Impacts of Oil Palm Activities in the Kokoda and Popondetta Catchments

An Initial Environmental Examination

February-March 2006

Sedimentation in Bauroda Lagoon – Ninianda Bay

Report for CELCOR and Ahora/Kakandetta Peoples Foundation

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Abbreviations

ACF	Australian Conservation Foundation
AKPF	Ahora/Kakandetta People's Foundation
CCA	Copper Chrome Arsenic
CDC	Commonwealth Development Corporation
CELCOR	Centre for Environmental Law and Community Rights Inc.
DEC	Department of Environment and Conservation (PNG)
EFB	Empty Fruit Bunch
EIA	Environmental Impact Assessment
FFB	Fresh Fruit Bunch
HOPPL	Higaturu Oil Palm Plantations Ltd.
IEE	Initial Environmental Examination
LSS	Land Settlement Scheme
OPIC	Oil Palm Industry Corporation
POME	Palm Oil Mill Effluent
RSPO	Roundtable on Sustainable Palm Oil
VOP	Village Oil Palm

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SECTION 1- EXECUTIVE SUMMARY

An initial environmental examination (IEE) of the impacts of oil palm activities in the Popondetta area has been undertaken. Through agreement with the Australian Conservation Foundation (ACF) and The Centre for Environmental Law and Community Rights Inc. (CELCOR), environmental consultants Ben Cole and John Craven were engaged to undertake the IEE. The aims of the IEE were to identify issues and to determine priorities for an environmental impact assessment (EIA) and evaluate whether available data could support legal action.

The consultants visited the site during February-March (2006) to undertake the IEE. Water and soil sampling was recorded in the field and samples were returned to Australia for further analysis. The consultants were supported and joined by members of the Ahora-Kakandetta Peoples Foundation (AKPF) during the investigation. Two members of AKPF were trained in water quality techniques using a simple testing kit. Interviews were conducted with local villages located downstream of the mill.

Water quality in the upper catchment of Kokoda was a very high standard. Sampling in the Popondetta catchment revealed coliforms in drinking water sources indicating ground and surface water biological contamination. Dissolved oxygen levels were depressed at the location of the discharge point from the mill. Oil and grease levels of 6ppm were detected in samples collected from the discharge point. The results suggest that discharge from the retention ponds from the mill is constant during the wet season.

Massive levels of sedimentation were observed throughout the rivers, streams and estuarine systems of Popondetta. Sedimentation of estuaries and rivers is recognized as a major environmental problem associated with oil palm plantations. Local community members described a range of environmental and health concerns that had occurred since the introduction of oil palm. The most serious concerns included the permanent loss of fish species, contamination of drinking water and general decline in health.

EXECUTIVE SUMMARY – RECOMMENDATIONS

1. **Further scientific studies are unlikely to support a compensation claim against the HOPPL mill**

Due to the time lag and confounding within the study site the gathering of scientific evidence for a legal compensation claim against the mill would demand high costs and time (~US$500,000). It is possible that any further scientific investigations would not provide adequate evidence to develop a legal claim.

2. Further environmental investigations should focus on CELCOR campaign outcomes

Any further environmental investigations should support the oil palm campaign activities of CELCOR. Two potential areas of study are; a) sedimentation of rivers downstream of oil palm plantations and b) comparison of fish populations in oil palm impacted and non-impacted river systems.

3. Support community-led environmental auditing and mapping skills with AKPF members in the Popondetta catchment

The benefits of encouraging environmental auditing and mapping skills would include; extend the community's negotiating power with the management of the HOPPL mill, encourage empowerment of the local community and promote more sustainable activities on a personal level. The environmental auditing skills would include community mapping techniques, recording of village-level health data, water quality assessment and recording of fish health and mortality.

4. Kokoda should be the preferred site for a detailed EIA

If CELCOR decides to fund an EIA we suggest the Kokoda catchment as a potential study site. As a mill has been proposed at the Mamba estate in Kokoda the development of a detailed, independent EIA would provide a vital baseline of the environmental conditions.

5. Contaminated drinking water poses a significant health threat in the Popondetta catchment

Contaminated drinking water is a major health issue in the Popondetta catchment. A comprehensive sampling regime and accurate microbiological laboratory equipment should be used to confirm this studies findings. The development of funding proposals and partnerships with the local Health Department and community groups should be encouraged.

SECTION 2 - INTRODUCTION

In 1976, the PNG government entered a joint venture with the British Commonwealth Development Corporation (CDC) and formed the Higaturu Oil Palm Plantation Ltd. (HOPPL). HOPPL began work by converting 4,500 hectares of a 16,000 hectare cocoa scheme into an oil palm estate-smallholder project. The development was on customary land and on land tenure conversion blocks. Village oil palm smallholders expanded significantly from 1993 under the World Bank's "Oro Smallholder Oil Palm Expansion Project". By 2000, the total area of smallholder plantings had increased to approximately 13,000 hectares.

HOPPL was recently acquired by Cargill and Temasek Holdings. Cargill is an international provider of food, agriculture and risk management products and services. Cargill BV, a part of Cargill joined the roundtable on sustainable palm oil (RSPO) in May 2004. Temasek Holdings is the Singapore government's investment arm and is managing a diversified global portfolio of US$63 billion, across the Asia-Pacific and the rest of the world.

In February 2006, consultants John Craven and Ben Cole were contracted by the Australian Conservation Foundation on behalf of CELCOR to conduct an initial environmental examination (IEE) of the HOPPL mill and plantations in Popondetta. A scoping document was produced to assist with the selection of priority issues in the IEE. The key objective of the IEE was to collect and assess scientific evidence that could be used to support claims for compensation by villages located downstream of the oil palm milling operations.

The study sites were located in the areas surrounding Kokoda and Popondetta townships. The scientific investigations focussed on water quality, soil fertility, sedimentation of waterways, chemical use and health indicators. Extensive community interviews were undertaken to record the environmental and health changes perceived by the local communities. The IEE was assisted by representatives from the Ahora-Kakandetta Peoples Foundation (AKPF). The AKPF have expressed ongoing concern about the environmental management of the HOPPL mill located in Popondetta.

The IEE was conducted during February and March 2006 with Ben Cole spending two weeks at the investigation site and John Craven joining him for the final week of the site investigation.

The activities of the IEE included:

- ✓ Mapping of the study areas
- ✓ Identification of reference sites for comparison of water quality parameters
- ✓ Measurement of water quality parameters downstream and upstream of discharge points from the mill and settlements
- ✓ Baseline assessment of water parameters within waterways unaffected by milling operations in Kokoda
- ✓ Pilot assessment of soil fertility and contaminants in plantation and reference sites

- ✓ Family-level identification of fish species in the study area
- ✓ Training CELCOR and AKPF field workers in water quality assessment techniques
- ✓ Interviewing community members, University of PNG staff and, company and government officials
- ✓ Collection of available data (documented and anecdotal) of health issues

This report is a compilation of the findings and recommendations of the IEE. The report includes nine sections.

1. **Executive summary**
2. **Introduction**
3. **Results**: include two parts, A) a scientific paper that records and discusses the water and soil parameter measurements, fish population losses and sedimentation observations and, B) a summary of interviews conducted with community members and others.
4. **Review of toxic chemicals**: overview of herbicides and pesticides used in oil palm plantations. It also includes a review of the wood preservative CCA.
5. **Summary of issues**: discussion of the environmental and health issues arising from the results of the IEE
6. **Legal options and issues**: identification and examination of the legal implications of the results of the IEE
7. **Issues and recommendations**: by CELCOR campaigners and AKPF field workers.
8. **Conclusion, continuing processes and recommendations**: processes and recommendations to assist the local community in the development of their environmental auditing, negotiating skills and local, sustainable development
9. **Appendices:** contains **s**coping document reviewing Environment Reports and chemicals used; interviews; information about activated carbon and production of soap from coconuts; and a data collection sheet.

SECTION 3: RESULTS

PART A: Findings from the initial environmental examination of the Popondetta and Kokoda catchments

Abstract

This study was a short-term examination of the environmental conditions in the Kokoda and Popondetta catchments. The Kokoda water quality was found to be of a very high standard. The waterways in the Popondetta catchment were regularly contaminated with oil palm mill effluent and human sewage. Levels of oil and grease in the Ambogo River from the discharge point were not measured to be excessively high (6ppm). Dissolved oxygen levels were depressed within the discharge plume throughout the four-day sampling regime and during the overnight sampling regime. Widespread sedimentation of the coastal region of the Popondetta catchment was observed. The observations support the hypothesis that a high level of sediment run-off occurs from oil palm plantations. Community interviews revealed numerous fish species were no longer present in the Popondetta catchment since the introduction of oil palm.

Plate 1: Sampling water quality with multi-parameter monitor.

Introduction

Large-scale agricultural practices and urbanisation have been identified as major contributors to environmental stress on the ecological health of rivers and coastal systems (Cooper, 1993; Nixon, 1995). The increased use of artificial fertilisers combined with the removal of natural vegetation for cultivation and urbanisation has caused a world-wide trend of increasing nutrient and sediment loads in coastal river systems (Berka et al., 2001; Gabrick and Bell, 2003). Problems associated with high nutrient and sediment loads include pollution of groundwater, decreases in coastal fishery populations, loss of biodiversity and shifts in natural ecosystem functioning (Costanzo et al., 2003). Contamination from sewage into river systems and groundwater is a common symptom of poorly managed urban and agricultural developments.

Oil palm plantations create a variety of impacts on the surrounding environment. Impacts of oil palm include loss of native vegetation, erosion of soil, sedimentation of streams, rivers and estuaries, introduction of pesticides and fertilisers and water and air pollutants (Keu, 2000). Environmental organizations have identified the lack of independent monitoring of the oil palm industry as a major flaw in its development throughout PNG (LaFranchi, 1999). An independent assessment of oil palm plantations and mills would provide important information in assessing their environmental impacts.

This study was conducted to; develop a baseline of water quality parameters in two regions in the Oro and Kokoda provinces of Papua New Guinea, assess changes in soil parameters in oil palm plantations, determine sedimentation of river and estuarine systems downstream of oil palm plantations and record oral histories of changes in fish populations.

Materials and methods

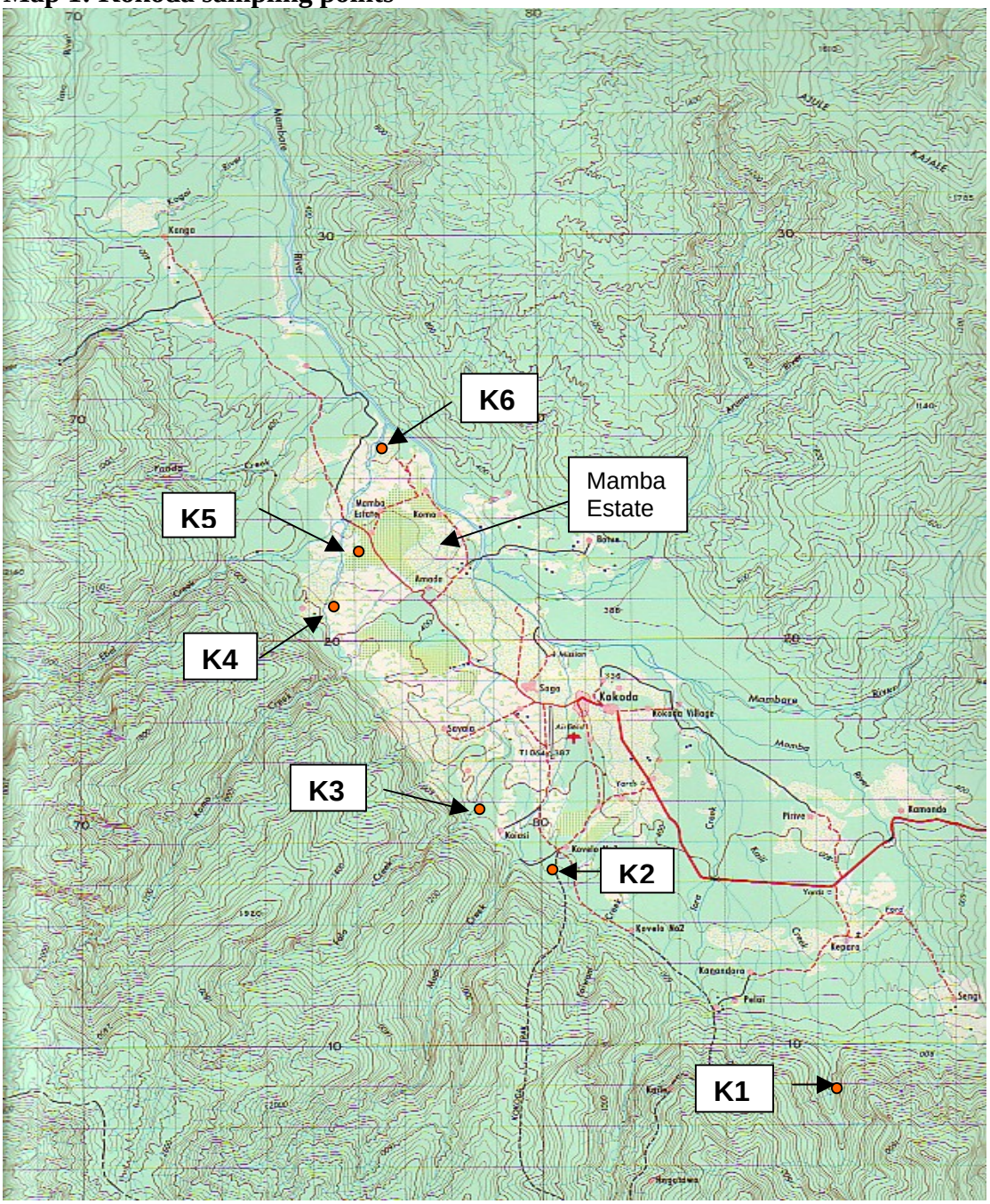
SITE LOCATIONS

The Kokoda region was selected as the reference region as the catchment did not have an operational oil palm mill and less intense plantation development. The sampling points were taken from two rivers that began in the Owen-Stanley Ranges. Six sampling points were selected including an upstream reference site that did not have any oil palm or other intensive agriculture upstream.

The site locations were K1 (S 8 55.763', E 147 47.467); K2 (S 8 52.194, E 147 44.029); K3 (S 8 52.194, E147 43.209); K4 (S 8 50.224, E 147 41.460); K5 (S 8 50.374, E 147 43.043); K6 (S 8 48.78, E 147 41.853). K1 was taken from the Kari River, K2 – K5 were taken from the Madi River and K6 was taken 200m downstream of the intersection point between the Madi River and the Mambara River.

