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CAN THE RAINFOREST OF PUERTO PRINCESA BE PRESERVED FROM UNSUSTAINABLE DEVELOPMENT?

Forest Conversion (Kaingin) and Charcoal Collection Environmental Impact Assessment in North West Puerto Princesa, Palawan, Philippines within the period 2002-2012

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Forest Conversion (Kaingin) and Charcoal Collection Environmental Impact Assessment In North West Puerto Princesa, Palawan, Philippines

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Abstract:

Within the Philippines Forest Conversion (Kaingin) and charcoal production are still two majors problems which threaten the last remaining patches of rainforest that have survived the destructive patterns of the last 50 years of intensive large-scale forestry management. In particular the island of Palawan is a safe haven , because development only started since the last 30 years due to its isolation. With a rainforest cover of at least 40% in the total Region this island is also called '' The Last Frontier''*(Bagadion, 2008)*. Although it seems that this region has a never ending supply of natural resources also on this island the environmental threats can be noticed on an increasing scale. The municipality of Puerto Princesa has the largest stretch of rainforest in Palawan and is motivated to protect this natural beauty.

In particular charcoal production and forest conversion are influential causes of the decline in this region which the local government tries to tackle. But before effective policies can be developed, research needs to be done on the present situation of the problems. For this research the North-West site of Puerto Princesa was chosen as study site to determine the impact of these two problems. This was done by the performance of Socio-Economic interviews with local residents concerning forest conversion, Charcoal Production and Charcoal Consumption in the North-West of Puerto Princesa. The results reveal that Kaingin is practiced by 18.6% *(N=118)* and Charcoal consumption by 46% *(N=112)* of the whole sample population. For charcoal production no sample population was possible, however 15 people were eventually interviewed which indicates that charcoal production was done in the study area. Respondents stated that although Kaingin and charcoal production were still done the numbers have declined in comparison with 30 years ago. The area was divided in three different zones and it seemed that the main Kaingin and Charcoal activity occurred in the Core/Buffer Zones where human activity should be minimized or averted.

This outcome was affirmed by the Kruskal-Wallis test that indicated that the difference for Kaingin *(P=0.000)* between the Multiple use Zone and the Core and Buffer Zone was below a P-value of 0.05 which means that the *Null Hypothesis* (Which assumes in this case that the three zones were similar) was rejected. A similar result was found for the charcoal consumption *(P=0.244)* where the P-value was below the 0.05 value.

Although these practices seem to have declined they still exist, in particular due to the fact that poverty was still a common fact within the more remote areas (The Core and Buffer Zone). Therefore this research tried to provide sustainable alternatives for the livelihood of the local residents in the hope that these practices would be adopted more on a widely scale and could serve as a good example for larger conflict areas in other parts of the Philippines.

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List of Abbreviations/Definitions:

AFMA-The Agricultural and Modernization Act
Barangay-The Smallest Administrative Division in the Philippines
DENR- Department of Environment and Natural Resources
CADC-Certificate of Ancestral Domain Claim
CCTA-Cabayugan Community Tourist Association
CHARMP-Cordillera Highland Agricultural Resource Management Project
ECAN-Environmentally Critical Areas Network
ELAC-Environmental Legal Assistance Centre
ERDB-Ecosystems Research and Development Bureau
GHG-Greenhouse Gases
FRDI-Forest Products Research and Development Institute
GIS-Geographic Information System
Kaingin-Agricultural Technique with Slash and Burn Practices in a rainforest to create fields
NREL-National Renewable Energy Laboratory
NCIP-National Commission on Indigenous People
NPAAAD-Network of Protected Areas for Agriculture and Agro-Industrial Development
NTFP-Non Timber Forest Product
PCSD-Palawan Council for Sustainable Development
PD-Protected Areas
PHP-Philippine Peso
PPSRNP-Puerto Princesa Subterranean River National Park
PTFPP-Palawan Tropical Forestry Protection Programme
RRA-Rural Rapid Appraisal
SEP-Strategic Environmental Plan
Sitio-Territorial Enclave which is part of a Barangay
Tagalog-Mother Language of the Philippines
TCTA-Tagabinet Community Tourism Association
UNESCO- United Nations Educational, Scientific and Cultural Organization

1. Introduction & Background

2.1 Country Profile

The Philippines was suffering, in similarity with many other developing countries, of a rapid decline of its natural resources. Since the 1950s much of the forest has disappeared many due to large-scale logging practices where massive clear cutting by professional timber companies was the norm *(Chokkalingam, 2006*). Since 1991 a logging ban has been introduced in the Philippines in old-growth or Primary Rainforest to prevent further degradation. However due to the fact that many Filipinos live under the poverty line many people were depended upon natural resources. This caused a further degradation of natural resources in the Philippines with two of the main causes *forest conversion (Kaingin*) and *charcoal collection.* One of the last areas with vast amount of rainforest is the Region of Palawan. Palawan was declared a biodiversity region since 1991 by UNESCO and the Biosphere Programme. In 1992 the Philippine legislature passed which was signed by the current president Corazon Aquino adopting the Strategic Environmental Plan (SEP) for Palawan. He also assigned the Palawan Council for Sustainable Development (PCSD) that would supervise the implementation of this strategy. The SEP included improvement in quality of life for the population of Palawan through the use of complementary activities of development and conservation that protect life support ecosystems and rehabilitate former exploited areas. The development encompasses different elements namely:

1. Ecological Viability where the physical and biological conditions of the natural resources are left intact.
2. Social Acceptability where the local people are fully committed, through participatory approach to support sustainable development.
3. Integrated Approach where all the problems are holistically viewed and tackled in a cooperative and efficient way by all associated stakeholders *(Ricardo, 1997).*

To implement the SEP the framework 'Environmentally Critical Areas Network' (ECAN) was formed . This framework is used as a tool to determine land use practices with zonation. The ECAN framework is divided in different zones namely:

- Core Zones: Designated areas free from any human activity (Palawan's sanctuaries and protected areas are included in these zones)
- Buffer use Zone: These areas encircle the core zones and form a buffer between human activity and fragile ecosystems. These buffers are divided into three segments: restricted zone, controlled zone and traditional use zones. Each of these different areas has another type of management and an increase in activities.
- Multiple/manipulative use Zone: Control & management is integrated with community based activities as agriculture, livestock herding, plantation management, logging practices.
- Coastal/Marine use Zone: Only found along the coastline this specific zone requisites a simplified management which is adapted to geographical characteristics, mature state & pattern of resource use by the local communities *(Ricardo, 1997.)*

Unfortunately even this pristine region (with its protected status and protection measures) was threatened by various problems which include (illegal) mining activities, slash and burn activities (Kaingin in Filipino), establishment Agriculture and livestock, illegal hunting/trade in wild animals, charcoal collection/logging practices and a large increase in tourism. These problems were very hard to tackle with the existing legal framework and management practices. This lack of reinforcement was being caused by misinterpreted delineation of ECAN zones which were confronted with; the present legal status of the province's land resources, a lack of environmental impact evaluation capacities, underestimation and maltreatment of the capabilities that local communities have on resource management, lack of enforcement in management within protected areas (only St Paul's National Park and St Ursula Island (has actual management) and environmental research/monitoring are neglected or are simply absent *(Ricardo, 1997).*

This report focused mainly on the threats that could be found in the municipality of Puerto Princesa which lies in the centre of the island 'Palawan'. The problems which occurred in the municipality can be divided into three major ones: Kaingin, illegal hunting/trade in wild animals and charcoal collection/logging of native wood. This report looks at the threats Kaingin and charcoal, collection which are the major problems for the municipalities existing rainforest.

