Report summary

REDUCING POST HARVEST LOSSES IN ARTISANAL FISHERIES

Artisanal fisheries communities of Vridi
(Abidjan- Republic of Côte d'Ivoire)

October 1998

Summary

In this document, the methodological approach is described and the results obtained from the tests carried out in the communities of artisanal fishermen of Vridi-Zimbabwe and Vridi-II at Abidjan in Côte d'Ivoire.

The tests which emanated from a study initiated by WADAF and NRI to develop tools and a methodology of evaluating artisanal fisheries post harvest losses in West Africa. Its aim was to measure the impact on post harvest losses of reduced mesh size of the grills used for smoking and improved package of the products sent to the markets.

The fieldwork lasted for three months (July to September) and in total twelve experiments (six with the grill and six with the packaging) were carried out through out the entire two communities.

The species used in the study were Herrings (*Sardinella aurita and Sardinella eba*) which is basically the fish landed by the artisanal fishermen of the selected communities.

The test on the grills involved proposing to the processors to use the smaller mesh size grills (grill G2) than the one they normally used G1. The mesh size G2 was chosen in such a way that no fish passed through its meshes, not even the smoked fish.

Five processors carried out the practical aspects of the tests, two at Vridi-II and three at Vridi-Zimbabwe.

As regards the test on the grill, the same quantity of fish was smoked on G1 and G2. The conditions of smoking were the same for the two categories of grills.

Weighing of the products after smoking indicated a weight difference varying from 1.98 % to 2.33 % of the weight of the products that were smoked on grill G1. Assuming that the level of dehydration of the products smoked on G1 and G2 are the same, then this difference was due to the grill mesh size G1 which is more permeable than G2.

The impact of the packaging on the quality of the products was measured in the course of the six tests. These tests involved conveying two loads with improved packaging to the market.

Like in the first case, the result of this test is unequivocal. Whereas in the improved parcels losses were 0.06 % to 0.09 % of the revenue of the processors, they are between 0.8 % to 3.7 % of the revenues in the loads with unmodified packaging.

We observe from the experiments that it is possible to reduce losses during smoking and transportation to the markets by the use of small size grills but also by improving the packaging.

There is no doubt that the level of loss reduction is small on the micro-economic scale. However, if this is viewed from the macro-economic plane, i.e. if one considers the communities of fishermen as a whole, one would find that substantial savings could be made by the use of appropriate smoking grills and improved product packaging. In fact, the actual conditions of the processors give rise to a monthly financial loss of 19,680 F CFA due to the grills in use and a loss equivalent to 2.25 % of revenue per sale due to packaging.

Key

1- Criteria for identifying the quality of fresh and smoked fish (tab. 4, 5, 6 and 7)

11- Fresh fish

Criteria	Good quality fish	Poor quality fish
Odour	Fresh	
Colour of eyes	White	Crushed
Colour of gills	Red	
Scale	Close	

12- Smoked fish

We consider fragmented fish as fish of poor quality. Fragmentation is due to the quality of the fish at the supply stage or the smoking conditions.

2- Value of losses due to the quality of the fish (Tab. 7, 8, 9 and 10)

The percentage of quality losses in terms of revenue was included calculated following the formula below.

(% of quality losses x total quantity x reduced price) / (total quantity x good price) x 100 = **Economic or total losses** (in % in relation to total revenue)

3- Note on species

The fish in this study were Herrings. They were the round Herring (*Sardinella aurita*) and the flat Herring (S*ardinella maderensis or eba*).

4- Miscellaneous notes

. The abbreviation F CFA is used to denote the Ivorian currency.

. 100 F CFA = 1 FF (with effect from 12 January 1994)

. 1 $ US = around 600 F CFA

5- List of acronyms

. WADAF: West Africa Association for the Development Artisanal Fisheries

. CRO: Centre de Recherches Océanologiques

. Infopêche: Organisation Intergouvernementale d'Information et de Coopération
                    pour la Commercialisation des Produits de la Pêche en Afrique

. NRI: Natural Resources Institute

. WARF: West Africa Regional Programme Improvement of post harvest utilisation of Artisanal Fish

Catches.

1- Introduction

This study was initiated by the Natural Resources Institute (NRI) in partnership with the Association for the development of artisanal Fisheries in West Africa (WADAF). It is a follow up of the recommendations of the summary report of the first phase of investigations with respect to developing a method for evaluating artisanal fisheries post harvest losses which took place from 21 October, 1997 to 28 February, 1998. The objective of this research is to field test certain recommendations researchers made to reduce post harvest losses in artisanal maritime fisheries. Funding was provided by by NRI for carrying out the field experiments.

Based on the summary report refered to above, losses are high during processing especially if the grill mesh sizes are large. They are also high in the course of transporting the product to the market as a result of poor handling and transport conditions and often inappropriate packaging of consignments.

The field tests were centred on the two areas cited above. The groups which were retained for the experiments were fishermen communities of Vridi-Zimbabwe and Vridi-Ako or VridiII who are among the most important in the surburbs of Abidjan. Two experiments were first carried out. The results obtained by four other experiments which took place under the same conditions.