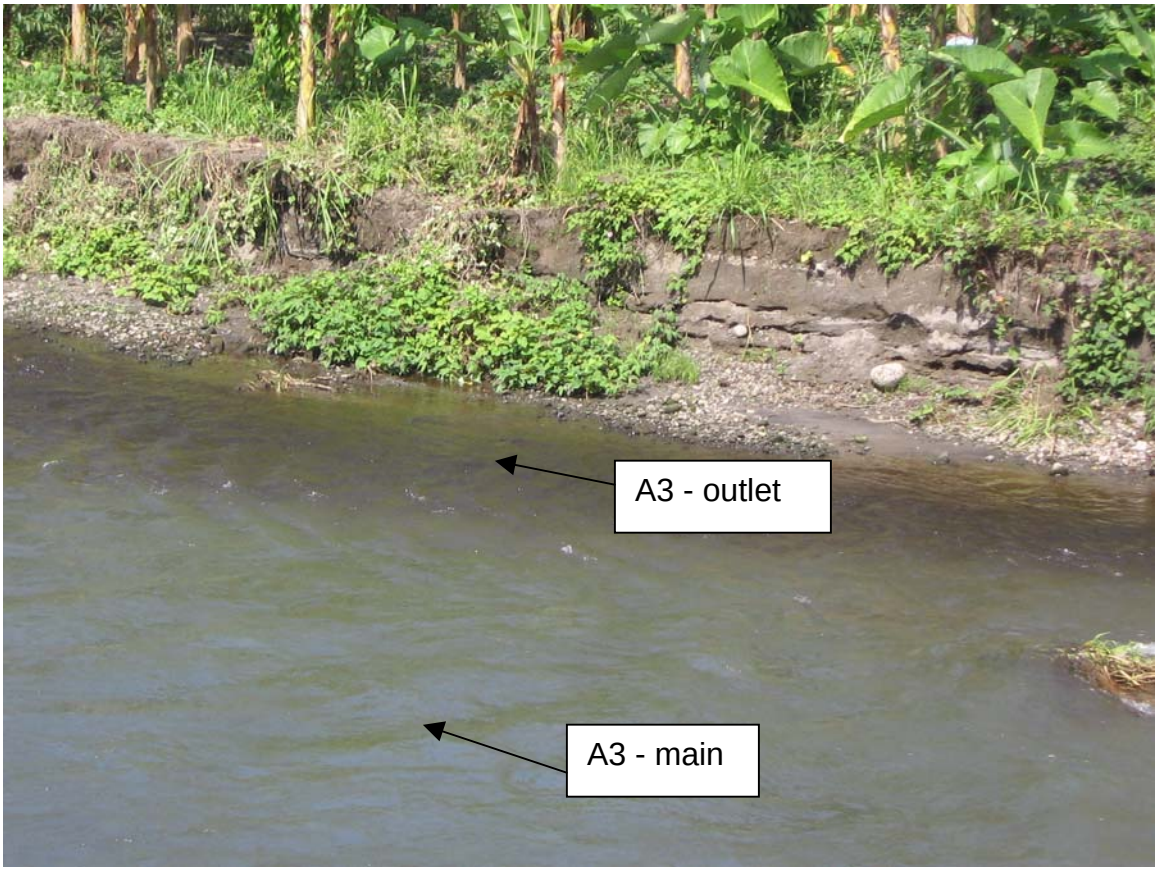
Limitations: All base maps were produced in the mid 1970s - they were the only ones readily available. Some base information shown has changed.

Map 1: Kokoda sampling points



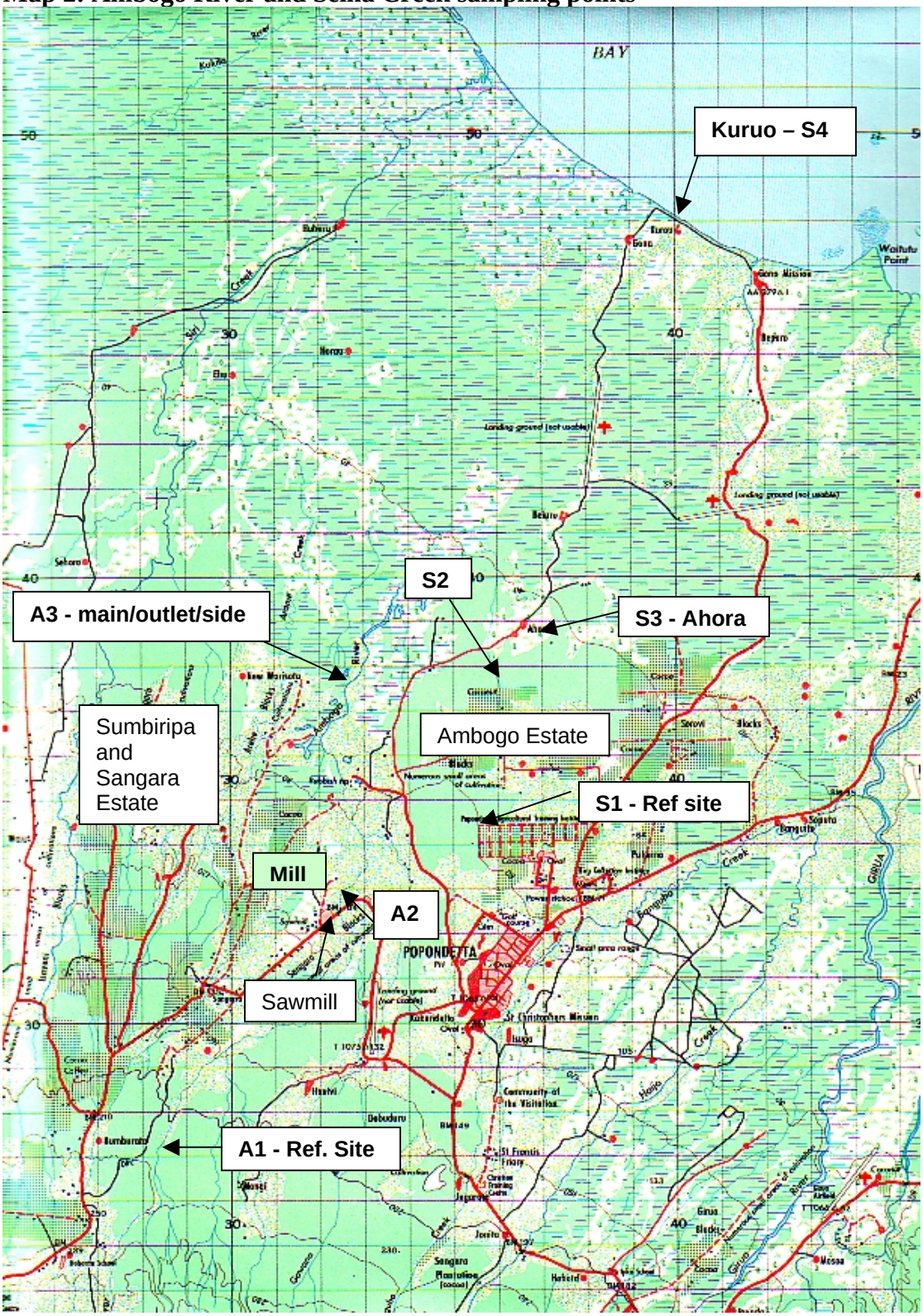
The Popondetta region was selected to represent an impacted catchment. The Ambogo River runs through the catchment and discharges into Oro Bay. There is a sawmill and oil palm mill located on or in close proximity to its banks. The sampling sites were selected to represent an upstream reference site (A1- S 8 49.052, E 148 09.362), a site between the sawmill and oil palm (POME) discharge points (A2 - S 8 44.765, E 148 12.306) and a site directly adjacent to a oil mill discharge point (A3 - S 8 43.350, E 148 12.366). Site A3-main (see Plate 2) was taken from the middle of the stream, site A3-outlet was taken along the western bank, 5m downstream of the creek that released the POME. A3-side was taken from the other side of the river adjacent to the Popondetta rubbish dump.

Plate 2: Ambogo River sampling locations (A3-outlet) and (A3-main) – note plume at A3



The Seiha Creek was selected to represent a smaller waterway that began downstream of the oil palm mill and ran through the plantations and discharged to the Solomon Sea at Kuroa. The four sampling points were identified as S1 (S 8 44.251, E 148 14.006); S2 (S 8 43.304, E 148 13.977); S3 (S 8 41.222, E 148 14.147) and S4 (S 8 36.508, E 148 16.457). As Map 2 indicates sites S3 and S4 were taken from Ahora and Kuroa village respectively.

Map 2: Ambogo River and Seiha Creek sampling points



WATER SAMPLING STRATEGY

The Kokoda sampling was undertaken over two consecutive days on the 26th and 27th of February, 2006.

The Ambogo River and Seiha Creek sampling was undertaken over four consecutive days from 1 – 4th of March, 2006. The Ambogo reference site (A1) was only sampled on two of the four days due to the landowners declining access to the site on day 3.

To determine any changes to water quality overnight in the Ambogo River an overnight sampling regime was undertaken downstream of a discharge point of the oil palm mill. The auto-sampler recorded water parameters every 10 minutes from 5pm on 7th March 2006 to 7 am on 8th March 2006.

WATER PARAMETER ANALYSIS

The instrumentation used was a TPS 90-FL multi-parameter monitor. The parameters measured included; dissolved oxygen, conductivity, pH, temperature and TDS. EnviroEquip calibrated all probes prior to the 2-week period of sampling. Conductivity and pH were calibrated daily as recommended by the operating procedures of the 90-FL.

A 1L water sample was taken during the overnight sampling regime and was sent to ALS Environmental Pty Ltd. in Sydney to determine oil and grease concentrations. The sample was chilled $<4^{o}C$ and was chilled during air freight.

Faecal coliforms, turbidity, phosphate and nitrate levels were measured in the Seiha Creek using the LaMotte GREEN low-cost monitoring kit. The faecal coliform tests provide a positive/negative test. A positive test indicate >20 coliforms per 100 ml (current WHO drinking water requirements are zero faecal coliforms). The nitrate and phosphate tests are colormetric tests that are scored against a colour indication card. Turbidity was measured using a secchi disk located on the bottom of a white 500mL sample bottle.

SOIL SAMPLE ANALYSIS

Soil samples were taken from an established VOP block located in Sorovi (Lynette's Block) to determine any changes in soil nutrition and build up of heavy metals (see map 3). Samples were taken at 150mm and 350mm. The three sites included; 20-year-old oil palm plantation (20yr-LYN), a block with 3-year-old replanted oil palm (Replant) and a garden area (Garden).

Results

KOKODA

The water parameters of the Kokoda sites recorded during the 26th and 27th March, 2006 displayed the water quality was of a very high standard. No significant changes were observed between the upstream reference sites and downstream sampling sites (see table 1). The low levels of conductivity and TDS suggest the surrounding soils do not exhibit significant levels of bio-available salts or nutrients. The high levels of dissolved oxygen suggest the river system has low organic inputs, which is supported by the turbidity being zero in all sampling sites.

Table 1: Kokoda water parameters from 26th-27th March, 2006

Date	Site	pH	DO - % sat	Temp - °C	TDS - ppm	Conduct. - us/cm	Turbidity -NTU
26/2/06	K1	7	108	20.4	22.0	41.0	0
	K2	6.8	113	20.5	23.3	49.0	0
	K3	6.9	104	23.0	13.0	25.0	0
	K4	7.1	107	22.7	17.0	34.0	0
	K5	7.1	102	24.5	21.0	40.0	0
	K6	7.0	102	24.1	12.6	26.0	0
27/2/06	K1	7.6	113	20.5	23.0	49.0	0
	K2	7.0	99	23.3	12.8	25.2	0
	K3	6.9	98	24.0	10.8	21.7	0
	K4	6.9	106	22.1	14.0	28.0	0
	K5	7.2	96	23.9	22.0	43.0	0
	K6	6.8	109	22.5	10.0	20.5	0

SEIHA CREEK

In the Seiha Creek, similar trends were displayed between the four sampling sites across the four days of sampling (see table 2). Conductivity and TDS displayed similar trends of increasing levels between S1 to S3, and reduced at S4. This result is unexpected as the mixing of ocean water at the mouth of the creek was predicted to increase the salt and nutrient levels of the water.

Dissolved oxygen levels showed consistent readings that did not exceed 86%. No nitrate was detected in the water samples, however high to moderate concentrations of phosphate were detected. The reference site (S1) had consistently the highest levels of phosphate during the 4-day study.

Table 2: Water parameters of the Seiha Creek on 1/3/06 – 4/3/06

Date	Site	pH	DO - % sat.	Temp - °C	Turbidity -NTU	Conduct. – us/cm	TDS - ppm	Nitrate - ppm	Phos - ppm
1/3/06	s1	7.0	86	28.1	20	125	2.5	0	>4
	s2	7.1	75	29.9	40	160	107	0	2
	s3 - river	7.3	84	29.1	40	360	203	0	2
	s4 - river	7.3	78	28.1	40	121	66	0	1
2/3/06	s1	7.1	84	26.1	0	168	1.5	0	4
	s2	7.1	79	26.3	60	340	102	0	2
	s3 - river	7.3	82	26.5	40	345	162	0	2
	s4 - river	7.1	79	26.8	100	140	72	0	2
3/3/06	s1	7	84	28.0	0	177	98	0	4
	s2	7.4	84	28.0	20	347	198	0	2
	s3 - river	7.3	77	29.3	20	355	205	0	2
	s4 - river	7.2	68	28.9	20	183	97	0	4
4/3/06	s1	6.9	74	28.4	0	184	70	0	4
	s2	7.4	88	29.4	10	363	187	0	2
	s3 - river	7.5	83	28.8	40	361	212	0	4
	s4 - river	7.5	78	28.6	20	238	134	0	2

Well water sampling

Samples of well water were collected at Ahora and Kuroa villages (sites 3 and 4 respectively) to determine nitrate and phosphate levels. No nitrate (0 ppm) was detected during the four-day sampling regime. Phosphate levels did not exceed 2ppm in the Ahora well, and did not exceed 1 ppm in the Kuroa well.

Coliform contamination

Samples from the Seiha Creek displayed positive indications for faecal coliforms >20 per 100mL at all sites throughout the sampling regime. The high level of bacterial contamination may be the result of heavy rainfall transporting the contents of local septic tanks via ground and surface water run-off to the Creek. These results are concerning and should be confirmed with a comprehensive sampling regime and accurate microbiological laboratory equipment.

