POST-HARVEST FISHERIES
MONSOON LOSSES:

Phase III -1999
Validation of Select Findings

of
A Study of Small-Scale Fish Processors (1998)

By

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Background

The Natural Resources Institute (Chatham Maritime, U.K.) are engaged in a series of studies, started in 1997 under the DFID funded RNRKS Project R6817 – Wet Season Losses in India.

Second in the series was a study in 1998, the report on which is titled – "Post Harvest Fisheries Monsoon Losses; Phase II, 1998'. The report describes the situation of small-scale (fish) processors **(SSPs),** and monsoon losses incurred by them.

Fishing communities in India are spread across several hundreds of villages over more than 4000 km of coastline. While the SSP profile described in the 1998 study was robust enough in the context of the few villages and SSPs covered, the extent of its validity for the larger fishing community in India remained to be established. The 1998 study was limited to 14 SSPs in three villages – one each in Andhra Pradesh, Orissa and Kerala.

A workshop (Chennai, India, March 1999) reviewed the 1998 study and suggested validation of important findings over a larger number of villages and SSPs than had been possible until then. This was done, in Andhra Pradesh & Orissa, as part of Phase III (1999) of the study series, the report of which is the present document.

Objective of the study:

To validate agreed elements of the SSP profile described in the 1998 report, in (the states of) Andhra Pradesh and Orissa.

Approach:

The Andhra Pradesh – Orissa coastline was divided into **5 zones**[1] of roughly equal length, 150 to 200 km (using earlier reports of DFID-PHFP/ CMS).

Each zone was sub-divided into sectors of 20 to 25 km; a total of 40 **sectors. Two sectors per zone** were selected at random. Fishing villages in those sectors were listed. **Three villages per sector** were then chosen at random, 30 in all; (only 27 were covered eventually).

In each selected village, the pattern outlined below was followed for data collection:

- Preliminary exercises to develop a village profile and classify fish processors into large, medium, small processors; small being defined as those who process up to Rs.5000[2] worth of fish in a cycle.
- Listing SSPs in village.
- Individual interviews of a random sample (30% SSPs in village), using structured questionnaires;

Information from questionnaires was processed (using an agreed MS Access database structure), to produce this report. An overview of the statistical analysis used in Annex 1.

In all, 242 SSPs were interviewed across 25 villages. Some respondents did not answer all questions and for some variables the sample size is slightly reduced. Figure 1 shows the number of small-scale processors interviewed in each village.

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[1] Zone I - Whitekuppam to Chinna Ganjam, Zone II - Chinna Ganjam to Uppada, Zone III - Uppada to Gopalpur, Zone IV - Gopalpur to Paradeep, Zone V - Paradeep to Chandipur

[2] Rs. – abbreviation for Indian rupees; US $ 1 = Rs. 43.52 (Jan 2000)