The methods used and the main conclusions reached are presented in the foregoing.

2- Research method

The tests were done on 2 stages of the artisanal fisheries distribution chain.

21- The test during smoking

211- The choice of women processors

The women fish processors chosen were among those who process the largest quantities of fish. This choice also took into consideration the place of sale of the products.

Three women were chosen from Vridi-Zimbabwe. These were ADIZA Kouao, AJOUA Exone and EFFFOUA Preba. At Vridi Ako, those chosen were KANGA Bernadette, President of the Fanti processors and NANIVI Brigitte , an Awran processor (the daughter of the president of Awran processors of VridiII).

212- Choice of grills

In the first instance, we held a discussion with the processors to gather their views on the use of smaller mesh size grills than they normally used . For each of them, we bought the same kind of grills that were normally used as well as grills whose mesh sizes matched with the size of fish species normally smoked. **The mesh sizes were chosen in such a way that they would not allow fish to pass through even after smoking**. The table below summarises the selected mesh sizes.

Table 1. Grills normally used and that proposed at Vridi-Zimbbwe and Vridi II

Village	Name and surname of processor	Number of ovens	Mesh sizes of grills used before intervention (length/ breadth)	Grills proposed by researchers (length/ breadth)
Vridi Zimbabwe	ADIZA Kouao	2	10 cm/6cm	3.7 cm/2.2 cm
	ADJOUA Esone	7	10 cm/ 6 cm	3.7 cm/ 2.2 cm
	EFFOUA Preba	17	10 cm/ 6 cm	3.7cm/2.2 cm
Vridi II	KANGA Bernadette	5	3.8cm/2.7 cm	1.3 cm/1.3 cm
	NANIVI Brigitte	6	3.8cm/ 2.7 cm	1.3 cm/1.3 cm

All the women were provided with grills and they were continually involved in the experiment.
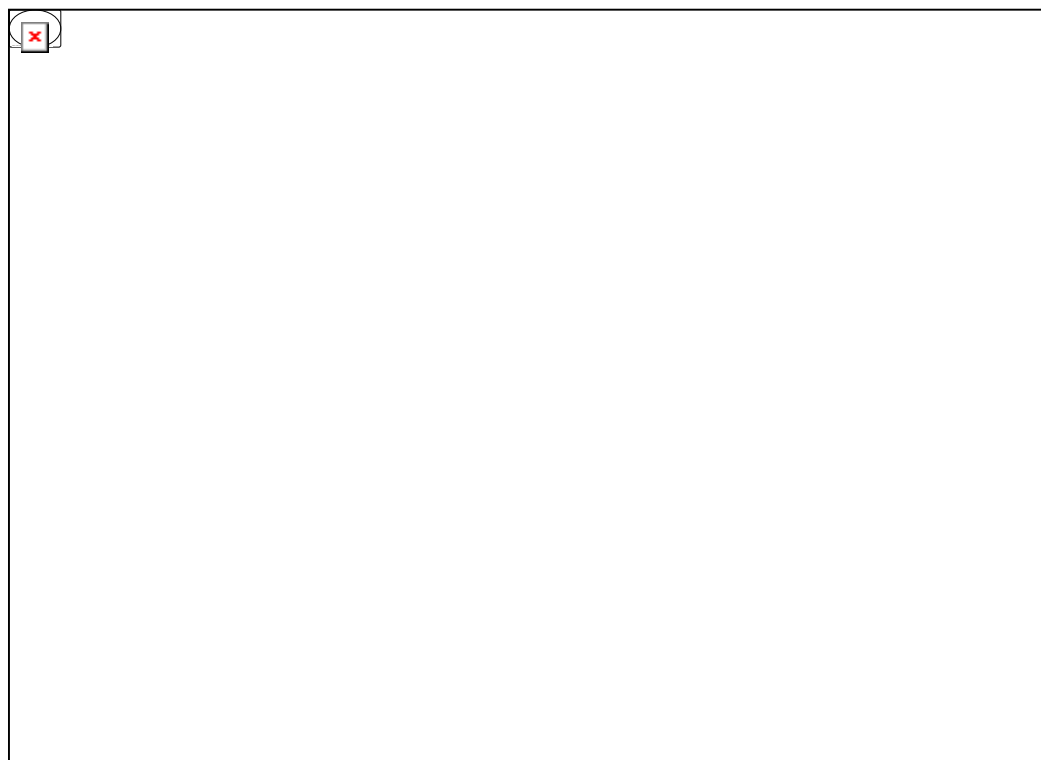
213- The conduct of the experiment

a- The fish batches

The experiments involved smoking two identical (herring) batches, one on the grills normally used by the processors and the other on grills with smaller mesh sizes as advised by the research team.

NB: The fish to be processed were weighed before and after smoking.