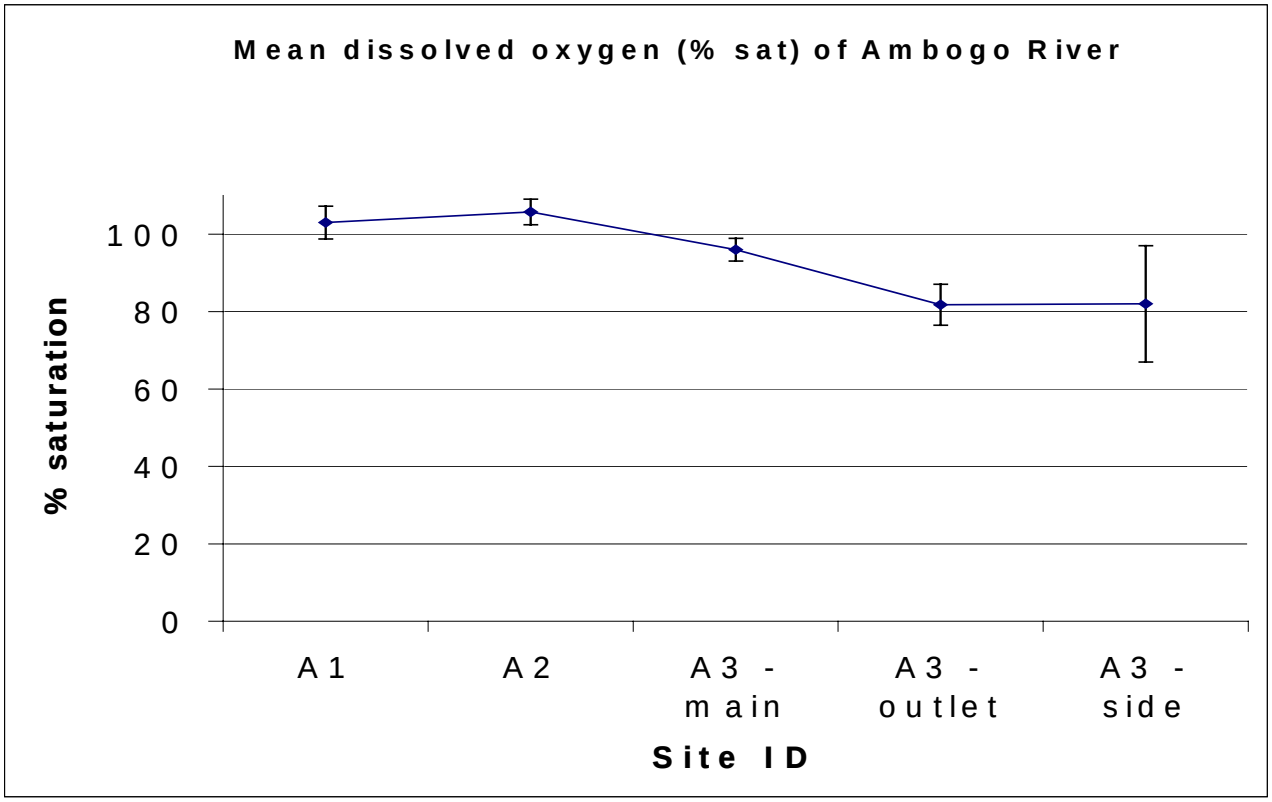
AMBOGO RIVER

The most significant finding of the four-day sampling regime was the consistently reduced dissolved oxygen levels at the discharge site (A3-outlet) (see Table 3 and Plate 2). The overnight sampling at A3-outlet recorded a mean concentration of 81% dissolved oxygen (% saturation). This result suggests that a constant flow of POME discharge occurred throughout the night.

Table 3: Water parameters of Ambogo River 1/3/06 - 4/3/06

Date	Site	pH	DO - % sat.	Temp - ^{o}C	Turbidity	Conduct. – us/cm	TDS - ppm
1/3/06	A1	8.0	106	27.2	0	335	191
	A2	8.0	105	30.0	0	264	146
	A3 - main	7.8	100	30.8	0	258	144
	A3 - outlet	7.7	79	30.5	40	305	177
	A3 - side	7.2	89	30.3	20	142	80
2/3/06	A1	7.9	100	26.3	0	358	203
	A2	7.9	102	25.5	40	234	72
	A3-main	7.5	93	25.8	100+	230	118
	A3-outlet	7.4	76	25.8	100	301	164
	A3-side	7.2	80	25.8	100	32	12
3/3/06	A1	Not sampled					
	A2	7.5	110	27.1	0	256	142
	A3 - main	7.7	95	28.0	0	250	125
	A3 - outlet	7.7	84	27.6	20	314	224
	A3 - side	7.2	62	27.0	20	7	3
4/3/06	A1	Not sampled					
	A2	7.8	106	28.7	0	273	153
	A3-main	7.8	96	29.3	0	270	148
	A3-outlet	7.7	88	29.0	10	315	189
	A3-side	7.3	97	29.6	10	5	4

Figure 1: Mean dissolved oxygen (% sat.) of Ambogo River 1/3/06-4/3/06



The overnight sampling displayed an increasing trend of TDS throughout the night, however this result may have been due to the probe being constantly immersed into the river and building up the salinity reading.

The 1-L sample taken at 4am recorded a oil and grease content of 6mg/L (ppm). This result suggests the retention pond is failing to reduce the overall content of oil and grease to 2ppm during wet weather.

SOIL SAMPLES

None of the sites recorded significant levels of cadmium (<1 mg/kg). All sites showed a profile of decreasing nitrate, NOx and reactive phosphorous from 150mmm to 350mm. Although not significant, the garden site showed higher values for nitrate as N and reactive-phosphorous than the 20 year old oil palm plantation and the replanted site.

Table 4: Soil pH and nutrient levels from oil palm plantation and garden blocks

	Units	**20yr – LYN 150mm**	**20yr-LYN 350mm**	**Replant – 150mm**	**Replant – 350mm**	**Garden – 150mm**	**Garden – 350mm**
pH	pH unit	5.4	5.9	5.6	6	6.2	6.5
Nitrate as N	mg/kg	2.02	0.543	6.57	2.66	9.07	1.78
NOx as N	mg/kg	2.21	0.672	6.69	2.76	9.24	1.97
Reactive - phosphorous	mg/kg	0.166	0.116	<0.1	<0.1	0.425	0.335

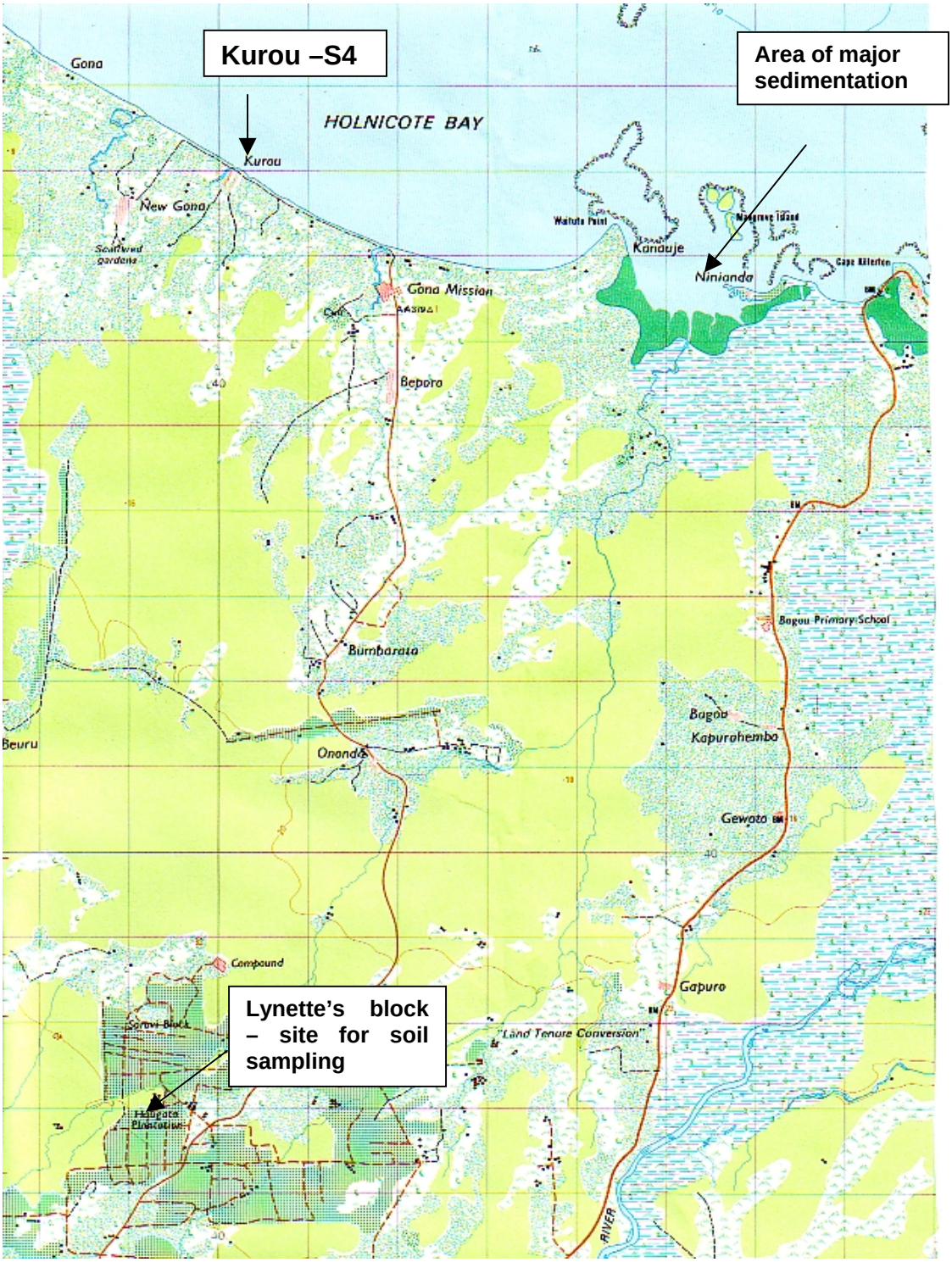
Reduced levels of nitrogen were recorded in samples taken from the topsoil of oil palm plantations in comparison to topsoil collected from local gardens. The increased nitrogen levels detected in the garden soil may indicate better soil health through the recycling of nutrients from leaf and root litter remaining in the soil. Alternatively, the increased nitrogen levels may be due to the application of artificial fertilisers by local landholders to increase productivity. The use of fertilisers in gardens is possible as it was commonly stated by community members that productivity of local gardens had declined over the last two decades. The loss of productivity of gardens surrounding oil palm plantations deserves further attention.

SEDIMENTATION OF NINIANDA BAY

A site visit was undertaken to Ninianda Bay (Barouda Lagoon) in response to community representatives stating the bay had undergone high levels of sedimentation since the introduction of oil palm. A comparison of the photo in Plate 3 taken in the middle of Ninianda Bay (6/3/06) to Map 3, supports the community's evidence that widespread sedimentation had occurred between the shoreline and the mangrove island in Ninianda Bay. The water level from the shore of the bay to the island did not exceed 1m in depth. At the site visit there was no sighting of the pre-existing fringing reef and deep water between the shoreline and the mangrove island. Sediments showed little evidence of benthic colonisation.

Plate 3: Ninianda Bay sedimentation - Bauroda Lagoon

Map 3: Soil sampling site in Sorovi Block and coastline at Ninianda Bay (mid 1970s)



FISH SPECIES

A village elder of Ahora village consulted the reference book "Field Guide to the Freshwater Fishes of Australia" 2003 G.R. Allen, S.H. Midgley and M. Allen. He was asked to consult with the other elders of Ahora village in making his selection of fish species and to identify all fish species that had disappeared from the local river systems. In total, 18 species were identified with the majority being identified as existing in the northern regions of Australia (see table 5). These findings were then confirmed by elders at Gona and by a member of the Ahora/Kakandetta People's Foundation.

Table 5: Fish species identified as no longer present in Seiha Creek and Ambogo River

Common name (English)	**Scientific name**
Marbled eel	*Anguilla reinhardtii*
Bony bream	*Nematalosa erebi*
Climbing galaxias	*Galaxias brevipinnis*
One-gilled eel	*Ophisteernon bengalense*
Nightfish	*Bostockia porosa*
Greenback gauvina	*Bunaka gyrinoides*
Snakehead gudgeon	*Giurus margaritacea*
Purple-spotted gudgeon	*Mogurnda adspersa*
Northern trout gudgeon	*Mogurnda mogurnda*
Kimberley mogurnda	*Mogurnda oligolepis*
Giant gudgeon	*Oxyeleotris selheimi*
River blackfish	*Gadopsis marmoratus*
Concave goby	*Glossogobius concavifrons*
Mulgrave goby	*Glossogobius species 4*
Indonesian goby	*Mugilogobius platystomus*
Fimbriate gudgeon	*Oxyeleotris fimbriata*
Sleepy cod	*Oxyeleotris lineolate*
Vachelli's glassfish	*Ambassis vachellii*

Discussion

Throughout the Kokoda catchment the water quality displayed neutral acidity, low levels of nutrients and salts and displayed high levels of dissolved oxygen. Although the sampling regime was conducted over a short time, the results indicated that the water quality within the Kokoda region is of a very high standard. As the water quality is of a high standard the development of environmental guidelines for the proposed Mamba Estate mill should protect the waterways and maintain this standard.

A major concern with the Seiha Creek was the consistent levels of faecal coliforms found throughout the waterway. Detection of coliforms at the reference site, and along all other sampling points suggests that both groundwater and surface water contamination from human and animal faeces is occurring along the length of the waterway. This is of particular concern as the local community use the Seiha Creek as a source of cooking and

drinking water. A thorough scientific study that utilised microbiological equipment that could measure coliform counts and broadening the study area is necessary to confirm these results. If contamination is confirmed at drinking water sources, support for the community in harvesting rainwater and point-of-use disinfection should be implemented immediately.

The POME discharged into the Ambogo River resulted in a depression of the dissolved oxygen levels within the effluent plume. The oil and grease content was recorded to be 6ppm, which after dilution within the creek and by heavy rainfall on the holding ponds, suggests the POME at discharge may exceed the 50ppm recommended by the Malaysian POME environmental standards. Further sampling during the dry season and directly from the discharge point would be required to confirm these results.

The effluent plume was observed on each of the 4 sampling days between 10 am – 1 pm. **The consistently depressed dissolved oxygen levels recorded during the overnight sampling suggests the release of POME from the mill's discharge point was continuous throughout the sampling period.** Persistent reductions in dissolved oxygen can result in fish and invertebrate death or immobilisation and loss of river biota. The impact of this plume on the downstream ecological system requires further study. This evidence supports the PNG's Department of Environment and Conservation's (2005) statement that "the zero discharge system would be inefficient during wet season and peak production at the mill".

Increased sediment loads have been recorded throughout regions that have undergone large-scale agricultural activities (LaFranchi, 1999). Evidence of extreme levels of sedimentation was observed in the regions downstream of the Popondetta catchment. The comparison of maps that were created in 1975 with the current height of the sea floor suggested that siltation is up to 10m in depth. The University of PNG has proposed a research project on sedimentation on West New Britain. This research will test the hypothesis that oil palm plantations cause dramatic sediment deposition into adjacent streams, rivers and estuaries.

Qualitative evidence suggests widespread loss of fish species throughout the river systems downstream of the Popondetta catchment. The loss of fish species could be attributed to a number of natural and man-made factors including sedimentation, acid sulphate soil, poor pesticide use, direct input of POME from the HOPPL mill and potential wood preservative waste input from the Ambogo saw mill. The identification of the reasons for the loss of fish populations was beyond the scope of this study. The loss of fish populations in catchments with oil palm plantations deserves further investigation.

