there are many problems at several levels.
We shall discuss in order three aspects, sharing system, trochus trading and sustainability of the trochus fishery.

In many other neighbouring villages, sharing-system still keep to the old system that is there is two kind of sasi, *sasi* umum and gereja and *sasi* pribadi. In the first case, several divers collected the shells and brought them to the head of the village. The profits would then go towards the village and divers would get a little wage. In the second case, every married man had the right to go and dive. Women were not allowed. If a man was too old or sick, he would then ask a diver from another village to dive for him and in that case, he would then share the profits with him. After the two or three days diving, and once the head of the village and the Deliberation Council members had chosen who would be the trader or traders, each man would then sell his catches directly to the trader(s). His profits would be equivalent to the how many trochus he collected. Watlaar also applied these rules since 1996 but then decided to change the system using the argument that it was better to allow everyone to dive, both men and women and then to share the money between *rahanyam* rather then replacing old and sick persons by neighbouring divers, thus giving away part of the profit. Since the resource belonged to the village, it seemed only natural to divide it among the villagers originated from that village.

By doing so, people did not get as much as they would have had usually and the best divers ended up earning less that they would have had if they had sold their catches alone. So what happened? There is no way people would have contested openly this new sharing-system since we know the social organisation and the sense of belonging to one social category and to a particular Rahanyam. People simply only brought back part of their catch, selling most of the big size trochus to the black market since they are the most expensive and instead bringing undersize trochus to their *rahanyam* to make up for it. The black market was traders from Watlaar who had offered to buy the trochus but who finally ended up not buying since the head of the village bought it all. Informations both from the traders and from the villagers show that about one ton of trochus of 6 centimeters and above were sold that way. Moreover, we must say that trochus is used as money between villagers and traders a couple of months before the actual opening of the sasi. People who need cash or food for example will borrow from the traders living in the village and promise in exchange to either pay them back with trochus. For the trader, this solution is very profitable because he will buy the trochus a little cheaper, thus making more profits from it. Villagers will find it difficult to bargain since they are not supposed to be selling trochus on their own. According to informations, it seems that this has been going on for a while, especially when the profits are meant to the go to the village and not the people individually. Villagers say that they do not trust their superiors with money transactions and that there is no transparency. In 1996, the changes brought about anger since the sharing-system was not fair according to the majority of the population who suspected the head of the *rahanyams* to take their share on the way.

Trochus trading has been going on for a long time now and revolves around a circuit of commercialisation in the hand of the chinese community based either in Elat or in Tual (Figure 20 : Trochus marketing network106). Traders buys from the village and therefore all transaction much go through the head of the village and the members of the Deliberation Council. These people, in the case of Watlaar as in most other villages belong to the social category *mel.* As we explained in the second part of the report, traders who intend to buy the trochus must do the customary *siri pinang* that is offer some money in cash and some tabacco to the head of the village. This only gives them the right to participate to the trading but does not guaranty them that they will get the buy. In some case, there happened to be two or thrre buyers in which case the most offering will get the buy or if all of them offer the same price, they will be allowed to buy together. This sometimes leads to conflits between traders who would prefer to be alone to buy so as to get more profits. There are all sorts of negociations under table or settling of scores before and after. But once the head of the village has decided on who will buy, villagers must officially sell to them. In 1996, the head of the village bought the trochus himself with the help of one of the traders who accepted to bring some capital. This particular transaction set the fire among the buyers who could not do anything since they could not rise their price because if they did so they would not have made profits considering the price they

would have to sell it again in Elat. But those buyers were tied to the buyers in Elat to whom they had promised to sell trochus if they could borrow money. Buyers were entangled between themselves just as villagers were entangles with the traders. The black market was a way out and a solution both for the buyers and the villagers to make money. Now, the head of the village himself got in trouble with the buyers in Elat since he sold his production directly to Tual thus making more profits. He could do so since he owns a little motor boat. The trader in Tual offered to buy the big size trochus at Rp. 14 000 a kilo (equivalent to US$ 6,30) but the head of the village decided to sell it to an unofficial market who was offering Rp. 15 000 a kilo regardless of the size of the trochus which means that the profits to be made were huge considering that the head of the village had bought 891 kilos of trochus measuring 6 centimetres and above at Rp. 13 000 a kilo and over one ton of undersize trochus at Rp. 3000 a kilo. This transaction remained secret in the village.

The question is what are the repercussions on the sustainability of the resource and in the village?

The action of the head of the village was a way to break away from the commercial circuit which obliged the villages to sell trochus at a much too lower price considering the price of trochus normally and making money on villages. It is difficult to know how he planned this action and whether he knew from the beginning that he could sell trochus at high price regardless of its size since transactions took place after the diving but observations on the fields showed that there was not too much control over the size of the trochus when they were brought back to the *rahanyam* by the villagers. When asked, heads of *rahanyam* answered that this species of trochus did not grow bigger anyway. Previous years, very little undersized trochus were collected since their price was rather low (Table 26: Total of trochus harvested (in kg)in Watlaar since 1981119) but as we mentioned earlier it can also be explained by the fact that villagers rather brought back undersized trochus so as not to arise suspicion and sell the bigger ones to the black market. Our reaction is to say then, why did not the head of the village divide the money after having sold it to a better price if his intentions were true? This remains quite and so far noone in the village apart those involved in the transactions is aware of the story. Other villages have fought over problems directly linked to trochus. Secondly the fact of having sold such a big quantity of undersized trochus in 1996 does not guaranty the good health of the stock.

When looking at biological results of estimation of abundance from the transects done after the opening of *sasi* compared to the official data of the quantity of trochus harvested by the villagers, there seems to be sign that only part of the stock were harvested thus ensuring a sustainable development. Yet, informal data showing the quantity of trochus sold to the black market equivalent to the estimation of the remaining stock prove that all the trochus of marketable size were harvested and that informal source of information must be taken into

consideration before asserting that from a biological point of view the trochus fishery is viable thanks to sasi.

Developing a village such as Watlaar with concern of viable development inevitably goes back to the notion of power, authority and custom.
So far, authority lies in the hand of the social category considered to be the upper class by which everything goes through, government, non-governmental, scientists since the upper class has the right of speech. Dr Laksono already write much about the question explaining that such sharp social categories did not exist at the beginning of the meeting of natives and immigrants since everyone worked together. There were differenciation in the roles of people within the community which were seen as an authority by foreigners, namely the Dutch who always looked for chiefs to deal with (Laksono, 1990). Later, the independance of Indonesia and the implementation of local governmental structure continued to reinforce the upper class authority in the village. The social organization slowly evolved and strenghened its notion of *rahanyam* by which people felt they belonged to a group and gave a sense to their lives. In the old days, people lived in a closed system based on exchanging things. The problem today is that everything is still kept at the level of the *rahanyam* by the people in power as a mean of controling the situation and exploiting that system since lower classes people have become so entangled and dependent of upper classes to live up to the custom with very speculative ideas for immediat profit and not in a concern of development of all the community.
Two examples illustrate this idea. The first one is how IDT programme has been conducted in the village and the reasons why it does not succeed and the second one retraces the initiative to introduce a purse seine fishing net in order to study the reaction of the villagers and perhaps develop the fishery since Tual is about to become the eastern door for maine product exportation.