In the beginning, the research team took care of the fish purchases. The aim of this was to facilitate handling of the products but afterwards the team succeeded in using part of the purchases of the processors. Only half of the products was financed by the research team. For example, out of 4 cases or boxes used, the research team financed only two.

b- The size of fish species

The experiment was conducted on herrings which is the most abundant species in the area. The species studied at Vridi-Zimbabwe were of large sizes (on average 23 cm in length and 6 cm in width) and at Vridi II, small sizes (14 cm in length and 3.2 cm in width). The choice of the fish sizes was done on the following justification: Large size herrings predominate at Vridi-Zimbabwe while at Vridi-II landings are composed of mainly small sizes . However, when the fishermen of Vridi- Zimbabwe found small sizes in their catch, they conveyed them to Vridi II since their wives do not have the grills needed for smoking them.

c- The fuel wood used

We ensured that the batches of fish were smoked with the same species and quantity of wood. The fire in the ovens was also controlled in order to avoid that a batch was more dehydrated than the other. The expenses related to fuel wood were provided by the research team.

Table 2: Wood used in the experiments

Village	Common name of wood used	Scientific name	Total quantity (kg)	Average price (F cfa)	Average quantity per oven (kg)

| Vridi-Zimbabwe | Manan | *Lophira alata* | 162 | 5,500 | 81 |
| Vridi-II | Sili | *Chlosphora excelsa* | 118 | 3,200 | 59 |

d- The features of the ovens and the duration of smoking

At Vridi- Zimbaabwe like in Vridi-II, the type of oven used was the rectangular oven. These ovens are generally constructed using cut and planed timber trunks. To support the grills, the processors use metal bars (about 10 per oven). The dimensions of an oven are on average 2.5 m by 2 m.

The duration of smoking varied from two to three days in all depending on the processor but especially in relation to the abundance of fish on the market. During periods of abundance, the products spend more time on the ovens since the processors are not in a hurry to sell them.

22- Test in the areas of packaging and transport

One of the problems experienced by the processors in the communities is fragmentation of smoked fish as a result of poor packaging and transportation (to market centres) conditions. The report summary of the first phase of the studies in the evaluation of post harvest fish losses indicates that 11 % of financial losses are attributable to this situation. The research team consequently made some improvements and modifications to the transport conditions and measured the impact of these changes on the quality of the fish on arrival at the market.

221- The type of packaging normally used

Table 3: features of the packaging normally used by the women

Community	Type of packaging used	Diameter of opening in cm	Diameter of base in cm	Depth in cm	weight in kg
Vridi-Zimbbwe	basin	66	33	22	2.5
Vridi-II	basket	62-72	48-62	25.5-32	3-5

At Vridi -II two types of baskets are generally used: large and small. Most of the measurements were carried out with the large baskets.

222- The package proposed by the research team

We were supplied with the packages commonly used by the women in the two communities. At Vridi II, in order to increase the full content, two baskets were superimposed. (ref. photo 8). This procedure gave satisfactory results in general. But the women having shown some resistance against this type of packaging due to handling difficulties, we ordered a type of basket for the experiment which were exhibited to the economic operators.

At Vridi- Zimbabwe, the means of transport being the "town taxi", the basins could not be superimposed due to shortage of space in the vehicle. We have ensured that the baskets tracked occupied the front seat near the driver (ref. photo 9), during which the other baskets loaded as usual that is, in the booth behind the vehicle (ref. photo 10).

3- Results and discussions

31- Results and discussion of test on grill mesh sizes

311- Results

Table 4: experiment no.1 (Vridi Zimbabwe and Vridi Ako)

	Vridi Zimbabwe	**Vridi Ako or Vridi 2**
Mesh size of grills (G1) normally used by processors	10 cm/ 6 cm	3.8 cm / 2.7 cm
mesh size of grills (G2) proposed by the research team	3.7 cm / 2.2 cm	1.3 cm /1.3 cm
Species and size of processed fish	Herring (23 cm /6 cm)	Herring (14 cm /3.2 cm)
Place of purchase	fishing harbour	on site
Total quantity purchased (kg)	260 kg	264 kg
Purchase price of the entire quantity (Kg)	74,000	44,000
Purchase price (F cfa/kg)	284.6	166.6
Quantity of fish processed using G1 1. Weight before smoking (P1) 2. Weight after smoking (P2)	130 kg 48.6 kg	132 kg 45.3 kg
Quantity of fish processed using G2 1. Weight before smoking (P1) 2. Weight after smoking (P2)	130 kg 51.4 kg	132 kg 46.5 kg
Duration of smoking (in days)	3 days	3 days
Weight difference (1) between G1 and G2 resulting from grill mesh size G1	2.8 kg	1.2 kg
Quantity of fish fallen into the fire through grill G1(equiv. kg) before the begining of smoking	6 fish of 150 g each being 900 g in total	12 fish of 40 g being 480 g in total
Quantity of fish fallen into the fire through grill G2(equiv. kg) before the begining of smoking	00 fish = 00kg	00 fish =00kg
Quality of fish before smoking: 1.Good quality 2.Poor quality	232 kg 28 kg	264 kg 0 kg
Quality of fish after smoking: 1. Good quality 2. Poor quality	89.2 kg 10.8 kg	91.8 kg 0 kg

NB: Smoked fish represents 38.33% by wieght of fresh fish at Vridi-Zimbabwe and 34.6% at Vridi-II

1-This value includes the quantity of fish that fall under the oven before the beginning of smoking. During the experiment, we observed that the fish which fall in the oven before the fire is lit are not picked up by the processor. It is burnt up in the fire. The processors indicate that the quantities are negligible.