Conclusion

Although limited in time and resources the initial environmental examination of Kokoda and Popondetta provided a snapshot of conditions during the wet season in the two catchments. Kokoda's water quality was found to be excellent. In the Popondetta catchment, the water quality was found to contain discharge of POME and sewage. Since the construction of the retention ponds it appears that the total amount of POME discharged to the Ambogo River has dramatically reduced. The findings of consistently low dissolved oxygen readings at the discharge point do support the Department of Environment and Conservation's (2005) findings that larger retention ponds must be constructed. The high levels of sedimentation and fish loss downstream of oil palm processing mills and plantations deserve further scientific inquiry.

References

Berka C., Schreier H. and Hall K. 2001. Linking water quality with agricultural intensification in a rural watershed. Water, Air and Soil Pollution 127:389-401

Charholm, M., Gustafson A. and Fleischer S. 1988. Does agriculture kill fish? Possible ways to decrease nitrogen leaching from land to water. *Ecological Bulletins* 39:139-140

Cooper C.M. 1993. Biological effects of agriculturally derived surface water pollutants on aquatic systems – A review. *Journal of Environmental Quality* 22:402-408

Costanzo S.D., O'Donohue M.J and Dennison W.C. 2003. Assessing the seasonal influence of sewage and agricultural nutrient inputs in a subtropical river estuary. *Estuaries* 26:857-865

Department of Environment and Conservation 2005 Compliance Audit Report sent to Higaturu Oil Palms on 20/05/2005

Gabric A.J. and Bell P.R.F. 1993. Review of the effects of non-point nutrient loading on coastal ecosystems. *Australian Journal of Marine and Freshwater Research* 44:261-283

Keu S.T. 2000 Masters thesis: Review of previous similar studies on the environmental impacts of oil palm plantation cultivation on people, soil, water and forests. Submitted to Faculty of Horticulture, Chiba University.

LaFranchi C. and Greenpeace Pacific 1999. Islands adrift? Comparing industrial and small-scale economic options for Marovo Lagoon region of the Solomon Islands.

Nixon, S.W. 1995. Coastal marine eutrophication: A definition, social causes and future consequences. *Ophelia* 41:199-219

PART B: Summary of eight community interviews conducted in Popondetta region from 24/2 – 8/3/06

This summary records the key issues that were presented to John Craven and Ben Cole during interviews with community members, villagers and community activists in the Popondetta region. The majority of interviews lasted for one and half hours and were conducted with villages that existed within or downstream of oil palm plantations and the Higaturu oil mill. The interviews were structured to allow the community to present a full range of opinions about the changes that had occurred to the environment and community health since the introduction of oil palm. *See Appendix 2 for record of individual interviews.*

Environmental impacts

- Dramatic reduction and extinction of crustacean, eel, fish and crocodile populations
- Large-scale fish kills were commonly reported particularly in mid-1980s and after heavy rainfall events
- High levels of sedimentation had reduced and changed the flow of the Ambogo River
- Ambogo R. and Seiha Creek water quality had become more turbid and was often greasy to the touch in the 1980s to early 1990s

Environmental health

- Ambogo R. and Seiha Creek were no longer used by the local community as a drinking water source due to the contamination of sewage and oil discharge
- Depleted fish stocks had resulted in loss of protein sources for local community
- Rotting of empty fruit bunches in plantations had increased the number of biting insects
- No training on herbicide/pesticide use had occurred

Health

- Increase in incidence and prevalence of TB, asthma, birth deformities, diarrhoea and malaria
- Higher prevalence of skin diseases and malnutrition

Social

- Lifestyle shift away from gardening and hunting has increased binge drinking and domestic violence
- Loss of access to forestry land had reduced sources of hardwood used for traditional building materials and boating equipment

SECTION 4: TOXIC CHEMICALS HUMAN and ENVIRONMENT HEALTH ISSUES

POTENTIAL CHEMICAL CONTAMINANTS

Introduction

During interviews with the communities around Popondetta a variety of health problems were described that many people associated with the introduction of oil palm production. They included increasing respiratory problems, diarrhea, infant deformities and mortality, retarded growth, birth defects and birth mortality. These may be attributable to the use of pesticides and herbicides. Unfortunately no epidemiological studies have been undertaken to investigate the association between pesticide/herbicide exposure and community health.

A number of potentially contaminating chemicals (pesticides and herbicides) are used in the production of palm oil kernels. Some may have acute toxicity while others have chronic effects and/or are carcinogenic. Whilst some may have little effect on humans they may affect other organisms, groundwater and terrestrial environments.

From interviews with people who work in the palm oil plantations it appears generally that the safety procedures for the application of pesticides and herbicides are not understood and that inadequate or no training (and monitoring) is undertaken. No protective gear is used and children often accompany adults when spraying is undertaken, exposing both applier and bystanders to sprays.

Whilst there may be training for workers at company estates there is no instruction in chemical use for VOP, LSS and Mini-Estate workers. It has been reported that washing of herbicide equipment into the creek “to save time” and herbicides are used to “stun fish and prawns”.

There is anecdotal evidence that suggests the lack of fish within the local waterways can be attributed to the use of chemicals. Major fish kills have occurred for the last 20 years and sores/ulcerations had been observed on fish. It is claimed that there are no longer any fish to catch whereas before oil palm plantations were established there were at least twenty different species in the creeks and rivers.

A number of the chemicals used presently are capable of causing mortality in fish and other aquatic organisms. It has not been established whether these chemicals are implicated in the loss of fish stocks. An investigation of past chemical use is necessary. This may also entail further interviews to establish exact year of fish kills and a full investigation of sediments to establish cause of fish kills.

Another factor that requires further examination is the possibility of Copper Chrome Arsenate (CCA – a timber preservative) leakages from the local timber mill. CCA could also cause fish kills and ulceration.

Of concern also is the potential for toxic chemicals to enter the groundwater affecting drinking water from wells. It has been suggested that the chemicals used become “neutralised/inactive” once they enter the soil profile. It is known that some of the

chemicals are groundwater contaminants. It is also possible that the use of different chemicals can destroy microorganisms that would normally mediate the "neutralization" of the toxic chemicals. This would allow the latter to be mobile with the potential to enter groundwater and surface water (through erosion).

The table below lists the chemicals purchased by the HOPPL mill in 2004.

Chemicals use in HOP 2004			
Product name	Product type	Amnt used	Value (USD)
L1700	Surfactant	80L	447
24D	Herbicide	4,406L	12,406
Activator 90	Surfactant	1,980L	7,000
Tricholor Tablets x 10Kg	Chlorine	70 buckets	6,192
Glyphosate 450	Herbicide	17,022	51,847
Gramoxone x 5L (paraquat)	Herbicide	3,685	16,816
(Alloy) Metsulfron X 500g	Herbicide	169/container	8,901
Icon 10WP X 50grams	Insecticide –malaria control	287 pkts	3,359
Diuron 500 FW	Herbicide	200L	1,005
Icon 2.5Cs x 500mL	Insecticide –malaria control	18/container	269

NB. Water from mill contains silica, which requires HCl and Caustic Soda to purify. Chlorine tablets were used to "decontaminate" sewage before discharge.

- The water discharge treated with HCl and caustic soda requires checking for pH.

The chemicals of concern were reviewed more extensively in a Report to CELCOR (Environmental and Health Issues HOPPL Site – February, 2006 – Scoping Document) - see Appendix 1.

Some chemicals that were not reviewed were:

- L1700 (a surfactant) – data unavailable;
- Activator 90 (another surfactant) – it seems not to be problematic;
- Trichlor – this is a large family of chemicals some of which are extremely problematic. It appears that this chemical was used as "chlorine" to decontaminate (disinfect) sewage before discharge. Even that use is problematic for numerous environmental reasons. This must be follow-up to determine what type was used.

Review of Presently used Chemicals

The following review of pesticides and herbicides indicates the potential for harm. It is recommended that monitoring of effects after spraying of particular chemicals be undertaken. This should happen at the local level (workers monitoring themselves) complemented by Health Department assessment and monitoring.

(Source: http://www.pesticideinfo.org/Index.html)

24-D Amine (Herbicide) - it may be difficult to implicate this chemical for long-term effects but short-term poisoning can occur. **If the latter is frequent chronic conditions may result.**

2,4-D Amine is a Chlorophenoxy compound

Symptoms of Poisoning with Chlorophenoxy Compounds

- **Irritation of skin, eyes and respiratory tract.**
- **Inhalation may cause burning sensation in nasopharynx and chest, coughing, and/or dizziness.**
- **Headache, vomiting, diarrhoea.**
- **Confusion, bizarre or aggressive behaviour.**
- **Kidney failure, increased heart rate.**
- **Metabolic acidosis resulting in peculiar odour on breath.**

Toxicity Information - Possible **Carcinogen**

Both the chemical appliers and the Health Department can monitor most of the above symptoms. Some symptoms may require more intense investigation in longitudinal epidemiological studies.

Glyphosate (herbicide)– this one would be difficult to implicate although there is evidence to suggest that roundup (Glyphosate) **is problematic particularly near waterways.**

Symptoms of Poisoning with Glyphosate Compounds

Formulations may show moderate toxicity.
- The trimethylsulfonium salt causes eye irritation in rabbits; some formulations may cause much more extreme irritation of the skin or eyes.
- Some formulations may show high acute inhalation toxicity

Both the chemical appliers and the Health Department should monitor any adverse health symptoms after use.

Paraquat (Gramoxone - herbicide) – this needs further investigation as evidence is growing that this is a problem contaminant.

Paraquat dichloride is a Bipyridylium compound

Symptoms of Poisoning with Bipyridylium CompoundsParaquat & Diquat:
(Ingestion) - burning pain in the mouth, throat, chest, upper abdomen; pulmonary oedema, pancreatitis, renal damage, CNS effects.
- Paraquat (dermal): dry and fissured hands, horizontal ridging or loss of fingernails, ulceration and abrasion. Diarrhoea, sometimes bloody, can occur. Central Nervous System effects include giddiness, headache, fever, myalgia, lethargy and coma. Pulmonary fibrosis is the usual cause of death.
- Diquat: neurologic toxicity (nervousness, irritability, restlessness, combativeness, disorientation, nonsensical statements, inability to recognize friends or family members, diminished reflexes). Intense nausea, vomiting and diarrhoea may occur.

- **Has acute toxicity and can potential contaminate groundwater.**

Aquatic Ecotoxicity

All Toxic Effects for Organism Group	
Organism Group	**Effects Noted**
Amphibians	Cell(s), Development, Growth, Histology, Mortality, Behaviour, Feeding Behaviour
Aquatic Plants	Accumulation, Injury, Mortality, Population Reproduction
Crustaceans	Mortality Avoidance, Population
Fish	Accumulation, Biochemistry, Enzyme(s), Growth, Histology, Intoxication, Morphology, Mortality, Physiology, Development, Growth, Histology,
Fungi	Development, Population, Reproduction, Physiology
Insects	Mortality, Population
Molluscs	Behaviour, Mortality, Physiology, Biochemistry, Morphology, Population
Nematodes and Flatworms	Population
Phytoplankton	Accumulation, Biochemistry, Growth, Mortality, Physiology, Population, Cell(s), Ecosystem Process,
Terrestrial Plants	Growth
Zooplankton	Intoxication, Mortality, Behaviour, Intoxication, Mortality, Population

It can be seen from the table above that human health, groundwater and the aquatic ecosystem can be adversely affected by Paraquat (Gramoxone). It is noted that it can accumulate, have effects on populations and growth, and can cause death in aquatic ecosystems. It may be implicated in the loss of the aquatic food chain.

Both the chemical appliers and the Health Department can monitor most of the above effects on humans. Some symptoms may require more intense investigation in longitudinal epidemiological studies. The RSPO has committed to a two-year work program to investigate alternatives to paraquat. CELCOR should maintain a watching brief on these investigations.

Metsulfuron (Herbicide) – have to check "alloy" – but generally ingestion may be needed for ill effect.

Metsulfuron-methyl is a Urea compound

Symptoms of Poisoning with Urea Compounds

Systemic toxicity is unlikely unless large amounts have been ingested.
- Many substituted ureas are irritating to eyes, skin and mucous membranes.
- Coughing and shortness of breath.
- Nausea, vomiting, diarrhoea, headache, confusion and electrolyte depletion.
- Protein metabolism disturbances, moderate emphysema, and weight loss with chronic exposure

- **Potential groundwater contaminant**.

Aquatic Ecotoxicity

All Toxic Effects for Organism Group

Organism Group	Effects Noted
AquaticPlants	Population
Fish	Mortality
Phytoplankton	Accumulation, Biochemistry, Physiology, Population
Zooplankton	Intoxication

It can be seen from the table above that human health, Metsulfuron can adversely affect groundwater and the aquatic ecosystem. It is noted that it can accumulate, have effects on populations, and can cause death in aquatic ecosystems. It may be implicated in the loss of the aquatic food chain.

Both the chemical appliers and the Health Department can monitor most of the above effects on humans. Some symptoms may require more intense investigation in longitudinal epidemiological studies.

Diuron (Herbicide) – generally ingestion may be needed for ill effect.

Diuron is a Urea compound.

Symptoms of Poisoning with Urea Compounds

Systemic toxicity is unlikely unless large amounts have been ingested.
- Many substituted ureas are irritating to eyes, skin and mucous membranes.
- Coughing and shortness of breath.
- Nausea, vomiting, diarrhoea, headache, confusion and electrolyte depletion.
- Protein metabolism disturbances, moderate emphysema, and weight loss with chronic exposure

- ***Toxicity Information*** **- Carcinogen, Ground Water Contaminant, Developmental or Reproductive Toxin**

Aquatic Ecotoxicity

All Toxic Effects for Organism Group

Organism Group	Effects Noted
Amphibians	Development, Growth, Mortality
Annelida	Growth, Mortality, Reproduction
Aquatic Plants	Biochemistry, Mortality, Physiology, Population
Crustaceans	Behaviour, Mortality, Physiology
Fish	Accumulation, Behaviour, Biochemistry, Growth, Histology, Mortality, Physiology, Reproduction
Insects	Development, Growth, Mortality
Molluscs	Accumulation, Development, Growth, Intoxication, Mortality
Phytoplankton	Accumulation, Biochemistry, Cell(s), Ecosystem Process, Enzyme(s), Genetics, Growth, Mortality, Physiology, Population
Terrestrial Plants	Growth
Zooplankton	Accumulation, Growth, Intoxication, Mortality, Population, Reproduction

It can be seen from the table above that human health, groundwater and the aquatic ecosystem can be adversely affected by Diuron. It is noted that it can accumulate, have effects on populations and growth, and can cause death in aquatic ecosystems. It may be implicated in the loss of the aquatic food chain.

Both the chemical appliers and the Health Department can monitor most of the above effects on humans. Some symptoms may require more intense investigation in longitudinal epidemiological studies.