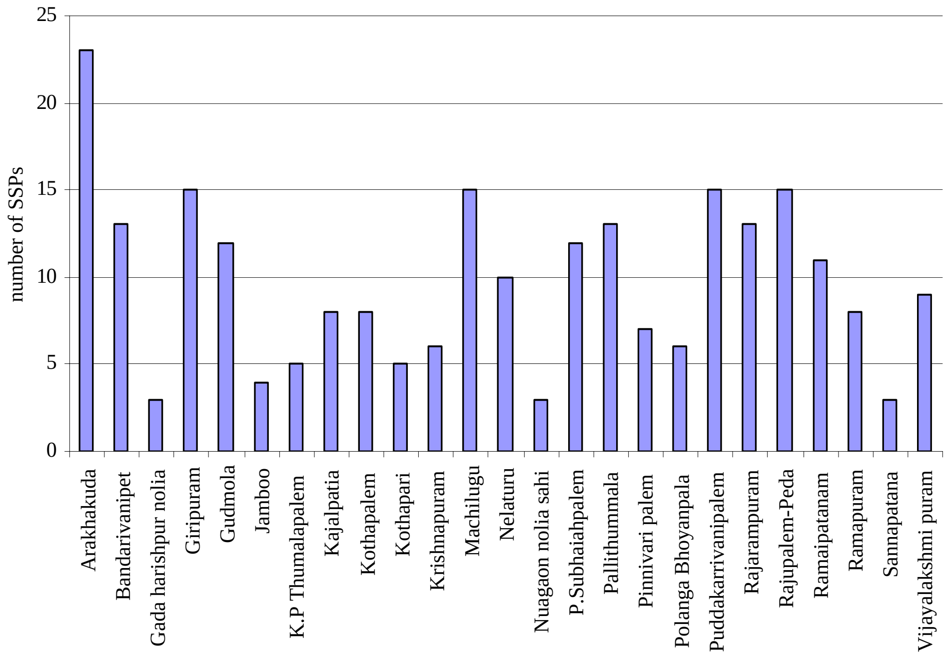


Figure 1 Distribution of number of SSPs per village

Fieldwork started in October 1999 and was close to completion a few weeks later when a severe cyclone struck in the very area where fieldwork was yet to be completed. There was much loss of human life and property. Given the state of fishing communities, who had lost almost everything, it was impossible to approach them with anything but relief supplies and aid. The situation remains largely unchanged at the time of writing this report. It was therefore decided to terminate fieldwork at that point, after consulting with NRI. Three villages in one sector (Orissa, Zone V) could not therefore be covered.

[The absence of information from the three remaining villages does not however seem to have affected the main purpose of the present exercise.]

FINDINGS:

The findings are in two parts:

EARLIER FINDINGS VALIDATED

EARLIER FINDINGS NOT VALIDATED

There is also a list of findings (of the 1998 study) whose validation was ***not attempted*** in the present study. Future studies could possibly address those.

Format of presentation

In bold italics below, numbered serially (and in blue colour), are ***short statements*** of specific 1998 study findings that were to be validated by the present study. Under each such statement, in ordinary print (and black colour), are findings of the present study (1999), which validate, qualify or question that particular statement.
The main report below presents findings in a narrative form for the general reader, with a minimum of figures.

Readers may bear in mind that the scope and depth of the present survey was limited. No doubt many more interesting questions could have been asked, and some avenues explored more thoroughly, to provide more details and insights, surer confirmation of known realities. Any analysis (especially statistical analysis) in this report is incidental, not central to its purpose. That must be left to future researchers. This report is offered on the basis of available information. To the extent that the present study was aimed at validating certain rather tentative findings of earlier studies, it seems to have fulfilled its purpose.

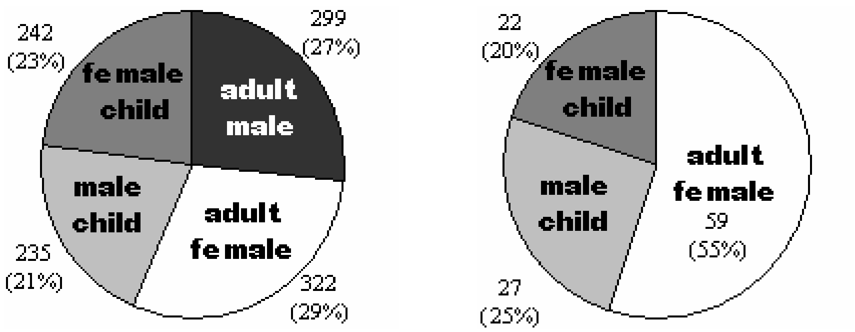
Part 1 – Earlier Findings Validated

1. SSPs are generally women.

Although the SSPs were selected randomly, 95% (230) of the sample were women. Male processors were found only in two communities - immigrants from Bangladesh, settled in Orissa and a few island / remote Orissa fishing village.

17% (42) of the SSPs belonged to households with no adult male member; i.e. woman-headed households. Without men to engage in fishing, women-headed households are cut off from the most important source of income and food available to their communities. Women-headed household SSPs are therefore especially vulnerable, and heavily dependent on fish processing and fresh fish trading. Incomes from fishing, the man's domain, are usually much more substantial than from processing/trading, which is the woman's domain.

Figure 2 shows the distribution of family members for both male and female headed households. The average family size for a male headed household is 5.5, however the distribution is skewed and boostrapping was used to calculate a 95% confidence interval of (5.2 to 5.8). The average family size for a female-headed household is 2.6 and a bootstrapped 95% confidence interval is (2.1 to 3.0). As the family size data is skewed the median is also a useful summary statistic. The median size for male headed households is 5, with an interquartile range of (4 to 6) and the median for women headed households is 3 with an interquartile range of (1 to 4).



200 Male headed households   42 Female headed households

Figure 2 Distribution of family members for male and female headed households

The average length of time that SSPs have been processing is 13.8 years, with a 95% bootstrapped confidence interval of (12.4 to 15.3) years. Again the distribution is skewed and the median time is 10 years with an interquartile range of (6 to 20).