We consider the weight difference after smoking between G1 and G2 is due to the quantity of fish that has fallen into the fire through the grills, G1. The number of burn(t up fish found under the oven G1 (this number being generally larger than the fish which has fallen under the oven before the beginning of smoking) after the smoking and the fish that fall when handling of the grills during smoking made us take this decision. We

however, continue to be careful since the weight difference could also be due to the different degree of dehydration, the latter which we have not been able to measure. (ref difficulties page 23).

Table 5: Experiment no.2 (Vridi Zimbabwe and Vridi Ako)

	Vridi Zimbabwe	Vridi Ako or Vridi 2
Mesh size of grills (G1) normally used by processors	10 cm /6 cm	3.8 cm /2.7 cm
mesh size of grills (G2) proposed by the research team	3.7 cm / 2.2 cm	1.3 cm /1.3 cm
Species and size of processed fish	Herring (18.9 cm /5.3 cm)	Herring (11.2 cm /1.8 cm)
Place of purchase	fishing port	on site
Total quantity purchased (kg)	304 kg	228 kg
Purchase price of the entire quantity (Kg)	66,000 F cfa	26,000 F cfa
Purchase price (F cfa/kg)	217.1 F cfa	114 F cfa

Quantity of fish processed using G1
1. Weight before smoking (P1)
2. Weight after smoking (P2)
	152 kg
	  60.3 kg
		114 kg
		  38 kg

Quantity of fish processed using G2
1. Weight before smoking (P1)
2. Weight after smoking (P2)
	152 kg
	  60.7 kg
		114 kg
		  41 kg

Duration of smoking (in days)	2 days	2 days
Weight difference between G1 and G2 resulting from grill mesh size G1	0.4 kg	3 kg
Quantity of fish fallen into the fire through grill G1(equiv. kg) before the begining of smoking	2 fish of 150 g each being 300 g in total	No. of fish undetermined but totalling 8,330 g
Quantity of fish fallen into the fire through grill G2(equiv. kg) before the begining of smoking	00 fish = 00 kg	00 fish = 00 kg

Quality of fish before smoking:
1.Good quality
2.Poor quality
	260 kg
	  44 kg
		228 kg
		  0 kg

Quality of fish after smoking:
1. Good quality
2. Poor quality
	105 kg
	  16 kg
		79 kg
		  0 kg

Table 6: experiment no.3 (Vridi Zimbabwe and Vridi Ako)

	Vridi Zimbabwe	Vridi Ako or Vridi 2
Mesh size of grills (G1) normally used by processors	10 cm /6 cm	3.8 cm /2.7 cm
mesh size of grills (G2) proposed by the research team	3.7 cm / 2.2 cm	1.3 cm /1.3 cm
Species and size of processed fish	Herring (15 cm /5 cm)	Herring (11.2 cm /1.8 cm)
Place of purchase	fishing port	on site
Total quantity purchased (kg)	300 kg	264 kg

Purchase price of the entire quantity (Kg)	68,000 F cfa	26,000 F cfa
Purchase price (F cfa/kg)	226.6	98.4
Quantity of fish processed using G1 1. Weight before smoking (P1) 2. Weight after smoking (P2)	150 kg 57.67 kg	118 kg 44 kg
Quantity of fish processed using G2 1. Weight before smoking (P1) 2. Weight after smoking (P2)	150 kg 57.5 kg	118 kg 45.2 kg
Duration of smoking (in days)	3 days	2 days
Weight difference between G1 and G2 resulting from grill mesh size G1	0.8 kg	1.2 kg
Quantity of fish fallen into the fire through grill G1(equiv. kg) before the beginning of smoking	6 fish of 134 g each being 800 g in total	no. of fish undetermined but totalling 1,220 g
Quantity of fish fallen into the fire through grill G2(equiv. kg) before the beginning of smoking	00 fish = 00 kg	00 fish = 00 kg
Quality of fish before smoking: 1.Good quality 2.Poor quality	266 kg 34 kg	236 kg 0 kg
Quality of fish after smoking: 1. Good quality 2. Poor quality	101.08 kg 13 kg	89.22 kg 0 kg

Table 7: Summary of the six experiments (Vridi Zimbabwe and Vridi Ako)