ICON 10WP – malaria control insecticide – needs further investigation

Cyhalothrin lambda (ICON) is a Pyrethroid compound

Symptoms of Poisoning with Pyrethroid Compounds

- Irritation of skin and eyes.
- Irritability to sound or touch, abnormal facial sensation, sensation of prickling, tingling or creeping on skin, numbness.
- Headache, dizziness, nausea, vomiting, diarrhoea, excessive salivation, fatigue.
- In severe cases: fluid in the lungs and muscle twitching may develop. Seizures may occur and are more common with more toxic cyano-pyrethroids
Toxicity Information - **Acute Toxicity** Moderate Suspected **Endocrine Disruptor**

Aquatic Ecotoxicity

All Toxic Effects for Organism Group

Organism Group	Effects Noted
Aquatic Plants	Accumulation, Development, Growth, Physiology, Population
Crustaceans	Mortality, Population
Echinoderms	Development
Fish	Accumulation, Avoidance, Biochemistry, Enzyme(s), Histology, Intoxication, Mortality
Insects	Intoxication, Population
Molluscs	Development, Enzyme(s), Growth, Mortality, Physiology
Nematodes and Flatworms	Population
Phytoplankton	Biochemistry, Physiology, Population
Terrestrial Plants	Growth
Zooplankton	Intoxication, Mortality, Population

It can be seen from the table above that human health, groundwater and the aquatic ecosystem can be adversely affected by Icon. It is noted that it can accumulate, have effects on populations and growth, and can cause death in aquatic ecosystems. It may be implicated in the loss of the aquatic food chain.

Both the chemical appliers and the Health Department can monitor most of the above effects on humans. Some symptoms may require more intense investigation in longitudinal epidemiological studies.

COPPER-CHROME-ARSENIC

Copper Chrome Arsenic (CCA) has been added to the list of reviewed chemicals as it has been reported that it has been used at the timber mill upstream from the oil palm mill. Discharges of CCA may occur during processing or during heavy rain or from flooding of site. Further investigation as a potential cause of pollution is required.

Chemical Identification and Use for Copper-chrome-arsenic

Basic Identification Information About This Chemical

Chemical Name:	Copper-chrome-arsenic
CAS Number:	37337-13-6
Use Type:	Wood Preservative
Chem Class:	Inorganic-Arsenic , Inorganic-Chromium(VI) , Inorganic-Copper

Other Names for this Chemical About Chemical Synonyms

37337-13-6 (CAS Number) , 37337136 (CAS Number) , Arsenic + Copper + Chrome , CCA , Chromated copper arsenate , Chrome + Arsenic + Copper (CCA) , Copper-chrome-arsenic , Copperchromearsenic

Signs and Symptoms of Copper-chrome-arsenic Poisoning

NOTE! There may be other diseases and chemicals that have similar symptoms.

Acute exposure

- -Garlic odour of breath and faeces, metallic taste in mouth.
  - Adverse GI effects predominate with vomiting, abdominal pain and rice-water or bloody diarrhoea. GI effects may also include inflammation, vesicle formation and eventual sloughing of the mucosa in the mouth, pharynx and oesophagus.
  - Central nervous system effects are common: headache, dizziness, drowsiness and confusion.
  - Symptoms may progress to include muscle weakness and spasms, hypothermia, lethargy, delirium, coma and convulsions.
  - Renal injury is manifest as proteinuria, hematuria, glycosuria, oliguria, casts in the urine and in severe poisoning cases, acute tubular necrosis.
  - Cardiovascular effects include shock, cyanosis and cardiac arrhythmia.
  - Liver damage may be manifested by elevated liver enzymes and jaundice.
  - Injury to blood-forming tissues may cause anaemia, leucopoenia and thrombocytopenia.

Chronic exposure may lead to:

- Muscle weakness, fatigue, anorexia, weight loss.
- Hyperpigmentation, hyperkeratosis.
- Peripheral neuropathy, paresthesia, paresis and ataxia.
- Inability to coordinate voluntary muscular movements.
- Subcutaneous oedema in face, eyelids, and ankles.
- Stomatitis, white striations across the nails (Mees lines) and sometimes loss of nails or hair.
- Liver toxicity as indicated by hepatomegaly, jaundice, cirrhosis.
- Renal toxicity leading to oliguria, proteinuria, and hematuria.
- EKG abnormalities and peripheral vascular disease.
- Hematologic abnormalities.
- Cancer.

Toxicity Information for Copper-chrome-arsenic

Summary Toxicity Information

PAN Bad Actor Chemical[2]	Acute Toxicity	Carcinogen	Cholinesterase Inhibitor	Ground Water Contaminant	Developmental or Reproductive Toxin	Endocrine Disruptor
			No			

 Indicates high toxicity in the given toxicological category.

 Indicates no available weight-of-the-evidence summary assessment. For additional information on toxicity from scientific journals or registration documents, see the "Additional Resources for Toxicity " section of the chemical detail page.

1. **PAN Bad Actors** are chemicals that are one or more of the following: highly acutely toxic, cholinesterase inhibitor, known/probable carcinogen, known groundwater pollutant or known reproductive or developmental toxicant. NOTE! Because there are no authoritative lists of Endocrine Disrupting (ED) chemicals, EDs are not yet considered PAN Bad Actor chemicals.

2. The acute toxicity reported on this page is of the pure chemical ingredient only and may not reflect the acute toxicity of individual pesticide products. To view acute toxicity of individual products, click on 'View Products' link in the 'Chemical Identification' section above.

Water Pollution Potential and Criteria for Copper-chrome-arsenic

PAN Ground Water Contaminant Rating ? Insufficient Data

No water quality standards or criteria have been established for this chemical by the U.S. or Canadian governments; however, there may be criteria established for related chemicals.

Ecotoxicity for Copper-chrome-arsenic

Aquatic Ecotoxicity

All Toxic Effects for Organism Group	
Organism Group	**Effects Noted**
Fish	Mortality
Zooplankton	Intoxication, Mortality

OTHER SOURCES OF POTENTIAL CONTAMINATION

The garbage tip for Popondetta is located on the bank of the Ambogo river (S 8 44.584, E 148^{o} 12.397). It may be a source of toxic leachates from residues from containers of domestic, agricultural and industrial chemicals. Leaching from the tip is obvious and requires thorough investigation to determine any potential effects.

It has been reported that HOPPL buried used chemical containers and other wastes in the past. It is unlikely the disposal pits were sealed with liners to prevent leachates.

Another source of contamination may be from the practice of using detergents, soaps and bleaches in the river for washing clothes and utensils.

There are numerous fertilizers used in oil palm production. Often fertilizers have impurities including heavy metals that can enter the food chain from the soil or aquatic environments.

Discharge of palm oil mill effluent (POME) has been a matter of concern. Improvements include retention ponds and recycling through application of concentrated POME onto empty fruit bunches that are applied to the plantations. It has been claimed that "zero discharge" is achieved. Nevertheless discharges from the ponds are still observed particularly during wet weather. Treated POME can contain suspended solids, pathogens and high nutrient loads.

Discussion

Toxic chemical impacts – herbicides and pesticides

It is clear that the chemicals commonly used in the management of oil palm plantations could have adverse impacts on human and environmental health. Most have acute toxic effects whilst others have both acute and chronic effects. Diuron and 2,4 D-Amine are potential carcinogens. Icon 10WP is an endocrine disruptor. Paraquat and Diuron are potential groundwater contaminants. Metsulfuron, Diuron, Paraquat and Icon 10WP all have adverse effects in aquatic environments and could be implicated in fish kills.

Suggestions that these chemicals become inactive on contact with soil should be viewed with some scepticism. It is unclear what synergistic or additive effects occur with application of these different chemicals. Further it is not known whether previously used chemicals have destroyed the micro-organisms in the soil that mediate any "neutralisation" of the toxic chemicals.

Previously used chemicals have not been identified. It is highly likely that they also had the potential for adverse impacts on human and environmental health. Further investigation would be required to determine these effects although data may be difficult to collect and any investigation may have to rely mainly on anecdotal evidence. Little written information is available and no epidemiological studies have been undertaken. Environmental studies available do not examine impacts on the food chain (airborne, aquatic or terrestrial) and no adequate baseline studies have been undertaken.

The uncontrolled application rates and methods of application suggest that the potential for pesticides and herbicides entering waterways and groundwater is high. Both humans and the environment generally would be adversely impacted. Aquatic ecosystems would be extremely vulnerable. Groundwater and wells for drinking could be impacted.

It is a matter of great concern that children are often present when spraying of chemicals occurs. It has also been suggested that there have been children born with deformities and increasing numbers of stillborn babies. This may be attributable to expose to past and/or present chemicals. Girls, pregnant women, women of child-bearing age and breast feeding mothers should not be exposed to any of the chemicals used. Men exposed to toxic chemicals could also suffer chromosomal damage – I don't think we should include this sentence, DNA damage hasn't been shown for any of the pesticides we are examining.

The wood preservative CCA, potentially used at the local timber mill upstream from oil palm processing facility, has a wide range of acute and chronic toxic effects including mortality in exposed fish. It may be implicated in fish kills and human health problems.

Other impacts and potential partnerships

The garbage tip for Popondetta is located on the bank of the river. It may be a source of toxic leachates from residues from containers of domestic chemicals. Leaching from the tip is obvious and requires thorough investigation.

Detection of these chemicals in soil, waterways and groundwater requires specialized investigation and testing. Nevertheless by building a profile of symptoms suffered by workers involved in the application of these chemicals it may be evident that there is a link between health issues and the application of toxic chemicals. The workers would be biological indicators. Whilst this may not stand as acceptable evidence for causation, doubts raised may be used as leverage for compensation and changes in practices. Certainly it would be helpful to identify an unaffected control group.

Sam Vegogo, the CEO of Popondetta Hospital, has also indicated that funding for research on the health of oil palm workers has been received and will begin in May 2006. To assist this process campaigners from CELCOR and members of the Ahora/Kakandetta Peoples Foundation could set up a process of collecting data about the health of workers before and after spraying regimes commence. This could be done in association with and cooperation from the local health clinics and the Department of Health workers based in Popondetta. Links have already been made between Kenneth from Ahora/Kakandetta Peoples Foundation and James from the Department of Health in relation to water quality sampling.

Initial investigation indicates that there are substantial man-hours used in spraying (eg 50 man/hrs/hec/year). Application is generally done without adequate or no protective equipment. Women often do spraying and children often accompany adults during the operation. The application rates are not properly monitored. There is a need for education in application rates, methods and protective measures. The CELCOR campaigner(s) in cooperation with the Ahora/Kakandetta Peoples Foundation could assist in an education program.

The Oil Palm Industry Corporation (OPIC), which is funded by a levy on smallholders, states in its Mission Statement and Five Year Strategic Plan (1999-2000) that it would protect the environment by being “an environmental guardian” and, that it was aware of the need for “careful environmental monitoring of the industry” and “new practices and competencies”. It is uncertain how OPIC achieves these goals. Certainly they would have a responsibility to ensure smallholders have appropriate training in the use and handling of toxic chemicals and that appropriate protective equipment is available and mandatory.

HOPPL/Cargills, as the only buyers and processors of oil palm bunches, have a dominating role in the industry in the area. To fulfill corporate responsibility they could consider supporting and providing training for their suppliers.

Conclusions

There is doubt about the safety of herbicides and pesticides used in the production of oil palm despite assurances by the industry to the contrary. It is clear from the summary above that the use of these chemicals is a matter of concern. Producers and the oil palm industry would dispute the impacts of these chemicals. It is of note that synergistic and additive effects are rarely considered when testing chemicals. Causation then is difficult to establish without longitudinal epidemiological studies. This would make any compensation claims directed at the impacts of toxic chemicals difficult.

Further confounding the issue of chemical impacts is the application rates and application methods of herbicides and pesticides. Anecdotal evidence suggests that people expose themselves to harm unnecessarily. Oil palm workers generally do not have adequate training although HOPPL states that their workers are trained. OPIC appears not to take any responsibility for ensuring workers are not exposed to potential contamination.

There have been reports of workers washing out spraying equipment in waterways and using chemicals to stun fish and prawns. Another issue as yet unresolved is whether the local sawmill has used and continues to use CCA and if it has been discharged to Ambogo River (accidentally or otherwise)

Recommendations

- Educate workers in the safe use of chemicals including handling, application rates, methods of application and occupational health issues. In the absence of OPIC taking responsibility, CELCOR campaigners, Ahora/Kakandetta Peoples Foundation (AKPF), the local women's association and the Health Department will have to develop a program.

- Create information sheets for pesticides and herbicides and include the symptoms of poisoning provided in this section. The information sheets should be developed with accompanying symbols and pictures to allow illiterate people to understand their content.

- Collect health details of workers before and after any spraying regimes to assess acute affects to determine whether there is an observable link between usage and any adverse reactions. This may have to be initiated by CELCOR and AKPF and integrate with campaigning.

- Further develop co-operative links with the local health clinics, Health Department and Popondetta Hospital research program in relation to the health of oil palm workers.

- Investigate past chemicals used in the oil palm plantations

- Collect data about fish stocks in areas not affected by oil palm plantations.

- Sample soils, surface water and groundwater for the presence of herbicides and pesticides.

SECTION 5: SUMMARY and DISCUSSION of ISSUES

This section provides a quick overview of the key issues that were reported in the scoping document and the field investigation of the HOPPL mill and plantations.

Background

A scoping document was prepared for CELCOR (Environmental and Health Issues – HOPPL Site – J.Craven, February, 2006). It reviewed available current and relevant environmental assessments/audits and DEC reports (see Appendices).

The table below summarises the main issues of concern expressed in those documents in relation to the operations of HOPPL. Many of the issues of concern overlap.

ISSUE	CONCERN
POME treatment ponds	Degradation of land (through irrigation), ground and surface water, fishery, biodiversity.
Sewage management	Ground and surface water contamination – environmental and human health.
Herbicides and pesticides	Occupational health, land and water pollution.
Aquatic environment - water quality	Turbidity, toxic chemicals, temperature, nutrients (eutrophication, algal growth, low oxygen), food (fish, prawns, etc), biodiversity, pathogens (sewage), water supply
Buffers	(Lack of) increased run-off of fertilizers, toxic chemicals, riverbank erosion.
Erosion	Fertility loss, movement of contaminated soil
Solid waste management	Leachates from disposal pits
Hydrocarbons	Diesel, oils degreasers etc – pollution of groundwater and overland flow, soils
Human health	Toxic chemicals, pathogens
Fertilizer use	Excessive use – land degradation, ground and surface water pollution.
Licences, Monitoring and Reporting	The company is not complying with conditions of consent
Air pollution	Occupational and community health
Social/cultural impacts	Loss of food sources, changes in social cohesion – community tension
Economic impacts	Changes to food production, reliance on imported foods
Noise pollution	Occupational health issue
Empty Fruit Bunches	Increase in pests, changes in soil composition (excess oil?)