1.2 Forest Conversion (Kaingin):

Forest Conversion is the process where forests are converted into agricultural or residential areas. In the Philippines this agricultural system is referred as ''Kaingin''. This term was used for the rest of the report instead of Forest Conversion, because the report goes in particular over this Philippine system of slash and burn. Kaingin is done by slash and burning techniques where the forest cover is burned and the remaining ash is used as a fertilizer for crop cultivation *(Lawrence, 1997)*. The main reasons for this process are a lack of livelihood resources, the increase in tourism which caused an influx of tourist-related companies in Palawan and eventually led to a migration of locals to areas which were still reasonable inaccessible but are now prone to deforestation *(Shively, 2001).*To prevent this deforestation Kaingin is considered forbidden (in forest lands) in the Philippines *(Arellano Law Foundation, Consulted on 30th August 2012*).
When looking at the preliminary literature research one article in particular revealed a gradual transition from forest cover into other forms of land use/cover as agricultural zones and urban development in the Northern Region (Cabayugan) of the Municipality of Puerto Princesa. The results indicated that during the period 1972-1989 ''4%'' of the rainforest cover was converted into agricultural land and 0.03 % was changed in other land use (urban expansion, erosion). The forest cover was 10899 in 1972 and changed into 10444 in 1989, 441 ha was changed into agricultural land and 4 hectares was converted into other land use. However from the period 1989-2005 only ''0.5% '' of the rainforest cover was converted into agricultural land and 0.07% into other land use. The forest cover was 10444 in 1989 and changed into 10388 in 2005, 48 ha was converted into agricultural land and 8 hectares was converted into other land use. The decrease between the different periods was caused by a shift from coercive conservation management into an integral community-based management and new policy schemes *(Palao, 2010).*
This coercive management was the common sense in Palawan in the 1970s. This was in particular a common practice in the protected areas as the Subterranean River National Park (PPSRNP) in North-West- Puerto Princesa which revealed that the local government and the park management repressed other type of land uses as swidden cultivation, which is part of the livelihood of the Tagbanua and the Batak tribes.
Yet this hard performance ultimately led to more conflicts and dissatisfaction whereby land management was more difficult to regulate than with an participatory approach which is nowadays a more common practice in Palawan *(Dressler, 2005).*

Despite the shift towards community-based management and that the Kaingin activity has decreased, many problems still occur, especially outside the protected areas as the PPSRNP. Natural Resources were still more and more transformed into a human dominated landscape and conflicts would arise more often between nature and humans because natural buffers are disappearing *(Campbell, 2001*). This stressed the need of a community based approach in whole Puerto Princesa where GIS can serve as a basic tool to identify changes and opportunities on landscape level *(Braber, 2011).*
Especially in the Philippines where land is the most important resource, GIS is necessary for accessing various land concerns as; soil erosion, upland utilization and property values *(Maling, 1988)* where the local communities can be involved *(Hoeven, 2007)*. During the community based approach various alternatives may provide a descent option to increase livelihood conditions of local communities and at the same time prevent further deforestation of Palawan. A previous conducted research in the upland areas of North East Palawan stated the following options; security of land tenure, increase production of the existing agricultural areas & effective agroforestry systems which may prove to be successful when implemented in the nearby future in Puerto Princesa *(Ortega-Espaldon, 1990).*

1.3 Charcoal collection:

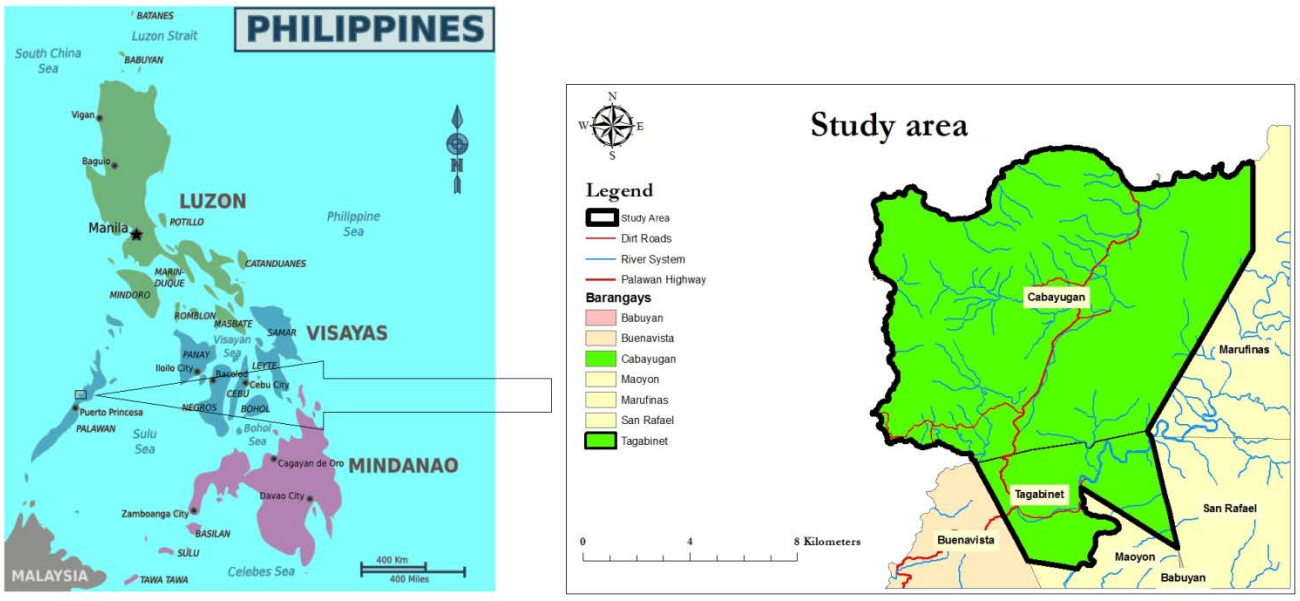
This is the process where wood is collected in the forests and is partially burned to obtain black carbon matter which is used as fuel for home consumption or traded on the local market. Charcoal collection in the municipality of Puerto Princesa was still a common practice, even found in protected areas. Different trees are favoured for this charcoal production. The process includes charcoal makers which burn different types of wood with variable volumes in particular burning sites. Normally the whole tree was being cut into small parts which are used for the charcoal production. These trees are then brought to a burning site where they were slowly being burned to make the charcoal *(Remedio 2009); (Hubert, 2009).* Charcoal sellers which sell their products in ''Sari-Sari stores'' and consumers usually of local origin. Charcoal collection has negative implications for the nearby environment e.g. direct consequences as deforestation and indirect consequences as a decrease in water (quality), biodiversity numbers and will ultimately lead to (soil) erosion *(Bascar, 2008).* In the Philippines charcoal collection (in forest land) is therefore forbidden in contrary with the consumption of charcoal that is allowed (*Arellano Law Foundation, Consulted on 30th August 2012).*
Different solutions could be addressed to prevent charcoal collection. Looking at a research that was conducted in Tanzania alternatives could be; the use of different stove types, the transition into alternative fuels (waste materials, Kerosene and Bio gas) to even alternative energy sources (hydropower) *(Klompberg, 2010).* These solutions would be interesting to perform by a public participating program where local LGU's Barangay officials and other concerned organizations help to support this establishment *(Bascar, 2004).* Nevertheless additional research is necessary beforehand if these alternatives are suitable for the inhabitants of Palawan.
The use of a participatory research as the Rural Rapid Appraisal (RRA) seems to be very promising for the job, because the field survey can be done in a far shorter amount of time, using fewer resources and is done on a more personal level (which is more beneficial to the respondents) then using an intrusive questionnaire for an academic performed survey *(Inglis, 1991).*

1.4 Study area

To conduct the research a suitable area was chosen where most of the problems occur.
The study area is located in the municipality of Puerto Princesa, in the Saint Paul Mountain Range, 80 kilometres North West of the city of Puerto Princesa in the centre part of Palawan Island *(See Figure 1)* and consists of the Barangays (village areas): Cabayugan and Tagabinet.
The area is bounded by the South-Chinese Sea in the West and the Sulu Sea in the East.
The area is comprised of various landscapes from flat plains (in the lowlands) and rolling hinterlands to hills and mountain peaks with the magnificent karst limestone mountain landscape of the St. Paul Range which is aligned north-south along the western coast of Palawan.
The area has a tropical climate with rainfall averages between 2,000 and 3,000 mm with the wet season starting in May until October while the dry season begins in November and end in April.
The average temperature year-round is about 27° C.
The area has a rich biodiversity which comprises of lowland, karst, limestone and cloud rainforest interspersed with savannah *(Protected Areas and Wildlife Bureau, 1992).*
In the North East part the dominated threats include tourism and related effects (Kaingin/agricultural expansion) while on the other hand in the North West part the main problems are tribal communities (Batak, Tagbanua tribes) and additional effects (charcoal making, illegal logging).The areas are divided into different villages (regarded as Barangays) with their own background, cultural perceptions and problems.
GIS maps are available of the study area with the selection been done into three different ECAN zones:

- Core Zone: This zone covers the whole Puerto Princesa Subterranean River National Park and most of the terrain belongs to the St. Pauls Mountain Range.
- Buffer Zone: A small amount of land falls under this zone in the study area and serves as a buffer between the Core and the Multiple use Zone. Within the study area this Zone is subdivided into the Controlled, Restrictive and Traditional use Zones.
- Multiple use Zone: Within the study area most urbanized centres are found in this Zone. Most of the area is located in the lowland and with the Palawan Highway found in the centre of the Multiple use Zone *(See Appendix E).*

Figure 1: Study Area: North West Puerto Princesa with the Underground River National Park (PPSRNP)



2. Research Focus

2.1 Study Objectives

This study was undertaken through a project of the Centre for Sustainability in collaboration with the city government of Puerto Princesa. This Philippine NGO collaborates with the local government of Puerto Princesa to preserve the remaining rainforest of the municipality. This research has increased understanding about two of these problems which pose a threat for the rainforest. The following objectives had therefore been identified:

Determine the current status and impact of Kaingin and Charcoal Collection on the rainforest cover of the Barangays of Cabayugan and Tagabinet in North-West Puerto Princesa.