	Vridi Zimbabwe	Vridi Ako or Vridi 2
Mesh size of grills (G1) normally used by processors	10 cm /6 cm	3.8 cm /2.7 cm
mesh size of grills (G2) proposed by the research team	3.7 cm / 2.2 cm	1.3 cm /1.3 cm
Species and size of processed fish	Herring (18.9 cm /5.3 cm)	Herring (11.2 cm /1.8 cm)
Place of purchase	fishing harbour	on site
Total quantity purchased (kg)	287.6 kg	252 kg
Purchase price of the entire quantity (F cfa)	69,335	32,000
Purchase price (F cfa/kg)	241	127
Quantity of fish processed using G1 1. Weight before smoking (P1) 2. Weight after smoking (P2)	144 kg 55.4 kg	121.3 kg 43.8 kg
Quantity of fish processed using G2 1. Weight before smoking (P1) 2. Weight after smoking (P2)	144 kg 56.5 kg	121.3 kg 43.8 kg
Duration of smoking (in days)	60 hours	56 hours
Weight difference between G1 and G2 resulting from grill mesh size G1	1.1 kg being 1.98 % the weight of the smoked products on ovens G1	1.00 kg being 2.33 % the weight of the smoked product on oven G1
Quality of fish before smoking: 1.Good quality 2.Poor quality	252.6 kg 35.4 kg	242.6 kg 0 kg
Quality of fish after smoking: 1. Good quality 2. Poor quality	98.4 kg 13.26 kg	86.6 kg 0 kg

NB: The weight difference between G1 and G2 comprise the fish which fall into the fire before smoking

Table 8: Data related to losses due to the mesh size of grills per experimental site.

Vridi-Zimbabwe	Experiment 1		Experiment 2		Experiment 3	
	Large mesh	Small mesh	Large mesh	Small mesh	Large mesh	Small mesh
Weight of fish lost (dried weight)	2,80	0,00	0,40	0,00	0,80	0,00
Weight of batch if no loss (dried weight)	51,40	51,40	60,70	60,70	57,50	57,50
Percentage physical Loss	5,45	0,00	0,66	0,00	1,39	0,00
Value of loss (F CFA)	2 464	0	254	0	498	0
Vridi-II	Experiment 1		Experiment 2		Experiment 3	
	Large mesh	Small mesh	Large mesh	Small mesh	Large mesh	Small mesh
Weight of fish lost (dried weight)	1,20	0,00	3,00	0,00	1,20	0,00
Weight of batch if no loss (dried weight)	46,50	46,50	41,00	41,00	44,00	44,00
Percentage physical Loss	2,58	0,00	7,32	0,00	2,73	0,00
Value of loss (F CFA)	770	0	1 500	0	420	0

NB: We assume that the fish lost would have been sold at the same price as good
quality

312- Discussion

3121- Advantages of the grills proposed by the team

a- The main advantage to be derived from the experiments with the grills is savings of around 2 % of the fish batch after smoking. The summary of the results shows that the difference in weight between the products normally smoked by the women and those that were smoked with the team's proposed changes is 1.1 kg in Vridi Zimbabwe and 1 kg at Vridi Ako. **If it was exclusively used , the grills proposed by the team would have resulted in a savings of an average of 2 kg in 100 kg out of smoked products.**
The difference in weight between the quantity processed on the grills proposed by the team and that produced from the grills in normal use by the women is due to the fact that the former prevents the fish from falling into the fire during smoking.

b- The fish smoked on the grills proposed by the research team remained very straight when smoking was complete in contrary to those which had been smoked on the grills in normal use
by the women which were slightly bent due to the mesh size. The products from the proposed grills were less liable to fragmentation during handling. The processors of the two communities but especially those of Vridi Zimbbwe recognised the advantages of the proposed grills which is strictly related to the mesh size (figure 3).

c- At Vridi Zimbabwe like in Vridi Ako, the fish smoked on the proposed grills had a better physical aspect. They had a better tan than those the women smoked in the usual way. Again, the processors attributed the colour of the products to the mesh size which, because of its smaller size prevented the smoke from passing easily. The fish on these grills therefore, had more smoke on them than those smoked on their normal grills, which would make them move faster on the market.

3122- Disadvantages of the grills proposed by the research team.

a- At Vridi Zimbabwe, the women did not report any disadvantages in using this type of grills. They found them quite suitable for processing large size Herrings which is popularly smoked in the village. They however, noted that our grills were difficult to use for processing large size species such as Tuna, which is often smoked. A large quantity of large species such as tuna on our grills weigh heavy and make the grill bend making it difficult to handle, which is different with the grills in normal use because they are more resistant. The women also expressed their concern about the durability (about 4 years) of the material used for its construction which seemed more fragile than their usual grills. The grills used at Vridi Zimbabwe have a useful lifetime exceeding 15 years. We have not seen them being sold anywhere on the market. They originate from industrial companies at Vridi and were sold to the women by certain discrete agents.

b- At Vridi II the main difficulty which lies in the fact that the fingers of the women do not pass through the meshes of the grill when they attempt to move them has been solved. The smokers had a choice between the removal of some meshes in order to allow their fingers to pass or to provide some wire on the ends to facilitate handling. (photo 10 & 11)

The women of this community however, pointed out that the high cost of the grills we proposed to them. The cost of the grills they normally used is 700 F cfa per metre while that which was proposed is 2,000 F cfa per metre. Often, one needs 50 metres of grill being 100,000 F cfa while at present they spend 35,000 F cfa on grills for their normal ovens. In spite the cost of our grills, it was observed that they enabled one to produce better quality products. Moreover, on comparing the cost of our grills with the sum which they lose due to their large size mesh grills, we observe that it is highly beneficial for the processors to make such an investment even if it is heavy since this enables them to make average savings of 984 F CFA per smoking([1]), a processor working averagely for 8 months in the year with 20 smoking per months[2]). On this basis we may evaluate the sum lost in one month and one year and four years.