The IEE conducted in February and March 2006 completed a sampling regime (described in results Section 3, Part A). Interviews were also conducted with community members and, government and company officials, about the impacts and management of the oil palm industry (described in results Section 3, Part B). Additional issues were raised. They were:

Environmental Impacts

- Dramatic reduction and extinction of crustacean, eel, fish and crocodile populations– food chain has collapsed
- Large-scale fish kills were commonly reported, particularly in the mid-1980s and after heavy rainfall events.
- Sedimentation has reduced and changed flow of Ambogo River.
- Siltation of Barouda Lagoon.
- Ambogo R. and Seiha Creek had become more turbid and was often greasy to the touch in the 1980s to early 1990s.
- Discharges of POME are still being made to the river – plumes, increased turbidity and lowered oxygen levels were noted during investigation period
- Sewage from company village treatment works is being discharged in close proximity to waterways.
- Leachates from Popondetta garbage dump.
- Decreased production in gardens

Environmental Health

- Amgogo River and Seiha Creek were no longer used by the local community as a drinking water source due to contamination by sewage and POME discharge.
- Some wells are contaminated.
- Depleted fish stocks had resulted in loss of protein sources for local communities.
- EFBs brought back to plantations to rot have increased number of biting insects.
- No training for VOPs in herbicide and pesticides application rates and methods

Health Issues

- Increased incidence and prevalence of TB, asthma, birth deformities, diarrhoea and malaria
- Higher prevalence of skin diseases
- Noticeable malnutrition

Socio-economic impacts

- Child labour
- Lifestyle shift from gardening and hunting has increased dependency on cash economy. It has also increased binge drinking and domestic violence.
- Loss of access to forestry land has reduced sources of hardwood for traditional housing and boat building.

Comments

POME treatment and discharge

Whilst the treatment of POME has been improved since 1996, the goal of "zero discharge" has not been fully achieved. During the IEE it was detected that discharges of POME (treated) were being made during the night and early to late morning. The Environmental Manager of HOPPL admitted that the current system was incapable of handling heavy rainfall and controlled discharges were made to prevent the retention pond breaking its banks.

The Environmental Manager stated that releases of oils and greases do not exceed 2ppm although, even once it had been diluted by heavy rain, the discharge stream and contact with swollen river, samples taken during the IEE indicated 6ppm (at the river). It is noted that if a mass balance of discharge was calculated the actual impacts could be better understood as the mixing with increased water in the system dilutes readings.

There is an intention by the company to establish irrigation systems to discharge excess POME. There is concern that this may lead, in the long term, to land degradation.

Clearly in the past when POME had no treatment the waterways would have been heavily impacted. Waterways would have increased levels of turbidity, oil and grease, and nutrients. Biological oxygen demand would have been increased and dissolved oxygen levels decreased. This would have impacted on the normal functioning of the aquatic ecosystem.

Sewage management

Sewage management in the company villages is slowly improving. Of particular concern though is treated sewage being disposed by surface irrigation within 15 metres of waterways. Generally, buffers to permanent waterways should be at least 100m, and 40m from intermittent streams (but considering the high rainfall in the area they should also be 100m). Further, irrigation should be sub-surface or under a heavy layer of mulch (eg. EFB mulch).

It was observed that pit toilets were used commonly in villages. They are also of concern as they can seep to groundwater contaminating wells and waterways. Examination of alternate means of sewage treatment should be considered eg composting toilets, contained sub-surface wetlands.

Herbicides and pesticides

A review of chemicals presently used in oil palm suggests that they can impact on human and aquatic ecosystems. Chemicals used in the past may have ongoing detrimental affects. Whilst the environmental and training managers of HOPPL stated they had programs in the safe use of herbicides and pesticides, there was no training for other oil palm workers (eg on VOPs). Responsibility for the training of the latter is with OPIC. Exposure to pesticides and herbicides can result in a range of acute and chronic illnesses on human health – see chemical review (Section 4).

Paraquat (Gramoxone), which is commonly used, is a chemical that the safety of is in dispute between NGOs, researchers and industry and is of particular concern.

Misuse and overuse of chemicals can impact on aquatic environments. Buffer zones of 50m from waterways have been suggested and should be enforced.

Aquatic environment- water quality

The waterways in areas of oil palm production are subject to many potential threats and observable impacts. These include: turbidity; toxic chemicals; rises in water temperature; increased nutrients leading to eutrophication, algal growth and low oxygen; loss of traditional foods (fish, prawns, etc) and biodiversity; increases in water borne pathogens from sewage; sedimentation; and contaminated water supplies. This has a direct impact on the lifestyle, health and general well being of communities who continue to rely on the clean waterways as an important economic, recreational and social resource.

Buffers

Buffers are needed around all permanent and intermittent waterways. They can protect waterways from soil run-off and chemical spray drift. Buffers can also absorb excess nutrient run-off from fertilizer applications. Any overland flow of sewage can be absorbed.

To be effective, buffers would have to be a minimum of 50m to permanent and 20m to intermittent waterways for most activities except for discharge of human sewage and POME where distances should be 100m and 40m respectively. All oil palm plantations require these buffers but there is little evidence of them being created. It is acknowledged that implementation of buffers would significantly impact on the area available for planting oil palm and would have the greatest impact on small holdings.

The issue of buffers has been pursued by DEC in a very perfunctory manner, which appears to have encouraged non-compliance by HOPPL. A staged approach with definite deadlines is needed to ensure that all buffers will be in place within five years. Buffer zones should include high nutrient uptake sedges, reeds and native palms and be supplemented with hardwood species.

Erosion

Erosion and subsequent sedimentation would have been particularly significant during the establishment of oil plantations. Other clearing and forestry activities would also have contributed. Erosion still occurs because of the lack of buffers and the need to maintain cleared zones around oil palms (see Buffers above). It can contribute to turbidity and, the movement of contaminated soils and excess nutrients to the waterways.

Solid waste management

Although the HOPPL states that it has improved waste management there is concern that the past and present disposal pits could be leaching to groundwater as no liners have been installed. It is likely that empty herbicide and pesticides and hydrocarbon containers have been buried in disposal pits.

Of concern also is the Popondetta garbage tip, which is located adjacent to the Ambogo River. Leachates have been observed and it is possible that these could be toxic.

Hydrocarbons

Concern has been expressed about the management of hydrocarbons at the mill site. We were unable to inspect the site and cannot comment on this issue.

Human health

It has been reported that there has been an increased incidence and prevalence of TB, asthma, birth deformities, diarrhea, skin diseases, malaria and noticeable malnutrition since the introduction of oil palm. Unfortunately medical histories have not been recorded or maintained sufficiently for analysis. Medical diagnosis and treatment has been inadequate. Longitudinal epidemiological studies are required to determine the medical impacts of the oil palm industry.

Sam Vegogo, the CEO of Popondetta Hospital, has also indicated that funding for research on the health of oil palm workers has been received and will begin in May 2006.

Nevertheless a program for monitoring the effects of use of pesticides and herbicides could detect obvious acute symptoms.

Air pollution

There has been concern about occupational and community health in relation to the smoke stacks at the mill. HOPPL staff has stated that a new stack with appropriate scrubbers is being installed. Old scrubbers will only be used during emergencies and they too will be fitted with scrubbers

Fertilizer use

Excessive use of fertilizer can cause land degradation and, ground and surface water pollution. Limited testing of waterways and soils suggested that nitrates and phosphates are not excessive. Further investigation is required in the dry season when heavy rainfall will not dilute results.

Of concern was the methods of applications, which can expose workers to fertilizers though direct skin contact and inhalation. Protective clothing and training is required.

Empty Fruit Bunches (EFBs)

EFBs are returned to the plantations as fertilizer/mulch. It has been reported that increases breeding habitats for biting insects and other pests (eg rats). Generally spreading of the EFBs is not inadequate as it is difficult without proper equipment.

The EFBs require being broken-down using a shredding/mulching machine before being returned to the plantations. This would solve the problems of spreading and the creation of habitats for pests.

Licences, Monitoring and Reporting

It is clear from successive DEC reports and Environmental Audit Reports (commissioned by HOPPL) that HOPPL has been slow to respond to recommended changes to operations. Further, it has not done the necessary or adequate monitoring to minimize impacts to the environmental and human health nor has it supplied reports when required. DEC enforcement of regulations and conditions has been inadequate.

Economic/Social/Cultural impacts

Promises of improved economic and housing conditions has not eventuated for the majority of communities located downstream of the oil palm mill.

The following economic, and social/cultural impacts have been reported:

Economic

- a loss of food sources (fish etc)
- decreased food production in gardens
- increasing reliance on imported foods and the cash economy
- loss of access to forestry land for building materials

Social/cultural

- changes in social cohesion – community tension
- impact of influx of workers from other provinces
- binge drinking
- domestic violence
- child labour
- lifestyle shift from gardening and hunting to increased dependency on cash economy

SECTION 6: LEGAL OPTIONS AND ISSUES

The Consultants do not have the legal expertise to indicate outcomes of any action or indeed what specific legal actions to take. What is provided within is a summary of the major issues and specific evidence that would need to be collected to suggest liability for harm to the environment and human health.

It is noted that in Part II (Objects and General Environmental Duty) Section 5 of *Environmental Act* (2000) (Matters of national importance):

All persons exercising powers and functions under this Act shall recognise and provide for the following matters of national importance:—

(a) the preservation of Papua New Guinea traditional social structures; and

(b) the maintenance of sources of clean water and subsistence food sources to enable those Papua New Guineans who depend upon them to maintain their traditional lifestyles; and

(c) the protection of areas of significant biological diversity and the habitats of rare, unique or endangered species; and

(d) the recognition of the role of land-owners in decision-making about the development of the resources on their land; and

(e) responsible and sustainable economic development.

Background

To develop any compensation claim against palm oil associated organisations the claimants would need to:

1) Establish that the deleterious environmental/health impacts were the direct result of palm oil plantations and/or milling operations
2) Identify the parties responsible for these impacts eg. HOPPL, OPIC, upstream plantation owners
3) Seek scientific and legal expertise to present and establish their compensation claim under PNG law

A number of problems exist in developing the above points (1-3).

Point 1: A number of confounding effects may have contributed to the environmental/health impacts identified in the Popondetta region. These include:

- the discharge of the HOPPL mill's POME
- potential discharge of waste from the copper, chrome and arsenate wood preservation process at Ambogo saw mill
- inappropriate disposal of pesticide containers,
- increased population density
- leachates from company garbage tips,
- siltation caused by removal of natural vegetation on VOP, LSS and company held land
- sewage contamination
- inappropriate use and application methods of herbicides and pesticides
- use of the waterways as laundries and bathrooms
- leachates from the Popondetta garbage tip
- lack of buffers
- excessive fertilizer use
- loss of protein sources from traditional foods (eg fish) and increased reliance on processed foods

Point 2: Identifying the responsible party would be a difficult process. For example:

- Would downstream villages be able to seek compensation from upstream villages that are involved in palm oil production?
- Damage could come from company estates (40% of land), VOPs and LSSs (60% of land)
- What is the role of OPIC in providing incentives and loans that encouraged oil palm?
- What was HOPPL's role in the overall impact of palm oil within the region?
- Do CDC or Cargills hold responsibility for the past milling activities?
- Will people be seeking compensation from neighbours?
- Is the PNG government responsible for allowing development with inappropriate environmental constraints?
- Has the DEC been negligent in its application of environmental regulations?

Point 3: The scientific evidence required to develop the legal case against a defendant would incur high labour and resource costs. This evidence would then be passed on for legal review that would incur further costs and time. It should also be noted the Ass. Prof. Environment Science at the University of PNG, David Mowbray was not aware of any precedent in PNG law of a successful compensation claim due to environmental pollution or contamination.

Possible areas for litigation

The following impacts present potential legal avenues for compensation by villages and individuals located in the Popondetta region against palm oil activities.

1. **Siltation of estuaries and river systems resulting in loss of suitable drinking water and fish resources**

Potential legal action
Siltation has removed Papua New Guineans access to clean water and subsistence food sources (see objectives of the Act).

Evidence required
The extent of siltation could be established by drilling down into the sediments to determine soil type, depth, pollution content and history. The expertise and type of drilling equipment required to analyse the soil samples would incur high costs.

Identification of parties responsible

CDC, the PNG Government (including OPIC), VOPs and LSS have all been involved in land clearing and planting practices that would have contributed to siltation. Logging in the catchments would also have contributed to build-up of sediments.

Comments
A study may not provide evidence suitable for a legal compensation claim, however it would add evidence of the overall environmental impacts of palm oil expansion.

A Masters student at the UPNG is currently investigating siltation in West New Britain associated with palm oil plantations. The results of this investigation would provide a good indication of the costing and logistics of conducting a similar investigation in the Popondetta region.

2. POME discharge from HOPPL direct to Ambogo River from 1976 – 1996

Potential legal action
The company acted against government regulation in its levels of direct discharge of POME.

Identification of parties responsible

HOPPL would be responsible if it had been discharging beyond the levels allowed by permit by DEC. It is noted that DEC did not monitor or audit the discharges by the mill diligently enough.

Evidence required
HOPPL installed retention and gully ponds in 1996 and claim to have ceased continuous, direct input of POME into the Ambogo River. It would therefore be necessary to develop a retrospective impact assessment based on predicted discharge rates and their impact on the Ambogo River from 1976 - 1996. Expert advice would need to be provided by toxicologists, hydrologists, ecotoxicologists, fresh water ecologists and entomologists.

Comments
Without baseline data of fishery stocks and water quality, a retrospective study would require the development of a number of assumptions that may not survive legal scrutiny.

3. Loss of fish resources

Potential legal action
Company actions removed Papua New Guineans access to clean water and subsistence food sources (see objectives of the Act).

Evidence required
Interviews with local communities identified a number of fish species that had disappeared from the river systems since the 1970s. The local communities also stated a number of dramatic fish kills had been observed after heavy rainfall events. To construct scientific support for these observations a large-scale ecological survey would be required. The survey would need to establish a reference river system that had not been impacted by palm oil, but did exhibit similar physical and biological conditions of the Ambogo River.

To establish history and potential cause(s) of fish kills evidence from sediments would be required. Study of the sediments, requiring in some areas setting-up of floating rigs (costly), may or may not reveal causes of fish kills (ie particular pollutants present during fish kill events).

Identification of parties responsible

The Company, VOPs and LSS have all been involved in processes that may have contributed to fish kills. The Ambogo sawmill may also be implicated (CCA discharge).

Comments
Fish kills can be caused by a number of natural processes and man-made activities.

Natural processes that may have caused the fish kills include:

- the exposure of acid sulphate soils resulting in low pH levels in the river
- high levels of BOD (and subsequent low dissolved oxygen) caused by leaf litter and organic inputs to the river system.

Man-made activities that may have caused the fish kills include:

- washing out of pesticide/herbicide containers into the river
- inappropriate use of, and application methods of, herbicides and pesticides
- poor management of POME waste from oil mill
- excess nutrients from sewage
- poor management of waste from CCA treatment* (including discharges during flooding of sawmill) at Ambogo sawmill.

