

"SOCIO – ECONOMIC ANALYSIS OF THE INDAWGYI LAKE AREA,
MOHNYIN TOWNSHIP"

A Thesis

Submitted to the Examination Committee of the International Master of
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The degree of Master of Environmental Science

By
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Thesis supervised by Professor Frauke Kraas

Professor Josef Nipper

SUMMARY

The Indawgyi lake area, located in the north-west of Myanmar is a wetland area and one of the largest freshwater reservoirs of the country. It is heritage to rich and manifold natural treasures in fauna and flora. It was declared a protected area as Bird Sanctuary in 1999.

At the same time it is rather densely populated due to comparatively attractive living circumstances, supported, besides others, by the rich aquatic and bird life.

However, only limited information about the present socio-economic situation of the inhabitants is available, due to poor administrative structures in the region and the lack of awareness from the central government, which is engaged to administrate other issues, which Myanmar has more than enough to counter.

These facts and the growing importance of a sustainable development in today's globalized environment have formed the concept for this study.

The aim was to collect information about the present socio-economic situation of the Indawgyi lake area, necessary for a risk assessment.

Besides literature studies at the Universities of Yangon, Myitkyina and Mohnyin Degree College, information was contributed from associates of the forest ministry and from the park wardens on site.

Personal, semi-structured interviews, conducted in the area, and observations to gain recent data have been accomplished with 100 randomly selected families, representing 536 inhabitants of the area. Those families lived in 5 villages within the survey area, namely Sweletpan, Mamonkaing, Hepa, Nyaungbin and Lonton. The questionnaire was set up to deliver data for three categories.

1. Social factors, like family size, gender distribution, homestead types, residence

time, educational status, access to health care facilities,... to education facilities, availability of transportation and communication.

2. Economic factors, like source(s) of income, land- / livestock- ownership, annual expenditures,
3. Socio- Economic risks to the environment and sustainable eco system services like firewood consumption, water and soil pollution, fishing behaviour – (overfishing), hunting practices.

The results were categorized and analysed to determine socio- economic and ecological differences between individuals, locations and occupations.

No distinct correlation between occupation and income was found. Family size proved to be the main deterrent, whether individuals incomes are below or above the World Bank defined poverty line. Most homes were frugal; a considerable share of interviewees lived on boat homes. Healthcare was clearly defined as an issue, so were transportation and communication. Education offerings were found acceptable.

Earn of livelihood often needs more than one occupation and in many cases is unsecure, due to business sizes, property and livestock ownerships and lack of knowledge. Some of the respondents had to invest, so their spending exceeded their incomes. Fishing has been found as main income source. Shrinking Fish population caused by manifold reasons (overfishing, pollution, disregard of closed season) is a threat.

Bird hunting practices by poisoning is another one, as it endangers not only the bird population of the protected sanctuary, but also directly the health of those who ingest them.

Mercury pollution is another risk factor which needs to be controlled by more strict regulations and surveillance.

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Especially heartfelt thanks are extended to all staffs of Indawgyi Wildlife Sanctuary, Nature and wildlife Conservation Division Mohnyin Township (Ministry of Forestry) and Indo-Myanmar Conservation (NGO). Without their support it would not have been a successful job.

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TABLE OF CONTENTS

SUMMARY	iv
ACKNOWLEDGEMENT.....	vi
LIST OF TABLES	x
LIST OF FIGURES.....	xii
LIST OF PLATES.....	xiii
LIST OF ABBREVIATIONS	xiv
CHAPTER 1: INTRODUCTION	1
1.1 The aims of the study	2
1.2 General description of the Indawgyi lake area.....	2
1.2.1 Topography and drainage	2
1.2.2 Climate and soil.....	3
1.2.3 Vegetation and land cover	4
1.3 Challenges for Indawgyi lake	4
1.3.1 Overfishing.....	4
1.3.2 Land use management	5
1.3.3 Gold mining	6
(i) Method	6
(ii) Emission of mercury in the environment	7
(iii) Mercury in fish.....	7
(iv) Human exposure pathways and health effects	8
(v) Ecological effects of mercury	8
1.3.4 Firewood consumption	9
1.3.5 Waste disposal.....	9
1.3.6 Hunting.....	11
1.3.7 Institutional management	11
CHAPTER 2: REVIEW OF LITERATURE	17
2.1 Socioeconomic aspects.....	17
2.2 Environment aspects.....	20
CHAPTER 3: MATERIALS AND METHODS	23
3.1 Study area.....	23
3.2 Interview-based survey.....	23

3.3 Recording of fish species and fishing gear	24
3.4 Recording of environmental data.....	24
CHAPTER 4: RESULTS	26
4.1 Social Factors	26
4.1.1 Population and settlement trend.....	26
4.1.2 Age groups and gender	27
4.1.3 Working classes.....	28
4.1.4 Education and health	29
4.1.5 House structures	30
4.1.6 Electric power supply	31
4.1.7 Water supply	32
4.1.8 Transportation and communication	33
4.2 Economic Factors	35
4.2.1 Fishery sector	35
4.2.2 Agriculture sector	36
4.2.3 Self-employment sector.....	38
4.2.4 Other sector	38
4.2.5 Livestock production	38
4.2.6 Entertainment and electronic equipment possession.....	39
4.3 Income and expenditure structure.....	39
4.3.1 Income analysis	39
4.3.2 Expenditure analysis.....	41
4.4 Recorded fish species	41
4.5 Fishing gears	42
4.6 Firewood consumption	43
4.7 Water sample analysis	44
CHAPTER 5: DISCUSSION	66
CHAPTER 6: CONCLUSION AND RECOMMENDATION	75
REFERENCES:	78
Appendix I. Population structure by gender and age of the study area	82
Appendix II. Percentage distribution of literacy and educational status in the study area	83
Appendix III. Number of households and population by occupation	84
Appendix IV. Number of households and population by occupation	85

Appendix V. Income and expenses in surveyed areas in 2010	86
Appendix VI. Per capita income and average household members by village.....	91
Appendix VI a. Economy breakdown by village in 2010 Shweletpan.....	92
Appendix VI b. Economy breakdown by village in 2010 Mamonkaing	93
Appendix VI c. Economy breakdown by village in 2010 Hepa.....	94
Appendix VI d. Economy breakdown by village in 2010 Nyaungbin	95
Appendix VI e. Economy breakdown by village in 2010 Lonton.....	96
Appendix VII. Expenses in surveyed area in 2010.....	97

LIST OF TABLES

Table 1. Population distribution and gender in surveyed areas	45
Table 2. Population composition in interview areas and of the whole village	45
Table 3. Interviewed population in % of surveyed areas	45
Table 4. Population distribution and density of surveyed areas	46
Table 5. Settlement trend in surveyed areas	46
Table 6. Age structure of surveyed areas according to the official classification	47
Table 7. Worker`s participation of surveyed areas	47
Table 8. The population of teachers and pupils in each village of the study area	48
Table 9. The population of teachers, pupils and students in interview areas	49
Table 10. Population of literacy and educational status in the study area	49
Table 11. Different roof-, wall-, floor materials and other homes in the study area	50
Table 12. Percentages of different roof-, wall-, floor material in the study area	51
Table 13. Lighting	51
Table 14. Relationship between lighting and household which has school children	51
Table 15. Water parameters and concentration of elements in water sample (Lonton village) March 2011	52
Table 16. Water source	52
Table 17. Number of boat, motorized boat, motorcycle, bicycle, car and tel. in study site	53
Table 18. Percentage of households that own boat, motorized boat, motorcycle, bicycle, car, telephone	53
Table 20. No. of household classified by fishing occupation in the study site	53
Table 19. Households classified by occupation	54
Table 21. Population composition by fishing family of the study site	57
Table 22. No. of households, population and percentage of farmer family in interview areas	57
Table 23. Number of livestock in the study site	57
Table 24. Percentage of households that own livestock	58
Table 25. Number of TV, video, radio, cassette, satellite equipment in families	58
Table 26. Percentage of households with TV, video, radio, cassette and satellite equipment in interview areas	58
Table 27. Income structure of surveyed areas in 2010 by occupation	59
Table 28. Income/Expense distribution of surveyed areas in 2010	60
Table 29. Expense structure of surveyed areas in 2010 by occupation	61

Table 30. Recorded fish species	62
Table 31. No. of household classified by fishing gear in interview areas	63
Table 32. Size of one gill net classified by different mesh size	63
Table 33. Firewood consumption in the study area	63

LIST OF FIGURES

Figure 1. Maps showing the study area	13
Figure 2. Drainage system map of Indawgyi region	14
Figure 3. Map of surveyed areas	25
Figure 4. Worker and dependents ratio in interview areas.....	48
Figure 5. Percentage distributions of literacy and educational status in interview areas.....	50
Figure 6. Map of Indawgyi lake region	55
Figure 7. Occupational structures in interview areas	56
Figure 8. Percentage of fishing population in interview areas	56
Figure 9. Income structure of surveyed areas in 2010 by occupation	59
Figure 10. No. of households/ income-/expense-class.....	60
Figure 11. Expense structure of surveyed areas in 2010 by occupation.....	61

LIST OF PLATES

Plate 1. Some resources and nature of the lake	15
Plate 2. Some challenges for the lake	16
Plate 3. House structures	64
Plate 4. Some fishing gears and fish species.....	65

LIST OF ABBREVIATIONS

FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
DOF	Department of Fishery
WHO	World Health Organization
MOEJ	Ministry of Environment Japan
NGO	Non-governmental Organization
UNDP	United Nations Development Program
EC	European Commission

CHAPTER 1: INTRODUCTION

Regional socio-economic analysis are fundamental to thoroughly understand present conditions, define chances and risks of future developments and indicate possibilities to minimize negative impacts on human life quality.

In many developing countries a majority of the people are dependent on water-related natural resources, such as aquatic resources and floodplains, for their livelihood (FAO, 2010). Moreover, some of those countries' GDP rely on their aquaculture.

Indawgyi lake area is one of the largest inland freshwater reservoirs, not only of Myanmar, but also for Central South East Asia. The lake has a rich and abundant aquatic macrophyte flora, vital for maintenance of biodiversity and the ecosystem services, which the local population depends on for their survival and social welfare.

A total of 64 fish species were recorded in the lake basin, including inflowing streams and marshy areas. Three of them are endemic. The Lake is also the most important bird area of Myanmar. 97 species of water birds have been recorded (Davies, Sebastian and Chan, 2004).

The Lake area is homestead for eleven village tracts and thirty-seven villages. Its size is about 1211.39 km² (Naing Naing Latt, July 2010). 10 villages are located on the fringe of the lake.

There are 7,131 households with a population of 45,345 (Ministry of Forest Department, Myanmar, Feb 2011). Fishing is besides agriculture the second economic activity and income source for these people.

Since many decades Myanmar's GDP depends on agro- and aquaculture. In 2009-2010 Inland fresh water fish contributed 3.7% of the country's total GDP, compared to rice 3.4% (Frauke Kraas, Vorlesung "Myanmar" SS 2011).

The pressure of population growth [annually 1.75% (Department of population, 2008)], market demand, globalization trend, and lack of knowledge and infrastructure lead to an unsustainable use of natural resources.

1.1 The aims of the study

This work shall analyse the present socio- economical and environmental situation of the Indawgyi area in depth, as it is not only important for the local population, but has significant impact on the ecosystem services, supplied for the whole central South East Asia. The aim is to deliver baseline data for measures to minimize negative impacts caused by the predictable future developments.

1.2 General description of the Indawgyi lake area

1.2.1 Topography and drainage

The Indawgyi lake is located in the northern part of the Myanmar and belongs to the Mohnyin Township, which is part of the Kachin State (Fig 1). Its geographical position is between latitude 24° 56' North and longitude 96° 39' east, the lake stretches over 23.8km from north to south, the maximum width is 10 km, the basin is slightly asymmetrical, the depth of the lake is between 15.88 to 22.19 m, it covers an area of about 120km² and the catchment area includes about 850km² (Davies, Sebastian and Chan, 2004)). Indawgyi lake

is surrounded by mountain ranges, 300 m to 1,300 m in elevation above sea level (Ministry of Forest Department, Myanmar, 2010).

The lake is fed by many streams, dendritic drainage system can be found (Figure 2) .At the northeast end of the lake, Indaw stream is the only outflow of the lake. This stream runs towards northeast and enters the Moegaung stream, which feeds its water into the Irrawaddy river.

1.2.2 Climate and soil

Indawgyi lake area falls within sub-tropical monsoon climate zones, which divide the year into three seasons. The wet season stretches between June to October, the cold season from November to February and the dry season from March to May respectively.

The average year-over temperature is between 17°C to 28°C. It can however stretch from as low as 4.6°C during December and January and to a peak of up 40°C in April. The area is a mountainous and densely forested region. Thus, it receives heavy rain. The annual rainfall is about 1,789 mm with the mean relative humidity of 80% to 90%.

Mist is common in the lake basin during morning in the cold season. Days are usually sunny during the dry and cold season. These climate data were obtained from the Meteorology and Hydrology Department, Mohnyin Station, Mandalay, 2010.

Meadow alluvial soil is found around the lake area and on the flat plain. It is mainly composed of silt and clay with a share of approximately 70% and 20% respectively, the pH value is around 6 and the ratio of nitrogen and carbon is 7:13. This soil is suitable to cultivate rice, sugarcane, groundnut, bean and vegetable (Naing Naing Latt, 2010).

Meadow swampy or grey soil is found particularly in poor drainage areas, especially north of the lake. This is wet throughout the year. The lower ground layers show blue or grey colour with tiny spots of red or brown. The soil is sticky with high contents of clay. The pH value is 6.5, i.e. it is slightly acidic. Red and yellow brown forest soil is dominant in the mountain ranges (Ministry of Agriculture and Irrigation, 2002).

1.2.3 Vegetation and land cover

The flat plains, surrounding the lake are mostly covered by rice fields. Some areas, which are the seasonally inundated and waterlogged plains surrounding the lake, are covered by herbaceous marsh, scrub swamp and swamp forest.

In the open water of the lake, especially at the north end between the Nyaungbin and Indaw stream outflow and at the southern end around the Nanyinkha stream inflow are extensive areas of herbaceous march and water hyacinths.

Due to the relatively high transparency of the water (3.5m), extensive beds of submerged and floating leaved macrophytes can be found in some places (Davies, Sebastian and Chan, 2004).

The mountain ridges are mostly covered with broad leaf forests with many teak (*Tectonagrandis*) individuals.

1.3 Challenges for Indawgyi lake

1.3.1 Overfishing

Over the past decades and on-going a growing number of fishermen migrate into the lake area. This immigration is supported by a growing market demand for fish and became one of the most serious threats for a sustainable ecosystem development, caused by overfishing.

The indigenous people, Shan, Myanmar, Kachin depend primarily on agriculture and use traditional, low impact fishing techniques, obviously since 1990 migrants use intensive fishing practice because fishing is their main source of income (Indo-Myanmar Conservation, 2009)

Fishing is carried out mainly with small motorized boats using gill nets with a variety of mesh size. Sometime, improper fishing methods can be found, i.e. electric shock fishing. Baskets are used to catch smaller fish and prawns in the weed margins.

In 2010 the official registration number is 435 fishermen in the Lake. They work on average 10 months per year, and set the nets twice per day (Indo- Myanmar Conservation, 2010).

In 2008-2009, the total fish production in Myanmar was around 3,542,290 tons, 26 % of it contributed from freshwater fish, with a considerable share from Indawgyi Lake (Aung Htway Oo, 2010).

Domestic consumption is estimated at 43 kg per capita per year (Aung Htay Oo, 2010). Bearing the annual population growth of Myanmar in mind, the scale of the issue for the ecosystem balance and its negative impact on socio- economic situation of the region becomes obvious.

1.3.2 Land use management

Most of the inhabitants of the Indawgyi lake area are engaged in agriculture. 80% of the total population makes its living from agriculture (Naing Naing Latt, 2010). Issues are that due to the small size of farms and lack of effective irrigation systems, most of the farmers can cultivate crop only during the raining season. Most of the farm land directly adjacent

to the lake and also other farm land are adequate to grow just paddy, because the soil is sticky containing large proportion of clay.

This monoculture leaches the soil and causes the use of more and more fertilizer, which forms another negative impact on the water quality- and in the medium term on the ecosystem service. Due to the limited crop production after harvest most of the farmers work as fishermen, reinforcing the overfishing issue.

1.3.3 Gold mining

Since 1995 gold mining on a commercial scale has developed in Kachin State (Hla Hla Than, Dec 2006). In the Indawgyi region gold mines are found along its inflow streams, near the village of Nyaungbin, Nanttaungse, Nammilaung, and Nampade. Sometime some illegal gold mines can be found near Mamonkaing and Mainnaung in the conservation area.

Most of the local people who own neither farms nor boats often work as daily labourers at gold mines during the dry and cold season. However, most of the gold miners are migrants.

Mostly mining is operated by Chinese companies (Irrawaddy news magazine, Oct 2006).

The visible threat of gold mining is the blocking of streams, or diversion by mud produced from the gold mines. Farmers now face water shortages from the stream diversion, and paddy fields are drying out. The invisible but most dangerous potential threat however is mercury contamination.

(i) Method

The widely used methods of the gold mining in Indawgyi region is hydraulic mining. This method directs a powerful stream of water against the gold bearing gravel or sand. This operation breaks down the material and washes it away through specially constructed

sluices in which the gold settles, while the lighter gravel is floated off. After that gold is extracted from gravel or crushed rock by dissolving it in mercury. The gold is recovered from the solution and melted into ingots.

(ii) Emission of mercury in the environment

Most of the mercury used by this technique is released into the biosphere. Some of it as elemental mercury vapour, which circulates in the atmosphere for up to a year. Hence it will be widely dispersed and transported thousands of kilometres from likely sources of emission (Pollution Probe, 2003, p. 27). It can be readily removed from the atmosphere by precipitation and is also dry deposited on the earth's surface. . Even after it deposits, mercury commonly is emitted back to the atmosphere either as a gas or associated with particles, to be re-deposited elsewhere.

Another share of mercury pollution from gold mining directly accumulates in water and soil. It appears as inorganic mercury salt and organic forms (e.g. methyl mercury). Some microorganisms in the water or soil can change inorganic forms of mercury to organic forms (methyl mercury) (United States Public Health Service, 1996-2010).

(iii) Mercury in fish

In the aquatic environment, most prevalent is mercury in organic form. Such as methyl mercury, which accumulates in fish tissue. Inorganic mercury, which is less efficiently absorbed and more readily eliminated from the body than methyl mercury, does not tend to bio accumulate. Therefore most fish carry trace amounts of methyl mercury. The level of mercury found in a fish is related to the level of mercury in its aquatic environment and its place in the food chain. Mercury tends to accumulate in the food chain. Large predatory

fish species tend to have higher levels than non-predatory fish or species at lower levels in the food chain (Pollution Probe, 2003).

(iv) Human exposure pathways and health effects

Humans are most likely to be exposed to methyl mercury through fish consumption. Exposure may occur through other routes as well (e.g. the ingestion of methyl mercury-contaminated drinking water, from food sources and from breathing contaminated air) (United States Public Health Service, 1996-2010).

However, the fish consumption pathway dominates these other pathways. Trace amounts of methyl mercury are not harmful to humans, but the highest level of methyl mercury, for example in predator fish can pose great risk to people who eat them regularly as outlined in the following.

Mercury is a known human toxicant. It is poorly absorbed from the gastrointestinal tract. Once in the body, mercury concentrates in the nerves, liver, and especially the kidneys. Mercury is a potent cellular toxin, known to decrease neurotransmitter production. It disrupts important processes within the nerve cells, and decrease important hormones such as thyroid and testosterone.

Symptoms of mercury poisoning are muscles cramps or tremors, headache, tachycardia, intermittent fever, acrodynia, personality change and neurological dysfunction (New Hampshire Department of Environmental Services, 2003).

(v) Ecological effects of mercury

Adverse effects of mercury on fish, birds and mammals include death, reduced reproductive success, impaired growth and development and behavioural abnormalities. Sub lethal

effects of mercury on birds and mammals include liver damage, kidney damage, and neurobehavioral effects. Exposure to mercury can also cause adverse effects in plant such as death and sub lethal effects. Sub-lethal effects on aquatic plants can include plant senescence, growth inhibition and decreased chlorophyll content. Sub lethal effects on terrestrial plants can include decreased growth, leaf injury, root damage, and inhibited root growth and function (United States Environmental Protection Agency, Dec, 1997).

1.3.4 Firewood consumption

48.3% of total land area in Myanmar is forested between 1990 and 2010 deforestation rate was on average 0.95% per year (FAO, 2011). Insufficient electric power supply is one driving factor. More than 50% of deforestation is caused by wood fuel production for household cooking, lighting, space heating and for commercial businesses (Zin New Myint, 2005).

The Indawgyi lake area has no public power supply. The lake area is surrounded by reserved forest with an area of 556 km² (Ministry of Forest Department, Myanmar 2004). So, most of the people totally depend on either protected or open forest for fire wood.

1.3.5 Waste disposal

Solid Waste disposal is a critical issue to the lake. There is no municipal waste collection. Most of the people who live in the lake fringe area deposit their household waste at the bank of the lake. Some people, who come to the lake wishing to take a bath, bring their household waste and throw into the lake. A few people burn the household waste in their yard.

Another reinforcing issue increasing the waste amount is tourism. An ancient pagoda is located on the lake's open water at the middle of its western edge. An annual pagoda festival takes place between the end of February and begin of March for 7 to 10 days. Everyday about 80,000 pilgrims attend the festival (source: locals report, 2010). Most of the pilgrims and all shopkeepers camp on the bank of the lake near pagoda. All haul their waste on the bank of the lake.

During the rainy season, the lake expands and the low-lying areas surrounding the lake basin are flooded. Thus, all waste is washed into the lake by either run off or flood. This causes water pollution and as a consequence of this the threat of aquatic community depends on the content of household waste and dissolved materials. Solid waste mostly consists plastic litter. There is non-biodegradable and biodegradable plastic litter. In addition the issue of litter in the lake is reinforced by fishermen, using plastic bottles as fishing tools to flood their nets.

Normal plastics are bio-degradable, but this process needs hundreds of years to complete, so normally they are not considered as bio-degradable. Only some very specialized microorganisms, like some bacteria, fungi can biologically degrade plastics, and this happens only under strictly controlled conditions, not available in this area.