Financial losses in one month
 984 x 20 = 19 680 F CFA

Financial losses in one year
19 680 x 8 = 157 440 F CFA

Financial losses in four years
157 440 x 4 = 629 760 F CFA

We observe that the small size grills enable one to make cost savings of the equivalent of six months of activity. In four years, the processors using it would have paid for it and and make a savings on top of this more than 500 000 F CFA.

32- Results and discussion of test on packaging and transport

321- Results

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[1]- This figure was obtained by averaging the values of losses due to the large mesh size grills at Vridi-Zimbabwe and à Vridi-II of table 8.(2 464 + 254 + 498 + 770 + 1 500 + 420/ 6 = **984 F CFA**)

[2]- These information were taken from the report summary of the research into tools and methodology of evaluating post harvest losses in artisanal fisheries. This report is available for those who would like to have more information.

Table 9 : Experiment no. 1 (Vridi Zimbabwe and Vridi Ako)

	Vridi Zimbabwe	Vridi II or Vridi Ako
Type of packaging used	basin	basket
Total quantity of fish transported	100 kg	91.8 kg
Number of load tracked: -load on improved packaging -load on un-improved packaging	2 2a 2b	2 21 22
Average weight of each load	50 kg	45.9 kg
Means of transport	town taxi	boat
Cost of transporting to market	850 F cfa / basin	900 F cfa / basket
Position of load in the vehicle	back booth, non superimposed	on the roof, with other baskets on top
Quantity of fish broken due to packaging and handling -load on improved package -load on un-improved package Total quantity	 0.23 kg (0.46 % of total weight) 0.86 kg (1.72 % of total weight) 1.09 kg	 0.03 kg (0.06 % of total weight) 0.35 kg (0.76 % of total weight) 0.38 kg
Place of sale of fish	new market of Treichville	Biafra market (Treichville)
Selling price of unbroken fish	880 F cfa / kg	642 F cfa /kg
Selling price of broken fish	492 F cfa / kg	350 F cfa / kg
Revenue after sale of unbroken fish	87,040 F cfa	58,690 F cfa
Revenue after sale of broken fish	(1.09 x 492) =536 F cfa	(0.38 x 350 = 130 F cfa
Amount lost on the quantity of broken fish	(1.09 x 880) - (1.09 x 492) 425 F cfa	(0.38 x 642) - (0.38 x 350) 114 F cfa
Total revenue after sale	87,575 F cfa	58,820 F cfa
Percentage of losses due to transport and packaging in relation to the revenue from the load on improved package	0.26 % of revenue	0.03 % of revenue
Percentage of losses due to transport and packaging in relation to the revenue from the load on un-improved package	0.96 % of revenue	0.41 % of revenue

NB Large herring has a higher purchase cost than small, it is also sold at a higher price.

Table 10 : Experiment no. 2 (Vridi Zimbabwe and Vridi Ako)

	Vridi Zimbabwe	Vridi II or Vridi Ako
Type of packaging used	basin	basket
Total quantity of fish transported	50 kg	90 kg
Number of load tracked: -load on improved packaging -load on un-modified packaging	2 2a 2b	2 21 22

Average weight of each load	25 kg	45 kg
Means of transport	town taxi	boat
Cost of transporting to market	850 F cfa / basin	900 F cfa / basket
Position of load in the vehicle	2 b = back booth, non superimposed. 2a = front seat near driver	on the roof, with other baskets on top
Quantity of fish broken due to packaging and handling -load on improved package -load on un-modified package Total quantity	0.00 kg (0.00 % of total weight) 0.48 kg (1.92 % of total weight) 0.48 kg	0.07 kg (0.16 % of total weight) 3.00 kg (6.67 % of total weight) 3.074 kg
Place of sale of fish	new market of Treichville	Biafra market (Treichville)
Selling price of unbroken fish	635 F cfa / kg	500 F cfa /kg
Selling price of broken fish	375 F cfa / kg	300 F cfa / kg
Revenue after sale of unbroken fish	76,900 F cfa	37,960 F cfa
Revenue after sale of broken fish	(048 x 375) =180 F cfa	(3.074 x 300 = 920 F cfa
Amount lost on the quantity of broken fish	(0.48 x 635) - (0.48 x 375) 125 F cfa	(3.074 x 500) - (3.074 x 300) 617 F cfa
Total revenue after sale	77,080 F cfa	38,880 F cfa
Percentage of losses due to transport and packaging in relation to the revenue from the load on modified package	0.00 % of revenue	0.10 % of revenue
Percentage of losses due to transport and packaging in relation to the revenue from the load on un-modified package	1.13 % of revenue	4 % of revenue