2.2 Research questions

2.2.1 Main Question:

What is the current status and impact of Kaingin and Charcoal Collection on the rainforest cover of the Barangays Cabayugan and Tagabinet in North-West Puerto Princesa?

2.2.2 Sub Questions:

1. In what amount has the forest cover changed in area in the period 2002-2012 in relation with the other land uses in the North West of Puerto Princesa?
    a) What kind of land use types can be found in the study area?
    b) Which stakeholders are involved in the land use?
    c) How many hectares of Kaingin can be found in the study area?
    d) Are other land use types of influence on the amount of Kaingin?
    e) Are there differences in Kaingin intensity between the Babuyan River, main road and the border of the St. Paul Subterranean River National Park?
    f) What are the consequences of Kaingin on the rainforest cover of the study area?
    g) Which kind of solutions can be addressed to resolve the Kaingin consequences?

2. What is the impact of charcoal production on the forest cover in North West Puerto Princesa?
    a) What is the main source for charcoal?
    b) Who are involved in the charcoal production?
    c) How many kilograms of charcoal is produced in the study area?
    d) What are the consequences of the charcoal production on the rainforest cover of the study area?
    e) Which kinds of solutions can be addressed to resolve the impact of charcoal collection?
    f) Who are involved in the charcoal consumption?
    g) How many kilograms of charcoal is consumed per year?
    h) Are there differences in collection intensity between the river, main road and the border of the St. Paul Subterranean River National Park?
    i) What are the consequences of the charcoal production on the rainforest cover of the study area?
    j) Which kinds of solutions can be addressed to resolve the impact of charcoal collection?

Table 1: The relation between the (sub) questions and the methods within this research

(Sub) Questions	**Methods**
1ab (Kaingin stakeholders, Kaingin amount in hectares)	4.3 Kaingin interviews
1c (Kaingin amount per zone)	4.3 Kaingin interviews
1de (Kaingin consequences, solutions)	4.3 Kaingin interviews, 4.5 Additional Literature Research
2abc (Charcoal production source, stakeholders and production rates)	4.4.1, 4.4.3 Charcoal production interviews, burning sites field surveys
2de (Charcoal production consequences, solutions)	4.4.1 Charcoal production interviews, 4.5 Additional Literature Research
2ef (charcoal consumption)	4.4.2 Charcoal consumption interviews
2g (charcoal consumption per zone)	4.4.2 Charcoal consumption interviews
2hij (Charcoal Consumption consequences, solutions)	4.4.2 Charcoal consumption interviews, 4.5 Additional Literature Research

4. Materials and Methods

4.1 Preliminary literature search

A literature search was performed to gather relevant background information of the study area (geology, species composition, zonation & buffering, policy schemes, current management practices) and the two identified threats (problems identification, stakeholders involved, cause-effect relationship methods on how to examine the threats impact). Furthermore, the methodology was prepared that includes; the interviews, on-ground surveys and the GIS data processing and modelling.

4.2 Pre-Assessment

A pre-assessment was undertaken to determine what the specific locations of the different communities are around North-West Puerto Princesa and the number of people that live in the area. This data was necessary to determine how many inhabitants needed to be interviewed for the research. Five people were consulted per village to determine the total number of people Village Area. Afterwards an average was calculated from the answers and was used as a final score for the population density. For the logistic planning information about the road system the area was investigated to determine if all the communities were accessible for interviews.
The ECAN zones were used as a framework during the research to analyze differences in the study area and to evaluate if the implementation of the ECAN framework had the positive management on the study area. When looking at the ECAN zonation *(See Appendix E)*, the map has 5 zones, but 3 of these zones were very similar in management (Traditional, Controlled and Restricted zone) and are in fact a subdivision of the Buffer Zone. For the research a convenient approach was chosen; therefore the original ECAN Zone Map was simplified into the three major zones e.g.: The Multiple use Zone, The Buffer Zone and the Core Zone *(See Appendix F)*.

4.3 Forest Conversion (Kaingin)

4.3.1 Socio-Economic interviews with the local communities

A pre interview was tested to decide whether the questionnaire had to be revised to gain better results from the interviews with the different communities. A simple random sample method was chosen with a sample size of ~ 10% of each village population (118 respondents out of 869 Households in the entire study area). With this sample size a Confidence Level of 80%, 5% Margin of Error and a 50% Degree of Variability was possible which doesn't provide a high level of reliability, but serves as a reasonable guideline for assumptions *(Journalinks, Consulted on 25th August 2012); (*PennState College of Agricultural Science*, Consulted on 25th August 2012).* This method was chosen because villages vary extremely in population size and in some of the villages official demographic data was not available.
Interviews with local people were conducted to determine what the main reasons are for Kaingin, what kind of method they use for forest conversion and in what amounts the Kaingin takes place according to the locals. Furthermore, questions are included to ask for their opinion concerning the impact on the environment and possible solutions that might be suitable to solve these issues *(See Appendix A).*

Land use identification:
To determine the impact of Kaingin on the study area at first a classification of the different land uses was made to get a good overview of the distribution and intensity of the land use in the study area. One question with land use type and a question with the Number of hectares per land use type was included in the questionnaire to gather data on this topic *(See Appendix A)*. After data processing the answers have been categorized in different land uses per village. Likewise the amount of areas was summed per village/land use. Next the totals per village were summed per zone and divided by the total number of respondents to calculate the average per zone. The last step was to put the data into one table for comparison of the different zones. In addition two maps were designed to visualize the distribution pattern in the study area; one map for Kaingin per ECAN Zone and the other for the Kaingin per village.

Land use stakeholder Analysis:
Kaingin actors were distributed per zone, per frequency and per area. Respondents who rent a house or own a small bamboo hut are excluded from the calculation. The reason too exclude the bamboo hut owners is because the respondents did not replied in the interview about the sizes of their lots. The stakeholders were divided into three major groups; this was done because of two reasons. The first is that this division is easier to make comparisons and the second one is that each group has different total different habits concerning *Kaingin and Charcoal Collection* . The three major groups are comprised of; ''Migrants'', ''Indigenous Tribes'' and ''The Palawan Residents''. An average Number of respondents per group is given per each separate Zone

Comparison between Permanent Land and Kaingin:
To understand the complex relationship between the different Land uses and Kaingin a comparison was made with the most common Land use type (Permanent Land) and the Kaingin. Two important subjects were used for the comparison; the stakeholder groups and the monthly income *(See Appendix A)*. The stakeholder groups were divided in the three main groups and per group the amount of area was calculated for each separate zone. In addition a map was drawn of the stakeholders per village to display the distribution over the study area.
Firstly the total amount of area per village was counted and afterwards this count was summed per zone. To calculate the total Kaingin intensity per village the total Kaingin area per village was summed. Because sample size was based on the villages , sample sizes per zone varied, which resulted in a sample size range of 12.5-16%.
The formulas which were used for the village and zone calculation is as follow:

1) Total Kaingin area per village: Kaingin in area*N respondents per village

2) Total Kaingin area per village: N villages*Total Kaingin area per village

With the result the Average, Total and Standard Deviation per zone was then computed.
For the monthly income a different method was done. The respondents were divided into the Kaingin group and the Permanent Land Group and afterwards sorted per ECAN Zone. The total monthly income and area was summed per Group/ ECAN Zone and then divided by the total Number of respondents per Group/ECAN Zone.
All monthly incomes above 10.000 PHP were deleted from the analysis, because these numbers are extreme in value and could strongly influence the correlation coefficient in a negative way. Next a comparison was made between the amount of area/monthly income for the Kaingin and for the Permanent Land per separate zone.

Statistical Analysis:
The Kaingin intensity varies greatly across the study area and therefore to determine differences between the zones a comprehensible statistical test was chosen.
At first a normal distribution was made of each separate zone and secondly the appropriate test was chosen which suites the best analysis while looking at the distribution if a Skewness could be found. To determine if there would be a difference between Kaingin practitioners and other land use holders the test was done two times. The first time with the whole population (all the land owners included) and with the second test only with the Kaingin practitioners (who have Kaingin areas).

Problem analysis:
Because there are some serious consequences concerning Kaingin one question was about the impact on the surrounding environment *(See Appendix A)*. The answers were categorized per village and afterwards the problems were counted. The final step was to put the problems in a Frequency table where they were ranked from high to low occurrence.

4.4 Charcoal Collection

4.2.1 Charcoal Production interviews

A pre interview was tested to decide whether the questionnaire needed to be revised. This was done for the purpose of gaining better results from the interviews with the different villages. A snowball sample method was used to reach charcoal-makers in the study area. This non-probability method was chosen because charcoal production is an illegal practice within the Philippines and a random sample therefore would have taken too much time because people would be quite reluctant to be interviewed. Via the snowball sample method local residents were consulted about the awareness of charcoal production in the area. Via these trustworthy residents charcoal producers were then approached. Next their trust was then slowly gained to achieve that an interview would be possible.