Plastic litter therefore causes serious problems to animals, which have a tendency of investigating and even ingesting plastics. Whether this behaviour results from the resemblance of plastics to prey or is an outcome of curiosity is unclear. But in either way, plastic litter causes major problems. Aquatic animals might be strangled in plastic bags often causing painful deaths. Ingestion of plastics in general can also lead to death by blocking the digestive tracks. Plastic waste also blocks soil enrichment and causes soil contamination as well.

1.3.6 Hunting

In the cold season the water bird population around the lake is likely to exceed 20,000 birds (Davies, Sebastian and Chan, 2004). Poisoning of birds is traditionally a popular hunting practice in the Indawgyi lake area. Some fishermen use it. According to the park wardens, they mix pesticide and food, and put the food on the floating plants in the lake. Water birds ingest it and become paralyzed. They are caught and sold in the market. It is a serious threat to the bird population diversity and consumer as well.

1.3.7 Institutional management

Since 1999 Indawgyi lake is declared conserved as Indawgyi Wetland Bird Sanctuary. It is managed by dedicated personnel from the Nature and Wildlife Conservation Division. This organization has emerged, according to The Wildlife, Wild Plants and Conservation of Natural Areas Law of 1994. It is under responsibility of the Forest Department. The Indawgyi region staff accounts 21 people. The wardens claim to be under staffed and the infrastructure for patrolling to be insufficient as outlined in the following examples.

Small-scale capture fishery is practiced and accepted in the lake area. The permit to fish needs a license, issued by the Department of Fishery (DOF), Myanmar. All fishing gears require such a license. Fees are variable according to the production levels and capacities. License fees for small gears are low.

Officially, it is required for all license holders to report their catches. In practice however, this is unlikely to happen without control. The entire fishery is terminated in May, June, July and August thus allowing spawning and recruitment (Aung Htay Oo, 2010). In

practice, the fishery in the lake goes on throughout the year. The wardens are unable to prevent this, due to organizational shortage, and lack of powerful law, they claim.

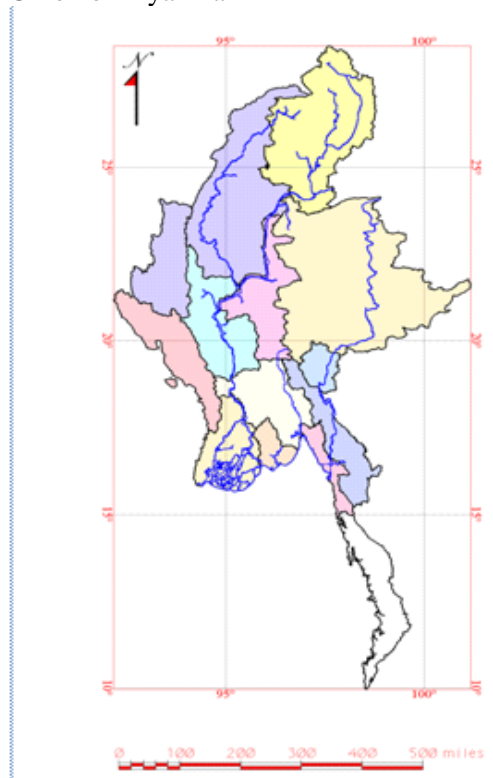
The Myanmar “Mines laws” of 1994 is vague and incoherent. They consist largely of general statements lacking the clarity regarding waste disposal.

In relation to pollution, Myanmar has no specific laws to govern air and water pollution.

These issues are loosely covered by the Public Health Law of 1972, empowered by the Ministry of Health.

Figure 1. Maps showing the study area

Union of Myanmar



Kachin State



Topographic map of Indawgyi lake area

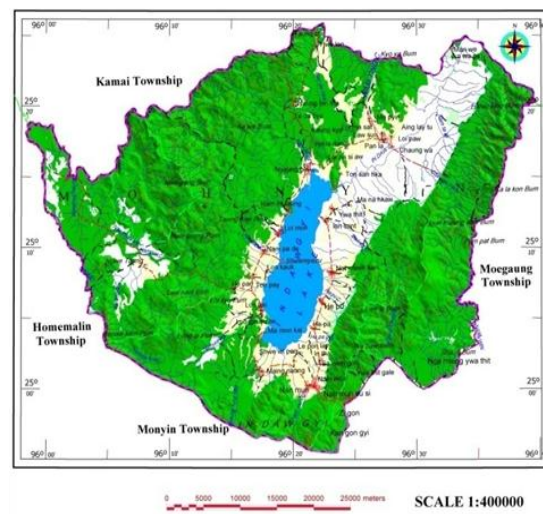


Figure 2. Drainage system map of Indawgyi region

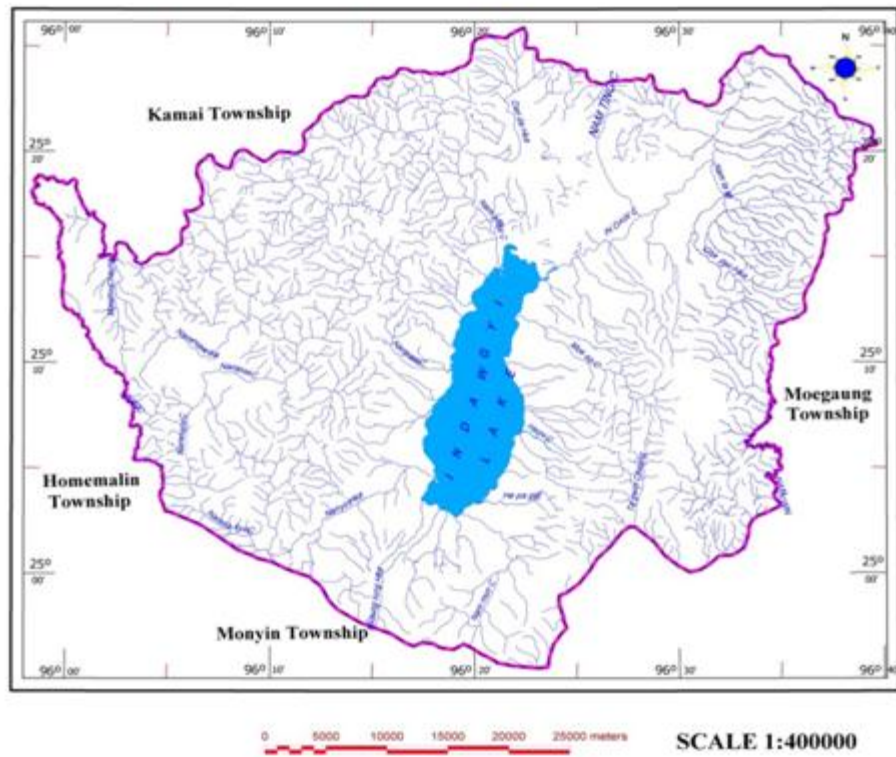


Plate 1. Some resources and nature of the lake

Water birds- *Anastomus oscitans* (Asian Openbill)



Fisherman`s houses, study area (Hepa village)



Fresh water supply in Lonton village



Surveyed area in Nyaungbin village



Collecting algae for pig food



Small prawn



Plate 2. Some challenges for the lake

Some waste disposal on the bank of the lake



Some litters are floating in the lake



Gold mining activity



Gold mining activity



Gold mining activity



Firewood (2 bullock carts)



CHAPTER 2: REVIEW OF LITERATURE

2.1 Socioeconomic aspects

Creston Valley (Canada wildlife management area, n.d.) as described and cited on the Ramsar website highlighted the importance of this wetland ecosystem and its services. It can serve as an example how wetland ecosystems provide with trillions of US dollars revenue every year us on a worldwide scale, - entirely free of charges- making a vital contribution to human health and well- being.

M.A. Abdrobo and M.A Hassaan (2003) provided conceptual and practical guidelines on how to conduct reliable assessments of the socioeconomic conditions, comparative analysis of various study sites and consequently establish a set of general guidelines for sustainable development in the coastal areas of the Mediterranean.

CJ Meintjes (March 2001) development paper 145 for the Development Bank of Southern Africa stated guidelines for regional socio-economic analysis, including purposes of regional socio-economic analysis, methodological frameworks and analytical techniques.

Environ Dynamics (Environmental Management Consultants, 2010) reviewed information on environmental impact assessment for the Elizabeth Bay optimization study, which was performed in conjunction with plans to extend the life of Namdeb Diamond mine in Namibia and targeted to meet the objective of acquiring maximum sustainability and to continue contributing towards the socio-economic well- being of its workforce and their families.

Peadar Kirby (2006) researched the different methods and parameters, developed to determine the direct and indirect impacts of Globalization and their dynamics on individuals and communities well-being. Comparisons of strengths and weaknesses as well as applicability of the results of his studies will be assessed.

Yin Yin Win (June, 2007) described the socioeconomic status of two villages of Maubin Township, Ayeyarwaddy Division, Myanmar including reproductive biology of fish species *Mystus pulcher*.

Dr. Naing Naing Latt, Daw Kyu Kyu Thin and Dr. Seng Aung (July 2010) presented a research paper regarding the geographical and socioeconomic condition of the Indawgyi Lake environ.

The EC- Burma/ Myanmar Strategy Paper (2007- 2013, pp. 9-34) recognized that, after decades of armed conflicts and relative isolation from and by the international community, Burma/Myanmar is significantly lagging behind its neighbours on most socio-economic indicators on poverty, health, and education, with a Human Development Index ranking at 129 out of 177. The EC- Burma/ Strategy paper identified, Burma/ Myanmar has one of the world`s lowest levels in public sector expenditure (approximately 4% of GDP).

The quality of public health services is very low and the de facto introduction of user fees has contributed to worsening conditions for many segments of the population who cannot afford proper health care.

In addition the education system is chronically under- funded and poorly managed. One of the greatest challenges is the low student retention and completion rates.

Only 68% Of the rural population has access to safe water and 57% to safe sanitation (cited WHO report 2004).

Images Asia & Pan Kachin Development society (Nov, 2004) `s report “*At What Price*” pointed out Gold mining in Kachin State, Myanmar and its economic and social impact in mining areas as well as unsafe working condition for miners.

Food and Agriculture Organization of the United Nations, (2010), published “*Inland Fisheries Resource Enhancement and Conservation in Asia*”. It included review papers of inland fisheries, resource enhancement and conservation covering practices, methodologies, operational modalities, impacts, constraints and recommendations for the way forward and one regional synthesis report generated from a regional expert workshop. Included were ten countries, namely Bangladesh, China, India, Indonesia, the Republic of Korea, Myanmar, Nepal, Sri Lanka, Thailand and Vietnam.

The Food and Agriculture Organization of the United Nations, (2003) implemented the mission for *Myanmar aquaculture and inland fisheries*. The mission identified that Myanmar urgently needs technical assistance, sustainable development of coastal and inland aquaculture and management of aquatic resources. It is also strongly recommended that Myanmar Department of fisheries increase its formal and informal networking with other line agencies and organizations within Myanmar and also with similar national networks in other countries.

2.2 Environment aspects

Walter K. Dodds, Wes W. Bouska, (Environmental Science Technology, 2009) studied the development of total Phosphorous and total Nitrogen concentration of the lakes and rivers in U.S. eco-regions. They also estimated annual economic losses in recreational water usage, waterfront property, recovery of threatened and endangered species, drinking water treatment, and microphyte- removal, resulting from human- induced eutrophication.

Their assumption was that eutrophication from anthropogenic activity are ultimately derived from fertilizers: Fertilizer use patterns can be used to indicate global trends of eutrophication. The two other assumptions were, river nutrient concentrations are directly proportional to lake concentrations, and hyper-eutrophication in the lake can be found mainly during the summer months.

Hla Hla Than (Dec, 2006), investigated the environmental impact caused by the gold mining area in the Kachin State by analysing water, soil, plant and fish samples from some selected regions of the state. She claimed that turbidity and biological oxygen demand (1.21-2.68 ppm) of the Indawgyi lake water samples increase during the summer. High pH values (8.8-9.2) develop. The concentration of Hg ranges in the lake from 0.059 to 2.858 ppb. This means that during the summer the Hg concentration of the lake was found two fold higher than the limit, set by the WHO (1ppb). The nutrient concentration, such as nitrate- nitrogen and phosphate- phosphorus indicate eutrophic conditions for the lake.

Davies, Sebastian and Chan (2004) published a text book of “A Wetland Inventory for Myanmar”, which is the systematic documentation of 99 wetland sites of Myanmar. It

summarizes the results from conducting surveys between 2000 and 2004, funded by the Ministry of the Environment, Japan (MOEJ).

Nguyen Hung Manh and Nguyen Phuong Thuy (August 2009, Fauna & Flora International) reported assessment of the fuel- efficient stove programme in Vietnam. In a particular a survey on the local people`s usage of fuel wood and the introduction of improved stoves had been carried out. The evaluation stated that for cooking meals about 25% to 35% of fuel wood can be saved by using improved stoves instead of the traditional local stoves.

The New Hampshire Department of Environmental Services (2003), the Environmental Fact Sheet, elucidated the sources of mercury emission, the impacts on health and the environment from mercury contamination: Strategies for reducing man-made releases of mercury to the environment were depicted.

The United States Public Health Service (1996-2010) described the nature of mercury, fate and transport of mercury, as well as exposure pathways and metabolism health effects.

The United States Environmental Protection Agency (Dec, 1997) outlined how to fulfil the requirements of the Clean Air Act Amendments of 1990. It is an eight volume assessment of the magnitude of U.S. mercury emissions by sources, the health and environmental impacts of those emissions, and the availability and cost of control technologies. One of them (Volume VI) is dealing with an ecological risk assessment for anthropogenic mercury emissions.

Pollution Probe`s Mercury Primer (June 2003) provided an overview of the presence and effects of mercury in the environment and its impacts of human health. The primer identified where mercury is being used and released, the risks associated with exposure to

mercury and the ways to help prevent mercury pollution. The primer also described what governments businesses and individuals are doing to eliminate the use of mercury and prevent its release to the environment. Finally, the primer highlighted that mercury is a significant global issue and threat to human and ecosystem health around the world.

Visit to an Ocean Planet Web site described the topic “Plastic in the Ocean” cited Western Regional Environmental Council (1987). It offered enhancing of awareness regarding the hazard of plastic litter for wildlife in both the marine and fresh water environments.

CHAPTER 3: MATERIALS AND METHODS

3.1 Study area

Five villages, Lonton, Mamonkaing, Shweletpan, Hepa and Nyaungbin, located in the fringe of the lake were chosen as study area (Fig 3). It has an expanse of about 438.72km². The villages are located at a distance of approximately 42km, 37 km, 31km, 35km and 69km from Mohnyin city respectively.

3.2 Interview-based survey

The stratified random sampling method was applied to choose respondents. One hundred households with 536 residents have been surveyed and interviewed.

Recorded for each of the families were: Family size, age status, worker/non-worker, literacy, occupation, income, expenditure for each family member;

Further subjects of the questionnaire were: access to electricity, water sources and self-assessment of the family's socioeconomic status.

Firewood consumption was also recorded to identify the human impact on the natural resources. It provides the expenditure item to analysis socioeconomic as well.

Interviews were conducted during family visits by personal communication.

Some further questions were answered by observation by the interviewer, (e.g. house type).

Local community leader interviews provided general information about villages.

3.3 Recording of fish species and fishing gear

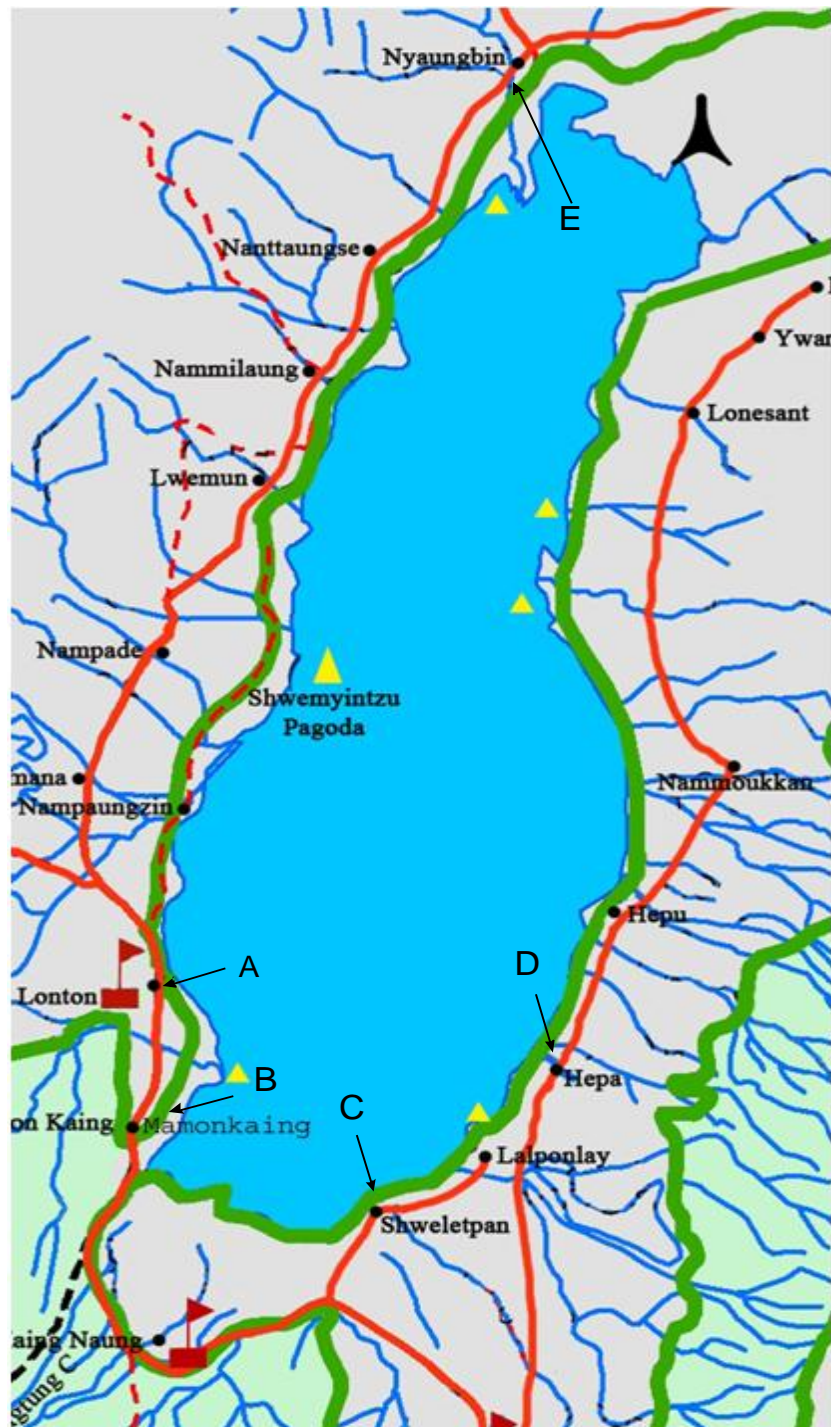
Fish species and daily catches, as well as their fishing gear in use were recorded by interviewing the fishermen at their fields. Identification of the species was performed according to the book “Inland fishes of Myanmar” (Chavalit Vidthayanon, Apichart Termvidchakorn & Myint Pe).

3.4 Recording of environmental data

Water samples were collected from the lake and analysed at Yangon Institute of Technology and at the Institute of Geography, University of Cologne. Rainfall and temperature data were obtained from the Meteorology and Hydrology Department, Mohnyin Station, Mandalay. Data about flora and fauna of the Indawgyi Wildlife Sanctuary were contributed by the Forest Department Myanmar. Soil sample data and all secondary data were collected by literature reviews. However the secondary data are less likely to be available and where few research are able to work.

Figure 3. Map of the surveyed areas

(A. Lonton, B. Mamonkaing, C. Shweletpan, D. Hepa, E. Nyaungbin)



CHAPTER 4: RESULTS

4.1 Social Factors

4.1.1 Population and settlement trend

Interviews were conducted from 19 households in Shweletpan, 22 households in Hepa, 14 households in Manmon Kaing, 18 households in Lonton and 27 households in Nyaungbin.

The family size data were recorded in five villages with 100 households of the surveyed area. The recorded results regarding family size were 19 households with 89 individuals in Shweletpan, 14 households with 72 members in Mamonkaing, 22 residences with 124 household members in Hepa, 27 dwellings with 153 residents in Nyaungbin, 18 households with 98 members in Lonton, respectively (Table 1).

This amounts to an average of approximately 5.4 members per household. The highest negative deviation from average is in Shweletpan (4.68 person/family) including one family with 10 members. Lonton also is home to three families with 10 members, but deviates only slightly positive from average (5.44members/ family). The highest no of members/family was recorded for Nyaungbin with 5.66 family members (Table 2).

The total no of interviewees was 536 which represent 100 households in all 5 villages covered. Those represent 7.8 % of the total population in the study area (Table 3). The average population density was 391 persons in one square mile (150 persons /km²) of the settlement areas (Table 4). (notice, the different in population no. shown in table 2 and 4 represent the population of the main village and village tract).

The residents' time of respondents are also recorded. The results were split into six groups, native, and ≤ 10 years, 11-20 years, 21-30 years, 31-40 years and ≥ 41 years.

The result stated that only 31% of respondent are native people. Natives are defined to be born in the area. 34 % of total respondents migrated into the area during the past 10 years or less. 20% of total respondents are living in the study area between 11 and 20 years. 11% of total respondents moved there 21 to 30 ago. Only one person could be found, who has lived in the area for 57 years, and one other fell into the category < 41 years i.e. 1% of respondents (Table 5).

The no of immigrants within 20 years is higher than the no of native inhabitants which indicates that the population of the region has more than doubled within 20 years (less than 1 generation).

4.1.2 Age groups and gender

The interview data have been assigned to thirteen age groups accordingly. The classes formed were: 0 to 5 years, 6 to 10 years, 11 to 15years, 16 to 20years, 21 to 25years, 26 to 30years, 31 to 35years, 36 to 40 years, 41 to 45years, 46 to 50 years, 51 to 55 years, 56 to 60 years and above 60 years. The census area was as for all other subjects 5 villages with a population of 536 people.