2. *Working capital employed by SSPs is in the range Rs. 500-3000 (1998 prices[3]).*

Figure 3 summarises the distribution of working capital.

Rs.	Men headed households (200)	Women headed households (42)	All households (242)
< 500	38	15	53
501 – 1000	52	10	62
1001 – 2000	90	11	101
2001 – 3000	7	5	12
3001 – 5000	12	1	13
>5001	1	0	1

Figure 3 Distribution of working capital

Working capital employed by 72% (175) of all SSPs (72%) is in the range Rs. 500 – 3000 (1999 prices)[3]. Overall 22% (53), presumably poor SSPs, employ less than Rs. 500 as working capital (1999 prices). Only 6% (14) use more than Rs. 3000.

From Figure 3 there are clear differences between male and female headed households and there is an indication that female-headed households have less capital at their disposal. . Using only the two columns for men and women headed households a chi-squared test can be performed to test whether the gender of household head is independent of working capital. Due to some small cell counts an exact permutation test must be performed. An exact chi-squared gives a p-value of 0.02, indicating that at the 5% level there is a significant difference in the distribution of working capital between men and women headed households

3. *The frequency of processing by SSPs is usually one to three cycles per week.*

Figure 4 shows the distribution of frequency of processing amongst all the SSPs.

Frequency of processing	Number of households (241)*
Daily	22
Once a week	46
Twice a week	55
Thrice a week	91
Less than once a week	27

* Only 241 households as there was one invalid response

Figure 4 Frequency of processing

Three cycles per week is most common, with 38% SSPs in this group. 79% SSPs process between one and three cycles per week. A chi-squared test gives highly significant evidence for a preference of three times a week.

[3] national average inflation based on the wholesale price index has remained generally in the range 3-5% (annualised) for most months in the years in question.

4. *SSPs choose to process in the monsoon despite risks and losses, because of opportunities to make a net profit.*

All but 1 of the 242 SSPs processed fish during the last monsoon (1999).

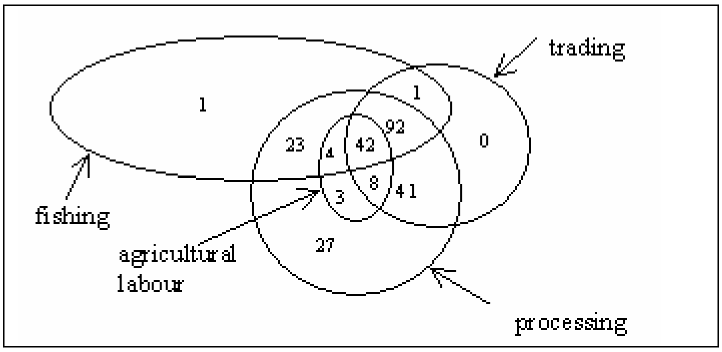
5. *Main sources of SSP household income are fish processing, fish trading, and fishing. Alternative sources of income are limited or non-existent.*

There is a complicated structure for the combinations of sources of income, which is summarised in Figure 5, where the combinations with the highest counts have been highlighted.

Fishing	Processing	Trading	Agricultural labourer	Other Labour	Own Agriculture	Count
Yes	Yes	Yes	Yes	No	Yes	2
Yes	Yes	Yes	Yes	No	No	40
Yes	Yes	Yes	No	Yes	No	1
Yes	Yes	Yes	No	No	Yes	3
Yes	Yes	Yes	No	No	No	88
Yes	Yes	No	Yes	Yes	Yes	1
Yes	Yes	No	Yes	No	No	3
Yes	Yes	No	No	No	No	23
Yes	No	Yes	No	No	No	1
Yes	No	No	No	No	No	1
No	Yes	Yes	Yes	No	No	8
No	Yes	Yes	No	Yes	Yes	1
No	Yes	Yes	No	Yes	No	8
No	Yes	Yes	No	No	Yes	1
No	Yes	Yes	No	No	No	31
No	Yes	No	Yes	No	No	3
No	Yes	No	No	Yes	No	1
No	Yes	No	No	No	Yes	1
No	Yes	No	No	No	No	25
Yes=163 No = 79	Yes = 240 No = 2	Yes = 184 No = 58	Yes = 57 No = 185	Yes = 12 No = 230	Yes = 9 No = 233	

Figure 5 All possible combinations of sources of income

It is clear that other labour and own agriculture account for a minority of SSPs and a useful summary of Figure 5 can be obtained by using a Venn diagram to represent the first four columns.