A standardized questionnaire was used with specific questions that include; general demographic data, location of charcoal production, amount of charcoal production, sales locations e.g. *(See Appendix B)*. Although the data is used in the report, no statistics will be applied on the data. The reason is that the data is collected via a non-probability method and no sample size could be chosen for calculations because it is unclear how many charcoal producers are present in the study area. Therefore results of the data are only used to provide assumptions on charcoal production, but are not figures that can be interpreted as hard evidence.

Charcoal Production Resources:
To determine the forest resources used by the charcoal makers one question was included in the questionnaire *(See Appendix B).* The local name was written down and latterly the scientific name was added. Afterwards the number of trees per species was then counted per species and listed in a frequency table.

Charcoal Production Analysis:
To calculate the total charcoal production per village some steps had to be made; the variables production frequency (per month), sack amount per burning and average weight per sack were used for calculations *(See Appendix B)*. An average weight per sack (which had been calculated from the variable *''weight survey method'' was* used for the calculation, because the weight of a sack of charcoal varies extremely and local people were very uncertain about the amount of kg per sack.

Firstly the charcoal production per month was calculated, secondly the charcoal production per year was calculated and thirdly the average amount per household to compare the different villages. The following formulas were used for the charcoal consumption rate:

1) Charcoal production per month: sack amount per burning * weight per sack*production frequency per month *total charcoal makers
2) Charcoal production per year: sack amount per burning * weight per sack*production frequency per month *total charcoal makers*12
3) Charcoal production per household: Total charcoal production per village/number of charcoal producers

N.B.: Due to the fact that some respondents don't make charcoal year-round, but in the rainy season or during the dry season monthly production rates were multiplied with 0.5 to get the production of charcoal over a period of 6 months. To indicate on the map were each charcoal producers is located and what amount of charcoal he produces a map was made.

Problem Analysis:
To answer what kind of consequences could be found due to charcoal production this topic was included in the charcoal production interview *(See Appendix B)*. All data was processed in Microsoft Excel and was after that categorized by village. Each problem was counted separately and afterwards placed in a frequency table ranked from the highest occurrence towards the lowest occurrence.

4.4.2 Charcoal consumption interviews

A pre interview was tested to decide whether the questionnaire had to be revised to gain better results from the interviews with the different communities. A simple random sample method was chosen with a sample size of ~ 10% of each village population (112 respondents out of 869 people). With this sample size a Confidence Level of 75%, 5% Margin of Error and a 50% Degree of Variability is possible which doesn't provide a high level of reliability, but serves as a reasonable guideline for assumptions *(Journalinks, Consulted on 25th August 2012); (*PennState College of Agricultural Science*, Consulted on 25th August 2012).* This method was chosen because villages vary extremely in population sizes and of some of the villages official demographic data is not available.

In addition, the interviews was done to gather information on the reasons of charcoal collection which is collected in the adjacent forest nearby each village. *(Bhatt, 2003)*
To get information about charcoal buyer's key-informants were chosen who could help with the selection of viable respondents for the interview. The local villages/ settlements were visited to interview locals. The amount of people and the locations for the interview were selected during the pre-assessment. To quantify the data again a weight survey was conducted by using a spring balance. A standardized questionnaire was used with specific questions which include; which tree species are used for charcoal, how much charcoal is consumed, what is the price, buying locations *(See Appendix C).* The interviews were divided in two different forms; one interview for the charcoal producers and one interview for the charcoal buyers.
The interviews were done in 3 areas, the main argument for this is to compare the collected data between the sites. The areas which are used are the Buffer Zone (with Ancestral land of indigenous communities), Core zone (St. Paul Subterranean National Park) and the Multiple zone (with mostly tourist development and migrants).

Stakeholders analysis:
To identify who were involved in the charcoal consumption cycle two questions on this topic were included in the interviews. One question was about the profession of the charcoal-buyer, the other question was about the charcoal-supplier *(See Appendix C).*
Both questions were categorized and ranked in a frequency list. Firstly the buyers and the suppliers were identified in the different villages. Secondly each of the groups was summed. In addition a frequency table was made of the buyers and the suppliers.
In addition (to make it more spatial) for the charcoal buyers a bar graph was made were the Fuel Resource was compared with the number of respondents. This was done then for each separate zone.

Charcoal consumption analysis:
To calculate the total charcoal consumption per village a few variables were used; average weight per sack multiplied with the amount of sacks consumed per month *(See Appendix C)*. The average weight per sack was chosen for the same reason as with the charcoal production method (see paragraph 4.1). Firstly the monthly consumption was calculated, secondly the annual production. For the calculation a sample size of 12.5% was calculated per zone. The formulas which were used are as follow:

1) Charcoal consumption per month: consumption frequency per month * average weight per sack

2) Charcoal consumption per year: consumption frequency per month * average weight per sack * 12

N.B.: Due to the fact that some respondents don't use year-round, but in the rainy season or during the dry season monthly consumption rates have been multiplied with 0.5 to get the production of charcoal over a period of 6 months.

To reveal how the charcoal production was spread throughout the study area two calculations were made; the first one is the comparison of the three different zones between each other. This was done to decide what type of statistical test should be used (because one significant village where lots of charcoal is produced) are normal distribution was made of the different zones separately.
The second calculation is a comparison between the monthly income and the monthly charcoal production. This has been done to provide information if the amount of charcoal production was being influenced by the income rates in the study area. In addition two maps were created to visualize how the charcoal consumption is distributed throughout the study area; the first one was the charcoal consumption per ECAN Zone and the second one was about the charcoal consumption per village.

Comparison between income and Charcoal use:
In connection with the charcoal consumption another aspect that was looked upon was the comparison between the monthly income and the monthly charcoal consumption to look if any correlations between these two variables could be drawn. The advantage of this analysis is that it provides a more comprehensible overview what factors influence charcoal consumption rates. Classes were made with steps of 500 pesos between a range of 0-10.000 pesos. At every class the average charcoal consumption rate was calculated. To compare both factors a correlation coefficient with additional histogram was processed.

All monthly incomes above 10.000 PHP were deleted from the analysis, because these numbers are extreme in value and could strongly influence the correlation coefficient in a negative way. Likewise missing data concerning missing incomes and refusal of answering was excluded from the calculation to avoid bias.

Problem analysis:
One of the questions in the interview involved the problems in relation to the charcoal production cycle *(See Appendix C)*. The problems in the answers were categorized and ranked. Firstly the problems in the different villages were identified and summed per problem. Secondly the problems were ranked in a frequency list from the highest to the lowest rank.

4.3 Burning sites field survey

To collect data about burning sites a field survey was executed. A consultation with the local residents was done to gather information on the location of charcoal burning sites found in the area. In addition a comprehensive examination was done along walking tracks in the rainforest. These track served as transect lines and were used to determine if burning sites would be present in the more remote areas of the rainforest. A field form was used with the following criteria being written down; the coordinates (waypoints with GPS) the total number of wood stems, the diameters of a burning site (height, length and wide) and stem diameters sizes *(See Appendix D)*.
To quantify the amount of charcoal produced at each burning site a weight survey was used. This is a method where the amount of charcoal is measured. The charcoal was weighted using a spring balance. Every bag was measured to estimate an average for the burning site (if bags were present).

4.6 Additional literature research

Secondary data was gathered on the topic to come up with valuable solutions and recommendations that are best suitable to resolve the identified threats. These journals were collected via different resources; the online database of the WUR library, SCOPUS, Google Scholar and dissertations which were collected in the library of the Palawan State University.

5. Results

5.1 Forest Conversion (Kaingin):

Agriculture in the Philippines is divided into different systems ; a few of these systems could be found in the study area. Most of the farmers are small-scale farming systems with predominantly rice and corn as major (food) crops. Besides these two crops other common crops are banana, coconut, pineapple, cassava and mango *(Briones, 2007).* The small-scale farming systems could be divided into two systems. Permanent land use that was in particular found in the Multiple use Zone and the Traditional Kaingin system which could be mostly found in the Buffer and Core zone *(See Appendix E).* Besides these agricultural systems two other types of land use were identified that are elucidated in the next paragraph. A fifth land use was identified that falls outside the study area. Kaingin is considered ''illegal'' in the Philippines and most of the research has been focused on this topic *(See Paragraph 1.2 Forest Conversion (Kaingin)*.

Land use Types:
In consideration to the interview 5 different types of Kaingin were identified that are subdivided into 3 different groups namely legal land tenure, Illegal land tenure and land tenure located outside of the study area borders. In total 109 respondents had some type of land use and the other 7 were removed from the land use analysis.