* Consultants were unable to confirm the use of CCA at the sawmill.

4. Loss of drinking water resources and increase in disease due to sewage contamination of streams, rivers and wells.

Potential legal action
Company actions removed Papua New Guineans access to clean water and subsistence food sources (see objectives of the Act).

Evidence required
Accurate medical records of diseases commonly associated with exposure to human sewage such as diarrhoea, Giardia and cholera would be required. A representative of the Department of Health indicated that these records are only maintained on a regional level and would not offer the level of evidence required to support this claim.

Identification of parties responsible

The Company, VOPs and LSS have all been involved in inadequate management of wastewater (in particular sewage) that may have contributed to contamination of drinking water.

Comments
HOPPL has embarked on a program of treating sewage in company villages. It is not complete and methods of disposal of treated effluent are inappropriate. Treatment methods are rudimentary and surface irrigation occurs too close to waterways. Nevertheless there has been some improvement in sewage management.

Apart from some sewage plants on company estates pit toilets are generally used for disposal of sewage. During the field visit, a number of village toilets were observed to be located along or in close proximity to the banks of the waterways and may contribute to contamination. Pit toilets (even when not in close proximity to waterways) can easily be contaminate the groundwater and consequently, both waterways and wells. It was also noted that people use rivers and streams for washing soiled clothes and as toilets.

5. Harm caused by toxic chemicals

Potential legal action
Harm to human health caused by herbicides and pesticides through negligence.

Evidence required
Accurate medical records of diseases commonly associated with exposure to toxic chemicals and provable negligence.

Identification of parties responsible

The Company, VOPs and LSS may have all been involved inappropriate use of toxic chemicals. The manufacturers of the chemicals and/or the authority that registers them may also be responsible.

Comments
There is doubt about the safety of herbicides and pesticides used in the production of palm oil despite assurances by the industry to the contrary. Producers and the oil palm industry would dispute the impacts of these chemicals. It is of note that synergistic and additive effects are not generally considered when testing chemicals. Causation then is difficult to establish without longitudinal epidemiological studies. This would make any compensation claims directed at the impacts of toxic chemicals difficult.

All chemicals presently used may be legally registered for use (that would require further investigation). If so, liability for any harm proven, would have to be directed at the registering authority and/or manufacturers.

Further confounding the issue of chemical impacts is the application rates and application methods of herbicides and pesticides. Anecdotal evidence suggests that people expose themselves to harm unnecessarily. Oil palm workers generally do not have adequate training although HOPPL states that their workers are trained. OPIC appears not to take any responsibility for training to ensure that workers are not exposed to potential contamination. How much liability for any harm do they bear?

There have been reports of workers washing out spraying equipment in waterways and using chemicals to stun fish and prawns. This could have caused harm to downstream users.

Conclusion

It is apparent that oil palm production has been a significant contributor to detrimental environmental changes and impacted on the health of the local communities including the decrease in quantity and quality of food, and drinking water, available in the Popondetta region. The question is, whether (and from whom) local communities can claim compensation for these impacts.

There are many confounding elements in establishing liability. Apart from other activities such as logging and saw milling processes, there are exacerbating factors like rapid population increases (including migration from other provinces). Wastewater/sewage management is problematic in Popondetta town, company villages and on customary land and no reliable studies have been undertaken tracking changes in environmental conditions. All plantations (not only company ones) are implicated in increased siltation of creeks and rivers, and inappropriate use of chemicals.

Developing a compensation claim for human health impacts would also be difficult, as health indicators and data have not be adequately maintained. There have also been no long-term epidemiological studies undertaken to assess changes (or reason for changes) in community health. The relatively low life expectancy would statistically confound any studies.

A question also arises whether the initial environmental conditions set by the PNG Government were in fact adequate. It appears that the company or DEC did not adequately monitor even those conditions that were established. It is also clear that the DEC has not been diligent in pursuing any licensing conditions that had been breached. How liable is DEC and can compensation claims be directed to them? Nevertheless improvements have been made in some areas albeit very slowly. Considering the closeness of the PNG Government to the development and encouragement of the industry, through OPIC, it has a direct responsibility for overseeing the industry. How much liability would OPIC incur?

Again, whilst the Consultants cannot give legal advice they believe that establishing a scientifically supported legal compensation claim and legal action against HOPPL/Cargills would take 3-5 years and could incur costs up to US$500,000 (including environmental, economic, human health and social impacts assessment, expert witnesses, lawyers etc).

There is also no guarantee that the scientific evidence gained would be sufficient to support a legal argument against HOPPL, OPIC or other palm oil organisations who would raise the confounding influences in their defence. This opinion has been confirmed through a peer review with academics from the School of Natural and Physical Sciences at University of Papua New Guinea and an Accredited Contaminated Sites Auditor (NSW) who has given advice on this matter.

It is recommended that CELCOR further investigate possibilities of litigation that do not rely specifically on irrefutable scientific evidence ie by using the generalities of the Objects of the *Act*. Collection of data then may be by comparisons of unaffected areas to impacted areas – the investigations would not have to be as rigorous or expensive. The community mapping processes suggested in the final recommendations could support these investigations (see Section 8).

Exploring the legal possibilities can assist in the focussing of issues to be investigated and could strengthen the negotiating position of communities in any mediated settlement for compensation through the political process.

SECTION 7: ISSUES AND RECOMMENDATIONS

BY CELCOR CAMPAIGNERS AND AKPF FIELD WORKERS.

A debriefing meeting was held with George Laume, Lester Seri (CELCOR) and field workers Kenneth Koja and Frank Koiko (from Ahora/Kakandetta Peoples Foundation) after field investigations and interviews (7/3/06). Numerous issues were raised and recommendations made.

George Laume

- Requirement for more training in Environmental Impact Assessment
- Identification of health issues will help campaign by creating links with palm oil production. This would include links to malnutrition.
- Identification of chemical use and safety issues would assist campaign.
- Links to river health and food chain issues (eg loss of fish) also would assist campaign.
- An independent study is essential.
- Continued collect of information on health and social impacts is important as a means to disseminate impacts to Provincial Governments, companies, the rest of PNG.
- Development of options for the company is important.
- Information (facts) from locals could be useful evidence for any court action.
- Main issues are - awareness of water quality (vital) and application of chemicals.
- A chemical awareness campaign must be undertaken to:
  1. identify toxic chemicals
  2. create simple resource information
  3. simplify awareness issues – what are effects - spraying near children, protective measures etc
  4. create posters
- Have local monitoring established in the communities and means for data collection.

Kenneth Koja

Kenneth noted that the idea of an EIA is new to the Popondetta communities and this was the first time anyone had visited the villages to listen and record the people's opinion. Points made:

- An assessment should be of the whole catchment.
- Information should be shared to educate and allow people to participate.
- The company should not be pouring waste to the people downstream.
- The training in water quality assessment given during the three weeks was an eye opener for the people.
- Key issues were training in: safe use of chemicals (quantities and application methods); basic water quality testing; alternate water supplies and hygiene.
- Need for assistance to have dialogue with Government and company – so they cannot be misled.
- Develop and maintain links with Health Department – JamesYangano/Kenneth Koja.

Frank Koiko

- There is a need for funding for quick responses to emergencies
- Develop communications
- Investigate fish stocks in unaffected areas.

Lester Seri

- Identify needs through this investigation
- Local communities were told that they would all get houses and cars if they grew Oil Palm. The dream did not manifest. A poster could be created to illustrate this – "Before – the Dream – the reality Now").
- Does the company follow the Palm Oil Code of Practice – a genuine code is needed
- Investigate compliance to ISO 14001 – the rating needs to be justified – have they been certified by an accredited assessor?
- Chemical information is needed for all – government and community. Side effects etc.
- Because Oil Palm is expanding is there enough land for gardens especially with rapidly expanding population especially in estate areas.
- Land degradation is happening – is Oil Palm sustainable?
- Loss of lifestyle – swimming in unpolluted creeks.
- Idea is not to close down Oil Palm industry but to assist in administration to mitigate problems by monitoring and controlling.
- The local hospital has limited capacity but incidents of ill health increase eg anaemia is particularly noticed in oil palm areas.
- Long term planning is needed – to allocate resources to impacted areas.
- Benchmarks are required for information quality and availability.
- Improvements in legislation, operations and conduct are required.

Summary

It is difficult to make the recommendations by CELCOR campaigners and the members of Ahora/Kakandetta Peoples Foundation more succinct. All issues raised are important. There was a strong emphasis on community capacity building and training of community members for building an effective campaign and improving participation. Campaigning would include training for toxic chemical awareness and monitoring, environmental assessment and, basic water quality monitoring. A need to develop communication techniques to improve dialogue with the Government and the company was identified. Development of options for the company was also suggested. Investigation and assessment of the whole catchment was also an important point raised.

This report has suggested concepts and techniques to assist in the achieving the recommendations made.

SECTION 8: CONCLUSION, RECOMMENDATIONS and CONTINUING PROCESSES

CONCLUSION

An investigation of the impacts of Oil Palm activities in the Popondetta area has been undertaken. Funding was received by CELCOR (The Centre for Environmental Law and Community Rights Inc. – PNG). They employed Environmental Consultants Ben Cole and John Craven to undertake studies to identify issues, to determine priorities for an Environmental Impact Assessment (EIA) and assess whether available data could support legal action. The Australian Conservation Foundation has also been collaborating in the investigation.

A screening process to determine whether environmental assessment was required was completed by CELCOR and ACF. They contracted the Consultants who, after examining all documentation available from DEC and HOPPL, prepared a scoping document, which defined issues of concern and reviewed potentially toxic chemicals. Building on the screening and scoping an Initial Environmental Examination (IEE) was proposed as a pilot study for an EIA. *It is noted here that any study undertaken, considering that the environmental is already impacted, is better described as an Environmental Audit rather than an EIA.*

The Consultants visited the site during February-March (2006) to undertake the IEE. Water and soil sampling was undertaken. The Consultants were supported and joined by the local community during the investigation. A simple water quality field-testing kit was also demonstrated to locals, some of whom were trained in the testing techniques to continue monitoring.

Local communities were interviewed to determine impact on them and their environment during the site visit. Many issues were identified. These included:

- Complete loss of fish/eels/crocodiles from creeks and rivers
- Siltation of rivers and a coastal lagoon
- Oil palm mill wastes in waterways
- Improper use of chemical sprays
- Child labour
- Sickness
- Poor water quality
- Sewage in waterways
- Air pollution
- Soil fertility loss

Sampling revealed coliforms in drinking water sources indicating groundwater and surface water contamination. Some community members were trained in water quality techniques using a simple colormetric sampling kit and are continuing a monitoring program in partnership with the Health Department. A community member will undertake a fish study when an appropriate book for

identification has been located. The study would examine neighbouring rivers not affected by Oil Palm plantations.

The consultants were not able to examine the HOPPL mill site to investigate complaints although were able to interview the HOPPL Environmental and Training managers. Any future site visit may have to be arranged under the auspices of and in partnership with the Health Department or Department of Environment and Conservation. Investigation was undertaken upstream and downstream of the mill on private/customary land. Illegal waste discharges were detected and sampled.

The IEE also included preliminary investigation of the Kokoda area where expansion of oil palm plantations and a mill is proposed.

Links were made with the University of PNG at Port Moresby. Members of the Environmental Studies Department did a peer appraisal of initial results. They were skeptical of being able to collect the necessary conclusive evidence to specifically implicate HOPPL and to support legal action.

They did suggest using the under-resourced facilities (in particular GIS/Remote Sensing) of the university if funding could be arranged for a post-graduate student to assist with more detailed mapping.

An assessment was made of the issues that may be used to seek compensation. The likelihood of collecting sufficient and defendable evidence was evaluated. It was concluded that even with further intensive studies it would be difficult to sustain a winnable case. The costs involved would be significant and there would be no guarantee of an equitable outcome. The final decision whether to proceed with any action rests with specialized legal advice.

Nevertheless there are many areas identified for further essential scientific investigation to ensure that oil palm production can proceed sustainably and, to protect human and environmental health. These investigations would support campaigning and the political processes necessary for changes to the social, economic and environmental impacts of the oil palm industry.

RECOMMENDATIONS:

- Assess recommendations of this report
- Explore possibilities for legal action (CELCOR)
- Seek further legal advice

If legal assessment is favourable:

- Undertake targeted Environmental, Social and Economic Audit/Impact Assessment
- Prepare legal brief for Court Action
- Pursue Court case or out-of-court mediation/negotiation for compensation

Not withstanding any legal action:

Community development

- Undertake Community Capacity Building – using Community Mapping techniques for a community based EIA (Kokoda) and an Environmental Audit (Popondetta) – see Continuing Process below for further description
- Purchase of additional GREEN Lamotte water quality kits to allow ongoing testing of dissolved oxygen, coliform and nutrient levels by Kenneth Koja and other member of AKPF during the dry season
- Continue training in water quality monitoring techniques with local community groups in Popondetta and Kokoda region and collate water monitoring data sheets (see Appendices).
- Educate workers in the safe use of chemicals including handling, application rates, methods of application and occupational health issues. In the absence of OPIC taking responsibility, CELCOR campaigners, Ahora/Kakandetta Peoples Foundation (AKPF), the local women's association and the Health Department will have to develop a program.
- Create information sheets for pesticides/herbicides and include the symptoms of poisoning. The information sheets should be developed with accompanying symbols and pictures to allow illiterate people to understand their content.
- Organise training for soil fertility investigation to determine changes in local garden productivity
- Examination of alternate means of sewage treatment eg composting toilets, contained sub-surface wetlands.
- Conduct further research into production of coconut oil soap and production of charcoal filters for village water supplies.

Government linkages

- Maintain and/or develop links with the local health clinics, Department of Health (particularly James Yangano – Environmental Health Officer, Division of Health) and Popondetta Hospital (CEO Sam Vegogo) to share results of any studies being undertaken and to collaborate in any future and current funding submissions for comprehensive studies into drinking water assessment and oil palm workers health.
- Maintain and/or develop links with Department of Health (particularly James Yangano – Environmental Health Officer, Division of Health) for assessment of management of sewage from plantation settlements and other wastes including POME.

- Maintain and/or develop links with the Department of Environment and Conservation by informing them of any relevant results from this study.
- Maintain water quality testing and the integration of data with Health Department monitoring.

Campaign-based scientific investigations

- Maintain and/or develop links with University of Papua New Guinea and sponsor a post-graduate student for GIS mapping of Popondetta and Kokoda.
- Collect health details of workers before and after any spraying regimes to assess acute affects to determine whether there is an observable link between usage and any adverse reactions. This may have to be initiated by CELCOR and AKPF and integrate with campaigning. Report findings to local clinics, Department of Health (particularly James Yangano – Environmental Health Officer, Division of Health) and Popondetta Hospital (CEO Sam Vegogo).
- Investigate past chemicals used in the oil palm plantations
- Undertake a fish population and abundance study in oil palm and non-impacted rivers – this could be suggested as a joint research project with UPNG and the fisheries department of the James Cook University located in Northern Queensland

Specialised scientific research

- Investigate soils, sediments, surface water and groundwater for the presence of herbicides and pesticides.
- Establish sources of sewage contamination.
- Test any fish, crustacea etc caught in the impacted areas for presence of toxic chemicals.
- Determine reasons for soil fertility losses in gardens.