Sample size = 242

Figure 6 Venn diagram for fishing, agricultural labour, processing and trading

Over half of all SSPs (55%) derive incomes from all three (fish-related) activities – fishing (through men) and processing & fresh fish trading (through women). Involvement in ***only fishing or trading alone*** is rare, 11% of SSPs are involved in ***only fish processing***.

As may be expected, SSPs and their households try to diversify income sources whenever possible. Where a particular source is not exploited, it would seem reasonable to look for a constraint.

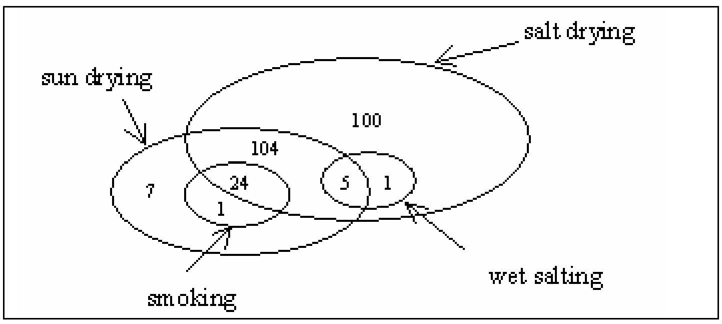
Fish processing and fresh fish trading are very important to all SSPs, and critical to SSPs from women headed households. (Fishing is open only to households with male members old enough to go to sea)

6. Some SSP households obtain income from labour.

From Figure 5, 24% of SSPs obtain some income from agricultural labour and 5% from other types of labour.

7. Wet salting and sun drying[4] are the main ways of processing fish by SSPs.

Figure 7 shows the relationships between the four recorded methods for processing fish.



Sample size = 242

Figure 7 Distribution of processing methods.

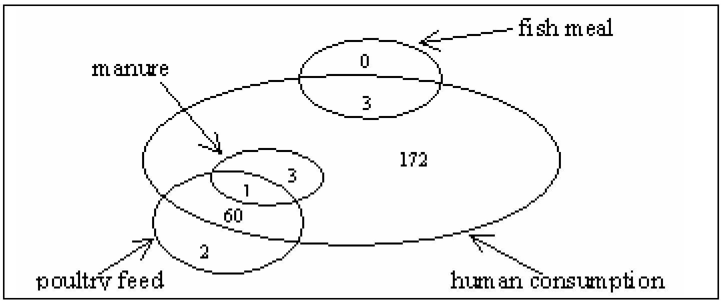
[4] For explanations of processes used, refer to monsoon loss study report 1998; see bibliography for details.

Salt drying is the most common process, employed by 97% of SSPs, with 41% employing only salt drying. Sun drying is preferred next, employed by 58% of SSPs, with 3% employing only sun drying.

Smoking and wet salting are location-specific processes; employed where there is a demand for products of these processes. 10% and 2% of SSPs respectively reported using these processes.

8. Most SSPs process fish for human consumption.

The utilisation of the processed fish is described in Figure 8.



Sample size = 241 (utilisation not recorded for one SSP)

Figure 8 Utilisation of processed fish.

99% of SSPs process fish primarily for human consumption, 71% exclusively.
Fish is processed for poultry feed by 24% of SSPs, but only 3% use processed fish for fishmeal or manure. These three products are usually the result of lots gone bad or when raw material available/used is of poor quality.

9. Most SSPs incur monsoon losses.

Both physical and quality (selling at reduced prices) losses were recorded. Figure 9 shows the number of lots discarded and it is clear that most SSPs reported physical loss (note two respondents gave no response).