1. Legal Land Tenure:
    - *Permanent Agricultural Land*

      These agricultural fields were the most widely common form of land use in the area. This land type started previously as Kaingin area and has been transformed into permanent land or the forest has been burned completely for the establishment of lowland rice paddies
    - *Residential/Home garden Area*

      Residential/Home garden areas could be found in the different villages and range widely in size; the areas varied from small farm lots until the big resort areas in the vicinity of Sitio Sabang. It was one of the smaller land types in size with an area of 24.7 ha.
    - *Managed Land*

      Managed land was a land type which consists of agricultural land where local inhabitants manage the land for a landowner. An example is the Sheridan Beach Resort Agricultural Land which was located in the vicinity of Sitio Cabayugan and pieces of land in Cabayugan which was owned by foreigners. *(See Table 2)*

2. Illegal Land Tenure:
    - *Kaingin*

      This type of land was the illegal variant in the study area. Local communities (within the more remote areas) do slash and burn practices to convert the rainforest into agricultural areas. Although Kaingin is forbidden it was still common in the research area, with the emphasis on the Buffer and Core Zones. In the field pure ''illegal'' Kaingin is hard to distinguish. This was due to the fact that in the CADC secondary forest can be legally utilized who a few respondents refer to as Kaingin.
    - *Additional illegal land tenure*

      Although difficult to quantify with the interviews, some respondents referred to the ''illegal'' selling of pieces of land by local residents to wealthy Filipino's or foreigners.

3. *Outlying Land Tenure:*
   This land type was in fact not located within the boundaries of the study area, but could be found in other Barangays as Macarascas, Buenavista and Marufinas. Although most of the respondents had their accommodation within the boundaries of the study area, some of them own more land besides these borders and were the owner of a second house or agricultural field where they occasionally return to *(See Table 1).*

Table 2: Different Land use Types per ECAN zone with (N=109)

Zones	Statistical Values	Permanent land (in ha)	Kaingin area (in ha)	Residential / Homegarden (in ha)	Managed Land (in ha)	Extra Land (in ha)
Core Zone	Total	60,9	13.8	0,2		1
	AVG	4,7	1,3	0,1		1
	N of households	13	11	2		1
Buffer Zone	Total	78.8	11,8		1,3	
	AVG	3,9	1,1		1,3	
	N of households	20	11		1	
Multiple use Zone	Total	163,6	7	24,5	52,8	14,7
	AVG	3,5	2	1,8	13,2	3,7
	N of households	47	3	14	4	4
Area per Land use (in %)		73	5	8	6	4

When looking at the overall results for the land use types it seemed that although Kaingin was a forbidden practice it still could be found throughout the study area (in all the 3 zones some Kaingin activity was found). When looking at the total hectares of the households surveyed it seemed that most of the Kaingin was located in the Core (13.8 ha) and Buffer Zone (11.8 ha) and a less amount was found in the Multiple Zone (7 ha). When considering the average size per household it seemed that ; the predominance was more towards the Multiple use zone (2.3 ha), but this also could be due to the fact that there was one main location in the Multiple use Zone that influenced the data (and the average) *(See Table 1).* Likewise the trend that most Total Kaingin was found in the Core Zone was illustrated by the Kaingin map per village (average per household) where most of the Kaingin is indeed found in the Core Zone while less of the Kaingin was found in the Buffer and Multiple use Zone *(See Appendix H)* and the Kaingin map per Zone *(See Appendix G).*
In the next paragraph Kaingin was scrutinized by making comparisons between Kaingin and the major land use; Permanent land.

Kaingin stakeholders:
In accordance to the interview 11 different Kaingin groups could be distinguished. Each of these groups had its own influence on the Kaingin process within the study area. For the analysis these 11 groups were again divided into three major groups, namely Indigenous Tribes, Migrants and Palawan Residents which would be compared with each other within the 3 different ECAN zones in the study area. To perform a good analysis the Average Number of the total households per group was calculated (Separately for each zone). The different groups are discussed down below:

1. Migrants:
   This is a large group that consists of 4 different subgroups migrated from different regions. These regions are Luzon, The Visayas, Mindanao and Busuanga/Cuyo/Agutaya Island (that belongs to the province of Palawan). Different flows of migrants have moved to Palawan with the earliest migrants arriving in the 60/70s of the twentieth century. The main reason for migration was a lack of income and a lack of natural resources which drove them to Palawan that is still considered ''The Last Frontier'' in the Philippines were natural resources are still abundant. Most migrants could be found in the Multiple Use Zone and were less represented in the Buffer and the Core Zone.

2. Palawan Residents:

This is a group of people that was born and raised in Palawan with most of the residents derived from Migrants (who came from other parts of the Philippines) and came to Palawan in the 60/70/80s of the 20st Century. The distribution for this group seemed similar when looking at the three different zones.

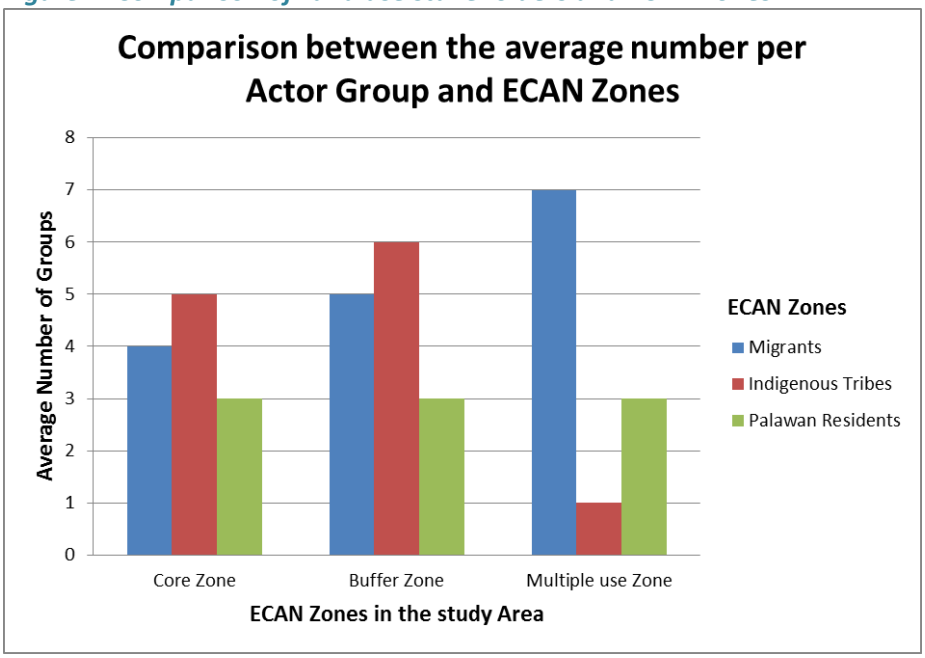
3. Indigenous Tribes:

This group are the original residents or '' aboriginals'' from the Island of Palawan. The group found in the study area consisted of three different tribes that was explained down below:

- Tagbanua Tribe:
  This tribe was one of the native indigenous communities found in Palawan and originally they were living in the lowland/coastal areas mainly in the North/Centre part of the island.
- Batak Tribe:
  This group of people was one of the last remaining tribes which still lived in a more traditional way. Originally these people were found in Centre Palawan in the mountainous areas. Within the study area they were located along the Eastern Border of Barangay Tagabinet.
- Pala'wan Tribe:
  This indigenous community was found in the South of Palawan. Originally they were a nomadic tribe, but due to influence of settlers they slowly transformed they lifestyle into more permanent settlements *(See Figure 2)*

While most Migrants could be found in the Multiple Use Zone, most Indigenous people were found on the other hand in the Buffer and Core Zone and are very low represented in the Multiple Use Zone. Most Indigenous people were living in the CADC areas that have been identified, delineated and awarded by the DENR and the National Commission on Indigenous People (NCIP); *(Prill-Brett, 2007)* .

Figure 2: Comparison of Land use stakeholders and ECAN Zones



Comparison between Permanent Land and Kaingin:
To understand what the relationship was between the two land use types two analysis were done. The first one was the relationship between the 3 stakeholders groups and the amount of hectares per zone and the second one was a comparison between the monthly income and the amount of hectares per zone.