IDT or Intruksi Desa Tertinggal is a governemental programme destined to develop economic activities in eastern indonesian villages. This programme takes place over three years by which groups of people (kelompok) must work together in one field. It may be in agriculture, fishing, cattle, furniture. The important is that a group be specialized in one activity. Over the three years, each group will receive a certain amount of money to be able to invest in equipment and start their activities. Since there are nearly one hundred households in Watlaar, three groups were created, one specializing in making furniture, the second in agriculture and the third one after failing in doing breeding, decided to open a small shop. After two years, there seems to be no results what so ever of some type of production from which people might start to receive an income. Half of the money received for 1997 was placed in a bank account so as to share the interests at the end of the year and divide them between the members of the group. A deeper study would be useful to explain in depth the reasons of this. Field observations and interviews can only bring out general conclusions. First of all, men are caught for the time being with

working their garden, the sagou and catching fish to feed their family. Since it is difficult to make a living from the proposed IDT activity, they rather do other work to have an income. Moreover, it is difficult to start anything since IDT activities are organized only one day a week, on tuesday. Finally, when we look at the members of the three groups, we quickly realize that they are organized after the *rahanyam* which implies that groups are not formed at the beginning by people with the same center of interests but once again by the upper class who manage everything. By organizing everything in *rahanyam*, it allows all the *mel* to have some power and a hold over opportunities and people from the lower classes. This seems to be the main problem since lower people are continuously entangled in their social category and cannot decide by themselves or chose by themselves. If a group was made of people who had a project in commun, the chance for success for be higher since they would be motivated. But the way it is happening now only shows the weariness of local classes people in front of the ruling class.

The second example relates a private initiative. An australian fisherman offered to give a purse seine net mesuring 200 by 40 meters to the village of Watlaar and to come for a couple of weeks in order to train local fishermen to use this new technic. Automatically, the idea was talked over with Bapak Raja and with his son the head of the village since they were the one in power and their authorization was needed to bring the net in the village. We explained to the head of the village that we would need to borrow his boat and make a team of fishermen to whom we would show the technic. We talked over this project with Bapak Raja for a long time explaining the possibility to develop fishing activities involving both men and women if that experience was successful but careful informed him and his son that the experience would require time and patience since this activity was very new.

After having prepared the boat, we taught fishermen how to trace the fishes with a motor boat so as to teach them to anticipate the way to catch fishes schools with a big net. Taking into consideration the sea environment, we quickly decided that the use of fish agregating device would be most appropriate for catching fish with that particular net. Day after day, we tried to set the net so as to teach fishermen all the different operations to be done on board, how to throw the net, how to close the purse line, how to bring back the net. The most difficult thing for us was to train a particular person with a particular task since the number of persons on board was never the same and that only three persons seemed to be on board at all time. And this for different reasons. Some persons were curious but when they saw that there was no fish, they quickly stopped and although we explained that it took time to catch them, people were either not interested or were too busy triyng to find food for their family. Moreover, we had no budget to pay people during the training and this alone dissuaded them to get involved much longer. The three persons who stayed with us from the beginning had sometimes problems coming along since their superior in hierarchy to whom they « belonged » often asked them to do things for them, repair something and so on. They also had a hard time from people in the village since they showed an interest in this new type of fishing although there

was no money to be made. Finally, the head of the village quickly lost interest in the project since we did not manage to catch lots of fish over the two weeks. We tried to explain that there was fish but that fishermen needed some time to acquire the technic both to steer the boat and set the net. But we did not manage to convince him and as soon as the australian fisherman left, the net was taken off the boat and kept in the back of his house and the boat was used to go back and forth to Tual and later to transport trochus. This example emphasizes several points which explain why this initiative did not work.

- The first one is perhaps the fact that we did not have a budget to finance this operation and pay people while they are training but when comparing the reaction of the people from Watlaar with other community, it is difficult to believe that is may be true since in some other villages people would have tried and tried until they managed to do something with it while the other members of the family would have worked to feed everyone. But, it may be cultural.

- Another idea would tend to say that the reaction of the head of the village probably played an important role, himself being caught in looking for money for himself and therefore being less attentive to others.

- Finally, we cannot help thinking how would this initiative work out if we had negociated with somebody else in the village. At the time, it seemed impossible since everything goes through the house of Bapak Raja, since people are so very much entangled to their social status and tasks. It seemed looking at the three fishermen originated from the village that stayed with us almost all the way, they had enjoyed learning a new technic and that they realized that they had to go through training to master it but in order to do so they had be free of community work (village work on monday and IDT on tuesday), they had to to be free of their social status in the eyes of their family who had to do all the work and in front of their superior to whom they constantly felt obliged.

CONCLUSION

In the past, on the island of Kei Besar, *sasi* called in local language «hawear » which is an sign caracterized by a palm leaf tied marking an interdiction and a property. It was used to prevent people from appropiating things that did not belong to them. For example, putting a *hawear* in front of a mango tree will let people know that the owner did not allow anyone to take fruit from the tree. The shape of the sign told about punishments which would happen to anyone trespassing the interdiction. *Sasi* has been created first by colonial and contemporary governmental elites as a secular, social-organizational armature facilitating commerce between traders from distant Asian and European lands, local rulers and small Moluccan communities(Zerner, 1993). Later, government and non-governmental organizations, scientists saw in *sasi* an armature for sustainable development and community equity. Until today, biologists, scientists, government and non-government organisations all tend to say that *sasi* is good simply because it comes from a long way back, because it is traditional, because of its history. There are many other biased reasons too why everyone should promote sasi. The question is how can a resource be viable if social conflict arise because of a resource? According to Zerner *sasi* is not something which is a long-lasting tradition but a construction and as everything in movement it is vulnerable (Zerner, 1993). The study of the village of Watlaar shows that because of social problems, *sasi* is no longer a sustainable development measure.

The village of Watlaar is in a difficult situation because the persons who show their authority in order to manage resources are also the ones who organize the selling and the profits sharing. It is difficult to conceive sustainable development within management system but in another hand if the core of the management system is not fair, it will directly have negative effects on the resources. And just like colonials did in the olden days using *sasi* to facilitate trading, the local elite is consolidating *sasi* in the eyes of those creating it to use it to speculative ends. So far, all the talks have contributed to make some kind of myth in which traditional leaders have played their parts, thus slowly coming out of the shadow and ensuring some kind of continuity in a world no longer the same and subject to fast moving development. A long field period allows enough time to be objective and to describe some aspects of the everyday reality of *sasi* behind the myth. Yet, how to come out of such a situation?