Table 11 : Experiment no.3 (Vridi Zimbabwe and Vridi Ako)

	Vridi Zimbabwe	Vridi II or Vridi Ako
Type of packaging used	basin	basket
Total quantity of fish transported	114.2 kg	79 kg
Number of load tracked: -load on improved packaging -load on un-modified packaging	2 2a 2b	2 21 22
Average weight of each load	40 kg	39.5 kg
Means of transport	town taxi	boat
Cost of transporting to market	850 F cfa / basin	900 F cfa / basket
Position of load in the vehicle	2 b = back booth, non super-imposed. 2a = front seat near driver	on the roof, with other baskets on top

Quantity of fish broken due to packaging and handling -load on improved package -load on un-modified package Total quantity	0.00 kg (0.00 % of total weight) 0.30 kg (0.75 % of total weight) 0.3 kg	0.04 kg (0.09 % of total weight) 3.70 kg (9.37 % of total weight) 3.74 kg
Place of sale of fish	new market of Treichville	Biafra market (Treichville)
Selling price of unbroken fish	622 F cfa / kg	350 F cfa /kg
Selling price of broken fish	350 F cfa / kg	250 F cfa / kg
Revenue after sale of unbroken fish	71,000 F cfa	26,342 F cfa
Revenue after sale of broken fish	0.3 x 350 =105 F cfa	3.737 x 250 = 935 F cfa
Amount lost on the quantity of broken fish	(0.3 x 622) - (0.3 x 350) 81.6 F cfa	(3.737 x 350) - (3.737 x 250) 373.7 F cfa
Total revenue after sale	71,105 F cfa	27,277 F cfa
Percentage of losses due to transport and packaging in relation to the revenue from the load on improved package	0.00 % of revenue	0.06 % of revenue
Percentage of losses due to transport and packaging in relation to the revenue from the load on un-modified package	0.42 % of revenue	6.69 % of revenue

Table 12 : Summary of the six experiments (Vridi Zimbabwe and Vridi Ako)

	Vridi Zimbabwe	Vridi II or Vridi Ako
Type of packaging used	basin	basket
Total quantity of fish transported	88.06 kg	87 kg
Number of load tracked: -load on improved packaging -load on un-modified packaging	2 2a 2b	2 21 22
Average weight of each load	38.33 kg	43.47 kg
Means of transport	town taxi	boat
Cost of transporting to market	850 F cfa / basin	900 F cfa / basket
Position of load in the vehicle	2 b =back booth, non super-imposed. 2a = front seat near driver	on the roof, with other baskets on top
Quantity of fish broken due to packaging and handling -load on improved package -load on un-improved package Total quantity	0.08 kg (0.20 % of total weight) 0.55 kg (1.43 % of total weight) 0.63 kg	0.05 kg (0.11 % of total weight) 2.35 kg (5.41 % of total weight) 2.40 kg
Place of sale of fish	new market of Treichville	Chicago market &Biafra market (Treichville)
Selling price of unbroken fish	712.33 F cfa / kg	497.33 F cfa /kg
Selling price of broken fish	405.67 F cfa / kg	300 F cfa / kg
Revenue after sale of unbroken fish	56,020 F cfa	42,832 F cfa
Revenue after sale of broken fish	273.76 F cfa	663.15 F cfa
Amount lost on the quantity of broken fish	209.78 F cfa	366.49 F cfa
Total revenue after sale	56,293.56 F cfa	43,495.38 F cfa

Percentage of losses due to transport and packaging in relation to the revenue from the load on improved package	0.09 % of revenue	0.06 % of revenue
Percentage of losses due to transport and packaging in relation to the revenue from the load on un-modified package	0.8 % of revenue	3.7 % of revenue

NB:The figures in this table are averages from the experiments done at Vridi Zimbabwe and Vridi II

Table 13: Data relating to post harvest losses due to packaging and transportation per survey site

Vridi-Zimbabwe	Experiment 1		Experiment 2		Experiment 3	
	Original	New	Original	New	Original	New
Quantity of fish broken (kg)	0,86	0,23	0,48	0,00	0,30	0,00
Price of unbroken fish (CFA/kg)	880,00	880,00	635,00	635,00	622,00	622,00
Price of broken fish (CFA/kg)	492,00	492,00	375,00	375,00	350,00	350,00
Loss due to broken fish (CFA)	757	202	305	0	187	0
Percentage loss in terms of revenue	**0,96**	**0,26**	**1,13**	**0,00**	**0,42**	**0,00**
Vridi-II	Experiment 1		Experiment 2		Experiment 3	
	Original	New	Original	New	Original	New
Quantity of fish broken (kg)	0,35	0,03	3,00	0,07	3,70	0,04
Price of unbroken fish (CFA/kg)	642,00	642,00	500,00	500,00	350,00	350,00
Price of broken fish (CFA/kg)	350,00	350,00	300,00	300,00	250,00	250,00
Loss due to broken fish (CFA)	225	19	1 500	37	1 295	14
Percentage loss in terms of revenue	**0,41**	**0,03**	**4,00**	**0,10**	**6,69**	**0,06**