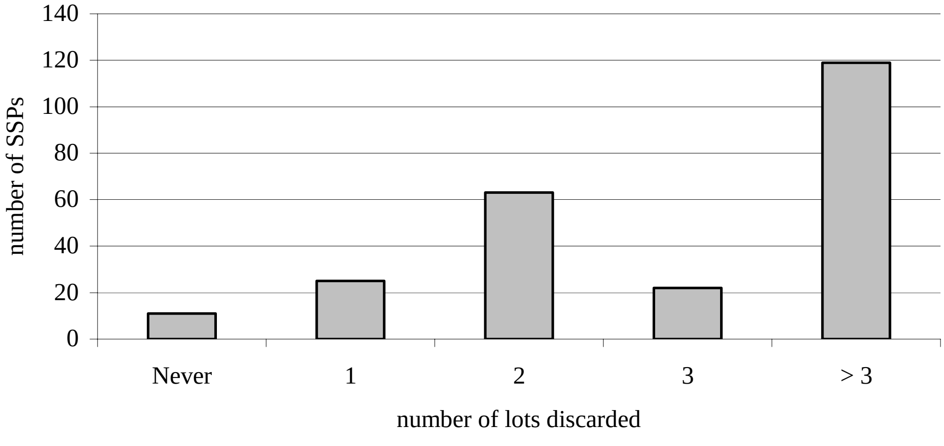


Figure 10 Number of lots discarded during monsoon

The frequency with which SSPs reported sales at reduced prices is shown in Figure 10 (Note there were 19 non-responses for this question).

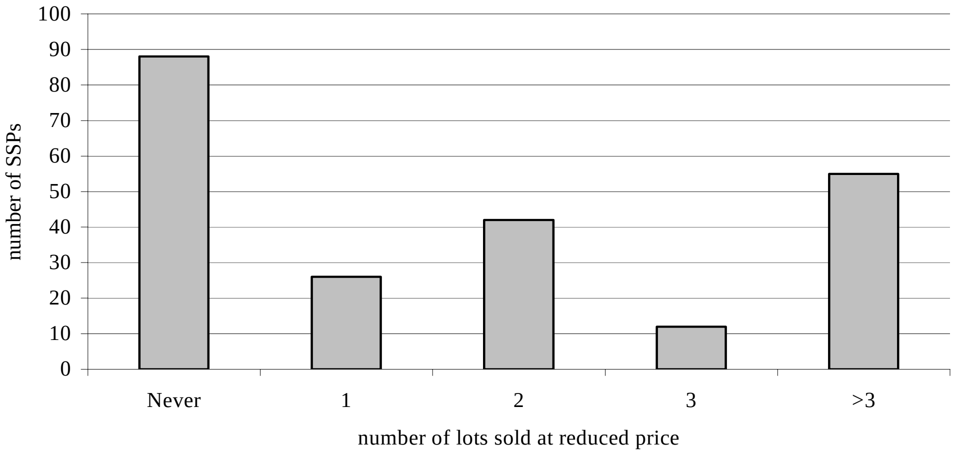


Figure 10 Number of lots sold at reduced price during monsoon

It is clear that the majority of SSPs do incur some losses during the monsoon, although 40% do not sell any lots at a reduced price. A more in depth analysis of the type of losses is shown in Figure 11 by the cross-tabulation of how many lots are discarded against how many lots are sold at reduced price. The highlighted cells show those combinations with the highest counts. Note the sample size for Figure 11 is the 223 SSPs who responded to the question 'How many lots sell at reduced price?'.

		How many lots sell at reduced price					
		0	**1**	**2**	**3**	**>3**	
How many lots are discarded	**0**	3	0	1	1	5	10
	1	5	13	2	0	2	22
	2	30	2	13	4	4	53
	3	7	3	7	3	2	22
	>3	43	8	19	4	42	116
		88	26	42	12	55	223

Figure 11 Cross-tabulation of physical versus quality loss

A Pearson chi-squared test (Monte-Carlo version of the exact test to allow for small cell counts, gives highly significant evidence (p-value < 0.001) for rejecting the null hypothesis that the number of lots discarded and the number of lots sold at reduced prices are independent. The nature of the dependence could do with some further interpretation.

10. The main causes of SSP monsoon losses are long rainy spells preventing timely drying, or sudden showers wetting partly dried fish.

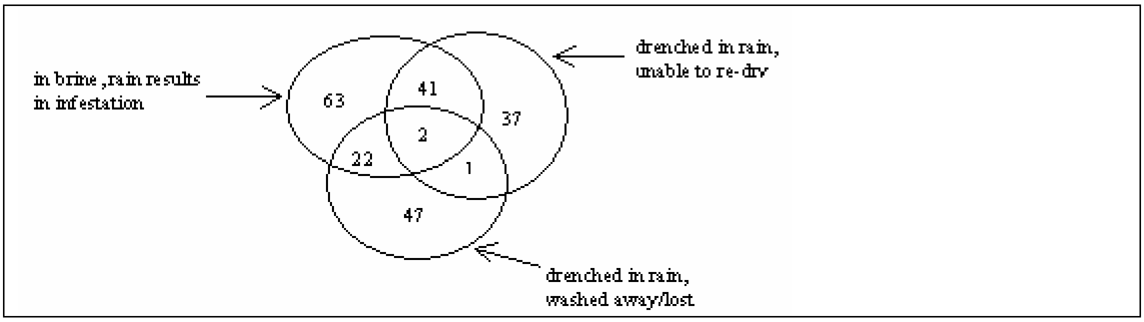
Seven causes of monsoon losses were recorded by the survey and the combination of answers is summarised in Figure 12.