If the present situation continues this way, trochus stocks will rapidly be damaged and villagers will be deprived of not only their highly commercial resources but also from a privileged statute in face of government, non-governmental organizations and traders. This privilaged statute has been given by the successful application of sasi. If *sasi* fails in its force to prevent the stocks

and a social equity community sharing-system, in addition of loss of earnings, local people will lose their prestige and the power acquired directly from that prestige. In the political and economical indonesian scene, *sasi* and trochus fishing is a very valuble card to play.

In the context of insularity in Watlaar, there are little alternatives to trochus fishing as a source of exterior earnings offering such low investment cost. It is therefore important to maintain the trochus fishery and *sasi* is the best management tool for that if it is well applied. In which case, it is well applied, it can be used within a perspective of long term exploitation (sustainable development) rather than a « quick and easy money » perpective. People are not even aware of themselves since there are always been trochus in the sea. People cannot perceive that there can be an end to it. The role of the Kepala Adat and Kepala Desa is crucial for the sustainability of the *sasi* system. In return, *sasi* which provide earnings, prestige and identity for its population will secure and enhance the Kepala Adat and Kepala desa's prestige both in the eyes of their people and to the outside. This analysis leads to some recommendations.

RECOMMENDATIONS

1) It would be important to inform villagers about :

- the biology of marine resources, especially trochus;
- the relationships between their fishing efforts and the status of the stocks and the earnings they can obtain from the resource.

2) We recommend to begin this type of information through the children at school who will in turn inform their parents. Such an education is probably the basis for a sustainable development.

3) In order to improve the management of trochus we recommend to create trochus sanctuaries where fishing activities would be banned during several years in order to protect and increase the number of old trochus as the number of eggs per shellfish increases with the age.

4) Regarding developing recommendations, an outline planning scheme to promote specialization of activies between villages so as to favour balanced economic relations between villages seems to be most appropriated.

5) In order to strenghten this planning outline, we recommend the use of commercial label which would provide a mark of distinction and an identity to Maur Ohoi-Wut goods.

6) Since they are a major source of conflict within the province and in Kei Besar, sea and land ownerships are a key issue for the sustainable development, so we highly recommend to continue researching on theses aspects. Especially in a perpective of an outline planning development project. GIS technics offer very powerful communication tools which could certainly be used to describe ownership system and prevent this way future new conflicts.

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APPENDIX

Appendix 1: List of coral in Watlaar, Kei island, Southeast Maluku.

No.	Family	Species
1	Pocilloporidae	*Pocillopora damicornis*
2	Pocilloporidae	*P. verrucosa*
3	Pocilloporidae	*P. eydouxi*
4	Pocilloporidae	*Seriatopora hystrix*
5	Pocilloporidae	*S. pistillata*
6	Pocilloporidae	*S. mordax*
7	Acroporidae	*Montipora danai*
8	Acroporidae	*M. aequiturbeculata*
9	Acroporidae	*M. efflorescence*
10	Acroporidae	*M. digitata*
11	Acroporidae	*M. hispida*
12	Acroporidae	*M. hofmeisteri*
13	Acroporidae	*M. monasteriata*
14	Acroporidae	*M. spumosa*
15	Acroporidae	*M. tuberculosa*
16	Acroporidae	*M. undata*
17	Acroporidae	*M. verrucosa*
18	Acroporidae	*M. foliosa*
19	Acroporidae	*Anacropora forbesi*
20	Acroporidae	*A. aspera*
21	Acroporidae	*A. pourtogalerae*
22	Acroporidae	*A. acuminata*
23	Acroporidae	*A. austera*
24	Acroporidae	*A. clathrata*
25	Acroporidae	*A. cytherea*
26	Acroporidae	*A. horrida*
27	Acroporidae	*A. florida*
28	Acroporidae	*A. nasuta*
29	Acroporidae	*A. formosa*
30	Acroporidae	*A. gemmifera*
31	Acroporidae	*A. granulosa*
32	Acroporidae	*A. humilis*
33	Acroporidae	*A. monticulosa*
34	Acroporidae	*A. paniculata*
35	Acroporidae	*A. hyancinthus*
36	Acroporidae	*A. anthocercis*
37	Acroporidae	*A. microphthalma*
38	Acroporidae	*A. nobilis*
39	Acroporidae	*A. palifera*
40	Acroporidae	*A. tenuis*
41	Acroporidae	*A. valenciennesi*
42	Acroporidae	*A. yongei*
43	Acroporidae	*A. robusta*
44	Acroporidae	*A. millepora*
45	Acroporidae	*A. secale*
46	Acroporidae	*A. lutkeni*
47	Acroporidae	*A. loripes*
48	Acroporidae	*A. solitaryensis*
49	Acroporidae	*Acropora* sp.
50	Acroporidae	*Austreopora gracilis*
51	Acroporidae	*A. myryopthalma*
52	Siderastreidae	*Psamocora digitata*
53	Siderastreidae	*P. contigua*
54	Poritidae	*Porites australiensis*
55	Poritidae	*P. cylindrica*
56	Poritidae	*P. lutea*
57	Poritidae	*P. nigrecens*
58	Poritidae	*P. lobata*
59	Poritidae	*P. rus*
60	Poritidae	*Geniopora lobata*
61	Poritidae	*G. djiboutiensis*
62	Poritidae	*Alveopora spongoides*
63	Agariciidae	*Gardineroseris planulata*
64	Agariciidae	*Pavona clavus*
65	Agariciidae	*P. varians*
66	Agariciidae	*Pavona* sp.
67	Agariciidae	*Coeloseris mayeri*
68	Agariciidae	*Pachyseris rugosa*
69	Agariciidae	*P. speciosa*
70	Agariciidae	*Leptoseris explanata*
71	Agariciidae	*L. scabra*
72	Agariciidae	*Leptoseris* sp.
73	Fungiidae	*Fungia concinna*
74	Fungiidae	*F. danai*
75	Fungiidae	*F. echinata*
76	Fungiidae	*F. fungites*
77	Fungiidae	*F. repanda*
78	Fungiidae	*F. scutaria*
79	Fungiidae	*Fungia* sp.
80	Fungiidae	*Heliofungia actinoformis*