According to this classification, in all villages except in Nyaungbin, the largest age group was recorded for the 0 to 5 years class. For Nyaungbin the age group 6 to 10 years had the highest headcount with 0 to 5 years in the second rank.

For Shweletpan, Nyaungbin and Lonton the lowest population group count fell in the group 56 to 60. In Hepa and Mamonkaing the lowest count was recorded for the age group 61 and over. Despite some variations, obviously the largest group for the whole study area was formed from those between 0-5 years old. The lowest headcount overall fell in the group 56 to 60 (Appendix I).

The age groups are officially categorized into three classes introduced by the Myanmar authorities. These are:

- 0 to 14 considered as children
- 15 to 60 considered as working classes
- 61 and above considered as dependents

Besides more specified classification, another reason to deviate from these official classes was, that in the surveyed villages (especially in Shweletpan and Nyaungbin) a considerable number of at young people the age between 9 to 14 years, are actually workers and a few from the age group above 61 effectively still belonged to the working classes. This finding indicates that the socioeconomic status of the rural areas is of the low level (Table 6).

The gender count as represented in Table 6 was 246 males and 290 females. Females dominate males in the population of study area. Although gender ratio was approximately 1:1 in Shweletpan, Mamonkaing and Hepa, the deviation came from Nyaungbin (66 males and 87 females) and Lonton (41 males and 57 females) (Table 1).

4.1.3 Working classes

The numbers of active- (workers) and dependent- population, counted among the family members, resulted in a ratio 47.6% worker versus 52.4% dependent or inactive of total respondents in study area.

Comparing the numbers per Village, for Mamonkaing and Hepa the ratio of workers and dependents differ from the overall results.

The active population in Mamonkaing was 52.8% against 47.2% dependants.

In Hepa the ratio of active versus dependants was 52.4% against 47.6% (Figure 4, table 7).

4.1.4 Education and health

Three primary schools, two affiliated middle schools and one affiliated high school exist in the study area. One primary school each was established in Shweletpan, Hepa and Lonton. One affiliated middle school was established in Mamonkaing and one in Nyaungbin. Only one affiliated high school can be found in Lonton. The number of teachers and school children of each school are as shown in Table 13. Teacher to pupil ratio is 1:33 in Shweletpan, 1:45 in Mamonkaing, 1:40 in Hepa, 1:100 in Nyaungbin and 1: 25 in Lonton respectively (Table 8).

The share of pupils and students of the entire population in the interview areas was also recorded. The percentage of pupils in all villages is higher than 20% except Hepa with 19.35%. The highest percentage of pupils was recorded for Mamonkaing and Nyaungbin with over 27%. While Shweletpan and Lonton are somewhere in between with about 24%. Another finding was that Shweletpan and Mamonkaing have no undergraduate students (Table 9).

The level of literacy is important to define the socioeconomic structure of the households in the study area. Most of the elder generation i.e. those who fall into the age groups 51-55, 56-60 and above 61years were recorded as monastery level education, whereas most members of the working class, of both males and females, fell in the primary and middle school education level due to struggle for their livelihood (Table 10).

The overall literacy percentage in the interview area was recorded at 81.53%. Only 3.36% of the population was classified as illiterates. Most of the literates visited primary and middle level school. Only 5.78% (3.17% incomplete + 2.61%) fall into the high school level class. University graduates constituted 1.87% and university undergraduates were

1.31%. All of the graduate University level group and more than 70% of the undergraduate university students come from Lonton and Nyaungbin villages. This indicates the socioeconomic status to be of higher level in Lonton and Nyaungbin compared to the other three villages (Figure 5, Table 10, and Appendix II).

Regarding health, the total number of inhabitants in the study area was 6,880 as shown in table 7. The study area has only one clinic with one medical doctor and two nurses in Lonton.

The published figure of 1 medical doctor per 2,985 inhabitants for total Myanmar (WHO, 2004) is more than two times higher than in the study area. The other villages, except Shweletpan, have health centers without stationary medical doctors. Generally all villages except Lonton have one midwife each. The nearest hospital is in Mohnyin with 100 beds.

Malaria is prevalent, especially in the wet season. In the cold months, bronchitis and pneumonia are very common.

4.1.5 House structures

Two types of homes can be found in the interview area. One is normal homes (houses) on the land and the second type is floating homes, imbedded in boats on the lake.

The structure of normal houses varies between villages, in terms of the roof material and shape, the construction of the walls and the floors.

The predominant roof structure used in the interview area was thatch, although tin (metal sheet) was used more frequently in Lonton.

The predominant wall material was bamboo mats or meshwork in all villages included in the survey. Lonton and Nyaungbin have 2 houses each with brick made walls.

The predominant floor material was bamboo in the whole interview area, although timber structures were found to be used more often in Lonton and Nyaungbin (Tables 11, 12).

14% of all interviewed households were located in boats on the lake, many of them with Nyaungbin and Shweletpan (Tables 11, 12) as home location.

Plate 3 shows examples of house structures, using different materials. Those were probably chosen, dependent on the availability and cost. People living in boat homes often are migrants immigrated for fishing. They often prefer to live in more temporary structures.

4.1.6 Electric power supply

Access to electric power is unequal between the different villages in the study area.

Nyaungbin has no public electricity at all. Lonton has a public generator installed by the government in 1996. It supplies electricity for governmental offices and street lighting from 6:00 pm to 9:00.

Other than that, three sources for electricity supply are available, but not area-wide accessible.

- The first one is private and private public supply, i.e. some residents use their generator for their own need plus supply their neighbourhood.
- The second one is supply by monastery.
- The third one is supply by local community.

All supply sources charge similar rates. The charge amount depends on the appliances the power is used for. - E.g. one electric lamp costs 3000 Kyats (appr. € 3.00) per month and usage from 6:00 to 9:00pm.

Electricity supply data were recorded in the five villages with 100 households of the surveyed areas. The outcome of these 100 respondents was that 5 households in Shweletpan

(26.3% of respondents), 13 households in Hepa (59% of respondents), 10 households in Mamonkaing (71% of respondents), 14 households in Lonton (78% of respondents) and 20 households in Nyaungbin (74% of respondents) have access to electric power supply. The database may be too small to claim statistical exactness. While Lonton, Nyaungbin and Mamonkaing seem to be close in development, the Shweletpan result shows clearly the lowest access rate, while Hepa is somewhere in between. The average access rate of the study area is approximately 62% of total households which have access to electric power supply (Table 13).

According to observations, a correlation between those families with access to electric power supply and households which have school children could be detected. 55% of the total respondents, who have school children, have access to electricity. 7% of interviewees, who have no school children, have access to electricity (Table 14).

4.1.7 Water supply

The inhabitants of the study site have access to two types of water sources:

- 1. surface water (lake)
- 2. ground water (tube wells)

The pH value of lake is about 7.8 and the value of tube well is between 7.5 and 7.6. So, both are chemically almost neutral and as such usable for drinking and household. The result of lake water analysis, as described in Table 15, indicates the water is usable for drinking. Lake water is by far the most used water source in the study area as the recordings show.

The depth of the aquifer, important for tube well building, is between 60 and 70 feet in the study area.

The following data of water sources for drinking and household use were recorded during the interviews. Another finding of these interviews was that none of the respondents uses separate sources for drinking and household water.

15.8 % of the respondents in Shweletpan obtain their water from tube wells and 84.2 % rely on lake water for both, drinking and household use. In Hepa 18.2 % use tube wells as source for drinking and cooking water and 81.8 % draw it from the lake for both purposes, 14.3% of the respondents in Mamonkaing use tube well water and 85.7 % are lake water users. In Lonton just 11.1% use tube well water supply and 88.9% depend on lake water. In Nyaungbin 25.9% use tube wells as water source and 74.1 contribute to the lake water user community (Table 16).

In total 82% of all respondents depend on lake water for drinking and household whilst just 18% are tube well users (Table 16).

4.1.8 Transportation and communication

The Indawgyi Wildlife Sanctuary is connected to Hopin and Mohnyin by a motor road (Figure 6).

Two lane dirt roads surround the lake almost entirely. One of them connects Hopin, with the villages Nammon, Hepa, Hepu and Losant. The west circular road separates from the Hopin- Losant road close to the village of Nammon and connects Lonton and Nyaungbin before it leaves the Sanctuary to the north. Dead end and side roads connect the various settlements on the west side of the lake, which are located off the “main road”.

During the wet season, these unfortified roads are in real bad condition and often blocked by landslides. To facilitate the transportation of vital goods, roads often are repaired on a self-help basis by the local authority.

The inter-village connection roads are mostly used by private people for goods interchange and sale of own agriculture products, fish and other goods, using cars, small lorries/tractors, motorcycles, bicycles. During the dry and cold seasons there is a kind of public transportation. It is a once- per- day connection, operated by privately owned cars. Every morning at a fixed schedule a car is collecting passengers and transports them to their destinations against fixed fees. This service is accessible for everyone who pays the charges.

The second equally important transportation way besides the sometimes impassable roads is by boat or motor boat. The number of boats and percentage of households who own one or more boats, motorized or without motorized were recorded in the five villages with 100 respondents of the survey area. At the same time the data for motorcycles, bicycles and cars were recorded.

The finding was the possession of motorized boats is dominant over other all transportation items in every village.

The highest dispersal rate of bicycles is in Shweletpan. None of the inhabitants however owns a motorcycle or other motorized land transportation vehicle. The possession of cars in the study area is almost zero. An exception is Nyaungbin, where 2 cars could be recorded (Table 17 and 18).

Regarding communication there is only one public telegraph office in the entire study area. It is located in Lonton.

In Hepa, Lonton and Nyaungbin some private telephones have been recorded (Table 17 and 18). These are CDMA mobiles and established in 2008. Most of the local people depend on the use of these private telephones. Usually the owners collect charges for use.

4.2 Economic Factors

The economic activities of the study area are divided into four sectors.

- (1) Fishery sector
- (2) Agriculture sector
- (3) Self -employment sector
- (4) Other sectors

Workers of respective sectors in addition to their main tasks often take up casual jobs and small scale animal husbandry, cultivation of crops or open retail shops. Occupational structure and respective percentage are shown in figure 7, table 19 and appendix III.

4.2.1 Fishery sector

This is the major branch of economic activity within the study area. The fish fauna in the lake is manifold. The inhabitants of the area catch fish in the lake, employing various fishing implements. Some of them catch fish in the Indawgyi lake contribution or outflow streams as well. Almost half of all fishermen were found to be involved not only in fishing but also undertake side-jobs in crop cultivation, especially paddy cultivation in rainy season (i.e. fishermen & farmer, it is explained more detail in agriculture sector), as casual workers, hired especially in seasonal agricultural activities either as monthly or daily employees, or work in open retail.

According to their job category fishing families were subdivided into four categories (Table 20).

- (1) Fishermen
- (2) Fishermen & farmer
- (3) Fishermen & general worker

(4) Fishermen and retailer

Eighty- four households, comprising of 205 members, were recorded as fishing families – (fishing includes all 4 categories above) in the interview areas.

This category includes 37 members in Shweletpan, 38 members in Mamonkaing, 59 members in Hepa, 42 members in Nyaungbin and 29 members in Lonton. They altogether constitute 38.25% of the total population in interview areas and represent 84% of total respondents.

The percentages by village are shown in figure 8, table 21.

The largest fishing population percentage was found in Mamonkaing, the second largest in Hepa. Nyaungbin had the lowest fishermen percentage related to the population number. Shweletpan and Lonton were somewhere in between (Table 21).

An interesting finding was, that some tribes resist to work as fishermen. This reason is caused by a religious taboo. It is also forbidden to catch fish within one mile radius of the pagoda in the lake. Another reason for no fishing is that there are 6 fishery ban zones with an area of 0.5 sq. mile each. They have been established by the Indo Myanmar Conservation (NGO, 2010).

4.2.2 Agriculture sector

Agriculture is the second important income generating activity in the interview areas. 5.78% of the total population in the interview areas engaged in agriculture (Table 22). Paddy is the main cultivated crop. Most of the agriculture lands are found on the lake fringe. Types of cultivated land are generally divided into four main classes.

(1) Le lands, which are mostly found in Indawgyi plain, are broken up into many small units. Farmers cultivate paddy, and the amount of harvest depends on the rainfall.

(2) Ya lands, which are found along the streams and on the forest land, where corn, maize, groundnut, sesame and mustard are grown.

(3) Garden lands, which include fruit gardens, home gardens and vegetable gardens, where mangoes, citrus fruits, flowers and vegetables are grown.

(4) Taung ya lands, which are found on the mountain slopes. Taung ya land usually has only a thin cover of soil. It is invested in deforested areas and taung-ya paddy, maize, sesame, pulse and vegetable are grown.

Agriculture practice is of intensive and monoculture character. Generally the rainfall is regular and abundant, sometimes precipitation is insufficient to plough and the rain comes too late for planting. There is no dam or canal system to irrigate the farms. So farmers totally depend on rainfall for cultivation. Most of the farmers in the interview areas own 5 to 6 acres of farm land. Some of the land owners have no sufficient manpower resources for farming. They hire labourers during the farming seasons. The agriculture labourers are compensated by 100 baskets of paddy in average, which equals approximately €200 income during the entire season. These incomes however vary, dependent on the working duration, determined by the farm size and type. Transplantation and harvesting are done mostly by women. The charges are in the order of € 20 per acre each. Most of the farmers in the interview areas have one team of cattle or buffaloes. One family each in Lonton and Hepa owns a tractor.

All farmers in the interview areas earn their extra income by undertaking side jobs. Fish capture in paddy fields or in streams was found to be one of the most common side- jobs.

The caught fish were not only a source for family food but also for market. Some farmers undertake casual jobs by renting their bullock cart for firewood transportation and so on. Some operate a retail shop or a mini store (Table 22).

4.2.3 Self-employment sector

Self-employment sector was the third largest sector in the interview areas. Five households, comprising 17 members, were recorded for this sector. It represents 3.17% of the total population. This sector included gold miners, ice machine owners, car rental, rice mill owners, mechanics, tailors and tea shopkeepers (Table 19 and appendix IV).

4.2.4 Other sector

This sector consists of only one family with 2 members comprising 0.37% of total population in interview areas. Government staffs were recorded in this sector (Table 19 and appendix IV).

4.2.5 Livestock production

Livestock production is not really existent in the interview areas. It is mostly practiced as means of subsistence for the families. However cattle and buffalos are important for agriculture. Chicken and pigs are raised for food. 76 cows, 23 buffaloes, 42 pigs and 256 chickens in the interview areas were recorded (see table 23).

The records prove that while 22.2% of the households in Lonton own one or more cows, only about 7.1% of the families in Mamonkaing and Nyaungbin are cow owners.

18.2% of the households in Hepa and 15.8% of the households in Shweletpan own cows.

None of the families in these two villages possesses buffalos. 11.1% of household in Lonton own one or more buffalos. About 7.1% of the households in Nyaungbin and Mamonkaing hold buffalos.

The highest share of households which own pigs and chicken was found in Shweletpan, the lowest in Nyaungbin. The other 3 villages, Hepa, Mamonkaing and Lonton were somewhere in between. All three have the same percentage of pig and chicken ownership (Table 24).

4.2.6 Entertainment and electronic equipment possession

With intent to obtain a measure for economic wealth of the various households in the interview areas, the ownership of television sets, video recorders, radio receivers, cassette recorders and satellite receiving equipment were recorded (Table 25).

Lonton families possessed more TV sets and video items than those in the other villages. Shweletpan families owned more radio and cassette items than the families in other villages. Only one family in Hepa owned satellite receiving equipment (Table 26).

4.3 Income and expenditure structure

4.3.1 Income analysis

General:

Incomes of households in the surveyed areas vary from < kyat 850,000 (appr.US\$ 830 to as high as > kyat 7.3 Mio. (appr. US\$ 10,300) as recorded in Appendix V, household number 89 and 98.

In general for the interviewees no correlation between occupation and income was found. For example the highest income (>7.3 Mio kyat) was achieved by a self -employee (Appendix V, ID no 98) another self employee had an income of < 1.4 Mio kyat (ID no. 96). Similar discrepancies were detected for all other occupation groups. One fish general

worker's income was as low as 900,000 Kyat (ID no. 74) and at the high end a fish-general worker was able to achieve an annual income of 2.500.000 Kyat (ID no. 50).

The number of household members was counted between 2 (ID nos. 12 & 70) and 10 (ID no. 60, 61, 72, 90). The higher the number of household members, the higher is the likelihood that these household family members live below the World Bank defined poverty index line (US\$ 1.25 per person per day). The detailed results are part of appendix V.

To develop income and expense structures by occupation and by village, 6 income classes have been formed. Those are:

- | | | |
|---------------------------|-----------------------------|----------------------------|
| 1. ≤ 0.9 Mio. kyat, | 2. $> 0.9 - 1.2$ Mio. kyat, | 3. $> 1.2 - 1.5$ Mio. kyat |
| 4. $> 1.5 - 2$ Mio. kyat, | 5. $> 2 - 3$ Mio. kyat und | 6. > 3 Mio. kyat. |

Income by occupation: The classes 4 (37 interviewees) and 3 (24 interviewees) have the highest no of members. Fishermen form the largest occupation group in both classes. They are also majority in classes 2 and 5. None of them exceeded the 3 Mio Kyat income level. One fish farmer, two farmer with shop and 2 self employees form this highest income group. The affiliation of the different occupations to the 6 income classes is listed in Table 27 and Figure 9.

Income class affiliation of households: As households and occupations are closely linked the data look similar Table 28 and Figure 10 contain the data of household affiliation to the income classes.

The classes by village and the average income per household member as well as information about the sample sizes are documented in Appendices VI - (a), (b), (c), (d) and

(e). As the number of Interviewees and the household member numbers are different between the villages, for comparison it is recommendable to use the per capita annual income. The results are summarized in Appendix VI.

4.3.2 Expenditure analysis

General:

The structure of the analysis done is identical to the income breakdown. Therefore no detailed description is made here.

As measure for the ratio between income and expense a column called “surplus” was introduced in Appendix V. It shows that 1 Hepa- , 5 Nyaungbin- and 2 Mamonkaing - households spent more than their respective incomes. Two of them belonged to the “below poverty index” households.

Expense by occupation data are outlined in Appendix VII Table 29 and Figure 11.

Expense class affiliation of households is documented in the same Table 28 and Figure 10 as the income data.

An expense breakdown by household members was not judged important and therefore not part of this study, as it adds only little meaningful information.

4.4 Recorded fish species

The recorded fish species found in the lake and the associated streams (in and outflow) are listed in Table 30. Among the species recorded *Notopterus notopterus* and *Puntius chola* predominate in the catch according to the records during February, which is part of the dry season. These species could be caught everywhere in lake and streams (Plate 4).

4.5 Fishing gears

The kinds of fishing gear in use are an indicator for the achievable income of the fisher households and disclose risks of overfishing and fish species extermination.

To analyse the situation in the surveyed areas under these aspects, fishing gear utilized were recorded. Fish- and gill-nets used, are categorized in four classes, 0.75"-1.0"meshsize, 1.75"-2.0"meshsize, 3.25"-4.0"- 4.5" mesh size and 7.25"meshsize. In addition freshwater prawn traps were recorded (Table 31, and plate 5).

14.3% of total fishing families in the interview area (84 households) used small mesh size gill nets (0.75"-1.0"meshsize).

21.4% of total fishing families used large mesh size gill nets (7.25").

30.9% used medium-small size nets (1.75"-2" mesh size)

65.5% of total fishing households used medium-large mesh size gill nets (3.25"- 4"- 4.5")

7.1% of the fishermen household used prawn traps (Table 31).

Obviously, different species of fish are caught, using different mesh size nets. Most fisher households use multiple nets, dependent on the fish category they are trying to catch. Season and proliferation widely determine which nets are used.

The different fish species have different market prices and therefore gain different incomes. The prices for small fish are generally lower than those for larger species. However the prices of the different gill nets are almost the same and rank around 10,000 Kyats/net (= € 10.00).

Most of the fishermen however had to pay 20% surplus, because they could not pay cash down. The life time of the gill nets is 1 to 3 years. Due to shortage in income most of the fishermen repair their nets and use them up to 7 years.

Length and depth of nets vary dependent on their mesh size (Table 32). In daily practice 10 to 17 nets are knotted together to improve the catch result.

4.6 Firewood consumption

Wood fuel is by far the most used energy source for cooking and heating all over the Indawgyi area.

25% of all households interviewed, collected the wood themselves. 75% bought their firewood requirements from different suppliers. These suppliers cut wood from near forests, either legally or illegally. The market prices vary from 15,000 Kyat to 20,000 Kyats per 2 bullock carts (= 0.7 ton) and depend on the associated transportation costs.

The consumption of each household per year was recorded in surveyed areas. The average total consumption of 100 household with 536 members was 169.44 tons per year. The average consumption rate per person calculates to 0.32 ton per year. However in Shweletpan, Mamonkaing and Lonton the per capita consumption was recorded to be approximately 10% below average (0.29 ton / person/ year). Nyaungbin inhabitants had a 10% higher firewood demand than the average. They consume 0.35 tons per person per year in average. One reason for this increased demand may be a tea shop and the small restaurant, both residing in Nyaungbin. They consume more fuel wood for their business compared to others (Table 33).

They all use the traditional three legged stove and cook in open air during the cold and dry season. It prevents indoor air pollution but is not efficient for wood consumption.

4.7 Water sample analysis

Considering that the Indawgyi lake is the major drinking water source for the inhabitants of the area (82% of total household water originates from the lake), lake water quality is of fundamental importance for the health and welfare of the population. Therefore water samples of the lake have been taken and analysed.

The samples were extracted close to Lonton. Part of the analysis had been conducted at the Yangon Institute of Technology, others like nitrite, nitrate, mercury, sulphate and phosphorus have been accomplished by the Institute of Geography, University of Cologne. The results are listed in table 15.

Fortunately no nitrite, no nitrate, no phosphate, no sulphate and no mercury traces could be detected in the water samples. According to the World Health Organization (WHO) the range for the medium alkalinity is 50 – 250 mg/l the analysis proofed that the Indawgyi lake water (tasted at 98mg/l) does not exceed this value.

The concentration of chlorides was determined to be in the range 1.58 mg/l, an indication that the water was polluted, neither from sewage nor from weathering of some sedimentary rocks.