1. Stakeholder Analysis

When looking at the tables 3 & 4 some interesting conclusions could be drawn. The results were looked upon per Stakeholder Group:

- Migrants *(Kaingin is N=7); (Permanent Land is N=40):*

  It seems that the most migrants did not perform Kaingin in comparison with the amount of Permanent Land. Another interesting outcome was the fact that most Kaingin was performed in the core Zone (4 respondents) with a total of 2.6 hectares. This is the opposite in Permanent Land; 23 respondents were found with an average area of 2,0 hectares.
- Indigenous Tribes *(Kaingin is N=13);(Permanent Land is N=22):*

  It appears that almost all indigenous people performed Kaingin as well as Permanent with most respondents located in the Buffer Zone. The area however revealed a total different relation; the highest average amount of Kaingin was found in the Buffer Zone (0,9 hectares) while in the amount of Permanent Land was much higher; namely 3.8 hectares in the Multiple use Zone.
- Palawan Residents *(Kaingin is N=2);(Permanent Land is N=25*):

  The Palawan Residents almost do not perform Kaingin practices (only two respondents were active) in contrary to the Permanent Land. Most of the residents had a large piece of land and could be found in the Multiple use Zone (19 respondents). The same accounts for the amount of land; most Kaingin was practices in the Buffer Zone (3 hectares) while most Permanent Land is found in the Multiple use Zone (4,3 hectares)hectares *(See Table 3 and 4).*

In the case of observing the whole group some clear differences could be seen. On average most Kaingin was performed by the Indigenous tribes with most people found in the buffer zone (9 Respondents) , but the Migrants still seemed to have more Kaingin land (5.85 hectares) in comparison with the Indigenous tribes (3.5 hectares). On the other hand most Permanent land seemed to be owned by the Migrants while the Indigenous people are less represented. When observing the Palawan Residents, they were fairly represented in the Permanent land, but had low numbers when looking at the Kaingin practice *(See Table 3, 4).*
The Kaingin map that was created for the stakeholder groups per village/ECAN Zone displayed a similar trend; most of the Kaingin practitioners are Indigenous located in Bayatao (Buffer Zone). Additionally Migrants are most dominant in the villages like Martape and Bentoan along the coast.

Table 3: Comparison between the Amount of Kaingin with the different stakeholders groups per zone (N=22)

Zones	Statistic Variables	Migrants			Indigenous Tribes			Palawan Residents		
		Number of Respondents	Number in % of total sample	Area (in ha)	Number of Respondents	Number in % of total sample	Area (in ha)	Number of Respondents	Number in % of total sample	Area (in ha)
Core zone	AVG			2,6			0,6			0
(N=6)	Total	4	18	10,5	2	9	1,25	0	0	0
	S			2,2			0,2			0
Buffer zone	AVG			0,25			0,9			3
(N=11)	Total	1	1	0,25	9	41	8,5	1	5	3
	S			0			0,3			0
Multiple use zone	AVG			3			2			2
(N=5)	Total	2	2	6	2	9	4	1	5	2
	S			0			0			0
Total		N=7	21		N=11	59		N=2	10	

Table 4: Comparison between the Amount of Permanent land with the different stakeholders groups per zone (N=85)

Zones	Statistic Variables	Migrants			Indigenous Tribes			Palawan Residents		
		Number of Respondents	Number in % of total sample	Area (in ha)	Number of Respondents	Number in % of total sample	Area (in ha)	Number of Respondents	Number in % of total	Area (in ha)
Core zone	AVG			2,8			3			3
(N=19)	Total	9	11	25	7	8	33,8	3	4	3
	S			4,7			4,9			3
Buffer zone	AVG			4,5			3,6			3
(N=19)	Total	8	9	35,7	8	9	40	3	4	3
	S			0			3,8			0
Multiple use zone	AVG			2,9			2,3			4,3
(N=47)	Total	23	27	67,5	5	6	12	19	22	81,5
	S			2,1			1,2			5,4
Total		N=40	21		N=20	59		N=25	10	

2. Income Analysis

The comparison between the variables revealed some interesting results *(See table 5)*. The results were discussed between the variables income and area.

- Average Income:

  It seems that a higher average income (per household) was generated by farmers from Permanent Land (2400 PHP) in comparison with the Kaingin (3925 PHP) when looking at the Core Zone. In contrast little differences in average income per household where found in the Core Zone and the Buffer Zone between Permanent Land and Kaingin.
  The differences however could be due to a predominance of specific respondents (the Standard Deviation seems lower in the Kaingin site); *(See Table 5)*.

- Average Area:

  The table showed that in the Buffer and Multiple use Zone the amount of Permanent Land (3,7 hectares) per household is higher in comparison with the amount of Kaingin (2,3 hectares). This contrasted with the Core Zone where almost no difference was found. Again outcomes should be interpret with prudence because the standard deviation is very different in most answers).

- Frequency of Respondents:

  When looking at the results most people tend to had permanent land (Total of 77) while only a fraction performed Kaingin (Total of 16 people). When looking at percentages (only accounted for people with an income lower than 10.000 PHP):

Table 5: Comparison between Permanent Land (N=77) and Kaingin (N=16) looking at Area (in hectares) and Income (in PHP)

Zones	Statistic variables	Number of Respondents	Permanent Land (income in Pesos)	Kaingin Aarea (income in Pesos)	Number of Respondents	Permanent Land (in ha.)	Kaingin area (in ha.)
Core Zone	AVG		2400	3925		4,2	4,4
	Total	13 (15%)	31200	15700	4 (25%)	54,1	17,5
	S		1521	1325,1		3,8	2,9
Buffer Zone	AVG		2594,1	2444,4		3,4	1,1
	Total	17 (19%)	44100	22000	9 (56%)	58,3	10
	S		2430,7	2686,1		2,4	0,8
Multiple use Zone	AVG		4865,9	5000		3,7	2,3
	Total	47 (47%)	199500	15000	3 (19%)	154,3	7,0
	S		2195,5	2000		3,9	0,6

Statistical Analysis

The results of the statistical analysis of the Kaingin intensity per zone were divided into two parts; the first part was with the entire land owner population of the study area and the second part was only with the Kaingin owners.

1. <u>The complete land owner population</u>

To begin the Skewness and the Kurtosis were discussed: in accordance to the ''Skewness'' and ''Kurtosis'' method the three samples were not normally distributed. These tests gave a good representation if a normal distribution is asymmetric or symmetric in comparison with the Mean. Normally the range of both measures have to fall between a value of -1 to +1 to represent a normal distribution or a symmetric form.
All three zones were elaborated down below:

- In the sample of the Multiple use Zone a Skewness was found of 3.018 and a Kurtosis of 25.074, therefore the outcomes exceed the range value.
- In the sample of the Buffer Zone a Skewness was found of 2.013 and a Kurtosis of 5.174 which indicated a similar situation as with the Core zonation.
- The Core Zone has a Skewness of 2.560 and a Kurtosis of 6.004, therefore none of the 3 zones were homogenous distributed *(See Appendix M).*

Because there were more than two samples and the samples were unmatched the Kruskal-Wallis test was chosen for the analysis and was performed in the program SPSS. This test is a non-parametric technique that compares the averages of several samples (*Fowler, 1998).* To strengthen the argument that a non-parametric test is suitable a non-parametric Lavene's test was chosen to compare if the Variance Homogeneity could be rejected (*Nordstokke, 2010*) To make this comparison a One-Way Anova was used. The test revealed a significance of 0.00. This indicates that the Variance Homogeneity was rejected, because the P-value is less than 95% *(See Appendix L).*

The Kruskal-Wallis test indicates a difference between the three different groups. The groups were constructed as follow:

- *Group 1* is similar to the *Multiple Use Zone*
- *Group 2* is similar to the *Buffer Zone*
- *Group 3* is similar to the *Core Zone*

When looking at the rank table of The Multiple use Zone the Mean rank (51.70) was clearly different from the Mean rank of The Buffer Zone 2 (75.19) and The Core Zone (67.91) although differences between zone 2 and 3 were likewise not very small *(See Table 6).*

In addition the P-value (Asymp.Sig) was less than 0.000 which indicates that the 0 hypothesis (that no differences were found between the populations) could be rejected *(See Table 6).*
Because the test does not makes differences between zones separately but combines the three zones into 1 comparison post-hoc testing was applied. To analyse the differences between 2 at a time instead of 3, the ''**Select Case Utility''** in SPSS was used *(Keselman, 1979) (Green, 2005)*.

Table 6: Kaingin Kruskal-Wallis Results of the entire land owner population

Ranks

	groups	N	Mean Rank
kaingin	1	72	51.70
	2	24	75.19
	3	22	67.91
	Total	118	

Test Statistics[a,b]

	kaingin
Chi-Square	22.776
df	2
Asymp. Sig.	.000

a. Kruskal Wallis Test

b. Grouping Variable: groups

In accordance to the ''Select Case Utility'' the separate zones where compared with the Kruskal-Wallis Technique. The outcomes were enumerated down below:

- Comparison between The Multiple use Zone and The Buffer Zone:
  The results viewed a significant difference between the two groups; the Multiple use Zone (43.69) was much lower in number then the Buffer Zone (62.92) mean Rank. Furthermore the P value was very low; 0.000.
- Comparison between zone The Buffer Zone and The Core Zone:
  The comparison showed a modest difference, but was statistically not significant. The Buffer Zone (22.77) was very similar with the Core Zone(22.11). The P-value affirmed this with a number of 0.445.
- Comparison between The Multiple use Zone and The Core Zone:
  Similarly to the first comparison the difference between The Multiple use Zone and The Core Zone was evident. The Multiple use Zone (44.53) was much smaller than The Core Zone (57.30). The P-value was very low; 0.000 *(See Appendix M).*

This analysis pointed out that a significant difference could be found between the Kaingin Intensity of the Multiple use Zone and the Buffer/Core Zones.