Material in brine, continuous rains resulted in infestation	Material drying drenched in rain, washed away/lost	Material drenched in rain, unable to redry, infestation	Material stored , infestation	Low quality material processed, infestation in brine	Market forces	Not processed properly	Count
Yes	Yes	Yes	No	No	Yes	No	1
Yes	Yes	Yes	No	No	No	No	1
Yes	Yes	No	No	No	No	No	22
Yes	No	Yes	No	No	No	No	41
Yes	No	No	Yes	No	No	No	1
Yes	No	No	No	Yes	No	No	1
Yes	No	No	No	No	No	Yes	1
Yes	No	No	No	No	No	No	60
No	Yes	Yes	No	No	No	No	1
No	Yes	No	No	No	No	No	47
No	No	Yes	Yes	No	Yes	No	1
No	No	Yes	Yes	No	No	No	1
No	No	Yes	No	No	No	No	35
No	No	No	No	No	Yes	No	4
No	No	No	No	No	No	Yes	4
No	No	No	No	No	No	No	21*
Yes = 128 No = 114	Yes = 72 No = 170	Yes = 81 No = 161	Yes = 3 No = 239	Yes =1 No = 241	Yes = 6 No = 236	Yes = 5 No = 237	

* Note 13 of these SSPs did report monsoon losses, but gave no reason.

Figure 12 Causes of monsoon losses

The highlighted rows give the most important combinations and the table can be summarised by considering a Venn diagram representation of the first three columns.



Sample size is 221 (21 SSPs who came up with no reason are taken as non-respondents)

Figure 13 Venn diagram for combination of most important losses

Other, relatively minor causes of losses were:

- Adverse market forces
- Poor raw material leading to low-quality produce
- Infestation in storage

The implication of these findings for any intervention on the technical front is clear. Protection of material from rain and/or feasible alternatives to sunlight for drying could potentially reduce monsoon losses for 95% of the SSPs.

11. SSPs cope with monsoon losses by selling affected material at lower prices, and/or by borrowing money to stay in business.

There is a number of coping strategies, with all recorded responses summarised in Figure 14, with the most important combinations highlighted.

	a	b	C	d	e	f	g	h	i	j	k	count
	Yes	Yes	Yes	No	No	No	No	No	No	No	No	6
	Yes	Yes	No	No	No	Yes	No	No	No	No	No	1
	Yes	Yes	No	No	No	No	No	No	No	Yes	No	1
	Yes	Yes	No	No	No	No	No	No	No	No	Yes	2
	Yes	Yes	No	No	No	No	No	No	No	No	No	61
	Yes	No	Yes	No	No	No	No	No	No	No	No	4
	Yes	No	No	Yes	No	No	No	No	No	No	No	6
	Yes	No	No	No	Yes	No	No	No	No	No	No	1
	Yes	No	No	No	No	Yes	No	No	No	No	No	2
	Yes	No	No	No	No	No	Yes	No	No	No	No	2
	Yes	No	No	No	No	No	No	Yes	No	No	No	5
	Yes	No	No	No	No	No	No	No	No	Yes	Yes	8
	Yes	No	No	No	No	No	No	No	No	Yes	No	5
	Yes	No	No	No	No	No	No	No	No	No	Yes	3
	Yes	No	No	No	No	No	No	No	No	No	No	52
	No	Yes	Yes	No	No	No	No	No	No	No	No	1
	No	Yes	No	Yes	No	No	No	No	No	No	No	1
	No	Yes	No	No	No	Yes	No	No	No	No	No	4
	No	Yes	No	No	No	No	No	Yes	No	No	No	2
	No	Yes	No	No	No	No	No	No	No	Yes	No	1
	No	Yes	No	No	No	No	No	No	No	No	No	34
	No	No	Yes	No	No	No	Yes	No	No	No	No	2
	No	No	Yes	No	No	No	No	No	No	No	No	2
	No	No	No	Yes	No	No	No	No	No	No	No	4
	No	No	No	No	Yes	No	Yes	No	No	No	No	1
	No	No	No	No	No	Yes	No	No	No	No	No	4
	No	No	No	No	No	No	Yes	No	No	No	No	3
	No	No	No	No	No	No	No	Yes	No	No	No	12
	No	No	No	No	No	No	No	No	Yes	No	No	1
	No	No	No	No	No	No	No	No	No	Yes	No	2
	No	No	No	No	No	No	No	No	No	No	Yes	2
	No	No	No	No	No	No	No	No	No	No	No	7*
Yes	159	114	15	11	2	11	8	19	1	17	15	
No	83	128	227	231	240	231	234	223	241	225	227	