No.	Family	Species
81	Fungiidae	*Herpolitha limax*
82	Fungiidae	*Polyphillia robusta*
83	Fungiidae	*Sandalolitha robusta*
84	Fungiidae	*Halomitra pileus*
85	Oculinidae	*Galaxea fascicularis*
86	Oculunidae	*G. astreata*
87	Pecteniidae	*Echinophyllia aspera*
88	Pecteniidae	*Oxypora lacera*
89	Pecteniidae	*Mycedium elephantotus*
90	Pecteniidae	*Pectinia lactuca*
91	Mussidae	*Acanthastrea hillae*
92	Mussidae	*Lobophyllia hemprichii*
93	Mussidae	*L. corimbosa*
94	Mussidae	*Symphillia agaricia*
95	Mussidae	*S. recta*
96	Mussidae	*S. radians*
97	Merulinidae	*Hydnophora exesa*
98	Merulinidae	*H. micronos*
99	Merulinidae	*H. rigida*
100	Merulinidae	*Merulina ampliata*
101	Merulinidae	*M. scabricula*
102	Faviidae	*Favia favus*
103	Faviidae	*F. mathaii*
104	Faviidae	*F. maxima*
105	Faviidae	*F. pallida*
106	Faviidae	*F. speciosa*
107	Faviidae	*F. stelligera*
108	Faviidae	*Favites abdita*
109	Faviidae	*F. pentagona*
110	Faviidae	*F. complanata*
111	Faviidae	*F. flexuosa*
112	Faviidae	*F. russeli*
113	Faviidae	*Goniastrea australensis*
114	Faviidae	*G. pectinata*
115	Faviidae	*G. retiformis*
116	Faviidae	*G. aspera*
117	Faviidae	*Platygyra daedalea*
118	Faviidae	*P. lamellina*
119	Faviidae	*P. pinni*
120	Faviidae	*P. sinensis*

No.	Family	Species
121	Faviidae	*Leptoria phyrgia*
122	Faviidae	*Oulophyllia bennetae*
123	Faviidae	*O. crispa*
124	Faviidae	*Montastrea curta*
125	Faviidae	*M. valenciennesi*
126	Faviidae	*Diploastrea heliopora*
127	Faviidae	*Lapastrea transversa*
128	Faviidae	*L. purpurea*
129	Faviidae	*Cyphastrea chalcidicum*
130	Faviidae	*C. microphthalma*
131	Faviidae	*Echinpora lamellosa*
132	Caryophillidae	*Euphyllia ancora*
133	Caryophillidae	*E. glabrescens*
134	Caryophillidae	*Physogyra lichtensteini*
135	Caryophillidae	*Turbinaria frodens*
136	Caryophillidae	*T. mesenterina*
137	Caryophillidae	*Turbinaria* sp.
138	Tubiorida	*Tubipora musica*
139	Helioporidae	*Heliopora coerulea*
140	Milleporidae	*Millepora dichotoma*
141	Milleporidae	*M. plathyphilla*

No. Family	16
No. Genus	49
No. Species	141

Appendix 2 : List of fishes in Watlaar, Kei island, southeast Maluku.

List of fishes found in Watlar. Cat = category (F=food; O=Ornamental)

No	Scientific Name	Local common name	Local name	Cat.
1	*Abudefduf bengalensis*		Syaan taongarun	O
2	*Abudefduf* spp.	Betok laut	Syaan	O
3	*Acanthurus lineatus*	Butana	Ahaesus	F
4	*A. triostegus*	Butana	Anwat	F
5	*Acanthurus* sp.	Butana	Ngasian	F
6	*Aluthera* sp.	Ikan Bodo	Manaa	O
7	*Amblygobius* sp.	Lapik	Bet-bet	O
8	*Anguilla renhardti*	Morea	Uh	F
9	*Apogon aureus*	Geteh-geteh	Kamon ten	O
10	*Apogon cyanosoma*	Geteh-geteh	Bong	O
11	*A. novemfasciatus*	Geteh-geteh	Bong	O
12	*Apogon* sp.	Geteh-geteh	Bong	O
13	*Arothron* sp.	Ikan durian / bibi	Ab	O
14	*Auxis thazard*	komu	Robuan	F
15	*Balistapus undulatus*	Tatu	Hong	F
16	*Brotula* sp.	Sembilan tak berbisa	Anahau	O
17	*Caesio cuning*	Lalosi ekor kuning	Waler rot duan	F
18	*Caranx sp.*	Bubara	Karit	F
19	*Carcharhinus* sp.	Kaluyu	Yeo	F
20	*Cephalopolis miniata*	Kerapu	Vwaar	F
21	*C. argos*	Kerapu	Kakarin	F
22	*Chaetodon* spp	Daun-daun	Yabzao	O
23	*Cheilinos undulatus*	Maming	Mamen	F
24	*C. trilobatus*	Maming	Sasatil	F
25	*Chilio inermis*	Lamboso	Kadangan	O
26	*Chromis scotochilopterus*	Betok	Si roa	O
27	*Chromis* sp.	Betok	Siter	O
28	*Chrysiptera glauca*	Betok	Siter	O
29	*Chrysiptera leucopoma*	Betok	Siter	O
30	*Chrysiptera unimaculata*	Betok	Siter	O
31	*Chrysiptera* sp.	Betok	Siter	O
32	*Ctenochaetus binotatus*	Butana hitam	Kasadaran ngametan	F
33	*Ctenochaetus striatus*	Butana hitam	Kasadaran ngametan	F
34	*Dascyllus reticulatus*	Zebra	Mar	O
35	*Dendrochirus* sp.	Noul	Lain	O
36	*Ephinephelus merra*	Garopa	Ker-ker bongar	F
37	*Epinephelus tukula*	Garopa	Kakarin	F
38	*Gerres* sp.	Kapas kapas	Koan	F
39	*Halichoeres miniatus*	Koja / Kindeli	Lamur	O
40	*Halichoeres purpurescens*	Koja / Kindeli	Lakor	O
41	*Halichoeres scapularis*	Koja / Kindeli	Lakor	O
42	*Halichoeres strigiventer*	Koja / Kindeli	Lakor	O
43	*Halichoeres* sp.	Pilo / Kindeli	Lakor	O
44	*Heniochus* sp.	Bendera	Safanuar	O
45	*Istigobius* sp.	Lapik	Bet-bet	O