2. <u>Kaingin owners population</u>

Similar to the entire land owner population the Skewness and the Kurtosis indicated that there was a difference between the normal distributions of the different zones *(See Appendix Q)*. Per zone the Skewness and the Kurtosis were listed down below:

- The Multiple use Zone a Skewness of 1.732 was found without a Kurtosis result
- The Buffer Zone had a Skewness of 2.041 and a Kurtosis of 5.515
- The Core Zone had a Skewness of 1.048 and a Kurtosis of -0.624

To affirm that the Skewness and Kurtosis are reliable an extra One-Way Anova was done.
The test revealed a P-value of 0.000 that indicates that the Variance Homogeneity was rejected, because the P-value falls outside the 95% confident range. The use of the Kruskal-Wallis test is therewith validated. The Kruskal-Wallis Test revealed a difference between all the different mean Ranks. The Multiple use Zone reveals is the highest (16.83) Rank in comparison with the Buffer (9.14) and the Core zone (11.43). In addition the P-value is 0.146 that confirms a difference between the 3 zones. Furthermore a post-hoc testing was done to look if differences would show up between the zones separately.

Table 7: Kaingin Krustall-Wallis results of the Kaingin owner Population

Ranks

	groups	N	Mean Rank
kaingin	1	3	16.83
	2	11	9.14
	3	7	11.43
	Total	21	

Test Statistics[a,b]

	kaingin
Chi-Square	3.855
df	2
Asymp. Sig.	.146

a. Kruskal Wallis Test

b. Grouping Variable: groups

In accordance to the ''Select Case Utility'' tool the following results were revealed:

- The Multiple use Zone (12.17) and Buffer Zone (6.23) are still different . The P-value confirms this with a number of 0.023.
- The Buffer Zone (8.91) and Core Zone (10.43) are very similar which is affirmed with a P-value of 0.542.
- The Multiple use Zone (6.67) and the Core Zone (5.00) seem to be more similar which is corroborated by a P-value of 0.418 *(See Appendix R)*.

The results give the impression that if only Kaingin owners would be compared only the Buffer Zone would be different while the Core and Multiple use Zone have a similar distribution pattern in contrary with comparing the entire land owners population where the Multiple use Zone is significantly different then the Buffer and Core Zone.

Problems analysis

Only 64 respondents could identify problems, that was why only these respondents were included in the table. In accordance to the interview the respondents encountered 13 different problems. These problems were listed in a sequence of importance and viewed in a frequency list. Most of the problems were not frequently found, only a few were significantly present. The most important problems found were loss of vegetation, water system disruption, erosion and animal plagues. The most important ones were clarified and discussed:

1. Loss of vegetation (34 % out of 64 respondents):
   Due to Kaingin and resort development many of the native vegetation had been influenced. Slash and burn practices did cause losses of forest cover, losses of primary rainforest species and triggered other related problems.
2. Water system disruption (18.8 % out of 64 respondents):
   Due to the removal of vegetation along rivers and on (steep) slopes in some parts of the study area minor flooding had been a problem. However in other parts of the study area the losses of vegetation caused a lack of water resources.
3. Erosion (14.1% out of 64 respondents):
   In some parts of the study area the removal of vegetation had caused minor landslides. Although respondents found this a problem, some of them explained it as a natural cause.
4. Animal Plagues (14.1% out of 64 respondents:
   Farmers experienced different plagues on the agricultural plots which were in their opinion due to Kaingin practices. Examples of these plagues were an abundance of rodents, insects and monkeys. These animals came into their fields and affect the fruit trees and root crops that the people grow on their properties *(See Table 4).*

Table 8: Kaingin Problem Frequency table (N=64)

Type of problems	Frequency List	Frequency in % of the total sample size
Loss of vegetation	22	34,4
Watersystem disruption causes water losses,	12	18,8
Erosion	9	14,1
Animal Plagues	9	14,1
Social Problems (conflicts land	5	7,8
Agricultural Crops die	4	6,3
Excessive Tourist Development	3	4,7
Decrease Wildlife	3	4,7
Social Degradation	3	4,7
Climate Change	2	3,1
Hole Ozonlayer	1	1,6
Increase Wildlfires	1	1,6
Smoke Development	1	1,6

5.2 Charcoal Collection

5.2.1 Charcoal production

Charcoal Production Resources

The most common tree species used for producing charcoal were Malabayabas *(Tristania decortidata)* used by 53% of the 13 respondents and Ngilo *(Elmerallia platyphylla)*; used by 46.7% of the charcoal producers. Several others species were used as well, but these were only mentioned by a few people. *(See Table 9).* The charcoal producers explained that *Tristania decortidata and Elmerallia platyphylla* that these species were quite common in the area and that they provide good quality charcoal. In this survey 15 people were interviewed, but only 13 could identify the specific species. For the table the other 2 respondents were therefore excluded.

Table 9: Tree Species List for Charcoal Production (N=13)

Domestic Name	Scientific Name	Frequency List:	Frequency in % of the sample population
Malabayabas	Tristania decortic	8	61,5
Ngilo	Elmerallia platypl	7	53,8
Balod	Neonauclea ovata	3	23,1
Bankal Bankal	Naucelan orienta	2	15,4
Ipil	Instia bijuga	2	15,4
Molave	Vitex parviflora	1	7,7
Red Nato	Palaquium luzoni	1	7,7
Putian	Alangium meyeri	1	7,7

Charcoal Production Rates

In total 15 charcoal makers were interviewed in the whole study area. While difficult to find at first, the people were very open-minded when it was expressed that the research is to help them with their livelihood. The charcoal-makers were located in two major areas.

The first area was located in the CADC area of West-Cabayugan. The second area was found from Tagnipa (highway) until the village of Bayatao which was located in the CADC area of Tagabinet *(See Appendixes F, H).*

From these areas there were 3 villages where most charcoal was produced namely Tagnipa (44751 kg/yr), Sugod 1 (28000 kg/yr)and Martape(25200 kg/yr). When looking at the averages most charcoal seemed to be made in Tagnipa (14917 kg/yr);*(See Table 10).*

Table 10: Charcoal Production per village (N=15)

Villages	Number of Charcoal Producers	Monthly charcoal prod. (in kg)	Annual charcoal prod. (in kg)	Charcoal production per household (in kg)
Bayatao	1	735	8820	8820
Tagabinet	1	210	2520	2520
Liang	1	560	6720	6720
Nasueduan	1	840	10080	10080
Tagnipa	3	4098,5	44751	14917
Sugod 1	4	4246,7	28000,6	7000,1
Martape	3	4200	25200	8400
Bentoan	1	980	11760	11760

Charcoal Production Problem Analysis

A range of problems was identified in accordance with charcoal production. In total 6 problems were identified with 3 problems standing out *(See Table 11).* Other problems mentioned were; an increase in the Whole of the Ozon Layer, Health Problems (smoke development) during producing charcoal and a warmer/more humid climate. The main problems are explained down below:

1. Loss of vegetation (46.7% out of 15 respondents):
   Charcoal production is an intensive process where large trees are being cut down and brought to a burning site. Respondents explained that before this practice was prohibited the production was large-scaled and very destructive. Many primary species were harvested for the charcoal production.
2. Loss of Natural Resources (26.7% out of 15 respondents):
   Mostly canopy species were selected for the charcoal production, because the wood is high in quality and will burn for a long period. Due to the fact these species are so popular they were intensively chopped down which caused a lack in potential charcoal species. Therefore most charcoal-makers have transferred their selection towards more fast-growing species.
3. Loss of Wildlife (20% out of 15 respondents):
   Some respondents stated that due to the destruction of the rainforest and the large burning in the past many species have disappeared. Accompanied with this activity people started to build more settlements which gave a further increase towards the decline of wildlife numbers.

Table 11: Problems found for charcoal production (N=15)

Problems	Frequency List	Frequency in % of sample population (N=15)
Loss of forests	7	46,7
Loss of natural resources	4	26,7
Loss of wildlife	3	20,0
Hole Ozon layer	1	6,7
Health problems	1	6,7
Intense Hot/Humid conditions	1	6,7

In addition to some respondents around 30 years ago the amount of charcoal production was far worse, but since the Community Based Management since the 1970s *(Palao, 2010*) and the more strict regulations of the DENR the amount of charcoal production has decreased drastically.
But these results have to be taken with precaution, because no official data is present.

5.2.2 Charcoal Consumption

In the study area around 72% of the total sample uses firewood and 46% uses charcoal on a daily basis (*See Table 13).* To analyse the charcoal consumption rates the whole market cycle (from producers, suppliers to consumers) was analysed. The producers were mainly analysed in the previous chapter *(See chapter 5.2.1 Charcoal Production),* but an additional analysis was done on the location of the production in combination with how the supply works in reality. Afterwards the buyers were analysed. A more detailed examination was done for the charcoal consumption and divided into different steps; first the consumption rates per zone were compared, secondly a comparison was made between the income rate/charcoal consumption rate if a correlation could be found and thirdly a Kruskall-Wallis test was used to analyse if differences per zone could be underpinned statistically.