* Only three of these SSPs reported no physical or quality loss

Figure 14 Coping strategies for monsoon losses

a	Made up in subsequent lots	g	Take up other work
b	Borrowed money	h	Brought in own money
c	Reduced turnover	i	Sold assets
d	Increased Turnover	j	Discount from fishermen
e	Stopped processing	k	Got credit facility
f	Pledged gold jewellery		

Key to columns

It is clear that making losses up in subsequent lots and borrowing money are the most common strategies. Of the 202 SSPs who use these two strategies, 88 make up loss in subsequent lots only, 43 borrow money only and 71 use a combination of the two. Nearly half (47%) of the sample report having to borrow to stay in business after suffering monsoon losses. 50% of the 42 SSPs from women headed households are also in the same situation. The cost of borrowing is high, and represents a heavy burden, especially on the poorest households.

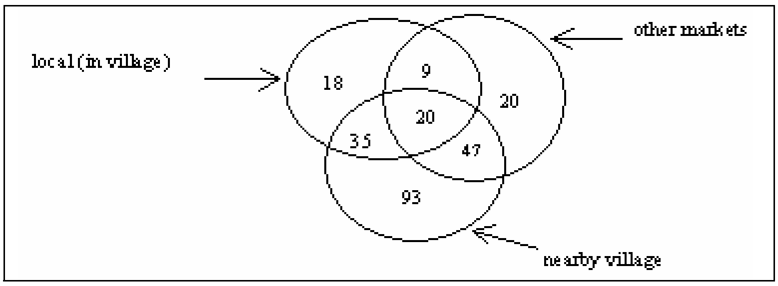
6% reduce turnover and 1% cease processing, following losses. These are presumably households with no access to credit, very likely the poorest in the community. Given the criticality of processing to poor households, the impact of monsoon losses is particularly harsh.

5% are able to cope with losses by ***increasing*** turnover. 8% make up losses by infusing more capital from their cash reserves, 6% through institutional credit, 5% by pledging gold and other valuables, and 3% by taking up other work. Interestingly, some 7% report, being able to obtain discounts from fishermen from whom they buy fish.

Note the % values are calculated from a sample size of 242. However seven of these SSPs had no coping strategies, although only three of these SSPs reported no physical or quality loss. Consequently it may be appropriate to adjust the sample size, but the reduction will be small, having little affect on the percentage values.

12. SSPs generally sell in village or nearby markets.

The responses are summarised in the Venn diagram of Figure 15.



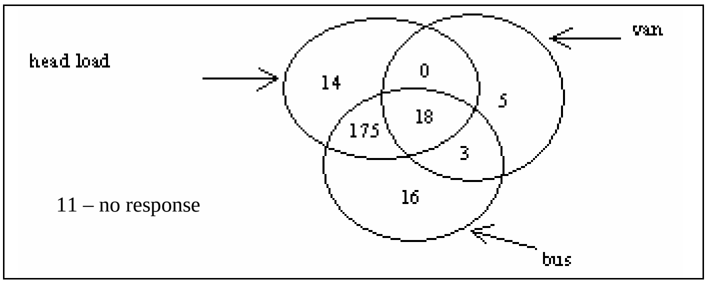
Sample size is 242

Figure 15 Summary of where SSPs sell their fish

Only 7% of SSPs sell ***all their*** produce within their own villages, but 34% sell at least ***some*** produce in their own villages. 93% of SSPs sell at least some produce outside their village, but 66% of processors do not sell produce in their village. 40% of SSPs sell in other markets (mostly in small towns), with about a fifth of these selling all their produce in such markets.

13. Walking long distances to markets/villages is one of the problems faced by SSPs.

Figure 16 summarises the responses with a Venn diagram – notice there is a non-response of 11 for this question.