Table 1. Population distribution and gender in surveyed areas

No	Village	Household	Male	Female	Total	
					Population	Percent
1	Shweletpan	19	42	47	89	16.61
2	Mamonkaing	14	34	38	72	13.43
3	Hepa	22	63	61	124	23.13
4	Nyaungbin	27	66	87	153	28.55
5	Lonton	18	41	57	98	18.28
	Total	100	246	290	536	100

Table 2. Population composition in interview areas and of the whole village

No	Village	interviewed		total/Village	
		Households	Population	Households	Population
1	Shweletpan	19	89	97	337
2	Mamonkaing	14	72	280	1878
3	Hepa	22	124	172	1015
4	Nyaungbin	27	153	428	2216
5	Lonton	18	98	229	1434
	Total	100	536	1206	6880

Table 3. Interviewed population in % of surveyed areas

No	Village	Household	Male	Female	interviewed	
					Population	% of total popul.
1	Shweletpan	19	42	47	89	26,41
2	Mamonkaing	14	34	38	72	3,83
3	Hepa	22	63	61	124	12,22
4	Nyaungbin	27	66	87	153	6,90
5	Lonton	18	41	57	98	6,83
	Total	100	246	290	536	7.8

Table 4. Population distribution and density of surveyed areas

ID	Village Tracts	Population	Area (sq. ml)	Density/sq. ml
1	Shweletpan	10,441	9.6	1087
2	Mamonkaing	2,999	12.16	246
3	Hepa	3,399	9.6	354
4	Nyaungbin	3,049	6.4	476
5	Lonton	3,681	22.4	164
	Total	23,569	60.16	391

Table 5. Settlement trend in surveyed areas

living years	Shweletpan	Mamonkaing	Hepa	Nyaungbin	Lonton	Total	
						HH	%
native	3	5	7	5	11	31	31
≤ 10 year	6	2	9	13	4	34	34
11-20	5	4	2	7	2	20	20
21-30	5	1	3	1	1	11	11
31- 40	0	1	1	1	0	3	3
≥ 41	0	1	0	0	0	1	1
Total	19	14	22	27	18	100	100

Table 6. Age structure of surveyed areas according to the official classification

		Age		
		0-14	15-60	≥ 60
Shweletpan	Total	41	47	1
	Male	16	26	0
	Female	25	21	1
Mamonkaing	Total	28	43	1
	Male	13	21	0
	Female	15	22	1
Hepa	Total	46	76	2
	Male	25	38	0
	Female	21	38	2
Nyaungbin	Total	62	85	6
	Male	25	38	3
	Female	37	47	3
Lonton	Total	39	56	3
	Male	13	27	1
	Female	26	29	2
Total of study area	Total	216	307	13
	Male	92	150	4
	Female	124	157	9

Table 7. Worker's participation of surveyed areas

No	Village	Active		Dependency	
		Population	%	Population	%
1	Shweletpan	42	47.19	47	52.81
2	Mamonkaing	38	52.78	34	47.22
3	Hepa	65	52.42	59	47.58
4	Nyaungbin	66	43.14	87	56.86
5	Lonton	44	44.90	54	55.10
	Total	255	47.57	281	52.43

Figure 4. Worker and dependents ratio in interview areas

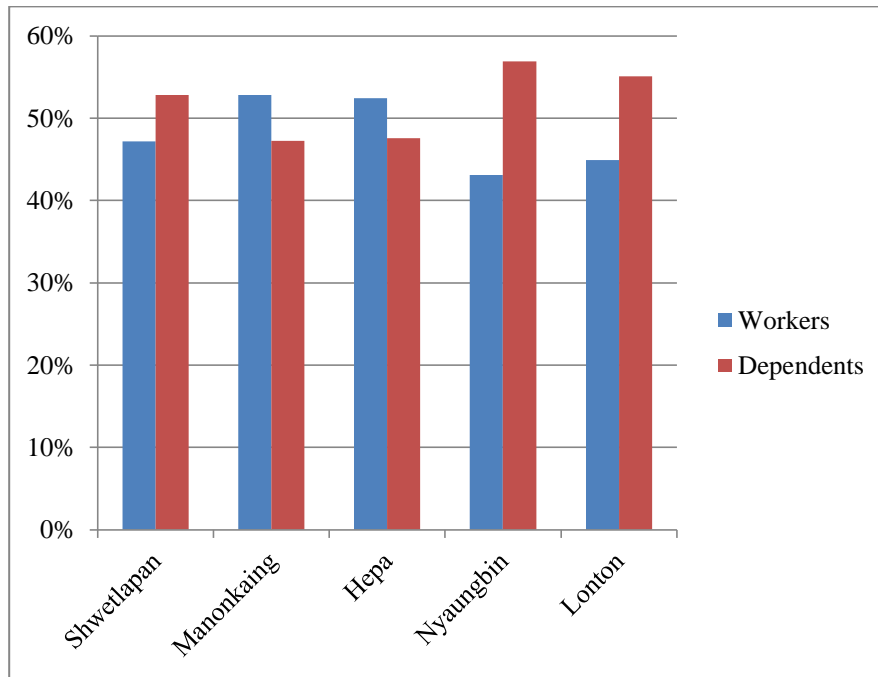


Table 8. The population of teachers and pupils in each village of the study area

No	Village	Number of Teachers	Number of Scholars
1	Shweletpan (primary school)	3	98
2	Mamonkaing (primary attach-middle)	9	403
3	Hepa (primary school)	3	120
4	Nyaungbin (primary attach-middle)	10	1000
5	Lonton (primary and one attach-high school)	20	500

Table 9. The population of teachers, pupils and students in interview areas

No	Village	Number of Teacher	scholars		Total	%	University students		Total	%
			Male	Female			Male	female		
1	Shweletpan (primary school)	3	8	1	21	23.56	0	0	0	0
2	Mamonkaing (primary, attach-middle)	9	9	11	20	27.78	0	0	0	0
3	Hepa (primary school)	3	10	14	24	19.35	0	2	2	1.61
4	Nyaungbin (primary, attach-middle)	10	14	28	42	27.45	2	1	3	1.96
5	Lonton (primary, attach-high school)	20	9	15	24	24.49	1	1	2	2.04

Table 10. Population of literacy and educational status in study area

No	Education Level	Shweletpan	Mamonkaing	Hepa	Nyaungbin	Lonton	Total
1	Monastery	3	9	3	15	4	34
2	Primary (Attending)	16	12	14	31	15	88
3	Primary (Incomplete)	28	14	33	29	20	124
4	Middle (Attending)	4	3	9	9	4	29
5	Middle (Incomplete)	15	12	32	36	19	114
6	High (Attending)	1	5	1	2	5	14
7	High (Incomplete)	2	5	0	6	4	17
8	Undergraduate university	0	0	2	3	2	7
9	Graduate university	0	0	2	3	5	10
	Total Literate	69	60	96	134	78	437
10	Illiterate	1	1	10	4	2	18
11	Young children	19	11	18	15	18	81
	Total	89	72	124	153	98	536

Figure 5. Percentage distributions of literacy and educational status in interview areas

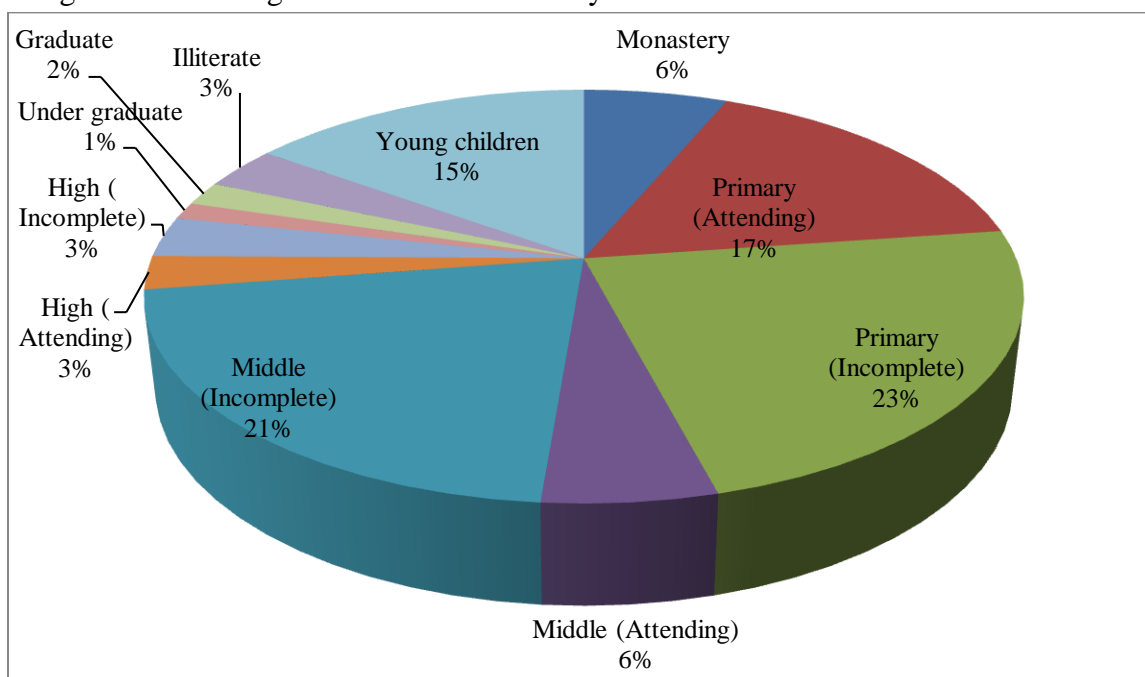


Table 11. Different roof-, wall-, floor materials and other homes in the study area

No.	Village	Roof			Wall			Floor		other
		thatch	yon	tin metal sheet	bamboo	brick	wood	bamboo	wood	on the boat
1	Shweletpan	14	0	0	14	0	0	12	2	5
2	Hepa	19	1	1	19	0	2	14	7	1
3	Mamonkaing	6	4	2	8	0	4	5	7	2
4	Lonton	4	2	12	11	2	5	4	14	0
5	Nyaungbin	8	8	5	18	2	1	10	11	6
	Total	51	15	20	70	4	12	45	41	14

Table 12. Percentages of different roof-, wall-, floor material in the study area

No	Village	Roof			Wall			Floor		other
		% thatch	% yon*	% tin metal sheet	% bamboo	% brick	% wood	% bamboo	% wood	% on the boat
1	Shweletpan	73.68	0	0	73.68	0	0	61.16	10.53	26.32
2	Hepa	86.36	4.55	4.55	86.36	0	9.09	63.64	31.82	4.55
3	Mamonkaing	42.86	28.57	14.29	57.14	0	28.57	35.71	50.00	14.29
4	Lonton	22.22	11.11	66.67	61.11	11.11	27.78	22.22	77.78	0
5	Nyaungbin	29.63	29.63	18.52	66.67	7.41	3.70	37.03	40.74	22.22
	Total	51.00	15.00	20.00	70.00	4.00	12.00	45.00	41.00	14.00

*Yon is palm leaves.

Table 13. Lighting

ID	Village	HS			
		lighting	no lighting	Total	lighting %
1	Shweletpan	5	14	19	26.3
2	Hepa	13	9	22	59
3	Mamonkaing	10	4	14	71
4	Lonton	14	4	18	78
5	Nyaungbin	20	7	27	74
	Total	62	38	100	62

Table 14. Relationship between lighting and household which has school children

Category	Households in Study site	%
Schooling + Lighting	55	55
schooling + non lighting	14	14
non schooling + lighting	7	7
non schooling + non lighting	24	24
Total	100	100

Table 15. Water parameters and concentration of elements in water sample (Lonton village) March 2011

Parameter	Result	WHO & EU guideline
pH	7.8	6.2-8.4
Conductivity (μS/cm)	142	250 μS/cm
Iron (mg/l)	0.23	0.2mg/l
Total hardness (mg/l)	69	500mg/l
Total alkalinity (mg/l)	98	<50 - >250 mg/l
Dissolved oxygen (mg/l)	5.6	no guideline
Biological oxygen demands (BOD) (mg/l)	0.8	no guideline
Chloride (mg/l)	1.58	250mg/l
Fluoride (mg/l)	0.09	1.5mg/l
Nitrite (mg/l)	0.00	0.50mg/l
Nitrate (mg/l)	0.00	50mg/l
Phosphate (mg/l)	0.00	no guideline
Sulphate (mg/l)	0.00	500(WHO) 250 (EU)mg/l
Mercury (mg/l)	0.00	0.001mg/l

Table 16. Water source

No.	Village	HS								
		drinking water		Household water		Total	drinking water		Household water	
		tube well	Lake	tube well	Lake		tube well %	Lake %	tube well %	Lake %
1	Shweletpan	3	16	3	16	19	15,79	84,21	15,79	84,21
2	Hepa	4	18	4	18	22	18,18	81,82	18,18	81,82
3	Mamonkaing	2	12	2	12	14	14,29	85,71	14,29	85,71
4	Lonton	2	16	2	16	18	11,11	88,89	11,11	88,89
5	Nyaungbin	7	20	7	20	27	25,93	74,07	25,93	74,07
	Total	18	82	18	82	100	18	82	18	82

Table 17. Number of boat, motorized boat, motorcycle, bicycle, car and tel. in the study site

No	Village	Boat	Motorized boat	Motorcycle	Bicycle	Car	Tel
1	Shweletpan	5	12	0	19	0	0
2	Hepa	12	16	2	7	0	2
3	Mamonkaing	2	12	4	2	0	0
4	Lonton	3	12	5	8	0	2
5	Nyaungbin	5	21	5	5	2	1
	Total	27	73	16	41	2	5

Table 18. Percentage of households that own boat, motorized boat, motorcycle, bicycle, car, telephone

No	Village	Boat	Motorized boat	Motorcycle	Bicycle	Car	Tel
1	Shweletpan	26.32	57.89	0	73.68	0	0
2	Hepa	27.27	63.64	9.09	27.27	0	4.55
3	Mamonkaing	14.29	78.57	28.57	7.14	0	0
4	Lonton	16.67	66.67	27.78	44.44	0	11.11
5	Nyaungbin	18.52	74.07	14.81	18.52	3.70	3.70

Table 20. No. of household classified by fishing occupation in the study site

Occupation Category	Shweletpan	Mamonkaing	Hepa	Nyaungbin	Lonton	Total	
						Household	%
Fishermen	10	4	5	17	8	44	44.00
Fishermen & farmer	2	1	2	0	1	6	6.00
Fishermen & general worker	6	7	9	2	2	26	26.00
Fishermen & retailer	0	2	4	1	1	8	8.00
Total	18	14	20	20	12	84	84.00

Table 19. Households classified by occupation

Occupation	Shweletpan	Mamonkaing	Hepa	Nyaungbin	Lonton	Total
I. Fishermen						
(1) Fishery only	10	4	5	17	8	44
(2) Fishery + agriculture labour	4	5	3		2	14
(3) Fishery + general worker	2	1	4	2	0	9
(4) Fishery+ retail shop	0	2	4	1	0	7
(5) Fishery + gold panning	0	1	2	0	0	3
(6) Fishery + farmer	2	1	2	0	1	6
(7) Fishery + self employment	0	0	0	0	1	1
subtotal	18	14	20	20	12	84
II. Farmer						
(1) Agriculture only						
(2)Agriculture+ shop	0	0	1	2	2	5
(3) Agriculture + selling fruit+ teacher	0	0	0	0	1	1
(4) Agriculture+ gold planning	0	0	1	0	1	2
(5) Agriculture + general worker	1	0	0	0	1	2
III Self employment						
(1) Gold panning	0	0	0	1	0	1
(2) ice machine+ car rental	0	0	0	1	0	1
(3) rice mill	0	0	0	1	0	1
(4) Tailor + technical	0	0	0	1	0	1
(5) Tea shop	0	0	0	1	0	1
IV. Others						
(1) Government staff	0	0	0	0	1	1
						100

Figure 6. Map of Indawgyi lake region

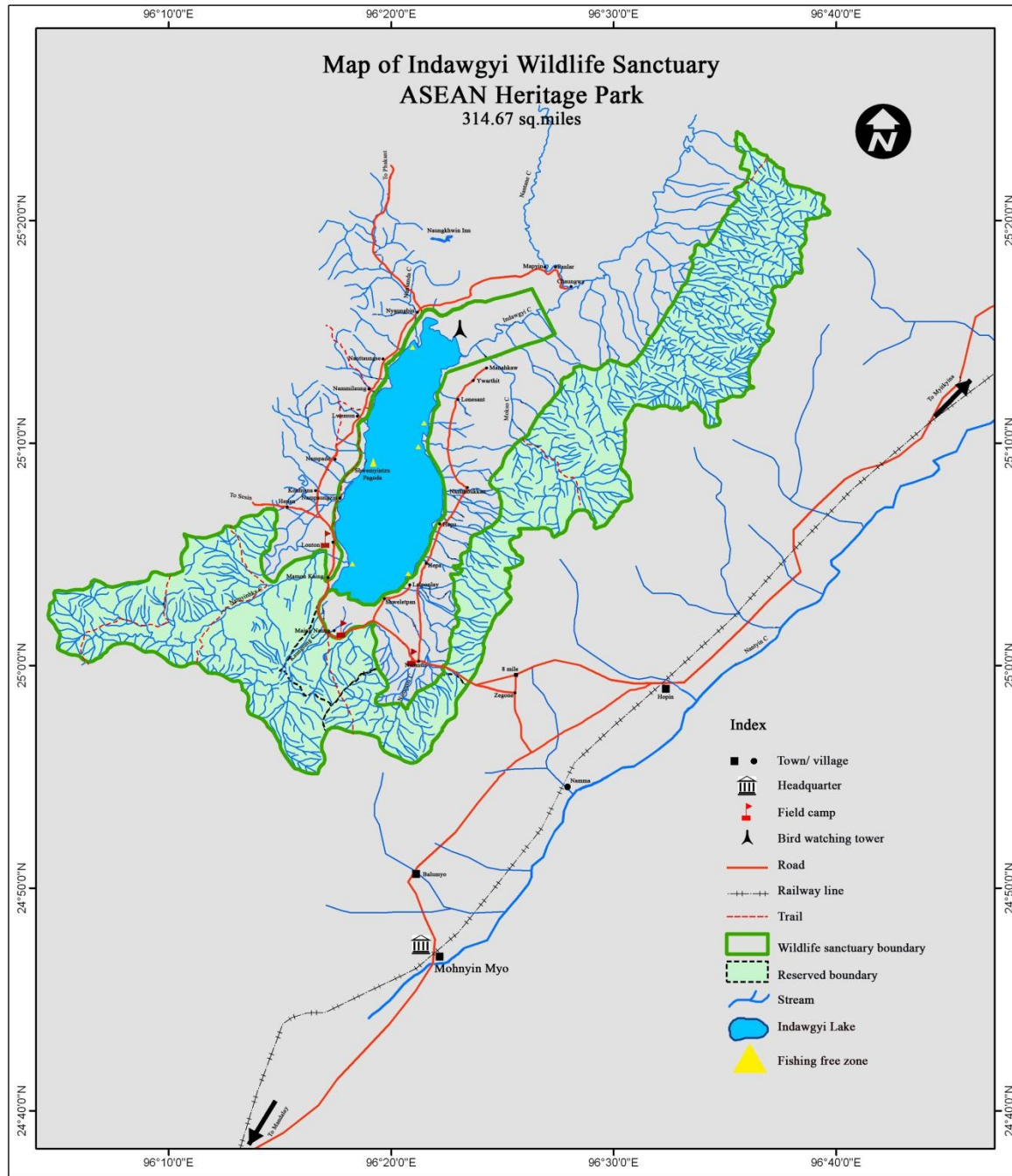


Figure 7. Occupational structures in interview areas

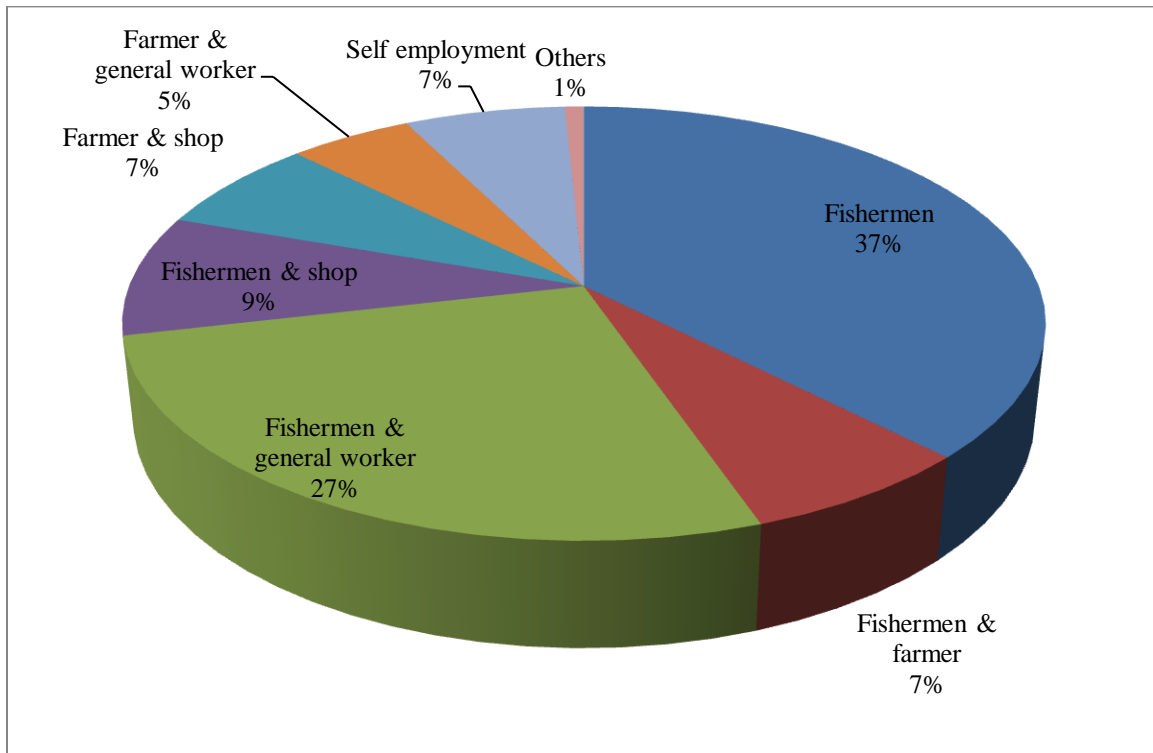


Figure 8. Percentage of fishing population in interview areas

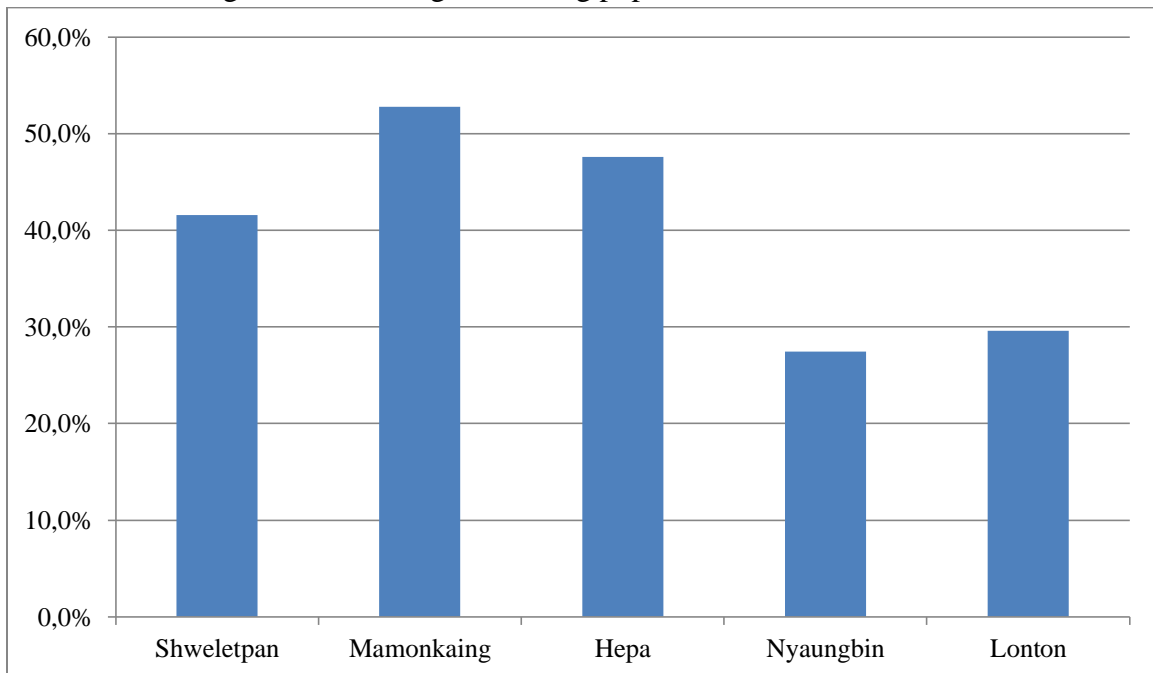


Table 21. Population composition by fishing family of the study site

Village	Households	Population		Total	
		Male	Female	Population	%
Shweletpan	18	20	17	37	41.57
Mamonkaing	14	19	19	38	52.78
Hepa	20	33	26	59	47.58
Nyaungbin	20	25	17	42	27.45
Lonton	12	15	14	29	29.59
Total	84	112	93	205	38.25