NB: We assume that the fish lost would have been sold at price of good quality

322- Discussion

3221- Advantages of packaging proposed by the research team ([3]1)

a- The stacking up of 2 baskets and the careful filling of loads at Vridi Zimbabwe permitted a substantial reduction of product fragmentation during transportation to the markets. The figures obtained indicate **0.06 kg**((0.08 + 0.05)/2) of products being fragmented which represents **0.15 %** ((0.20 + 0.11)/2) of the quantity transported in the modified load against **1.45 kg**((0.55 + 2.35)/2) which is **3.42 %**((1.43 + 5.41)/2) of the quantity transported in the unmodified load.

b- The average financial losses due to fragmentation were evaluated at **0.075%** ((0.09 + 0.06)/2) of the revenues of the baskets with modified packaging and **2.25 %**((0.8 + 3.7)/2) for those which ordinary packaging. The processors would have therefore, lost **4.5 %**(2.25 x 2) of their revenues if no particular precaution had been taken.

3222- Disadvantages of packing proposed by the research team

a. The packaging used in Vridi II prevent the utilization of two baskets per load. The processor should as a result of this make an effort to increase her packaging capacity if she would like to follow the recommendations of the research team. To solve this problem, we

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[3]1- The figures of this chapter were obtained by addition of the results of the report summary of Vridi-II and de Vridi-Zimbabwe

ordered a sample of basket that looks like and has the capacity of two stacked baskets (photo 7). This basket is provided with a lid that is strong enough to resist shocks in case of overloading of the boat. The trials with the new basket made it possible to remove some weaknesses(the basket being too heavy and difficult to handle). Other baskets of similar type were ordered and tried in the target communities even outside the project with the aim of helping the economic operators reduce losses due to product fragmentation.

b- The stacked baskets contain less fish than those which are covered by plastic sheet or cloth. This was a major area of concern to the processors who feared carrying more load and hence spending more on transportation. The new type of basket tested makes it possible to solve this problem but the weaknesses underlined below remain to be solved.

c- In as much as we did not have any complaints from the owners of the transport boats during the three days of the trials, the processors think that in the long run the former would make them pay double the rate for the stacked baskets or our proposed large baskets since handling them would be more delicate.

d- At Vridi Zimbabwe, we were not able to find a final solution to the problem of product fragmentation, the interior of the vehicle not being able to carry all the load conveyed to the market, part of the goods having to be put in the back booth which often is responsible for triggering spoilage of the products. By being careful in the filling of the basins, we observe a substantial reduction of losses but the length of time in loading in this case delays the transporters who are generally in a hurry because they would like to make as many trips as possible to increase their revenue.

Conclusion and recommendations

a- The tests conducted demonstrate that it is possible to bring about a reduction in post harvest losses. The experiments revealed that during processing, we may make savings of one kilogramme of fish on a consignment of about 130 kg if the grill size is meticulously chosen. At marketing stage, it is possible to reduce the rate of fragmentation from **3.42%** to **0.15%** on a load of 40 kg by improved packaging of the same contents.

b- The level of post harvest loss reduction recorded remains weak but if we compare this with the total quantity of fish processed by the community, it becomes high. The annual landing of fish in Vridi area reaches 9,000 tonnes and this is entirely processed by smoking. The overall level of losses at present is therefore, estimated at 69 tonnes([4]1) of fish during smoking whereas fragmentation reaches about 122 tonnes([5]2) of processed fish which is sold for a lower price due to their lower quality.

c- These experiments have generated a lot of interest in the processors who eventually understood our aim in their midst.

d- The results obtained are interesting and should be spread to the communities of fishermen in Cote d' Ivoire and other countries in the West African sub region.

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[4]1- 9 000 tonnes/ 130 kg = 69 230 kg
[5]2- (9 000 tonnes x 36,46 / 100) = 3 281,4 tonnes of smoked fish
   3 281 x 3,57 / 100 = 121,08 tonnes
NB: - 36,46% =represents smoked fish in relation to fresh fish
   - 3,57% = (0,20 + 1,43) + (0,11 + 5,41)/ 2 = Average percentages of fragmented fish as a result of packaging (Table 12, 8 th line)

Difficulties

a- The main difficulty faced during the work was the disruption of landings of herrings due to the climatic changes recorded this year which prevented us from making fuller use of the experiments.

b- There is a problem with the weight difference obtained after smoking since as much as we ensured that the same quantity of fuel wood and intensity of fire in each oven were used, we are not certain if the degree of product dehydration is the same each time. It may be that the weight difference after smoking is partly due to the degree of dehydration of the fish lots. In our experiments we could not measure the degree of dehydration of the products but we would recommend that this be done in future investigations since it would make it possible to be certain of the reasons for the differences in weight.

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