No	Scientific Name	Local common name	Local name	Cat.
46	*Katsuwonus pelamis*	Cakalang	Rabuan	F
47	*Kyphosus vaigiensis*	Ile	Kakuat	O
48	*K. cinerascens*	Ile	Uvau	O
49	*Labroides* sp.	Dokter	Lamur	O
50	*Lethrinus harak*	Sikuda	Voo	F
51	*L. oratus*	Sikuda	Voo kub	F
52	*L. olivaccus*	Sikuda	Voo nuaryoik	F
53	*L. nebulosus*	Sikuda	Volafa	F
54	*Lutjanus bohar*	Gorara	Sewaing	F
55	*L. gibbus*	Gorara	Ngara	F
56	*L. kasmira*	Gorara	Yadar	F
57	*L. erenberghi*	Gorara	Mar dee	F
58	*L. johnii*	Gorara	Mar taur	F
59	*L. russelli*	Gorara	Mar taur	F
60	*L. monostigma*	Gorara	Mar taur	F
61	*L. fulvilamma*	Gorara	Mar dee	F
62	*Mulloides vanicolensis*	Salmaneti	Ngingik divuan	F
63	*Myrispristis* spp.	Gora	Kabuil	F
64	*Myrispristis adusta*	Gora	Kabuil matlai	O
65	*Naso* sp.	Kulit Pasir	Manaa	F
66	*Parupeneus bifasciatus*	Salmaneti	Kamelyanan	F
67	*P. multifasciatus*	Salmaneti	Kadari	F
68	*Parapercis* sp.	Ikan Pasir	Bakek	O
69	*P. barberinos*	Salmaneti	Srean	F
70	*Pempheris vanicolensis*	Pisau-pisau	Um	O
71	*Peterocaesio* spp.	Lalosi	Rot duan	F
72	*Plectropomus* spp.	Garopa	Toi	O
73	*Plectorhynchus* spp.	Raja bau	Ahvar	O
74	*Plectorhincus* spp.	Raja bau	Vou	O
75	*Plesiops* sp.	Jenggot	Kabakar	O
76	*Plotosus anguilaris*	Sembilang	Nadang	O
77	*Pomacentrus* sp1.	Betok	Siten	O
78	*Pomacentrus* sp 2.	Betok	Siten	O
79	*Priacanthus* spp.	Mata bulan	Mamalom	O
80	*Pseudobalistes flavimarginatus*	Tatu/triger	Han	O
81	*Pseudorhombus arsius*	Sebelah	Duad ankadi	F
82	*Rhinecanthus aculeatus*	Tatu/triger	Hong	O
83	*Rhinecanthus verrucosus*	Tatu/triger	Hong	F
84	*Salarias fasciatus*	Glodok	Bet bet	O
85	*Sardinella* sp.	Tembang / Make	Ngeru	F
86	*Sargocentron caudimaculatum*	Gora	Kabuil heat	F
87	*S. spiniferum*	Gora	Kabuil heat	F
88	*Sargocentron* sp.	Gora	Kabuil sasor	F
89	*Saurida gracilis*	Kepala busuk	Aroek yahauw	O
90	*Scarus atropectoralis*	Kakatua	Maluan Yaher	F

No	Scientific Name	Local common name	Local name	Cat.
91	*S. forsteni*	Loli-loli	Maluan kamaniat	F
92	*Scarus* spp.	Kakatua	Maluan	F
93	*Scorpaenodes* sp.	Kerapu setan	Nev	O
94	*Scorpaenopsis diabolus*	Kerapu setan	Nif	O
95	*Siganus spinus*	Beronang	Kadari	F
96	*Siganus* sp.	Beronang	Kadari	F
97	*Sphyraena ganie*	Welem	Sumlain	F
98	*Stelophorus* sp.	Puri	Fu	F
99	*Thalassoma janseni*	Pisang-pisang	Lakor tarut	F
100	*Thalassoma* spp.	Lakur/ Pisang-pisang	Lakor	F
101	*Tylosaurus crocodilus*	Sirui / Saku	Seru	F
102	*Valenciennea immaculata*	Bungking	Bet langvav	O
103	*Valenciannea sp.*	Bungking	Bet wadan	O
104	*Vincentia* sp.	Kalkiwur	Kamoan	O

Appendix 3 : List of gastropod molluscs in Watlaar, Kei island, Southeast Maluku.

No.	Family	Species
1	Ampullariidae	*Pila* sp.
2	Architectonicidae	*Architectonica sp.*
3	Architectonicidae	*Heliacus variegatus*
4	Angariidae	*Angarius delphinus*
5	Buccinidae	*Engina alveolata*
6	Buccinidae	*Engina zonalis*
7	Buccinidae	*Engina* sp.
8	Buccinidae	*Phos* sp.
9	Buccinidae	*Pisania truncata*
10	Bullidae	*Atys cylindricus*
11	Bullidae	*Bulla* sp.
12	Cassidae	*Cassis cornuta*
13	Cerithidae	*Cerithium nodulosum*
14	Cerithidae	*Cerithium* sp.
15	Cerithidae	*Clypeomorus* sp.
16	Cerithidae	*C. batillariaeformis*
17	Cerithidae	*Pseudovertagus aluco*
18	Cerithidae	*Rhinoclavis sinensis*
19	Columbellidae	*Mitrella* sp.
20	Columbellidae	*Pyrene testudinaria*
21	Conidae	*Conus arenatus*
22	Conidae	*C. coronatus*
23	Conidae	*C. ebraeus*
24	Conidae	*C. musicus*
25	Conidae	*C. mustelinus*
26	Conidae	*Conus sponsalis*
27	Conidae	*Conus vitulinus*
28	Conidae	*Conus* sp1.
29	Conidae	*Conus* sp2.
30	Conidae	*Conus* sp3.
31	Costellaridae	*Vexillum rugosum*
32	Costellaridae	*Vexillum plicarum*
33	Costellaridae	*Vexillum* sp.
34	Cymatiidae	*Charonia tritons*
35	Cymatiidae	*Gyrenium gyrinum*
36	Cypraeidae	*Cypraea annulus*

No.	Family	Species
37	Cypraeidae	*Cypraea moneta*
38	Cypraeidae	*Cypraea tigris*
39	Cypraeidae	*Cypraea* sp.
40	Fasciolariidae	*Latirus* sp.
41	Fissurellidae	*Diodora* sp.
42	Haliotidae	*Haliotis asinina*
43	Haliotidae	*H. varia*
44	Littorinidae	*Littorina* sp1.
45	Littorinidae	*Littorina* sp2.
46	Littorinidae	*Littorina* sp3.
47	Marginellidae	*Marginella* sp.
48	Melampidae	*Elobium* sp.
49	Melampidae	*Melampus flavus*
50	Melampidae	*Melampus* sp.
51	Melampidae	*Melanella major*
52	Melampidae	*Pythia* sp.
53	Mitridae	*Imbricata punctata*
54	Mitridae	*Mitra cucumerina*
55	Mitridae	*Mitra* sp.
56	Mitridae	*Pterygia scabricula*
57	Mitridae	*Scabricola casta*
58	Muricidae	*Drupa ricinus*
59	Muricidae	*Drupa* sp.
60	Muricidae	*Maculotriton serriale*
61	Muricidae	*Morula margariticola*
62	Muricidae	*Morula* sp.
63	Muricidae	*Muricodrupa fenestrata*
64	Muricidae	*Thais aculeata*
65	Nassariidae	*Nassarius albescens*
66	Nassariidae	*N. distorsus*
67	Nassariidae	*N. globosus*
68	Nassariidae	*N. horridus*
69	Nassariidae	*N. reeveanus*
70	Nassariidae	*N. sufflatus*
71	Nassariidae	*N. undulata*
72	Nassariidae	*Nassarius* sp1.