Table 22. No. of households, population and percentage of farmer family in interview areas

Occupation Category	Shweletpan		Mamonkaing		Hepa		Nyaungbin		Lonton		Total		
	HH	Pop	HH	Pop	HH	Pop	HH	Pop	HH	Pop	HH	Pop	%
Farmer & shop	0	0	0	0	1	3	2	7	3	8	6	18	3.36
Farmer & general worker	1	5	0	0	1	3	0	0	2	5	4	13	2.43
Total	1	5	0	0	2	6	2	7	5	13	10	31	5.78

Table 23. Number of livestock in the study site

No	Village	Cow	Buffalo	pig	chicken
1	Shweletpan	7	0	19	131
2	Hepa	20	0	9	76
3	Mamonkaing	13	3	5	12
4	Lonton	16	8	7	34
5	Nyaungbin	20	12	2	3
	Total	76	23	42	256

Table 24. Percentage of households that own livestock

No	Village	Cow (%)	Buffalo (%)	pig (%)	chicken (%)
1	Shweletpan	15.79	0	36.84	47.37
2	Hepa	18.18	0	18.18	18.18
3	Mamonkaing	7.14	7.14	14.29	14.29
4	Lonton	22.22	11.11	11.11	11.11
5	Nyaungbin	7.41	7.41	7.41	3.70

Table 25. Number of TV, video, radio, cassette, satellite equipment in families

No	Village	TV	Video	Radio	Cassette	Satellite
1	Shweletpan	1	1	4	6	0
2	Hepa	2	2	4	5	1
3	Mamonkaing	0	0	1	1	0
4	Lonton	5	5	2	3	0
5	Nyaungbin	7	7	4	5	0
Total		15	15	15	20	1

Table 26. Percentage of households with TV, video, radio, cassette and satellite equipment in interview areas

No	Village	TV (%)	Video (%)	Radio (%)	Cassette (%)	Satellite (%)
1	Shweletpan	5.26	5.26	21.05	26.32	0
2	Hepa	9.09	9.09	18.18	22.72	4.55
3	Mamonkaing	0	0	7.14	7.14	0
4	Lonton	27.78	27.78	11.11	16.67	0
5	Nyaungbin	25.93	25.93	7.41	11.11	0

Table 27. Income structure of surveyed area in 2010 by occupation

Income by Occupation (Mio Kyat)	Fishermen	Fish farmer	Fish general worker	Fishermen & shop	Farmer & shop	Farmer general Worker	Self employment	others	Total	
									HH	%
≤ 0,9	0	0	1	0	0	1	0	0	2	2
>0,9 - 1,2	8	3	3	1	0	0	0	0	15	15
>1,2 - 1,5	10	1	10	1	0	0	2	0	24	24
>1,5 - 2	18	0	9	6	1	2	0	1	37	37
>2 - 3	8	1	3	0	3	1	1	0	17	17
>3	0	1	0	0	2	0	2	0	5	5

Figure 9. Income structure of surveyed areas in 2010 by occupation

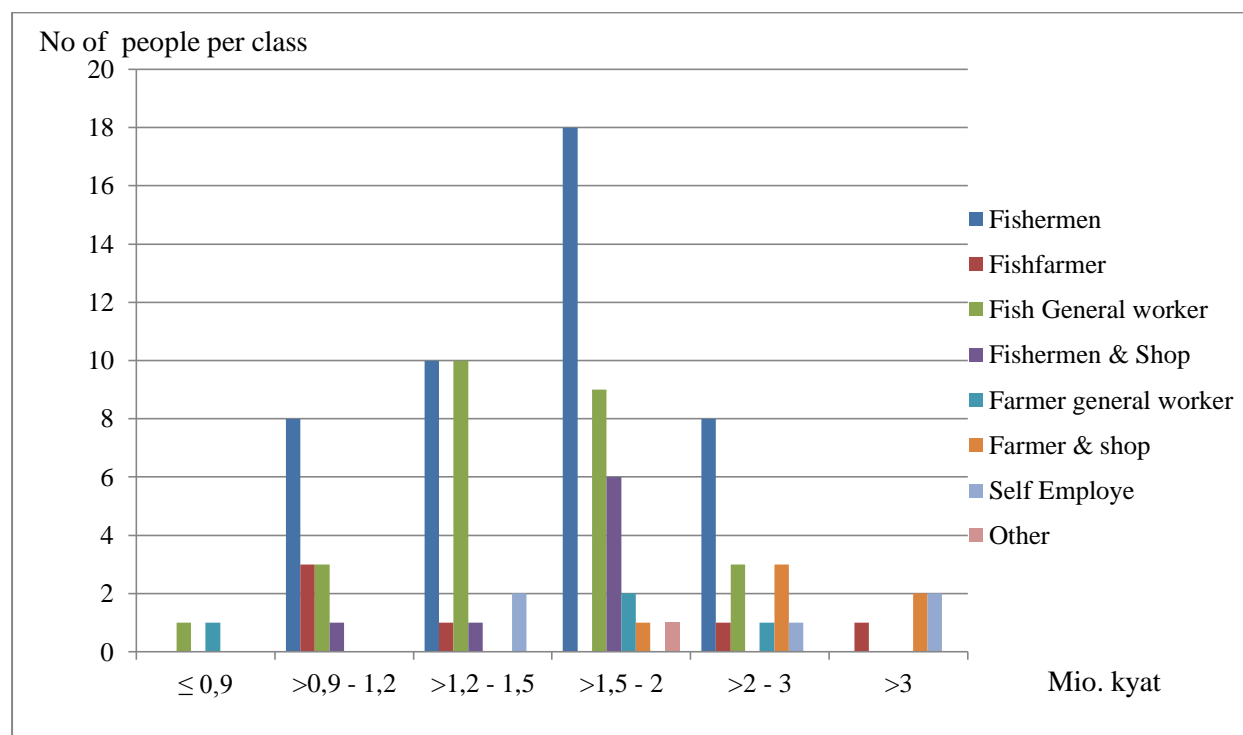


Table 28. Income/Expense distribution of surveyed areas in 2010

Income/expenditure classes	incomes	expenditures
(Mio Kyat)	no of households/class	no of households/class
$\leq 0,9$	2	17
$>0,9 - 1,2$	15	22
$>1,2 - 1,5$	24	16
$>1,5 - 2$	37	28
$>2 - 3$	17	13
>3	5	4

Figure 10. No. of households/ income-/expense-class

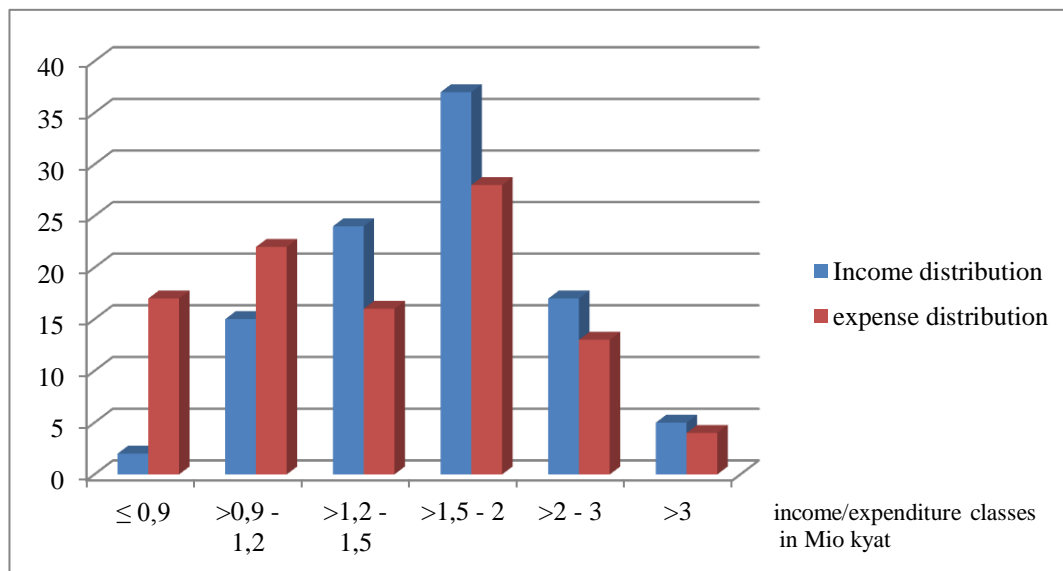


Table 29. Expense structure of surveyed areas in 2010 by occupation

Expense (Mio Kyat)	Fishermen	Fishermen & farmer	Fishermen & general worker	Fishermen & shop	Farmer & shop	Farmer general Worker	Self employment	others	Total	
									HH	%
≤ 0,9	8	2	5	1	0	1	0	0	17	17
>0,9 - 1,2	10	2	7	0	2	0	0	1	22	22
>1,2- 1,5	6	0	3	4	0	1	2	0	16	16
>1,5 - 2	13	1	8	3	1	1	1	0	28	28
>2 - 3	7	0	2	0	2	1	1	0	13	13
>3	0	1	1	0	1	0	1	0	4	4

Figure 11. Expense structure of surveyed areas in 2010 by occupation

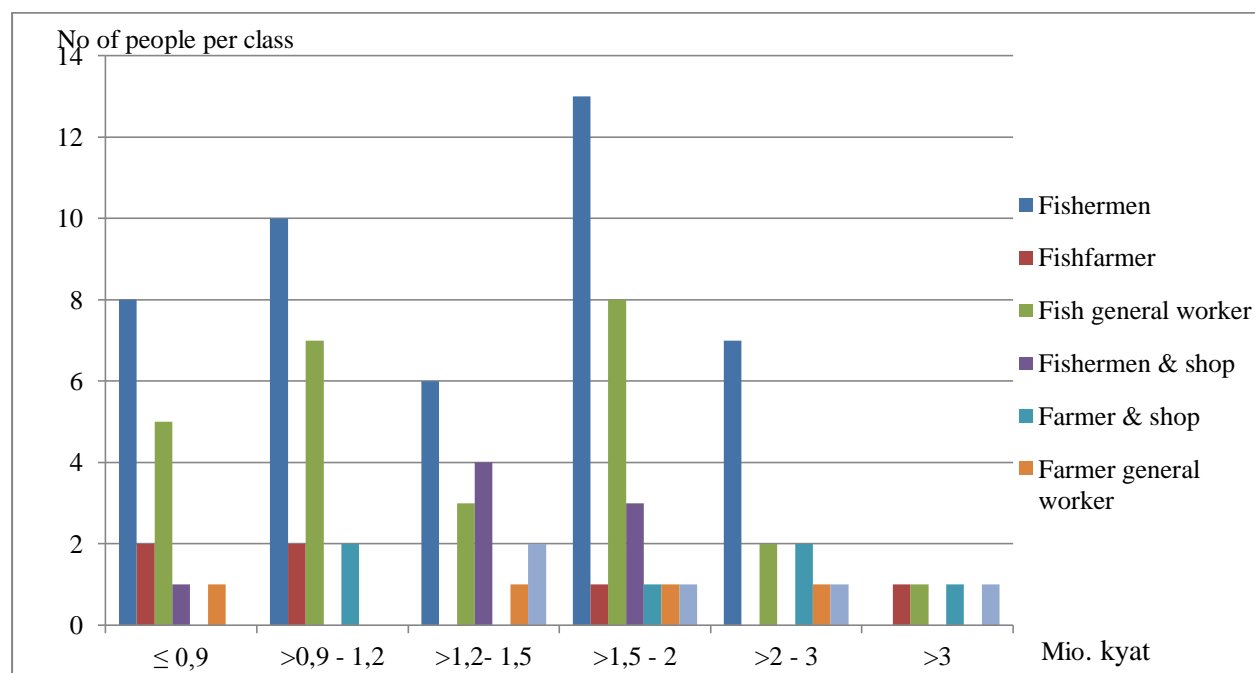


Table 30. Recorded fish species

No.	Vernacular Name	English	Scientific name
1	nga-knonn-pa-dote	hi fin barb	<i>Oreochthys Casuatis</i>
2	nga-byet	mud skipper	<i>Boleophthalmus boddarti</i>
3	nga-zin-sat	glass fish	<i>Parambasis ranga</i>
4	nga-phe`	feather back	<i>Notopterus notopterus</i>
5	nga-la-bie	Burmese river shad	<i>Gudusia variegata</i>
6	nga-phe-aunn	kind of carp	<i>Rohtee belengeri</i>
7	nga-myt-chinn	rohu	<i>Labeo rohita</i>
8	nga-lone	Burmese algae eater	<i>Crossocheilus burmanicas</i>
9	nga-khone-ma	swamp barb	<i>Puntius chola</i>
10	nga-zin-yine	striped dwarf catfish	<i>Mystus vittatus</i>
11	nga-mhway		<i>Mastacembelus</i>
12	nga-yant	snake head murrel	<i>Channa striata</i>
13	nga-gyaung	giant catfish	<i>Aorichthys aori</i>
14	nga-phaun-yoe	garfish	<i>Xenentodon cancilla</i>
15	nga-byay-ma	climbing perch	<i>Anabas testudineus</i>
16	nga-net-sein	carp	<i>Labeo calabasu</i>
17	nga-net-poke	Black Sharkminnows.	<i>Labeo chrysophekadion</i>
18	nga-gyee	stinging catfish	<i>Heteropneustes fossilis</i>
19	nga mway htoe kyarr	zig-zag eel	<i>Mastacembelus armatus</i>
20	nga-khue	walking catfish	<i>Clarias batrachus</i>
21	nga-nu-than	pabo catfish	<i>Ompok pabo</i>
22	nga shint ne	swamp eel	<i>Monopterus albus</i>

Table 31. No. of household classified by fishing gear in interview areas

Note: some households use more than 1 net type

No	Village	Household				
		Net				Freshwater prawn trap
		0.75"-1.0"	1.75"-2.0"	3.25"-4.0"- 4.5"	7.25"	
1	Shweletpan	2	10	12	3	3
2	Mamonkaing	2	4	9	2	0
3	Hepa	2	7	11	5	3
4	Nyaungbin	2	2	16	3	0
5	Lonton	4	3	7	5	0
	Total	12	26	55	18	6
	%	14.29	30.95	65.48	21.43	7.14

Table 32. Size of one gill net classified by different mesh size

0.75"-1.0"	1.75"-2.0"	3.25"-4.0"- 4.5"	7.25"
length=200 yard depth= 3 yard	length= 102 Yard depth= 4 yard	length= 130 yard depth= 12 yard	length= 130 yard depth= 12 yard

Table 33. Firewood consumption in the study area

No	Village	Household	population	Consumption/ household/year (Tons)	consumption/ person/year (Tons)
1	Shweletpan	19	89	26.39	0.29
2	Mamonkaing	14	72	21.06	0.29
3	Hepa	22	124	38.54	0.31
4	Nyaungbin	27	153	54.22	0.35
5	Lonton	18	98	29.23	0.29
	Total	100	536	169.44	0.32

Plate 3. House structures



Live in the boat on the lake

Plate 4. Some fishing gears and fish species

Featherback



Swamp Baarb



Prawn traps



Prawn traps



Small mesh size gill net



Measuring meshes of a net



CHAPTER 5: DISCUSSION

The Indawgyi lake sanctuary is a Ramsar Site and the most important bird area of Myanmar. The lake environment, its soil, water, and the climate are suitable to grow rice, crops, vegetables and fruits. A wide variety of flora and fauna resources remain in the area. These conditions forced a permanent settlement growth leading to a relatively high population concentration within the past 20 years. Today's lake area population density is 150 persons per km² - almost twice the average population density of the country, which is 82 people/ km² (WHO, 2006).

The country wide number of individuals per family in rural areas is published to be 4.67 (Ministry of National Planning and Economic Development Myanmar, 2006). In the surveyed areas an average household size of 5.4 members was recorded.

Contraceptives are not commonly available in government health centres. If at all, the private sector is the sole source of contraception offerings. However private clinics are less likely to be available in rural areas and where few international agencies are able to work, they face tight restrictions on the use of permanent methods of family planning. (John Bercow (n.d.)).

The EC-Burma/ Myanmar Strategy Paper (2007-2013) also pointed out that the quality of public health service is very low and the de facto introduction of user fees adds another hurdle especially for the poor.

Despite the high population density, the Indawgyi area health infrastructure, with only 1 clinic with one medical doctor for 45,000 people, was found significantly lower than published for the balance of Myanmar.(1 medical doctor per 2985 inhabitants, (WHO, 2004)). Whether this is the result from an over proportional population growth rate, caused by immigration, a lack of family

planning, or from the before mentioned bureaucracy hurdles, is regardless. Most likely it is the accumulation of all factors.

The life expectancy of Myanmar people is 61 years for men and 67 years for woman (WHO, 2011). The Indawgyi lake area population falls behind. The age group above 61 counted only 13 persons (9 females and 4 males) out of 536.

For classification of a society Dr Devendra P Shrestha, n.d. introduced the following raster:

“The economic active population can be categorized into employers, employees, self-employed or own account workers, unpaid family workers and persons seeking employment for the first time.”

The economically inactive population, on the other hand, includes children below the age of six, persons retired from work, too old to work, or unable to work, persons able to work but neither working nor looking for work. This large group includes females solely occupied with their own household work, full-time school children, students and voluntarily idle persons. (Yin Yin Win, 2007 cited Hirashima, 1977).

Members of all of the above defined categories have been found among the population surveyed in the 5 villages, Shweletpan, Mamonkaing, Hepa, Nyaungbin and Lonton. However the majority of the economic active group were recorded as self-employed workers since most family members regardless of sex participated in farming and fishing.

Farmers were mostly owners of land, but often of insufficient size to support the family members. Only monsoon paddy cultivation is practiced in the surveyed areas. Even though Naing Naing Latt, (2010) reported that most of the inhabitants of the Indawgyi lake area were engaged in agriculture. 80% of the total population should make their living from agriculture. The result

of this survey proves that only 5.78 % of the interviewees were farmer families, whilst 38.25% of the families made their living mainly from fishing.

It would need further investigation to define if this discrepancy results from classification differences, (some farmers work as fishers as well during the off season), the low percentage of population interviewed (7.8% of the total population in the study area), if it is caused by the chosen random sampling method, or if this study reflects more of the reality.

Generally, it must be admitted, that socioeconomic conditions are hard to analyse, as results of interviews depend on the cooperation willingness of human beings and their characters, which usually differ widely within the same community and from one community to another (M.A. Abdrabo & M.A. Hassaan 2003). Some interviewees were willing to answer the questions discovering their economic situation, others were not.

Household income is one of the most important determinants of welfare in a region. The ability to meet basic needs, such as adequate food, clothing, sheltering and basic amenities, is largely determined by the level of income. Poverty is often defined as the lack of resources to meet these needs (CJ Meintjes, Development paper 145, Southern Africa, March 2001).

No distinct income correlation to occupation could be detected in the survey areas. Clear became, according to the survey, 48% of total interviewees live below the World Bank defined poverty index line (US\$ 1.25 per person per day). As noticeable from the income per capita chart, the inhabitants of Nyaungbin and Lonton enjoy slightly higher incomes as those living the others 3 villages. This result, however must be critically assessed as family size, which has been found as main determinant for the living standard, is comparable if not higher than in the poorer” villages”. Reason for the higher per capita income is the fact that the number of families falling

into the income classes 5 and 6 is apparently higher than in Sweletpan, Hepa and Mamonkaing. (Appendix VI).