Sample size is 231, plus 11 non-respondents

Figure 16 Transport used by SSPs

Retailing to consumer houses in or around villages necessarily involves headloading. Even for lots sold in markets, headloading part of the way, when motor transport is not available, is necessary. 89% of SSPs report using headloading, and 93% some form of motor transport. 83% of SSPs report using both. A few (6%) SSPs report transporting all their produce by headloads, and another 10% by motor transport only.

14. Processing small species is risky, as is sun drying in monsoons.

All 242 respondents associated at least one species with loss during the monsoon. 59% of SSPs associate (various) small species with monsoon losses. 37% of SSPs practice sun-drying ***and*** associate small species with monsoon losses. This is especially significant, given that sun drying is the process used for most small species.

Specific species identified as loss-prone in monsoon processing are – sardines (41% of SSPs), ribbonfish (40%), mackerel (34%), anchovy (31%), croaker (24%) and mullet (23%).

Part 1 – Earlier Findings Not Validated

15. Between 20 and 30% of all processors in a village are SSPs.

On average 60% of all processors in the 25 villages covered by the present study are SSPs. (Std. Dev. 29%, range 13 – 100%). There is too much variability in this data to obtain a meaningful estimate.

Annex 1

Useful statistical methods

i. Graphical techniques

As in any survey analysis graphical methods have an important role for the concise representation of data. Venn diagrams have been particularly useful in this analysis for displaying the intersecting relationships between up to four classifications. They can be used with any number of classification groups, but they can become so intricate that they are no longer simple to interpret. It should be noted that pie charts are generally only used when the classification groups are not intersecting.

ii. Basic statistics

Basic summary statistics have a central role in any analysis. Point estimates of summary statistics should where possible be accompanied by some indication of their accuracy.

iii. Confidence intervals

Point estimates (the mean of a data set for example) are often accompanied by an estimate of their standard deviation (usually called the standard error). Although this conveys some information, it is more informative to actually give a 95% confidence interval for the point estimate. This can be interpreted as meaning that the confidence interval has a 95% chance of containing the true mean of the population.

Assuming that the data is sampled from a normal distribution the confidence interval can be estimated as point estimate ± 2 * standard error of the mean. However, as in the time and percentage data here, it is difficult to justify the assumption of normality, especially for counts, scores or ratios. As the distributions are often skewed a central confidence interval might not be representative.

iv. Calculation of confidence intervals for non-normal distributions.

The median is often a better summary statistic for a skewed distribution (i.e. non-normal) than the mean, because it is less affected by extreme values. However there are no general parametric methods for calculating the confidence interval for a median. Consequently a numerical technique called bootstrapping [1] is used. This re-samples from the observed data to quantify how unusual the observed data set is.

It is also useful to calculate the confidence interval for the mean, but as the non-normality implies that the standard central interval of the previous section might not be appropriate. Again the bootstrapping technique can be used to estimate a non-central interval. If the distribution is approximately normal then bootstrapping intervals which are very close to the parametric central intervals.

If non-normality and skewness is suspected then it is often better to quote both the median and the mean and their respective confidence intervals.

v. *Cross-tabulations*

These are excellent methods for comparing information from two or more responses. Two-dimensional tables can be analysed using the chi-squared technique [2] to determine whether the rows and columns are independent. However this makes the important assumption that cell counts within the cross-tabulation should be greater than five. This case is often violated and the chi-squared test result should be validated using a numerical permutation test.

This is another numerical technique and samples all possible tables given the row and column totals [3]. This is an intensive technique and the number of possible tables can grow very large, even for small numbers of row and columns. If computationally feasible all possible tables are evaluated and this is termed an exact test chi-squared test. Often it is not possible to enumerate all possible tables and a large sample (in excess of a 1000) of the tables is taken and this is called a Monte-Carlo chi-squared test.

vi. *Distribution tests*

In Section 3 it was useful to know whether the distribution of SSPs amongst the different frequencies of processing was equal or not. Here another form of the chi-squared test can be used to test this assumption. This test can be used to test whether it is reasonable to assume that data has been sampled from a particular distribution such as the normal distribution.

References

[1] 'Randomisation, bootstrap and Monte-Carlo methods in biology', B.F.J. Manly, Chapman & Hall.

[2] 'Statistical methods in agriculture and experimental biology', R. Mead and R.N. Curnow, Chapman & Hall.

[3] 'Applied non-parametric statistical methods', P. Sprent, Chapman & Hall.