No.	Family	Species
73	Nassariidae	*Nassarius* sp2.
74	Naticidae	*Nassarius* sp3.
75	Naticidae	*Natica undulata*
76	Naticidae	*Natica* sp.
77	Naticidae	*Polinices flemingianus*
78	Naticidae	*P. sebae*
79	Naticidae	*P. tumidus*
80	Naticidae	*Polinices* sp1.
81	Naticidae	*Polinices* sp2.
82	Neritidae	*Nerita* sp.
83	Olividae	*Oliva annulata*
84	Olividae	*Oliva oliva*
85	Ovulidae	*Ovula ovum*
86	Patellidae	*Patela* sp.
87	Pyramidellidae	*Agatha* sp.
88	Pyramidellidae	*Milda ventricosa*
89	Pyramidellidae	*Odostomia* sp.
90	Pyramidellidae	*Pyramidella sulcata*
91	Pyramidellidae	*Pyramidella* sp.
92	Rissoinidae	*Rissoina* sp.
93	Scaphanderidae	*Acteocina* sp.
94	Strombidae	*Lambis lambis*
95	Strombidae	*Lambis chiragra*
96	Strombidae	*Strombus labiatus*
97	Strombidae	*Strombus luhuanus*
98	Strombidae	*Strombus* sp.
99	Terebridae	*Terebra affinis*
100	Terebridae	*Terebra funiculata*
101	Terebridae	*Terebra parkinsoni*
102	Terebridae	*Terebra* sp.
103	Tonnidae	*Tonna* sp.
104	Triphoridae	*Mastonia* sp.
105	Triphoridae	*Torresophora elongata*
106	Triphoridae	*Viriola* sp.
107	Triviidae	*Trivia oryza*
108	Triviidae	*Trivia* sp.
109	Trochidae	*Clanculus* sp.
110	Trochidae	*Euchelus atratus*
111	Trochidae	*Jujubinus* sp.
112	Trochidae	*Monilea* sp.
113	Trochidae	*Pseudostomatella* sp.
114	Trochidae	*Stomatella* sp.
115	Trochidae	*Tectus fenestratus*
116	Trochidae	*Tectus pyramis*
117	Trochidae	*Trochus maculatus*
118	Trochidae	*Trochus niloticus*
119	Trochidae	*Trochus* sp.
120	Turbinellidae	*Vasum turbinellus*
121	Turbinidae	*Angaria delphinus*
122	Turbinidae	*Astraea calcar*
123	Turbinidae	*Turbo bruneus*
124	Turbinidae	*Turbo chrysostomus*
125	Turbinidae	*Turbo marmoratus*
126	Turbinidae	*Turbo* sp.
127	Turitellidae	*Turitela terebra*
128	Turridae	*Clavus unizonalis*
129	Turridae	*Eucithara* sp.
130	Turridae	*Inquisitor tuberosa*
131	Turridae	*Turridrupa bijubata*
132	Turridae	*Turris* sp.
133	Volutidae	*Cymbiola vespertillio*
134	Volutidae	*Melo* sp.
135	Xenophoridae	*Stellaria solaris*
136	Phyllidiidae	*Phyllidia* sp.

No. Family	43
No. Genus	81
No. Species	136

Appendix 4 : List of pelecypod molluscs in Watlaar, Kei island, Southeast Maluku.

No.	Family	Species
1	Arcidae	*Anadara antiquata*
2	Arcidae	*Barbatia* sp.
3	Cardiidae	*Fragum unedo*
4	Cardiidae	*Fragum* sp.
5	Lucinidae	*Codakia tigerina*
6	Lucinidae	*Codakia* sp.
7	Mytilidae	*Septifer bilocularis*
8	Mytilidae	*Hormomya mutabilis*
9	Pteridae	*Pinctada margaritifera*
10	Tellinidae	*Tellina* sp.
11	Tonnidae	*Tonna* sp.
12	Trapeziidae	*Trapezium bicarinatum*
13	Tridacnidae	*Tridacna squamosa*
14	Tridacnidae	*Hippopus hippopus*
15	Veneridae	*Tapes* sp.
16	Veneridae	*Pitar* sp.
17	Veneridae	*Periglypta puerpera*
	No. Family	10
	No. Genus	15
	No. Species	17