The indicative proxy indicators of poverty, as defined by the UNDP, which include basic factors for wellbeing, such as access to farm land (food production), type of roofing system (shelter), education level and health care facilities and sanitation (health) (FAO, 2003).

Applying these criteria, approximately 14% of interviewees are landless, and live in boats on the lake. 66% of the houses in the survey area have grass/ palm thatch roofs, thus total 80% of households fulfil at least one of the UNDP poverty indicators.

Looking at the availability of social services, such as health and education, the other indicators for poverty, used by UNDP, the situation can be summarized as follows

Before 1960, in the Indawgyi Lake area the education standards were very low. People, who wanted to attend middle or high school education, had to relocate to Mohnyin or other larger cities. Between 1960 and 1988, the government enforced an anti-illiteracy campaign with the target that all people should become literate. In consequence of this campaign, between 1988 and 1993, two state middle schools and 17 primary schools were established in the Indawgyi Lake area. These were constructed and operated on self-help basis under the supervision of local authorities. Teacher to pupil ratio was 1:50 in primary school level, 1:60 in middle school level and 1:35 in high school level. (Naing Naing Latt, 2010).

During this study only 3.36% of the population was classified as illiterates. The student/teacher ratios were found to be in the range defined by Naing Naing Latt in her work of 2010 or better. An exceptional case was found in Nyaungbin where the teacher to pupil ratio was 1:100 in middle school level. Primary level education is available for every village in the surveyed areas.

To get middle and high level education, school children from Shweletpan and Hepa have to visit neighbour villages within a distance of 3 to 5 miles. Scholars from Nyaungbin and Mamonkaing have to get over distances between 5 and 7 miles to benefit from high school level education. After high school completion students can study in Mohnyin, Myitkyina (State capital) or Mandalay Universities. It can be concluded, that the education offering in the area is more satisfactorily than other criteria, like for example the health service infrastructure, as discussed earlier in this chapter, for human well-being in the study area,

The provision of infrastructural services also plays an important role for the welfare of households. Access to clean water and sanitation reduces mortality; access to transport provides access to markets; access to electricity improves the living standards and saves food supply; it also opens employment opportunities; telecommunications contributes to improvements in economic activities and in living conditions.

In contrast, the non-provision of alleviates economic performance, since much time has to be devoted to activities such as collecting fuel wood or clean water.- Time that could otherwise be spent on income-earning activities (CJ Meintjes, Development paper 145, Southern Africa, March 2001).

70% of Myanmar's total population lives in rural areas (WHO, 2006). Only 10% of rural households have access to electric power supply (Johannesburg Summit 2002). The surveyed areas do not fall within these 10%, as the survey result proved.

In total 82% of all respondents depend on lake water for drinking and household whilst just 18% are tube well users. . Considering the litter and other pollution brought uncontrolled into the lake, it is dangerous to use lake water for drinking and cooking without treatment. In addition building

tube wells to the necessary depth (between 60 and 70 feet) is a difficult, costly and time consuming task.

The HG concentration was reported to be 0,059 to 2,858ppm for the lake during the summers. This exceeds the limit, set by the WHO (1ppb) significantly (> 200%). The nutrient concentration, such as nitrate- nitrogen (0.096- 0.212) ppm and phosphate- phosphorus (0.034- 0.064) ppm indicate eutrophic conditions for the lake (Hla Hla Than, Dec 2006).

Reasons for the analysis results of water samples, taken during this study, which show neither nitrate, nor phosphate, nor mercury, can be manifold. Probably the collection places chosen, a relatively long storage period between sample collection and analysis and the season at the sample draw caused the deviation from earlier measurements.

Therefore the statement, based on the results of the water analysis during this study, that the surveyed areas are part of that 68% of the rural population, which have access to safe water (The EC- Burma/ Myanmar Strategy Paper (2007- 2013) cited WHO report, 2004)) should be critically reviewed.

The transportation infrastructure in Myanmar is relatively poor (Anthony Truong, Justin Tan, 2006). Light transportation such as buses and cars are a private sector activity in Myanmar. In the surveyed areas 2 private owned cars serve as regular transportation alternative. During the wet season the unpaved roads in the lake area hamper communication traffic seriously or even prevent it. This issue exists despite the fact, that private efforts are undertaken to repair damaged road sectors, because they are mandatory to facilitate the transportation of local products to the market in towns.

Mobile phones were first introduced about 17 years ago (1994). In the beginning this technology was only available to very few high ranking government officers and foreign diplomats. A few years later, the government started selling CDMA mobile phones to the public. Those were followed by GSM phones. The average density was 8 phones per one thousand inhabitants (Today in Myanmar, Jan. 2009).

CDMA mobile phones were established in the surveyed areas in 2008. The costs were as high as about 900,000 kyat per phone (= €900). During the interviews for this study, 5 phones per 536 inhabitants have been recorded. (2 phones however belong to one household). So the phone density is statistically meeting the countries average.

Addressing the sustainability issue the following statements shall be used as guidelines.

To achieve a sustainable development, economic growth and environmental protection are viewed as mutually comparable activities and not as conflicting ones (M.A. Abdrabo & M.A. Hassaan 2003)

Environmental issues need to be carefully considered in the development of coastal and inland aquaculture in Myanmar, paying close attention to environmental management of the sector will not only provide a sound basis for sustainable development, but will also ensure continued market access into importing markets that are becoming increasingly sensitive to environmental concerns (FAO, 2003)

In Thailand the minimum mesh size designed for inland fisheries is set at 5 cm/ 2 inches (stretched mesh), which allows the juveniles and sub-adults of many species to escape from the gear (FAO, 2010). Myanmar freshwater fisheries law (1991) did not describe it. The result showed that 14.29% of interviewees use smaller mesh size net (0.75"- 1").

By notification prohibited is the catching or keeping in capacity of spawners, breeders, and fingerlings of freshwater fish in the months of May, June, July, and August (Aung Htay Oo, 2010).

Most people in the surveyed areas however work with their normal gear throughout the year. 14% of interviewees, who mostly live in boats on the lake pause for 2 months per year. (Information derived from the answers on questions regarding their annual income).

Davies, Sebastian and Chan (2004) recorded 64 fish species in the lake basin. Local, Brang Gam claimed that some fish which were popular and abound in the past have become rare (Irrawaddy Magazine, Oct 2006).

During this study only 22 species were recorded. It needs further investigation, if this discrepancy is caused by seasonal impacts or by diversity degradation. Answers from interviewees on questions regarding their catch volume, support the fear that indeed a serious reduction of the fish quantity and diversity in the lake has occurred over the past decade. Fishermen report that nowadays their catch, using 27 nets equals the catch using 5 nets ten years ago.

Gold mining, “the boom and bust economic” causes great inequality and poverty in area, where mining is taking place, prices for many goods and services have become inflationary. It also creates numerous social problems, such as drug dependence and alcohol abuse, compulsive gambling, malaria, and sexually transmitted diseases. Another serious issue is long term exposure of workers to mercury. Often they handle mercury with their bare hands and spend long hours; bare legged in mercury contaminated water. In addition local people lose their land due to gold mining (Image Asia & Pan Kachin Development society (Nov.2004).

During the survey, above mentioned problems became not obvious, as they are long term issues. But blocking of streams has been monitored and the potential risks, such as mercury contamination can have happened unnoticeable in water and soil. Another reason was that the surveyed villages are not part of the main gold mining area in the region. Only very few interviewees were engaged in gold mining activity.

The fuel-efficient stove program conducted for Vietnam executed by Fauna & Flora International recommended that using improved stoves for cooking meals can save 25% to 35% of fuel wood compared to usage of traditional local stoves (Nguyen Hung Manh and Nguyen Phuong Thuy, Aug 2009).

In the surveyed areas all households still use the traditional three legged stove and cook in open air during the cold and dry season. The average total consumption of 100 household with 536 members was 169.44 tons per year. Considering that deforestation is one of the issues to achieve sustainability in economic and ecologic developments and that especially a bird sanctuary needs healthy forests this issue should be addressed.

CHAPTER 6: CONCLUSION AND RECOMMENDATION

The natural treasures of the Indawgyi Wildlife and Bird Sanctuary traditionally offered, and still offer a variety of economic chances for the people living around the lake. These chances attract immigrants and lead to an on-going population growth. The concomitant circumstances of growing, unstructured population leads to pollution, increasing fresh water requirements and food demand; are serious contingencies relating to a sustainable socio-ecologic development and concurrent resource protection of this important wetland nature reserve.

In parallel the pressure on the eco-system and the underdeveloped infrastructure hamper the chances for the inhabitants to structure solid bases for their families' well-being. Overfishing and limitations for successful farming, by the lack of irrigation systems form barriers to generate better incomes, which leave margin to care about other, than the very basic needs to survive. Under the given circumstances it is a challenge to develop higher environment awareness amongst the population.

Besides these fundamental issues, the absence of social security systems in parallel to a poorly developed health care infrastructure, as well as traditional minted thinking, that children are the only way to secure the survival of the elder, lead to high birth-rates. As matter of fact, this security thinking was partly true in the past. Today's world however offers no longer enough resources to support this model. So one of the less surprising results of this study was, family size and per capita income, as one of the fundamentals for human well-being, are counter proportional. This reflects the fact, that the available resources for income generation are limited and will even further decrease, if no counteractions are implemented.

A positive finding during the survey was the educational sector has significantly improved over the past decade. All scholars today have access to basic and middle school education. Also high school level education can be achieved without relocation. University grades can be obtained at Mohnyin, Myitgyina and Mandalay. The limiting factors for more extensive use of the educational offering are again the family incomes. However, better education is one of the important keys to break the downward spiral, triggered by the before mentioned issues. It can however be only one of the necessary measures to further support this sector.

Great affords are needed to improve the infrastructure as base for all other progress. This includes in the first step the construction of roads, to enable transport of goods from the producer to the consumer all year over. Paved roads will also support eco-touristic exploitation, which will be discussed later, as a source of additional income.

Just as important is the need to supply electric power to the region and give access to it for all inhabitants. This will ease the supply of freshwater from tube wells for the people and such decrease health risks from lake water as cooking and drink water source. Electric supply will also enable people to pump water from the lake and irrigate farmland on the fringe. So the harvests can be improved, such increasing family incomes and reducing the needs to enlarge farmland areas at the expense of protected forests.

To counter further degradation of fish diversity and density in the lake it will be indispensable to install the necessary infrastructure and give it the power to control immigration and /or survey the fishing activities. It is mandatory that the close seasons are strictly obeyed and fishing of immature fish with tiny meshes is not practiced. Once further overfishing is stopped, measures to recover the fish diversity should be implemented.

A controlled environment friendly touristic infrastructure would be an alternative to generate additional income and compensate for losses caused by the before mentioned limitations for the fishermen. An important positive side effect of such exploitation would be that the littering issue which is a growing risk for the environment and as a consequence for the eco system service, would get higher awareness of the producers as it lowers the attractiveness for tourists and have direct impact on incomes.

Similar effects in regard to poison hunting may be expected from eco- tourism valorisation. If locals continue to poison the birds and degrade the fauna diversity, less tourists will be attracted to visit , lowering the chances of the involved to generate income.

To not be misunderstood, this is not a plea to open the doors for mass tourism like for example in southern Thailand, which would destroy the fragile natural treasures. But the advantages of a structured eco tourist approach are by far greater than the possible load on nature and it opens opportunities for a sustainable socio- economic development, which through other approaches would be more difficult to reach.

To realize such a structured approach for a sustainable socio- economic development of the Indawgyi region, collaboration of all relevant stakeholders in the area, in the region, in the country and also from the international community is mandatory. The experience of the past and the economic situation of the country, which suffers from ineffective structures in many government levels plus the constraints of many years under embargo from the western hemisphere highlight the need of international engagement. This is not only in the interest of the Myanmar people but also of the world, as natural treasures like the Indawgyi Nature Reserve have become rare in today's globalised world and their importance for the worldwide ecosystem becomes more obvious with each natural disaster, the world is facing.

REFERENCES:

Cinner, J. (2000), “*Field Survey Questionnaire – Socioeconomic Aspects of Resource Use and Perception in Mahahual, Quintana Roo, Mexico*”

http://www.crc.uri.edu/download/CM_Mahahualquestionnaire.pdf , (accessed 5 February 2011)

“Questions on socio-economic status”

<http://www.ktl.fi/publications/ehrm/product1/section9.htm>, (accessed 5 February 2011)

National Council of Applied Economic Research, New Delhi (2004), “*Socio- Economic Survey of Households*”,

<http://data.undp.org.in/hiv/SEI%20HIV/doc/NonHIVhhs-Questionnaire.pdf>,

(accessed 5 February 2011)

“*Socio-economic and Ecological Survey Questionnaire*”,

http://www.unep-aewa.org/meetings/en/tc_meetings/tc6docs/pdf/tc6_inf6_8_pdf/9_appendix11.pdf,

(accessed 5 February 2011)

M.A. Abdrabo, M.A. Hassaan, (2003), “*A Manual for Socioeconomic Study,*

From river catchments area to the sea: comparative and integrated approach to the ecology of Mediterranean coastal zones for sustainable management (MEDCORE)”

http://www.medcore.unifi.it/socioeconomy_manual_cedare.pdf, (accessed 4 July 2011)

“*The EC- BURMA/ MYANMAR STRATEGY PAPER (2007-2013)*”

http://www.eeas.europa.eu/myanmar/csp/07_13_en.pdf, (accessed 4 July 2011)

CJ Meintjes (March 2001), “*Guidelines to Regional Socio-economic Analysis (Development paper 145)*”

<http://www.dbsa.org/research/documents/guidelinestoregionalanalysis.pdf>,

(accessed 7 July 2011)

Crestone Valley (Wildlife management area, n.d.), *Important of Wetlands*” (Source: Ramsar web site)

<http://crestonwildlife.ca/wetlands/importance>, (accessed 7 July 2011)

“*Poverty Threshold*” (n.d.),

http://en.wikipedia.org/wiki/Poverty_threshold, (accessed 7 August 2011)

Peadar Kirby (2006), “*Vulnerability and Violence The impact of Globalization*”, (pp.1-27)

Yin Yin Win (2007). “*Socioeconomic Studies in Two Villages of Maubin Township, Ayeyarwaddy Division, Myanmar*”, PhD Thesis, University of Yangon

Naing Naing Latt (2009), “*Preliminary Study on the Holocene Climate Environments of Indawgyi Lake Basin in Myanmar*”, Dagon University Research Journal 2009, Vol.2

Dr. Naing Naing Latt, Daw Kyu Kyu Thin and Dr. Seng Aung (July 2010), “*A Geographical Study on the Socio-economic development of Indawgyi Lake Environment Area in Kachin State*”, Dagon University Research Paper

Mohnyin Degree College, Department paper (1994), “*Physical Geography of Indawgyi Lake*”

Davies. J. Sebastian. A.C. & Chan, S. (2004), “*A Wetland Inventory for Myanmar*”, Ministry of the Environment, Japan.

Walter K. Dodds, Wes W. Bouska, (Environmental Science Technology, 2009), “*Eutrophication of U.S Freshwaters analysis of Potential Economic Damages*”

<http://pubs.acs.org/doi/pdfplus/10.1021/es801217q> (accessed 13.08.2011)

Hla Hla Than (Dec, 2006), *Environment Impact of Mercury Contamination in some Gold Extractions in Kachin State*, PhD Thesis, University of Yangon, Myanmar.

Nguyen Hung Manh and Nguyen Phuong Thuy (August 2009) Fauna & Flora International Vietnam Programme, “*Assessment of the Fuel-efficient Stove Programme in Trung Khanh District, Cao Bang Province*”

Myanmar Forest Information and Data (n.d.),

<http://rainforests.mongabay.com/deforestation/2000/Myanmar.htm> (accessed 10.07.2011)

Myanmar tops list in deforestation in world (n.d.),

[http://www.merineews.com/article/myanmar-tops-list-in-deforestation-in-world/135582.shtml%](http://www.merineews.com/article/myanmar-tops-list-in-deforestation-in-world/135582.shtml%20) (accessed 10.07.2011)

Johannesburg Summit 2002, (United Nations) “*Myanmar Country Profile*”

<http://www.un.org/esa/agenda21/natlinfo/wssd/myanmar.pdf> (accessed 07.07.2011)

Pollution Probe (June 2003), *Mercury in the Environment: A Primer*

<http://www.pollutionprobe.org/report/mercuryprimer.pdf> (accessed 14.08.2011)

United States Public Health Service (1996-2010), “*Mercury*”

<http://www.eco-usa.net/toxics/chemicals/mercury.shtml> (accessed 15.08.2011)

Mercury poisoning (n.d.)

http://en.wikipedia.org/wiki/Mercury_poisoning#cite_note-31, (accessed 15.08.2011)

New Hampshire Department of Environmental Services (2003),

<http://des.nh.gov/organization/commissioner/pip/factsheets/ard/documents/ard-28.pdf> (accessed 15.08.2011)

United States Environmental protection Agency (Oct, 2010), “*Environmental Effects*”, (*Fate and Transport and Ecological Effects of Mercury*),

<http://www.epa.gov/mercury/eco.htm> (accessed 15.08.2011)

Volume VI: (Dec, 1997), “*An Ecological Assessment for Anthropogenic Mercury Emissions in the United States*”

<http://www.epa.gov/ttn/oarpg/t3/reports/volume6.pdf> (accessed 15.08.2011)

Images Asia & Pan Kachin Development society (Nov, 2004) “*At What Price*”, “*Gold Mining in Kachin State, Burma*”

<http://www.ibiblio.org/obl/docs/gold%20pdf1.pdf> (accessed 16.08.2011)

Khun Sam (Oct, 2006), Irrawaddy magazine, “*Sanctuary under Threat*”

http://www.irrawaddy.org/print_article.php?art_id=6396 (accessed 14.07.2011)

Western Regional Environmental Council (1987) pp. 158 – 161 (Visit to an Ocean Planet), “*Plastic in the Ocean*”

<http://topex-www.jpl.nasa.gov/files/archive/activities/ts3hiac1.pdf> (accessed 12.07.2011)

Zin Nwe Myint (Megacity Yangon Second German- Myanmar Workshop 2005) “*population and wood fuel use*”

Unit 9, *Litter* (n.d.),

<http://www.arc.govt.nz/albany/fms/main/Documents/Council/Education/AWOW/AWOW%20Unit%209%20-%20Litter.pdf> (accessed 12.07.2011)

Myanmar Law (1994), “*The Myanmar Mines Law*”

http://www.blc-burma.org/html/myanmar%20law/lr_e_ml94_08.html (accessed 07.07.2011)

Ministry of Agriculture and Irrigation (2002), Myanmar, “*Soil Types and Distribution*”

http://www.apipnm.org/swlwpnr/reports/y_ta/z_mm/mmtx221.htm#s01 (accessed 15.07.2011)

Food and Agriculture Organization of the United Nations (2003), “*Myanmar aquaculture and inland fisheries*”

<ftp://ftp.fao.org/docrep/fao/004/ad497e/ad497e.pdf> (accessed 12.07.2011)

Food and Agriculture Organization of the United Nations (2010), “*Inland Fisheries Resource Enhancement and Conservation in Asia*”

http://library.enaca.org/inland/projects/inland_fisheries_resource_enhancement/inland_fisheries_resource_enhancement_asia.pdf (accessed 12.07.2011)

Myanmar-population density (Oct, 2006)

http://www.studentsoftheworld.info/pageinfo_pays.php3?Pays=MMR&Opt=population (accessed 07.07.2011)

Central Statistical Organization (Ministry of National Planning and Economic Development) (Myanmar National- wide Sample Survey in 2006)

<http://www.csostatat.gov.mm/survey.asp> (accessed 24.07.2011)

John Bercow (n.d.), *Reproductive health in Burma: priority for action*

http://www.google.de/search?rlz=1C1SVED_enDE390DE390&sourceid=chrome&ie=UTF-8&q=family+planning+in+Myanmar (accessed 22.08.2011)

World Health Organization, Country Myanmar, Statistics (2011)
<http://www.who.int/countries/mmr/en/> (accessed 22.08.2011)

S. Hirashima (July, 2001), *RURAL POVERTY AND THE LANDED ELITE: SOUTH ASIAN EXPERIENCE REVISITED*
http://dyson.cornell.edu/research/researchpdf/wp/2001/Cornell_Dyson_wp0110.pdf (accessed 22.08.2011)

Dr. Devendra P Shrestha (n.d.), CHAPTER 9 TRENDS, PATTERNS AND STRUCTURE OF ECONOMICALLY ACTIVE POPULATION
<http://www.cbs.gov.np/Population/Monograph/Chapter%2009%20%20Trends,%20Patterns%20and%20Structure%20of%20Economically%20A.pdf> (accessed 23.08.2011)

Country Health System Profile, Myanmar (World Health Organization, 2003-4)
http://www.searo.who.int/en/Section313/Section1522_10916.htm (accessed 24.08.2011)

The Freshwater Fisheries Law Myanmar (1991),
http://www.blc-burma.org/html/myanmar%20law/lr_e_ml91_01.html (accessed 29.08.2011)

Telecommunication in Myanmar (n.d.),
<http://www.myanmar2day.com/myanmar-information/2009/01/telecommunication-in-myanmar/>
(accessed 29. 08.2011)

Burma (Myanmar) - *Infrastructure, power, and communications* (n.d.),
<http://www.nationsencyclopedia.com/economies/Asia-and-the-Pacific/Burma-Myanmar-INFRASTRUCTURE-POWER-AND-COMMUNICATIONS.html> (accessed 29.08.2011)

Anthony Truong, Justin Tan (Dec, 2002), *Rural Telecommunications Network Project Northern Myanmar*
https://ccnet.stanford.edu/cgi-bin/course.cgi?cc=ee244&action=handout_download&handout_id=ID11318645837934
(accessed 29.08.2011)