In the following pages a continuing process has been suggested that is based on **community development**, facilitated by **Community Mapping**, within a **Self-Help Catchment**.

THE CONTINUING PROCESS

Now that the IEE has been completed the following processes are suggested (see Figure 1):

- Assess recommendations of this report
- Assess possibilities for legal action (CELCOR)
- Seek further legal advice
- If legal assessment is favourable undertake targeted Environmental, Social and Economic Audit/Impact Assessment
- Prepare legal brief for Court Action
- Pursue Court case or out-of-court mediation/negotiation for compensation

The above course of action is contingent on favourable legal advice and evidence. Other actions are also advised, which can be concurrent with the above processes that will support legal action and community development. Whether or not legal action is possible, building community capacity and continued collection of data and monitoring are essential.

Considering the vast local knowledge it is recommended that **community capacity building** be undertaken to better utilize local people to collect data for any further assessment rather than relying only on imported "experts". The latter need only be used at critical points of data collection and interpretation and for training.

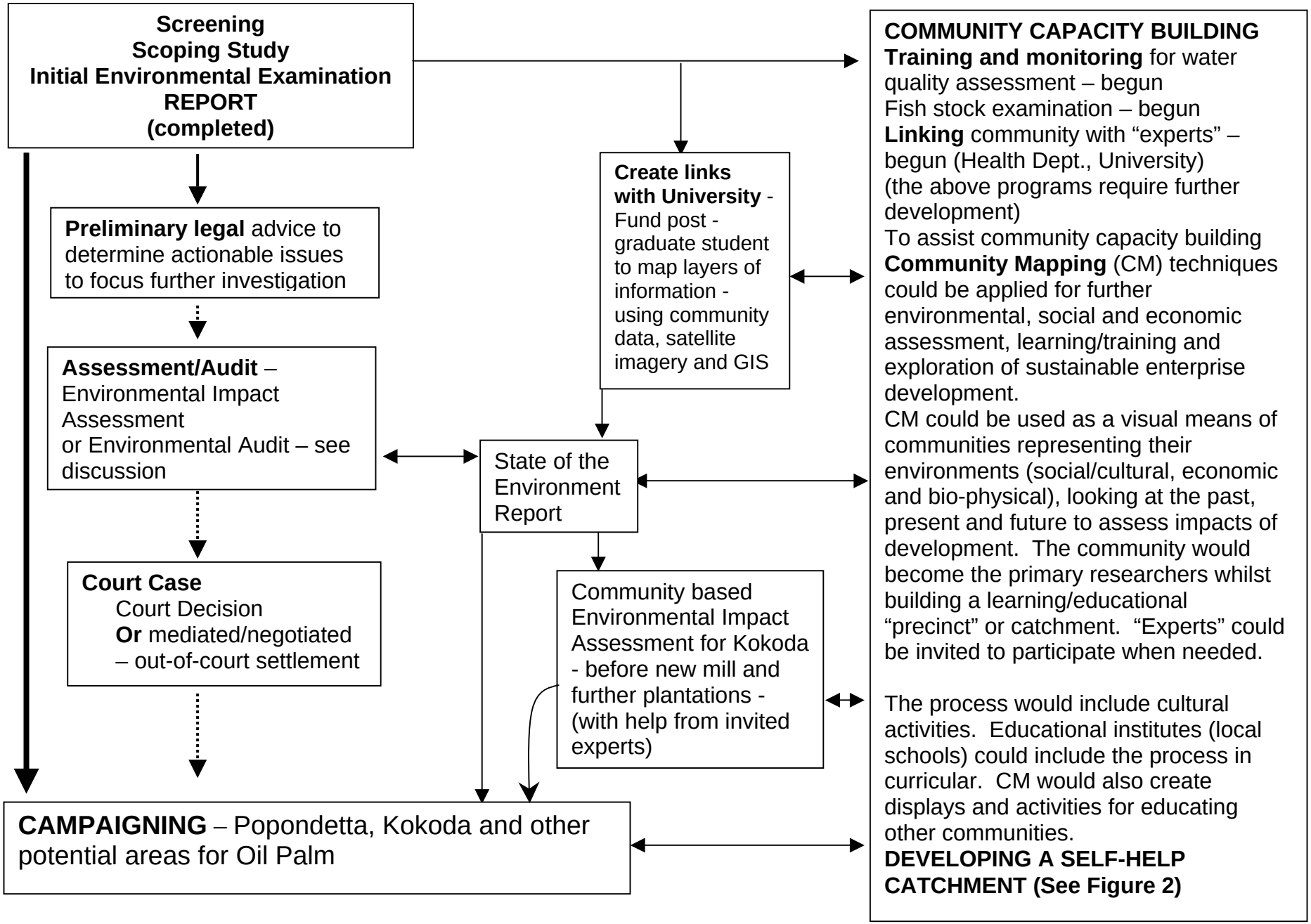
CELCOR and the Ahora/Kakandetta Peoples Foundation are well advanced in the assessment of impacts in the Popondetta area but further work is needed. This would involve further training and collection of data through a community mapping process to complete an Environmental Audit.

It is also important to ensure that an Environmental Impact Study be undertaken in the Kokoda area to establish baseline data and raise awareness. Campaigning in the area has already commenced in that area to raise awareness of the impacts of the expansion of oil palm production. The iconic nature of Kokoda (for Australians in particular) may be helpful in focusing attention on the problems caused by oil palm production for Papua New Guineans and other countries impacted.

Any investigation at Kokoda should be undertaken with the participation of local communities. They should be the major researchers and collectors of data. Assistance could be given by selected "experts" from appropriate disciplines, CELCOR and the Ahora/Kakandetta Peoples Foundation.

A COMMUNITY MAPPING model is suggested as a means to facilitate community capacity building (see Figure 1 and 2). It would be part of a process of developing SELF-HELP CATCHMENTS (See figure 2)

Figure 1: Investigations and Community Capacity Building



MOVING TO A SELF-HELP CATCHMENT (see Figures 1 and 2)

There are a number of different means of managing a social, economic and environmental catchment. They vary from "top-down" approaches to the development of a "Self-Help" catchment.

Top-down approach – The Catchment

The top-down approach is often the typical model. "Experts" from Government, business and various disciplines examine the catchment from a centralist position making decisions for the community of the catchment. Local knowledge is not sought and solutions to problems are imposed on the community and environment. Inappropriate decisions are made and conflicts occur.

Top-down "consultative" approach. – The "Consultative" Catchment

This model is similar to above except that select members of the community are consulted. Some community knowledge is used in decision-making but generally the approach could be considered to be to the benefit of sectional interests and individuals within the community. The broader community views and knowledge are ignored.

Top-down/Bottom-up approach – The Communicative Catchment

Greater community participation is encouraged in this model. Extension Officers facilitate actions and collaborate with community over land management issues. Local knowledge is more respected and included in more integrated decision-making. Some community training is given but "experts" still dominate data collection and final management decisions. This is the Australian Landcare model.

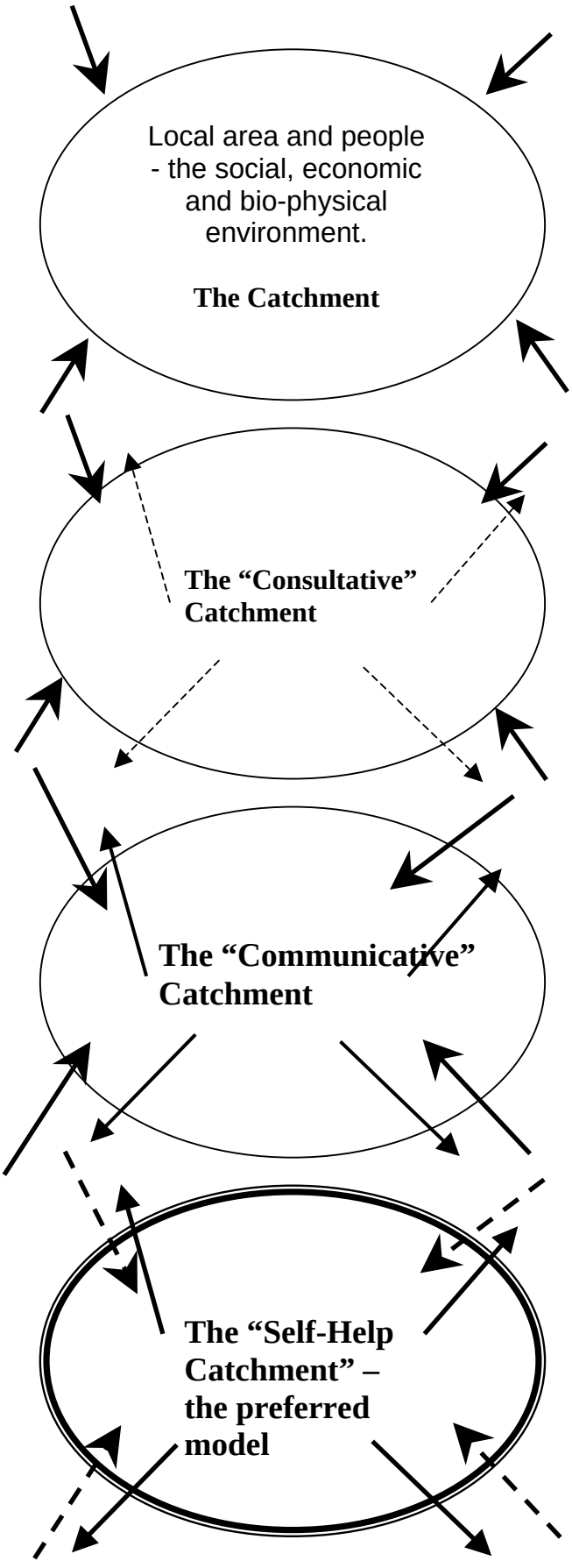
Ground-out approach – The Self-help Catchment – the preferred model

This model incorporates some of the elements of the Communicative Catchment. Community action is emphasized rather than the development of "Grand" plans. Authorities, "experts" and trainers are invited to become part of the process of management of the catchment (social/cultural, economic and environmental) at the same level as the community members. The community takes responsibility for their activities, becoming the primary researchers/facilitators/teachers. Local knowledge becomes the basis for assessment of the catchment. "Expert" knowledge and training is sought only when required. As community capacity increases trained community members will become responsible for imparting more specialized knowledge.

Respect for local knowledge is fundamental to this approach. Local knowledge, especially that of communities with strong connections to their land, is the basis for collection of data about the catchment. It is also the most acute, accurate and relevant data. **Community Mapping** can facilitate the activity of collecting data. It can be used to present data and allow dialogue about the data. It can be used as a visual database to promote learning and dialogue between and within communities and, between communities, authorities and researchers/experts. Community mapping can be used as an educational/training tool.

Figure 2: MOVING TO A SELF-HELP CATCHMENT

Prepared by J.Craven 2006 for CELCOR (adapted from Craven, 1994 and Martin, 1991)



Governments, business and specialists **telling** local people what to do. Planning not integrated. Locals not participating in process. Local social, economic and environmental issues/problems ignored. Local knowledge is not respected.

Top-down approach.

Governments, business and specialists **still telling** local people what to do. Planning not integrated. Some local knowledge sort from selected few. "Grand" plans ignore local social, economic and environmental issues. **Top-down "consultative" approach**.

Governments, business and specialists communicate with and **allow** local community to participate in data collection, decision-making, planning and monitoring. Greater integration of expert and local knowledge (and issues). Multi-disciplinary. Towards sustainability. Local ownership of issues arises.

Top-down/Bottom-up approach.

Governments, business and specialists are **invited into the catchment by local people** to train the community in skills they require to manage their environment and make decisions about economic, social and environmental development/sustainability. Integration of expert and local knowledge (and issues) using locals as researchers and monitors facilitated by **Community Mapping techniques,** multi-disciplinary **building of community capacity** and the development of **the catchment as a learning precinct** fostering **local ownership of processes.**

Ground-out approach.

COMMUNITY MAPPING

The Objectives of Community Mapping are to:

- Create community maps reflecting social/cultural aspects, economic activities and the environment of a particular area
- Stimulate, attract and increase community participation in decision-making
- Make sense of the past and present to understand the future
- Develop a "rich" picture of the area
- Encourage and facilitate learning, connection, cooperation and dialogue
- Reduce power imbalances when dealing with authorities
- Create and access networks within and outside the community
- Emphasize the patterns and relationships between culture, the environment and enterprise
- Maintain local identity
- Create a database of knowledge to be used when confronting threats to the community
- Develop local Environmental Impact Assessment and Auditing tools
- Create baseline data
- Acknowledge the community as "researchers"
- Impart information about important issues– eg safe use of chemical sprays, water quality
- Create self-help catchments

Methods

Multiple physical "trigger" or "base" maps can be created on large sheets of paper or permanent boards (preferable). These will be a representation of the catchment/area using simplified topographic information. Community members can add layers of information (these layers can be transferred to an electronic GIS if available). It is interactive – community members are encouraged to add information and/or create their own maps. The information can be land use, sites of cultural importance, land ownership, water quality data collected, placement of wells, community issues etc. The maps can be supplemented by photographs (historic and new), narratives and drawings.

The maps can become an important campaigning tool. They should be made as portable as possible to be moved from community to community.

Where Community Maps are used as a campaigning tool it is important to incorporate them in other activities. For example - festivals including plays related to particular issues (eg impacts of Oil Palms) can be arranged to create an atmosphere for interaction in the process of mapping (ie information collection and dissemination).

The mapping process requires facilitation by members of the community who have had some training in methods of Community Mapping. Methods are simple and can be easily adapted to local conditions. Participants can identify easily obtainable materials for developing display materials (eg suitable boards for displaying maps, written histories, posters, photos etc). All presentation material must be portable to enable transport of materials to different sites. Displays can be taken to meetings with

Government bodies, companies, politicians, other communities etc. Graphic presentation can be an effective tool for dialogue. As the process evolves community members can develop their own unique means of communication of ideas and information.

People of all ages can contribute to community maps (in fact it is essential). Schools can introduce the concept to curricula to encourage participation and planning concepts.

Greater critical understanding of a community catchment can emerge with prospects for community input to management increased. Community Mapping can also trigger better connections and potential for stimulating ideas for self-help enterprise opportunities.

Local Enterprise

During the study a desire to find alternatives to Oil Palm was expressed by some members of the community. One suggested enterprise was the production of coconut oil soap. The processing of the soap will include heat. This could be achieved by burning coconut husks. The charcoal produced may be suitable for filtering water to improve quality. This is worthy of further investigation (and funding). See Appendices.