Table . **Appendix 5 : Contingency table used to estimate the trochus density.**

No	Name of site	Zone	Distance (m)	Substrates		Density
				Primary	Secondary	
1	Sesaluk	Lower Intertidal	47	2	a	a
1	Sesaluk	Upper Subtidal	110	6	d	b
1	Sesaluk	Middle Subtıdal	160	5	f	b
1	Sesaluk	Mıddle Subtidal	205	5	f	c
1	Sesaluk	Lower Subtidal	275	1	d	b
3	Ngabub	Lower Intertidal	20	2	a	a
3	Ngabub	Upper Subtidal	70	8	e	b
3	Ngabub	Middle Subtıdal	140	6	f	c
3	Ngabub	Middle Subtidal	212	5	d	c
3	Ngabub	Lower Subtidal	244	1	d	b
6	Labes	Lower Intertidal	30	4	a	a
6	Labes	Upper Subtıdal	50	5	f	c
6	Labes	Middle Subtidal	124	5	f	b
6	Labes	Mıddle Subtıdal	171	5	f	c
6	Labes	Lower Subtidal	260	1	d	c
7	Fidvu	Lower Intertıdal	11	4	a	a
7	Fidvu	Upper Subtidal	64	5	f	c
7	Fidvu	Middle Subtidal	100	5	f	c
7	Fidvu	Middle Subtıdal	160	5	d	c
7	Fidvu	Lower Subtidal	220	1	d	c
10	Vaut Mader	Lower Intertidal	16	4	a	a
10	Vaut Mader	Upper Subtidal	50	5	f	c
10	Vaut Mader	Middle Subtidal	90	5	f	c
10	Vaut Mader	Middle Subtidal	140	6	d	d
10	Vaut Mader	Lower Subtıdal	220	1	d	c
11	Vaut Afnit	Lower Intertidal	15	4	a	a
11	Vaut Afnit	Upper Subtidal	70	6	f	b
11	Vaut Afnıt	Middle Subtidal	154	6	f	b
11	Vaut Afnit	Middle Subtidal	215	5	d	c
11	Vaut Afnit	Lower Subtidal	285	1	d	b
12	Dedlair	Lower Intertidal	20	2	a	a
12	Dedlaır	Upper Subtıdal	83	6	d	c
12	Dedlair	Middle Subtıdal	146	6	f	c
12	Dedlaır	Middle Subtidal	210	5	d	d
12	Dedlair	Lower Subtidal	315	1	d	c
14	Arvai	Lower Intertidal	26	2	a	a
14	Arvaı	Upper Subtidal	113	6	f	c
14	Arvai	Mıddle Subtidal	185	7	f	c
14	Arvai	Middle Subtidal	244	5	f	d
14	Arvai	Lower Subtidal	340	1	d	c
15	Yath tuvun	Lower Intertidal	22	4	a	a
15	Yath tuvun	Upper Subtıdal	76	6	d	c
15	Yath tuvun	Middle Subtidal	180	7	f	c
15	Yath tuvun	Middle Subtidal	250	5	f	d
15	Yath tuvun	Lower Subtidal	340	1	d	c
16	Vaut Ruban	Lower Intertıdal	30	2	a	a
16	Vaut Ruban	Upper Subtidal	87	8	a	c
16	Vaut Ruban	Middle Subtıdal	185	7	f	d
16	Vaut Ruban	Middle Subtidal	250	5	f	e
16	Vaut Ruban	Lower Subtidal	350	1	d	c
17	Ruwaın	Lower Intertidal	30	2	a	a
17	Ruwaın	Upper Subtidal	110	8	d	e
17	Ruwain	Middle Subtidal	167	7	f	f
17	Ruwain	Middle Subtıdal	220	5	f	f
17	Ruwain	Lower Subtidal	330	1	d	c
19	Lutur kev kufuan	Lower Intertıdal	22	2	a	a
19	Lutur kev kufuan	Upper Subtidal	65	8	d	d
19	Lutur kev kufuan	Middle Subtıdal	100	6	d	b
19	Lutur kev kufuan	Middle Subtidal	140	1	d	c
19	Lutur kev kufuan	Lower Subtıdal	240	1	d	c
21	Wear Seran	Lower Intertidal	27	2	a	a
21	Wear Seran	Upper Subtıdal	60	8	d	d
21	Wear Seran	Middle Subtidal	100	6	d	b
21	Wear Seran	Middle Subtidal	140	1	d	c
21	Wear Seran	Lower Subtidal	195	1	d	c
22	Hoar soın	Lower Intertidal	6	2	a	a

22	Hoar soin	Upper Subtidal	40	8	d	d
22	Hoar soin	Middle Subtidal	70	6	d	b
22	Hoar soin	Middle Subtidal	95	1	d	c
22	Hoar soin	Lower Subtidal	165	1	d	c
24	Vaut ngameten ko	Lower Intertidal	14	2	a	a
24	Vaut ngameten ko	Upper Subtidal	50	7	d	b
24	Vaut ngameten ko	Middle Subtidal	90	6	d	b
24	Vaut ngameten ko	Middle Subtidal	120	1	d	c
24	Vaut ngameten ko	Lower Subtidal	170	1	d	c
25	Nguurkoit	Lower Intertidal	5	2	a	a
25	Nguurkoit	Upper Subtidal	34	7	d	b
25	Nguurkoit	Middle Subtidal	70	6	d	b
25	Nguurkoit	Middle Subtidal	100	1	d	c
25	Nguurkoit	Lower Subtidal	150	1	d	c
26	Vaut luis yab	Lower Intertidal	7	2	a	a
26	Vaut luis yab	Upper Subtidal	32	7	d	b
26	Vaut luis yab	Middle Subtidal	75	6	d	b
26	Vaut luis yab	Middle Subtidal	110	1	d	c
26	Vaut luis yab	Lower Subtidal	160	1	d	c
28	Vaut soin	Lower Intertidal	12	2	a	a
28	Vaut soin	Upper Subtidal	35	7	d	b
28	Vaut soin	Middle Subtidal	58	6	d	b
28	Vaut soin	Middle Subtidal	98	1	d	c
28	Vaut soin	Lower Subtidal	140	1	d	c
30	Vaut Kabanuir	Lower Intertidal	10	2	a	a
30	Vaut Kabanuir	Upper Subtidal	37	8	a	b
30	Vaut Kabanuir	Middle Subtidal	65	6	d	b
30	Vaut Kabanuir	Middle Subtidal	100	6	d	b
30	Vaut Kabanuir	Lower Subtidal	150	1	d	b
32a	Kabalus	Lower Intertidal	12	2	a	a
32a	Kabalus	Upper Subtidal	43	7	a	b
32a	Kabalus	Middle Subtidal	64	7	d	c
32a	Kabalus	Middle Subtidal	94	5	f	c
32a	Kabalus	Lower Subtidal	160	1	d	b
32b	u	Lower Intertidal	11	2	a	a
32b	u	Upper Subtidal	39	7	d	b
32b	u	Middle Subtidal	64	7	d	c
32b	u	Middle Subtidal	94	7	d	e
32b	u	Lower Subtidal	160	1	d	c
33	Warso	Lower Intertidal	17	2	a	a
33	Warso	Upper Subtidal	64	7	a	b
33	Warso	Middle Subtidal	101	7	e	c
33	Warso	Middle Subtidal	130	1	f	c
33	Warso	Lower Subtidal	200	1	d	b
34	Fauwawan	Lower Intertidal	15	2	a	a
34	Fauwawan	Upper Subtidal	72	8	a	c
34	Fauwawan	Middle Subtidal	101	7	d	c
34	Fauwawan	Middle Subtidal	140	1	f	c
34	Fauwawan	Lower Subtidal	210	1	d	c
36	Wak Enmeh	Lower Intertidal	22	2	a	a
36	Wak Enmeh	Upper Subtidal	120	7	a	b
36	Wak Enmeh	Middle Subtidal	163	5	f	c
36	Wak Enmeh	Middle Subtidal	195	5	d	c
36	Wak Enmeh	Lower Subtidal	270	1	f	b
37	Nguur Lobar	Lower Intertidal	18	1	a	a
37	Nguur Lobar	Upper Subtidal	100	1	e	c
37	Nguur Lobar	Middle Subtidal	140	5	f	c
37	Nguur Lobar	Middle Subtidal	170	5	d	c
37	Nguur Lobar	Lower Subtidal	255	1	d	c
38	Karang Lair	Lower Intertidal	30	2	a	a
38	Karang Lair	Upper Subtidal	74	8	a	c
38	Karang Lair	Middle Subtidal	103	7	d	c
38	Karang Lair	Middle Subtidal	140	3	d	c
38	Karang Lair	Lower Subtidal	260	1	d	c
39	Vaut Maler	Lower Intertidal	19	2	a	a
39	Vaut Maler	Upper Subtidal	80	7	a	a
39	Vaut Maler	Middle Subtidal	115	5	f	c
39	Vaut Maler	Middle Subtidal	145	1	f	c
39	Vaut Maler	Lower Subtidal	200	1	d	c
40a	Wear Fadir	Lower Intertidal	18	2	a	a