Appendix I. Population structure by gender and age of the study area

		Age													
		≤ 5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	≥ 61	Total
Shweletpan	Total	24	12	7	5	10	8	8	6	2	3	3	0	1	89
	Male	11	4	2	2	7	5	4	2	2	1	2	0	0	42
	Female	13	8	5	3	3	3	4	4	0	2	1	0	1	47
Mamonkaing	Total	12	8	11	7	6	8	3	7	4	1	2	2	1	72
	Male	6	4	5	3	2	5	1	4	3	0	1	0	0	34
	Female	6	4	6	4	4	3	2	3	1	1	1	2	1	38
Hepa	Total	22	14	11	13	17	17	7	2	8	6	2	3	2	124
	Male	13	6	6	4	9	10	5	1	5	1	0	3	0	63
	Female	9	8	5	9	8	7	2	1	3	5	2	0	2	61
Nyaungbin	Total	24	28	13	12	12	24	6	8	5	3	10	2	6	153
	Male	9	14	2	4	6	11	4	3	3	2	5	0	3	66
	Female	15	14	11	8	6	13	2	5	2	1	5	2	3	87
Lonton	Total	20	11	10	9	8	9	12	4	4	1	6	1	3	98
	Male	7	2	4	4	3	4	7	3	2	0	3	1	1	41
	Female	13	9	6	5	5	5	5	1	2	1	3	0	2	57
Total	Total	102	73	52	46	53	66	36	27	23	14	23	8	13	536
	%	19.03	13.62	9.70	8.58	9.89	12.31	6.72	5.04	4.29	2.61	4.29	1.49	2.43	100
	Male	46	30	19	17	27	35	21	13	15	4	11	4	4	246
	%	8.58	5.60	3.55	3.17	5.04	6.53	3.92	2.43	2.80	0.75	2.05	0.75	0.75	45.90
	Female	56	43	33	29	26	31	15	14	8	10	12	4	9	290
	%	10.45	8.02	6.16	5.41	4.85	5.78	2.80	2.61	1.49	1.87	2.24	0.75	1.68	54.10

Appendix II. Percentage distribution of literacy and educational status in the study area

ID	Education Level	Shweletpan %	Mamonkaing %	Hepa %	Nyaungbin %	Lonton %	Total %
1	Monastery	3.37	12.5	2.42	9.80	4.08	6.34
2	Primary (Attending)	17.98	16.67	11.29	20.26	15.31	16.42
3	Primary (Incomplete)	31.46	19.44	26.61	18.95	20.41	23.13
4	Middle (Attending)	4.49	4.17	7.26	5.88	4.08	5.41
5	Middle (Incomplete)	16.85	16.67	25.81	23.53	19.39	21.27
6	High (Attending)	1.12	6.94	0.80	1.31	5.10	2.61
7	High (Incomplete)	2.25	6.94	0	3.92	4.08	3.17
8	Under graduate	0	0	1.61	1.96	2.04	1.31
9	Graduate	0	0	1.61	1.96	5.10	1.87
	Literate	77.53	83.33	77.42	87.58	79.59	81.53
10	Illiterate	1.12	1.39	8.06	2.62	2.04	3.36
11	Young children	21.35	15.28	14.52	9.80	18.37	15.11
	Total	100.00	100.00	100.00	100.00	100.00	100.00

Appendix III. Number of households and population by occupation

Occupation Category	Shweletpan		Mamonkaing		Hepa		Nyaungbin		Lonton		Total		
	HH	Pop	HH	Pop	HH	Pop	HH	Pop	HH	Pop	HH	Pop	%
Fishermen	10	18	4	11	5	16	17	32	8	19	44	96	37.65
Fishermen & farmer	2	4	1	3	2	6	0	0	1	5	6	18	7.06
Fishermen & general worker	6	15	7	20	9	25	2	5	2	3	26	68	26.67
Fishermen & shop	0	0	2	4	4	12	1	5	1	2	8	23	9.02
Farmer & shop	0	0	0	0	1	3	2	7	3	8	6	18	7.06
Farmer & general worker	1	5	0	0	1	3	0	0	2	5	4	13	5.10
Self -employment	0	0	0	0	0	0	5	17	0	0	5	17	6.67
Others	0	0	0	0	0	0	0	0	1	2	1	2	0.78
Total	19	42	14	38	22	65	27	66	18	44	100	255	100

Note: % depends on working population

Appendix IV. Number of households and population by occupation

Occupation Category	Shweletpan		Mamonkaing		Hepa		Nyaungbin		Lonton		Total		
	HH	Pop	HH	Pop	HH	Pop	HH	Pop	HH	Pop	HH	Pop	%
Fishermen	10	18	4	11	5	16	17	32	8	19	44	96	17.91
Fishermen & farmer	2	4	1	3	2	6	0	0	1	5	6	18	3.36
Fishermen & general worker	6	15	7	20	9	25	2	5	2	3	26	68	12.67
Fishermen & shop	0	0	2	4	4	12	1	5	1	2	8	23	4.29
Farmer & shop	0	0	0	0	1	3	2	7	3	8	6	18	3.36
Farmer & general worker	1	5	0	0	1	3	0	0	2	5	4	13	2.43
Self -employment	0	0	0	0	0	0	5	17	0	0	5	17	3.17
Others	0	0	0	0	0	0	0	0	1	2	1	2	0.37
Total	19	42	14	38	22	65	27	66	18	44	100	255	47.57

Note: % depends on total population

Appendix V. Income and expenses in surveyed areas in 2010

incomes and expenses in surveyed area in 2010							household in \$ US - per head & poverty status					Income classes in Mio Kyat					
No	Name	Fm size	Village	Occupation	est. ann. Inc. kyat	ann. exp. Kyat	income \$ US	exp. \$ US	surpl. \$ US	HH pov.inc. \$ US	status	≤ 0,9	>0.9 - 1.2	>1,2 - 1,5	>1,5 - 2	>2 - 3	> 3
1	Chit Than	9	Shweletpan	Fish general worker	1,544,125	1,507,500	2,161.78	2,110.50	51.27	4,106	under				X		
2	Zayar	5	Shweletpan	fishermen	1,263,375	950,000	1,768.73	1,330.00	438.73	2,281	under			X			
3	Kyaw Kyaw	5	Shweletpan	Fish general worker	1,193,187	920,000	1,670.46	1,288.00	382.46	2,281	under		X				
4	Htun Win	4	Shweletpan	fishermen	1,333,562	1,020,000	1,866.99	1,428.00	438.99	1,825				X			
5	Maung Zaw	4	Shweletpan	fishermen	1,644,125	1,450,000	2,301.78	2,030.00	271.78	1,825					X		
6	Aung Naing Win	3	Shweletpan	fishermen	1,200,500	650,000	1,680.70	910.00	770.70	1,369				X			
7	Pho Pyar	6	Shweletpan	fish farmer	1,403,750	1,090,000	1,965.25	1,526.00	439.25	2,738	under			X			
8	Kyaw Myint	5	Shweletpan	Fish general worker	1,499,000	1,290,000	2,098.60	1,806.00	292.60	2,281	under			X			
9	Pho Chin	4	Shweletpan	fishermen	1,093,000	851,000	1,530.20	1,191.40	338.80	1,825	under		X				
10	Zaw Khaing	4	Shweletpan	fishermen	1,099,000	850,000	1,538.60	1,190.00	348.60	1,825	under		X				
11	San Lin	3	Shweletpan	fishermen	1,125,000	930,000	1,575.00	1,302.00	273.00	1,369			X				
12	Min Zaw Oo	2	Shweletpan	fishermen	1,443,750	1,204,000	2,021.25	1,685.60	335.65	913				X			
13	Chit San Mg	3	Shweletpan	fishermen	1,403,750	735,000	1,965.25	1,029.00	936.25	1,369				X			
14	Htun Htun Naing	3	Shweletpan	fishermen	1,270,000	792,000	1,778.00	1,108.80	669.20	1,369				X			
15	Aung Myint Naing	5	Shweletpan	fish farmer	1,125,000	945,000	1,575.00	1,323.00	252.00	2,281	under		X				
16	Htay Lwin	4	Mamonkain g	fishermen & shop	2,000,000	1,800,000	2,800.00	2,520.00	280.00	1,825					X		
17	Ma Naing	5	Mamonkain g	fish general worker	1,600,000	1,290,000	2,240.00	1,806.00	434.00	2,281	under				X		
18	San Kyi	3	Mamonkain g	fishermen	2,000,000	1,680,000	2,800.00	2,352.00	448.00	1,369					x		
19	Myint Win	5	Mamonkain g	fish general worker	1,500,000	1,195,000	2,100.00	1,673.00	427.00	2,281	under			X			
20	Aung Maunn	5	Mamonkain g	fishermen	2,500,000	2,410,000	3,500.00	3,374.00	126.00	2,281						x	

Fm = family, est. ann. Inc = estimate annual income, ann. exp. = annual expense, exp. = expense, surpl. = surplus, HH pov. Inc. = household poverty income (number of household member x \$ 1.25 x 365 days)

incomes and expenses in surveyed area in 2010							household in \$ US - per head & poverty status					Income classes in Mio Kyat					
No	Name	Fm size	Village	Occupation	est. ann. Inc. kyat	ann. exp. Kyat	income \$ US	exp. \$ US	surpl. \$ US	HH pov.inc \$ US	status	≤ 0,9	>0.9 - 1.2	>1,2 - 1,5	>1,5 - 2	>2 - 3	>3
21	Ba Wai	5	Mamonkain g	fish general worker	1,800,000	1,790,000	2,520.00	2,506.00	14.00	2,281					X		
22	Aung Lwin	8	Mamonkain g	Fish general worker	1,250,000	965,000	1,750.00	1,351.00	399.00	3,650	under			X			
23	Aung Aung	3	Mamonkain g	Fish general worker	1,263,300	880,000	1,768.62	1,232.00	536.62	1,369				X			
24	Tin Soe	4	Mamonkain g	fishermen & shop	1,200,000	899,000	1,680.00	1,258.60	421.40	1,825	under		X				
25	Win Maung	7	Mamonkain g	fishermen	2,200,000	2,470,000	3,080.00	3,458.00	-378.00	3,194	under					x	
26	Soe Naing	6	Mamonkain g	fish famer	2,073,000	1,730,000	2,902.20	2,422.00	480.20	2,738						x	
27	Pho Si	5	Mamonkain g	Fish general worker	1,150,000	940,000	1,610.00	1,316.00	294.00	2,281	under		X				
28	Pho Si	5	Mamonkain g	Fish general worker	2,000,000	2,100,000	2,800.00	2,940.00	-140.00	2,281					X		
29	Aung Than	7	Mamonkain g	fishermen	1,650,000	1,600,000	2,310.00	2,240.00	70.00	3,194	under				X		
30	Thein Aung	6	Hepa	fish general worker	1,400,000	1,090,000	1,960.00	1,526.00	434.00	2,738	under			X			
31	Min Yi	5	Hepa	Fish general worker	1,800,000	1,600,000	2,520.00	2,240.00	280.00	2,281					X		
32	Than Kyaw	8	Hepa	fishermen	1,810,000	1,725,000	2,534.00	2,415.00	119.00	3,650	under				X		
33	Kalar	5	Hepa	Fish general worker	1,500,000	1,405,000	2,100.00	1,967.00	133.00	2,281	under			X			
34	Ko Oo	8	Hepa	fishermen & shop	1,450,000	1,330,000	2,030.00	1,862.00	168.00	3,650	under			X			
35	Min Lwin	7	Hepa	Fish general worker	2,300,000	2,290,000	3,220.00	3,206.00	14.00	3,194						x	
36	Myo Chit	5	Hepa	fishermen & shop	2,000,000	1,510,000	2,800.00	2,114.00	686.00	2,281					X		
37	Win Hlaing	9	Hepa	Fish general worker	1,800,000	1,725,000	2,520.00	2,415.00	105.00	4,106	under				X		
38	Tin Nyunt	3	Hepa	fishermen	1,200,000	1,172,000	1,680.00	1,640.80	39.20	1,369			X				
39	Win Than	7	Hepa	fishermen	2,400,000	2,470,000	3,360.00	3,458.00	-98.00	3,194						x	
40	Soe Myint Naing	8	Nyaungbin	fishermen & shop	1,900,000	1,820,000	2,660.00	2,548.00	112.00	3,650	under				X		

incomes and expenses in surveyed area in 2010							household in \$ US - per head & poverty status					Income classes in Mio Kyat					
No	Name	Fm. size	Village	Occupation	est. ann. Inc. kyat	ann. exp. Kyat	income \$ US	exp. \$ US	surpl. \$ US	HH pov.inc. \$ US	status	≤ 0,9	>0.9 - 1.2	>1,2 - 1,5	>1,5- 2	>2 - 3	>3
41	Htay Lwin	4	Nyaungbin	fishermen	1,840,000	1,940,000	2,576.00	2,716.00	-140.00	1,825					X		
42	U Moe	4	Nyaungbin	fishermen	1,000,000	806,000	1,400.00	1,128.40	271.60	1,825	under		X				
43	Mg Mg	8	Nyaungbin	fishermen	1,200,000	1,185,000	1,680.00	1,659.00	21.00	3,650	under		X				
44	Tun Shwe	5	Nyaungbin	fishermen	1,250,000	1,186,000	1,750.00	1,660.40	89.60	2,281	under			X			
45	Sein Win	5	Nyaungbin	fishermen	1,150,000	903,000	1,610.00	1,264.20	345.80	2,281	under		X				
46	Thet Tin	3	Nyaungbin	fishermen	1,500,000	1,471,000	2,100.00	2,059.40	40.60	1,369				X			
47	Nay Lin	7	Nyaungbin	fishermen	1,510,000	1,460,000	2,114.00	2,044.00	70.00	3,194	under				X		
48	Than Win	7	Nyaungbin	fishermen	2,650,000	2,760,000	3,710.00	3,864.00	-154.00	3,194						x	
49	Tun Thin	4	Nyaungbin	fishermen	1,800,000	1,700,000	2,520.00	2,380.00	140.00	1,825					X		
50	Aung Than	8	Nyaungbin	Fish general worker	2,500,000	3,014,000	3,500.00	4,219.60	-719.60	3,650	under					x	
51	Zaw Win Tun	6	Nyaungbin	fishermen	2,400,000	2,830,000	3,360.00	3,962.00	-602.00	2,738						x	
52	Htay Win	4	Nyaungbin	fishermen	2,550,000	2,790,000	3,570.00	3,906.00	-336.00	1,825						X	
53	Kyaw Aye	3	Nyaungbin	Fish general worker	1,800,000	1,687,000	2,520.00	2,361.80	158.20	1,369					X		
54	Saw Naing	4	Nyaungbin	fishermen	2,000,000	1,920,000	2,800.00	2,688.00	112.00	1,825					X		
55	Nyunt Lwin	6	Nyaungbin	fishermen	1,900,000	1,840,000	2,660.00	2,576.00	84.00	2,738	under				X		
56	Aung Ko Win	6	Nyaungbin	fishermen	1,750,000	1,565,000	2,450.00	2,191.00	259.00	2,738	under				X		
57	Htay Win	6	Nyaungbin	fishermen	1,250,000	1,020,000	1,750.00	1,428.00	322.00	2,738	under			X			
58	Pho Than	4	Nyaungbin	fishermen	1,500,000	1,256,000	2,100.00	1,758.40	341.60	1,825				X			
59	Soe Lin	5	Nyaungbin	fishermen	1,840,000	1,465,000	2,576.00	2,051.00	525.00	2,281					X		
60	Kyaw Phe	10	Lonton	fish farmer	3,200,000	3,092,000	4,480.00	4,328.80	151.20	4,563	under						x

incomes and expenses in surveyed area in 2010							household in \$ US - per head & poverty status					Income classes in Mio Kyat					
No	Name	Fm. size	Village	Occupation	est. ann. Inc. kyat	ann. exp. Kyat	income \$ US	exp. \$ US	surpl. \$ US	HH pov.inc. \$ US	status	≤ 0,9	>0,9 - 1,2	>1,2 - 1,5	>1,5- 2	>2 - 3	>3
61	Myo Htet	10	Lonton	Fish general worker	2,100,000	1,892,000	2,940.00	2,648.80	291.20	4,563	under					x	
62	Tun Tun	3	Lonton	fishermen	1,800,000	1,596,000	2,520.00	2,234.40	285.60	1,369					X		
63	Than Tun	4	Lonton	fishermen	1,700,000	694,000	2,380.00	971.60	1,408.40	1,825					X		
64	Aung Aung	7	Lonton	fishermen	2,100,000	1,875,000	2,940.00	2,625.00	315.00	3,194	under					X	
65	Tin Aung San	5	Lonton	fishermen	2,000,000	1,580,000	2,800.00	2,212.00	588.00	2,281					X		
66	San Kyaw	4	Lonton	Fish general worker	1,300,000	984,000	1,820.00	1,377.60	442.40	1,825	under			X			
67	Win Bo	6	Lonton	fishermen	2,500,000	2,006,000	3,500.00	2,808.40	691.60	2,738						x	
68	Nay Myo Aung	3	Lonton	fishermen	1,600,000	980,000	2,240.00	1,372.00	868.00	1,369					X		
69	U Htwe Mg	8	Shweletpan	fish general worker	1,685,125	1,576,000	2,359.18	2,206.40	152.78	3,650	under				X		
70	U Thaug Nyunt	2	Shweletpan	fish general worker	1,700,000	1,627,000	2,380.00	2,277.80	102.20	913					X		
71	U Htay Maung	4	Shweletpan	fish general worker	1,350,000	623,000	1,890.00	872.20	1,017.80	1,825				X			
72	Daw Htoo	10	Shweletpan	farmer general worker	1,916,000	1,848,000	2,682.40	2,587.20	95.20	4,563	under				X		
73	A Mg Gyi	6	Hepa	fishermen	2,000,000	1,627,500	2,800.00	2,278.50	521.50	2,738					X		
74	Myo Naing	4	Hepa	Fish general worker	900,000	599,900	1,260.00	839.86	420.14	1,825	under	X					
75	Ma Mya htwe	6	Hepa	fish farmer	1,000,000	715,700	1,400.00	1,001.98	398.02	2,738	under		X				
76	Ko Than Tun Oo	4	Hepa	Fish general worker	1,365,000	845,000	1,911.00	1,183.00	728.00	1,825				X			
77	Ko Tun Tun	4	Hepa	fishermen	1,100,000	797,000	1,540.00	1,115.80	424.20	1,825	under		X				
78	Ko Aye Ko	5	Hepa	Fish general worker	1,050,000	854,000	1,470.00	1,195.60	274.40	2,281	under		X				
79	Ko Myint San	3	Hepa	Fish general worker	1,400,000	928,500	1,960.00	1,299.90	660.10	1,369				X			
80	Ko Moe Win	4	Hepa	fish farmer	1,000,000	686,020	1,400.00	960.43	439.57	1,825	under		X				

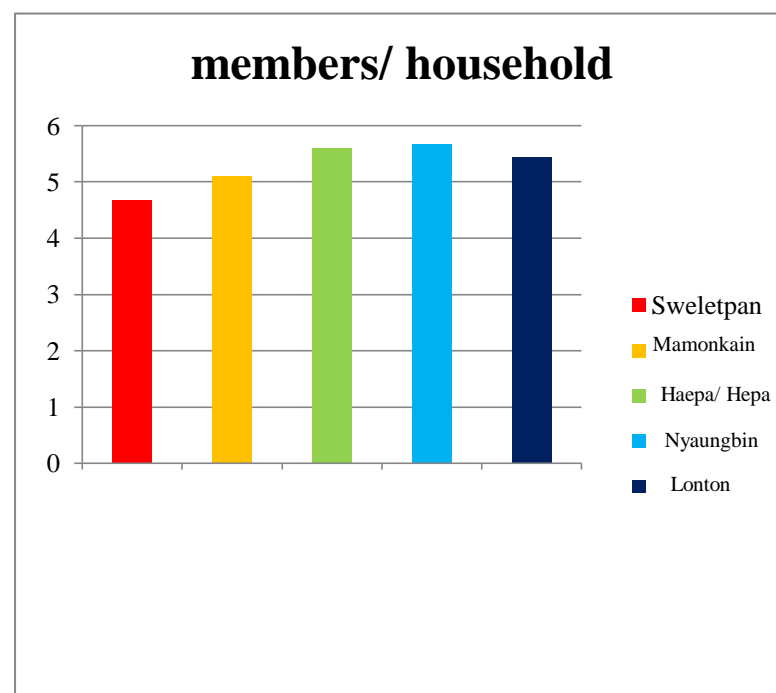
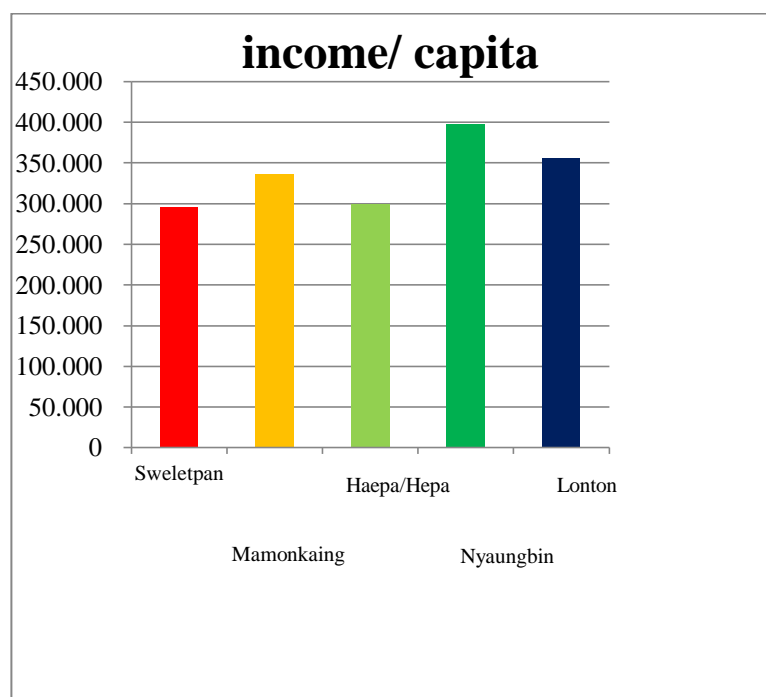
incomes and expenses in surveyed area in 2010							household in \$ US - per head & poverty status					Income classes in Mio Kyat					
No	Name	Fm.	Village	Occupation	est. ann.	ann. exp.	income	exp.	surpl.	HH	status	≤ 0,9	>0.9 - 1.2	>1,2 - 1,5	>1,5- 2	>2 - 3	>3
		size			Inc. kyat	Kyat				pov.inc . \$ US							
81	Ko Thet Sein	5	Hepa	fishermen & shop	1,623,500	1,293,500	2,272.90	1,810.90	462.00	2,281	under				X		
82	Ko Tin Tun	7	Hepa	fishermen & shop	1,547,900	1,307,900	2,167.06	1,831.06	336.00	3,194	under				X		
83	Ma Ya Min	6	Hepa	farmer general worker	2,244,000	1,405,600	3,141.60	1,967.84	1,173.76	2,738						x	
84	Moe moe San	7	Hepa	farmer & shop	4,260,900	2,869,300	5,965.26	4,017.02	1,948.24	3,194							x
85	Maung Pye	4	Lonton	fishermen	2,000,000	1,669,000	2,800.00	2,336.60	463.40	1,825					X		
86	San Naing Win	3	Lonton	fishermen	1,925,000	1,150,500	2,695.00	1,610.70	1,084.30	1,369					X		
87	Kyaw Naing Win	4	Lonton	fishermen & shop	1,905,000	1,462,500	2,667.00	2,047.50	619.50	1,825					X		
88	Daw Chaw	5	Lonton	farmer & shop	2,920,000	2,205,000	4,088.00	3,087.00	1,001.00	2,281						x	
89	Mat Naw	5	Lonton	farmer general worker	848,800	594,000	1,188.32	831.60	356.72	2,281	under	X					
90	Daw Toe Sein	10	Lonton	farmer & shop	1,503,000	1,186,500	2,104.20	1,661.10	443.10	4,563	under				X		
91	U Wai Moe Tun	3	Lonton	other	1,920,000	1,002,500	2,688.00	1,403.50	1,284.50	1,369					X		
92	Daw Si Si Naing	7	Lonton	farmer general worker	1,557,100	2,214,000	2,179.94	3,099.60	-919.66	3,194	under				X		
93	U Nay Win	5	Lonton	farmer & shop	2,012,000	1,076,500	2,816.80	1,507.10	1,309.70	2,281						x	
94	U San Shwe	9	Nyaungbi n	self employment	4,508,000	2,408,000	6,311.20	3,371.20	2,940.00	4,106							x
95	Ah Yin	7	Nyaungbi n	farmer & shop	2,015,000	1,695,000	2,821.00	2,373.00	448.00	3,194	under					X	
96	Aung Kyaw Myint	6	Nyaungbi n	self employment	1,390,000	1,373,200	1,946.00	1,922.48	23.52	2,738	under			X			
97	Kyaw San Win	8	Nyaungbi n	farmer & shop	5,790,000	3,362,004	8,106.00	4,706.81	3,399.19	3,650							x
98	Daw Khin Nyo	9	Nyaungbi n	self employment	7,350,000	3,669,000	10,290.00	5,136.60	5,153.40	4,106							x
99	U Soe Win	3	Nyaungbi n	self employment	1,460,000	1,435,000	2,044.00	2,009.00	35.00	1,369				X			
100	Ko Thet Zaw	4	Nyaungbi n	self employment	3,000,000	1,560,000	4,200.00	2,184.00	2,016.00	1,825						X	

Appendix VI. Per capita income and average household members by village

Sweletpan		Mamonkaing		Hepa		Nyaungbin		Lonton	
income*	members**	income*	members**	income*	members**	income*	members**	income*	members**
(Kyat)		(Kyat)		(Kyat)		(Kyat)			
295,418	4.68	335,921	5.1	299,607	5.6	397,405	5.67	356,030	5.44

* income per household member

** members per household



Note: income per capital 50.000 means 50,000 kyats and so on...

Appendix VI a. Economy breakdown by village in 2010 Shweletpan

		sample size	total Income	av.HH Income
			(annual)	(annual)
			Kyat	Kyat
total no. of households	97			
total no. of inhabitants:	337	26.41%		
interviewed:				
household(s)	19		26,292,249.0	1,383,802.6
inhabitant(s)	89			295,418.5
av. Inhab. / household	4.68			

av. Inhab. = average inhabitant

no. Households per income class (Mio Kyat)					
class 1	class 2	class 3	class 4	class 5	class6
≤ 0,9	>0,9 to 1,2	>1,2 to 1,5	>1,5 to 2	>2 to 3	> 3
0	5	9	5	0	0
	(3f,1fw,1ff)	(6f,2fw,1ff)	(1f,3fw,1faw)		

legend:

- f = fisherman
- fw= fish general worker
- fs= fisher plus shop
- ff= fishfarmer
- faw= farm general worker
- fas= farmer plus shop
- se= self employed

Notes:

The common **international poverty line** has in the past been roughly \$1 a day. (Sachs, Jeffrey D. The End of Poverty 2005).

In 2008, the World Bank came out with a revised figure of \$1.25 at 2005 purchasing-power parity (PPP).[The World Bank Economic Review, 23, 2, 2009, pp. 163-184]

Converted into kyat (1 US \$= 715kyat) and calculated per year (365 days) - kyat per inhabitant 326,219

Findings:

The average income of inhabitants of Sweletpan is almost 10% below the world bank poverty line (295,418kyat/ 326,219 kyat).

The no of members per household has stronger impact on poverty than the absolute household income (appendix v)

Actually 47.36% of all households of Shweletpan (9) have high enough incomes to excess the poverty line for their members. (appendix v)

No Swetlapan household incomes fall in the higher categories 2to 3 mio or above 3 mio kyat.

No distinct income correlation to occupation can be detected.

All households earn more than they spend. The annual saving amounts in 2010 were between US \$ 50 to 1000. (appendix v, surplus)

Appendix VI b. Economy breakdown by village in 2010 Mamonkaing

		sample size	total Income	av.HH Income
			(annual)	(annual)
			Kyat	Kyat
total no. of households	280			
total no. of inhabitants:	1878	3.83%		
interviewed:				
household(s)	14		24,186,300.0	1,727,592.9
inhabitant(s)	72			335,920.8
av. Inhab. / household	5.1			

no. Households per income class (Mio Kyat)					
class 1	class 2	class 3	class 4	class 5	class6
≤ 0,9 mio	>0,9 to 1,2	>1,2 to 1,5	>1,5 to 2	>2 to 3	> 3
0	2	3	6	3	0
	(1fs,1fw)	(3fw)	(2f,3fw,1fs)	(2f,1ff,)	

legend: f = fisherman
 fw= fish general worker
 fs= fisher plus shop
 ff= fishfarmer
 faw= farm general worker
 fas= farmer plus shop
 se= self employed

Notes:

The common **international poverty line** has in the past been roughly \$1 a day. (Sachs, Jeffrey D. The End of Poverty 2005)

In 2008, the World Bank came out with a revised figure of \$1.25 at 2005 purchasing-power parity (PPP).[The World Bank Economic Review, 23, 2, 2009, pp. 163-184]

Converted into kyat (1 US \$= 715 kyat) and calculated per year (365 days) - kyat per inhabitant 326,219

Findings: (assuming the low % of total population interviewed, can be utilized to deliver meaningful results)

The average income of inhabitants of Mamonkaing is slightly above the world bank poverty line (335,920 kyat/ 326,219 kyat).

The higher no of members per households as compared to Sweletpan results in slightly more poor households, although the incomes are significantly higher

Actually 50% of all households of Mamonkaing (7) have high enough incomes to excess the poverty line for their members.
 (appendix v)

The average income per household is almost 25% above that of the Sweletpan households

Two Mamonkaing households with 7 members and 2.2 mio kyat income and with 5 members and 2 mio kyat income respectively had higher expenditures than income

No distinct income correlation to occupation can be detected.

The annual saving amounts in 2010 except for the 2 deficit households were between US \$ 14 to 536. (appendix v)

Appendix VI c. Economy breakdown by village in 2010 Hepa

		sample size	total Income	av.HH Income
			(annual)	(annual)
			Kyat	Kyat
total no. of households	172			
total no. of inhabitants:	1015	12.22%		
interviewed:				
household(s)	22		37,151,300.0	1,688,695.5
inhabitant(s)	124			299,607.3
av. Inhab. / household	5.6			

no. Households per income class (Mio Kyat)					
class 1	class 2	class 3	class 4	class 5	class6
≤ 0,9 mio	>0,9 to 1,2	>1,2 to 1,5	>1,5 to 2	>2 to 3	> 3
1	5	5	7	3	1
1fw	2f,1fw,2ff	1fs,4fw	(2f,2fw,3fs,)	1f,1fw,1faw	1fas

legend:

- f = fisherman
- fw= fish general worker
- fs= fisher plus shop
- ff= fishfarmer
- faw= farm general worker
- fas= farmer plus shop
- se= self employed

Notes:

The common **international poverty line** has in the past been roughly \$1 a day. (Sachs, Jeffrey D. The End of Poverty 2005)

In 2008, the World Bank came out with a revised figure of \$1.25 at 2005 purchasing-power parity (PPP).[The World Bank Economic Review, 23, 2, 2009, pp. 163-184]

Converted into Kyat (1 US \$= 715 kyat) and calculated per year (365 days) - kyat per inhabitant 326,219

Findings:

The average income of inhabitants of Hepa (299,607 kyat) is about the same as in Sweletpan, about 8% below the world bank poverty line (299,607 kyat/ 326,219 kyat). Hepa households have a high average family member number (5.6)

Actually 45.45% of all households of Hepa (10) have high enough incomes to excess the poverty line for their members. (appendix v)

The average income per household (1,688,695 Kyat) is approximately 22% above that of the Sweletpan households

One Hepa household with 7 members and 2.4 mio kyat income had slightly higher expenditures than income (US\$ 98 -kyat 70,560)

No distinct income correlation to occupation can be detected.

The annual saving amounts in 2010 except for the1 deficit household were between US \$ 14 to 1,948. (appendix v, surplus)

Appendix VI d. Economy breakdown by village in 2010 Nyaungbin

		sample size	total Income	av. HH Income
			(annual)	(annual)
			Kyat	Kyat
total no. of households	428			
total no. of inhabitants:	2216	6.90%		
interviewed:				
household(s)	27		60,803,000.0	2,251,963.0
inhabitant(s)	153			397,405.2
av. Inhab. / household	5.67			

no. Households per income class (Mio Kyat)					
class 1	class 2	class 3	class 4	class 5	class6
≤ 0,9	>0,9 to 1,2	>1,2 to 1,5	>1,5 to 2	>2 to 3	> 3
0	3	6	9	6	3
	3f	4f,2se	7f,1fs,1fw	3f,1fw,1fas,1se	1fas,2se

legend:

- f = fisherman
- fw= fish general worker
- fs= fisher plus shop
- ff= fishfarmer
- faw= farm general worker
- fas= farmer plus shop
- se= self employed

Notes:

The common **international poverty line** has in the past been roughly \$1 a day. (Sachs, Jeffrey D. The End of Poverty 2005)

In 2008, the World Bank came out with a revised figure of \$1.25 at 2005 purchasing-power parity (PPP).[The World Bank Economic Review, 23, 2, 2009, pp. 163-184]

Converted into Kyat (1 US \$= 715 kyat) and calculated per year (365 days) - kyat per inhabitant 326,219

Findings:

The average income of inhabitants of Nyaungbin (397,405 kyat) is about 22% above the world bank poverty line (397,405 kyat/ 326,219 kyat).

Nyaungbin households have about the same average family member number(5.67) than Hepa households

Despite the high level of household incomes, only 55.56% of households earn more than the individual's poverty line level, due to high member numbers (appendix v)

The average income per household (2,251,963Kyat) is approximately 35% above that of the lowest (Sweletpan) households

5 of the Nyaungbin Households had higher expenses than incomes, 3 of them significantly (= > 10% above income).

No distinct income correlation to occupation can be detected, even though self- employed contributed over proportional to the village average income.

The annual saving amounts in 2010 were between US \$ 21to >5000. (appendix v, surplus)

Appendix VI e. Economy breakdown by village in 2010 Lonton

		sample size	total Income	aver. Income
			(annual)	(annual)
			Kyat	Kyat
total no. of households	229			
total no. of inhabitants:	1434	6.83%		
interviewed:				
household(s)	18		34,890,900.0	1,938,383.3
inhabitant(s)	98			356,029.6
av. Inhab. / household	5.44			

no. Households per income class (Mio Kyat)					
class 1	class 2	class 3	class 4	class 5	class6
≤ 0,9	>0,9 to 1,2	>1,2 to 1,5	>1,5 to 2	>2 to 3	> 3
1	0	1	10	5	1
1faw		1fw	(6f,1fs,1fas,1faw,1o)	2f, 1fw,2fas	1ff

legend:

- f = fisherman
- fw= fish general worker
- fs= fisher plus shop
- ff= fish farmer
- faw= farm general worker
- fas= farmer plus shop
- se= self employed
- o= other

Notes:

The common **international poverty line** has in the past been roughly \$1 a day. (Sachs, Jeffrey D. The End of Poverty 2005)

In 2008, the World Bank came out with a revised figure of \$1.25 at 2005 purchasing-power parity (PPP).[The World Bank Economic Review, 23, 2, 2009, pp. 163-184]

Converted into kyat (1 US \$= 715 kyat) and calculated per year (365 days) - kyat per inhabitant 326,219

Findings:

The average income of inhabitants of Lonton (356,029 kyat) is 9% above the world bank poverty line (356,029kyat / 326,219 kyat).

Lonton households have an average household member number of 5.44.

Actually 61.11% (11) of all households in Lonton have high enough incomes to excess the poverty line for their members. (appendix v)

The average income per household (1,938,383 kyat) is approximately 40% above that of the lowest (Sweletpan) households

1 Lonton household has higher expenses than income (40%)

No distinct income correlation to occupation can be detected.

The annual saving amounts in 2010 except for the 1 deficit household were between US \$ 151 to 1408. (appendix v, surplus)

Appendix VII. Expenses in surveyed area in 2010

Expenses in surveyed area in 2010						expense classes by occupation					
No	Name	Fm · size	Village	Occupation	ann. exp. kyat	≤ 0,9	>0.9 - 1.2	>1,2 - 1,5	>1,5- 2	>2 - 3	>3
1	Chit Than	9	Shweletpan	Fish general worker	1,507,500				X		
2	Zayar	5	Shweletpan	fishermen	950,000		X				
3	Kyaw Kyaw	5	Shweletpan	Fish general worker	920,000		X				
4	Htun Win	4	Shweletpan	fishermen	1,020,000		X				
5	Maung Zaw	4	Shweletpan	fishermen	1,450,000			X			
6	Aung Naing Win	3	Shweletpan	fishermen	650,000	X					
7	Pho Pyar	6	Shweletpan	fish farmer	1,090,000		X				
8	Kyaw Myint	5	Shweletpan	Fish general worker	1,290,000			X			
9	Pho Chin	4	Shweletpan	fishermen	851,000	X					
10	Zaw Khaing	4	Shweletpan	fishermen	850,000	X					
11	San Lin	3	Shweletpan	fishermen	930,000		X				
12	Min Zaw Oo	2	Shweletpan	fishermen	1,204,000			X			
13	Chit San Mg	3	Shweletpan	fishermen	735,000	X					
14	Htun Htun Naing	3	Shweletpan	fishermen	792,000	X					
15	Aung Myint Naing	5	Shweletpan	fish farmer	945,000		X				
16	Htay Lwin	4	Mamonkaing	fishermen & shop	1,800,000				X		
17	Ma Naing	5	Mamonkaing	fish general worker	1,290,000			X			
18	San Kyi	3	Mamonkaing	fishermen	1,680,000				X		
19	Myint Win	5	Mamonkaing	fish general worker	1,195,000		X				
20	Aung Maunn	5	Mamonkaing	fishermen	2,410,000					X	
21	Ba Wai	5	Mamonkaing	fish general worker	1,790,000				X		
22	Aung Lwin	8	Mamonkaing	Fish general worker	965,000		X				
23	Aung Aung	3	Mamonkaing	Fish general worker	880,000	X					
24	Tin Soe	4	Mamonkaing	fishermen & shop	899,000	X					
25	Win Maung	7	Mamonkaing	fishermen	2,470,000					X	
26	Soe Naing	6	Mamonkaing	fish famer	1,730,000				X		
27	Pho Si	5	Mamonkaing	Fish general worker	940,000		X				
28	Pho Si	5	Mamonkaing	Fish general worker	2,100,000					X	
29	Aung Than	7	Mamonkaing	fishermen	1,600,000				X		
30	Thein Aung	6	Hepa	fish general worker	1,090,000		X				
31	Min Yi	5	Hepa	Fish general worker	1,600,000				X		
32	Than Kyaw	8	Hepa	fishermen	1,725,000				X		

Expenses in surveyed area in 2010						expense classes by occupation					
No	Name	Fm. Size	Village	Occupation	ann. exp. kyat	≤ 0.9	0.9 < 1.2	1.2 < 1.5	1.5 < 2	2 < 3	3+
33	Kalar	5	Hepa	Fish general worker	1,405,000			X			
34	Ko Oo	8	Hepa	fishermen & shop	1,330,000			X			
35	Min Lwin	7	Hepa	Fish general worker	2,290,000					X	
36	Myo Chit	5	Hepa	fishermen & shop	1,510,000				X		
37	Win Hlaing	9	Hepa	Fish general worker	1,725,000				X		
38	Tin Nyunt	3	Hepa	fishermen	1,172,000		X				
39	Win Than	7	Hepa	fishermen	2,470,000					X	
40	Soe Myint Naing	8	Nyaungbin	fishermen & shop	1,820,000				X		
41	Htay Lwin	4	Nyaungbin	fishermen	1,940,000				X		
42	U Moe	4	Nyaungbin	fishermen	806,000	X					
43	Mg Mg	8	Nyaungbin	fishermen	1,185,000		X				
44	Tun Shwe	5	Nyaungbin	fishermen	1,186,000		X				
45	Sein Win	5	Nyaungbin	fishermen	903,000		X				
46	Thet Tin	3	Nyaungbin	fishermen	1,471,000			X			
47	Nay Lin	7	Nyaungbin	fishermen	1,460,000			X			
48	Than Win	7	Nyaungbin	fishermen	2,760,000					X	
49	Tun Thin	4	Nyaungbin	fishermen	1,700,000				X		
50	Aung Than	8	Nyaungbin	Fish general worker	3,014,000						X
51	Zaw Win Tun	6	Nyaungbin	fishermen	2,830,000					X	
52	Htay Win	4	Nyaungbin	fishermen	2,790,000					X	
53	Kyaw Aye	3	Nyaungbin	Fish general worker	1,687,000				X		
54	Saw Naing	4	Nyaungbin	fishermen	1,920,000				X		
55	Nyunt Lwin	6	Nyaungbin	fishermen	1,840,000				X		
56	Aung Ko Win	6	Nyaungbin	fishermen	1,565,000				X		
57	Htay Win	6	Nyaungbin	fishermen	1,020,000		X				
58	Pho Than	4	Nyaungbin	fishermen	1,256,000			X			
59	Soe Lin	5	Nyaungbin	fishermen	1,465,000			X			
60	Kyaw Phe	10	Lonton	fish farmer	3,092,000						X
61	Myo Htet	10	Lonton	Fish general worker	1,892,000				X		
62	Tun Tun	3	Lonton	fishermen	1,596,000				X		
63	Than Tun	4	Lonton	fishermen	694,000	X					
64	Aung Aung	7	Lonton	fishermen	1,875,000				X		
65	Tin Aung San	5	Lonton	fishermen	1,580,000				X		
66	San Kyaw	4	Lonton	Fish general worker	984,000		X				
67	Win Bo	6	Lonton	fishermen	2,006,000					X	

Expenses in surveyed area in 2010						expense classes by occupation					
No	Name	Fm. size	Village	Occupation	ann. exp. kyat	≤ 0.9	0.9 < 1.2	1.2 < 1.5	1.5 < 2	2 < 3	3 +.
68	Nay Myo Aung	3	Lonton	fishermen	980,000		X				
69	U Htwe Mg	8	Shweletpan	fish general worker	1,576,000				X		
70	U Thaung Nyunt	2	Shweletpan	fish general worker	1,627,000				X		
71	U Htay Maung	4	Shweletpan	fish general worker	623,000	X					
72	Daw Htoo	10	Shweletpan	farmer general worker	1,848,000				X		
73	A Mg Gyi	6	Hepa	fishermen	1,627,500				X		
74	Myo Naing	4	Hepa	Fish general worker	599,900	X					
75	Ma Mya htwe	6	Hepa	fish farmer	715,700	X					
76	Ko Than Tun Oo	4	Hepa	Fish general worker	845,000	X					
77	Ko Tun Tun	4	Hepa	fishermen	797,000	X					
78	Ko Aye Ko	5	Hepa	Fish general worker	854,000	X					
79	Ko Myint San	3	Hepa	Fish general worker	928,500		X				
80	Ko Moe Win	4	Hepa	fish farmer	686,020	X					
81	Ko Thet Sein	5	Hepa	fishermen & shop	1,293,500			X			
82	Ko Tin Tun	7	Hepa	fishermen & shop	1,307,900			X			
83	Ma Ya Min	6	Hepa	farmer general worker	1,405,600			X			
84	Moe moe San	7	Hepa	farmer & shop	2,869,300					X	
85	Maung Pye	4	Lonton	fishermen	1,669,000				X		
86	San Naing Win	3	Lonton	fishermen	1,150,500		X				
87	Kyaw Naing Win	4	Lonton	fishermen & shop	1,462,500			X			
88	Daw Chaw	5	Lonton	farmer & shop	2,205,000					X	
89	Mat Naw	5	Lonton	farmer general worker	594,000	X					
90	Daw Toe Sein	10	Lonton	farmer & shop	1,186,500		X				
91	U Wai Moe Tun	3	Lonton	other	1,002,500		X				
92	Daw Si Si Naing	7	Lonton	farmer general worker	2,214,000					X	
93	U Nay Win	5	Lonton	farmer & shop	1,076,500		X				
94	U San Shwe	9	Nyaungbin	self employment	2,408,000					X	
95	Ah Yin	7	Nyaungbin	farmer & shop	1,695,000				X		
96	Aung Kyaw Myint	6	Nyaungbin	self employment	1,373,200			X			
97	Kyaw San Win	8	Nyaungbin	farmer & shop	3,362,004						X
98	Daw Khin Nyo	9	Nyaungbin	self employment	3,669,000						X
99	U Soe Win	3	Nyaungbin	self employment	1,435,000			X			
100	Ko Thet Zaw	4	Nyaungbin	self employment	1,560,000				X		