40a	Wear Fadir	Upper Subtidal	59	7	a	b
40a	Wear Fadir	Middle Subtidal	105	5	f	c
40a	Wear Fadir	Middle Subtidal	165	1	f	c
40a	Wear Fadir	Lower Subtidal	215	1	d	c
40b	v	Lower Intertidal	22	2	a	a
40b	v	Upper Subtidal	73	3	d	b
40b	v	Middle Subtidal	145	1	f	b
40b	v	Middle Subtidal	200	1	f	c
40b	v	Lower Subtidal	320	1	d	c
40c	w	Lower Intertidal	18	2	a	a
40c	w	Upper Subtidal	62	3	d	b
40c	w	Middle Subtidal	165	1	f	b
40c	w	Middle Subtidal	215	1	f	c
40c	w	Lower Subtidal	335	1	d	c
41	D. Hoar	Lower Intertidal	17	2	a	a
41	D. Hoar	Upper Subtidal	105	3	a	b
41	D. Hoar	Middle Subtidal	200	1	f	c
41	D. Hoar	Middle Subtidal	265	1	f	c
41	D. Hoar	Lower Subtidal	385	1	d	b
43a	x	Lower Intertidal	11	2	a	a
43a	x	Upper Subtidal	83	3	a	b
43a	x	Middle Subtidal	210	1	f	b
43a	x	Middle Subtidal	255	1	d	c
43a	x	Lower Subtidal	350	1	d	b
43b	Vatro Ohoi Rufan	Lower Intertidal	11	2	a	a
43b	Vatro Ohoi Rufan	Upper Subtidal	40	3	d	b
43b	Vatro Ohoi Rufan	Middle Subtidal	145	6	d	b
43b	Vatro Ohoi Rufan	Middle Subtidal	210	5	d	c
43b	Vatro Ohoi Rufan	Lower Subtidal	320	1	d	c
44	Wear Afni	Lower Intertidal	7	3	a	a
44	Wear Afni	Upper Subtidal	130	3	b	b
44	Wear Afni	Middle Subtidal	258	3	c	b
44	Wear Afni	Middle Subtidal	333	1	d	b
44	Wear Afni	Lower Subtidal	435	1	a	b
46	Wear Ngayaan	Lower Intertidal	25	1	b	a
46	Wear Ngayaan	Upper Subtidal	180	3	b	b
46	Wear Ngayaan	Middle Subtidal	290	3	c	b
46	Wear Ngayaan	Middle Subtidal	388	1	d	c
46	Wear Ngayaan	Lower Subtidal	560	1	a	b

Appendix 6 : Method of study for biology sampling

Most of the field work was conducted from December 1996 to March 1997. An additional bathymetric and habitat studies were done in October 1997. The studies conducted included Bathymetry, Habitat, Benthic organism transect, and Coral reef transect. Complementary informations were obtained either by interviewing the villagers, specimen collections or litterature study.

a. Bathymetry

Bathymetry data of intertidal and subtidal area down to 3 m depth was collected using a teodolith, compass, meter band and graduated wood bar. A total of 35 transects was carried out to represent 3.7 km long of coastal area. Since Watlaar is situated at eastern coast of Kei Besar island, therefore each transect was perfomed at west-east direction. The measurement was done at 5 m intervals beginning from highest tide level on the beach. Tidal coefficient, starting and ending time of each transect were noted as well as seawater height..

The relation of tidal coefficient and true seawater height was established on measurements made during one tidal cycle. This table was then used to calibrate all the transect measurements to obtain the corresponding depths comparing to highest tide level.

In order to obtain the bathymetric map of the area down to 100-120 m depth, an echosounding technique was performed at high tide from coast to the offshore. The data obtained was combined with to teodolith measurements an was then used to establish the complete bathymetric map.

b. Habitat

The habitat study was performed at the same time as bathymetric transect. The study was aimed to map the different habitat found in front of Watlaar village. Since habitat is related to certain type of organisms, it can be considered as biotope. Biotope characteristics observed included substrate or sediment composition, benthic vegetal and animals.

c. Benthic organism

Preliminary observations showed that the intertidal and subtidal areas down to 3 m were poorly inhabited by benthic organisms which was probably due to overfishing. Therefore, it is no point to conduct usual transect study. Instead, a sporadic/choosen transects, combined with specimens collection were done. The transects were made in three different sites to represent the distinct area of Watlaar, i.e. Sasaluk, Ruwain and Wear Ngayaan.

d. Coral reef

The study was aimed to evaluate the condition of coral reef in Watlaar by Benthic Life Form method (De Vantier *et al.*,1985). Eleven sites were choosen, i.e. Selsaluk, Vaut Afnit, Dedlair, Wear Seran, Vaut Luis Yab, Kabalus, Warso, Waka Enmeh, Karang Lair, Wertom Veil and Wear Ngayaan. Transects were done perpendicularly to the shoreline. All coral colony, coral-associated and other organism were observed according to the criteria given by Dartnal & Jones (1996). Free collection was done to evaluate the stony coral community. Samples of unidentified species were brought to R&D Center for Oceanology in Ambon and identified according to Randal (1983) and Veron & Pichon (1986).

Evaluation of coral community stability was done according to criteria given by Soekarno (1985). The category of coral reef condition, based on coral coverage critearia, is given below (Soekarno, 1985) :

75	-	100 %	:	Very good
50	-	74.9 %	:	Good
25	-	49.9 %	:	Fair
0	-	24.9 %	:	Bad

3. Trochus Fisheries Study

In order evaluate the density, repartition, biomass and influence of harvest to trochus population, two series of transect were conducted i.e. before and after trochus harvest (*sasi* opening), respectively. The transects were made at the same 19 sites for the two transect series :

Selsaluk, Ngabub, Fidvu, Vaut Mader, Vaut Afnit, Dedlair, Arvai, Yah Tuvun, Vaut Ruban, Ruwain, Vaut Kabanuir, Kabalus, Warso, Waka Enmeh, Vaut Fadir, Deban Hoar, Vatro Oih Rufan, Wear Afni and Wear Ngayaan.

The study was done by line transect method using 100 m meter band and diving equipment. Transects were conducted perpendicularly to the coastline. Trochus found within 2.5 m area of both sides of transect line were counted and collected. Maximum basal diameter (referred hereafter as diameter) of each individuals was measured on the shore by using vernier calliper at nearly 0.1 mm.

Complementary studies were performed in two neighbouring village of Watlaar, i.e. Banda Efaruan and Hollath. The former represented a population of trochus where no fishing regulation is applicated, while in the later, the natural population has not been disturbed (harvested) for at least 4 succesives years. In each of the 2 village, 2 sites were choosen for study.