Charcoal suppliers:

Charcoal was still widely produced by a variety of different groups. In total 7 groups were identified with 1 group as an intermediate between the makers and the consumers and the other 6 straight from the burning site *(See Table 12)*. Most people bought their charcoal from the local Sari-Sari stores. They got their supplies from the communities who made the charcoal. There were two main regions within the study area where charcoal is produced. The rest of the charcoal came from outside the study area.

Table 12: Charcoal Suppliers frequency table (N=41)

Charcoal-buying location	Frequency	Frequency in %
Local Sari-Sari store	12	29,3
Marufinas	9	22,0
Sugod 1	7	17,1
Martape	3	7,3
Sari-Sari store Buenavista	2	4,9
Puerto Princesa	2	4,9
Delivered	2	4,9
Burning site Mandahon	2	4,9
Burning site Buenavista	1	2,4
Bentoan	1	2,4

There were three villages in the CADC named Sugod 1, Martape and Bentoan which produce charcoal for their livelihood. The second one was a region between the villages Tagnipa and Bayatao close to the borders of the PPSRNP. Within the study area Sugod 1 seems to produce most charcoal (17,1% out of 41 respondents) Outside the study area there were two major suppliers of charcoal. For Cabayugan that is the Barangay of Marufinas (which lies North-East of Barangay Cabayugan) and for Tagabinet the main suppliers were coming from Barangay Buenavista (which lies South of Tagabinet). Within both areas different groups produce charcoal, both indigenous communities and migrant populations *(See Table 12)*.

Charcoal buyers:

An analysis was made to compare the different buyers of charcoal. In accordance to the table 17 profession groups can be distinguished. Of these profession groups 12 groups consume charcoal, but almost all of the groups use firewood. When looking at the consumption two calculations had to be made:

1) Charcoal consumption: *Variable charcoal + Variable firewood, charcoal*

2) Firewood consumption: *Variable firewood + Variable firewood, charcoal*

When looking at the consumption two calculations had to be made:
Most of the charcoal was consumed by the vendors (13 persons) and fishermen (10 persons). In comparison, the groups who consumed most of the firewood are farmers (22 persons) and fishermen (21 persons). When looking at the entire sample size 81 (60 + 21) persons consume firewood while only 52 (31 + 21) persons consume charcoal *(See Table 8).* This meant that 72% (81/112*100) of the total sample population used firewood while only 46% (52/112*100) of this population consumes charcoal *(See Table 13)*.

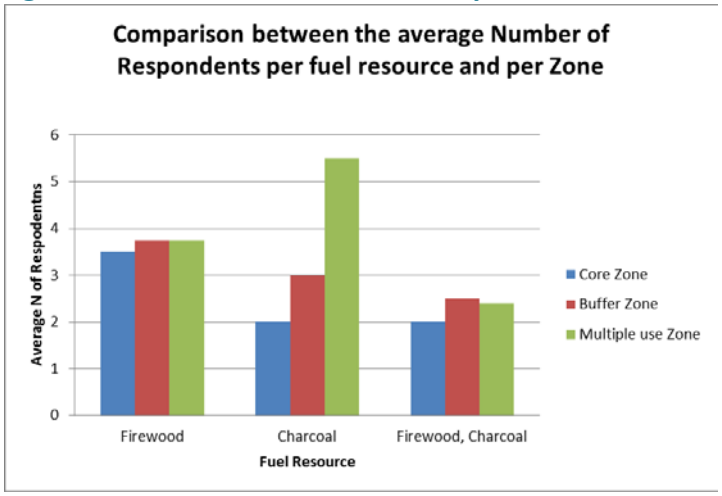
Table 13: Charcoal Consumers(N=112)

	Fuel resource		
Profession	charcoal	firewood	firewood, charcoal
farmer	1	19	3
fishermen	4	15	6
tourist operator	6	2	2
vendor	10	4	3
Resort owner/manager	5	1	
gov. official	1	4	2
resort employee		3	2
jobless	2	3	
NTFP's collector		3	
nursery worker		1	2
massage therapiste	1	1	
truck driver		1	
construction worker		1	
security guard		1	
charcoal-maker			1
park-ranger		1	
ngo employee	1		
Total	31	60	21

Besides the obvious differences between the type of fuel consumers variations were likewise found in the fuel distribution per Zone. The differences were given in Averages per Zone *(See Figure 3)*. The results were listed in order of fuel resource:

1. Firewood:
   When looking at the firewood consumption no clear distinction between the Zones could be given. A minor difference appears to be present between the Core Zone and the Buffer and Multiple Zones, but this seems so small that it is insignificant.
2. Charcoal:
   The bar graph revealed a large variety of users between the different zones. While the average consumption for the Core Zone was only 2 the average consumption for Multiple use Zone evident with a Number of 5.5 respondents.
3. Firewood, Charcoal:
   The last group represents the number of people that used both fuel resources. Not only was the average number of consumers very low in addition the differences are similarly very limited. The biggest differences seemed to be found between the Core and Buffer Zone *(See Figure 3)*.

Figure 3: Fuel Resource distribution per Zone



Charcoal consumption rates

The total number of respondents interviewed accounted for a total of 112 households.
The results of the charcoal consumption revealed that a large difference could be found between the consumption rates of the different zones. The Multiple use zone seemed to have the highest Total Consumption Rate (26568 kg/year) in comparison with the Core (3948 kg/year) and Buffer Zone (3032 kg/year). In addition it appeared that the average amount of charcoal in the Multiple use Zone (359 kg/year) was twice the size of the Core (197 kg/year) and the Buffer Zone (201 kg/year). But a precaution had to be made because the Standard Deviations seem to deviate from one another. *(See Table 14).*

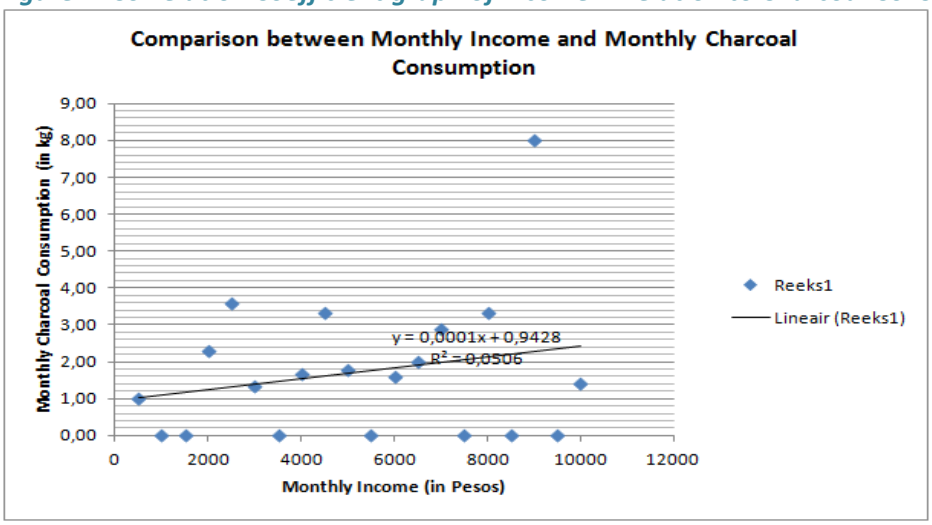
Table 14: Charcoal Consumption per Zone (N=112)

Zones	Statistic variables	Charcoal Consumption per month (in kg)	Charcoal Consumption per year (in kg)
Core Zone *(N=20)*	AVG	17	197
	Total	329	3948
	S	30	363
Buffer Zone *(N=20)*	AVG	17	201
	Total	336	3032
	S	31	368
Multiple use Zone (N=72)	AVG	31	359
	Total	2214	26568
	S	51	606

Comparison between income and Charcoal use:

The comparison between the monthly income and the monthly charcoal consumption revealed no significant connection. An R^2 (correlation coefficient) was found of 0.0506. This numbers indicated a very low correlation between the two variables. The range is normally found between -1 and +1. The closer the R^2 is to these numbers the stronger the two variables are related. *(Creative Research Systems, Consulted on August 25th 20120).*
In other words there was no strong evidence that the amount of income was of influence on the monthly charcoal consumption rates in the study area *(See Figure 4)*.

Figure 4: Correlation Coefficient graph of Income in relation to Charcoal Consumption



Charcoal Consumption Statistics

For the charcoal consumption the same statistical analysis has been the same as for the Kaingin. The analysis was divided in two parts; one part was about the total number of fuel consumers while the other part was only about charcoal consumers.

1. Total Number of Respondents:

In accordance to the ''skewness'' and ''Kurtosis'' method the three samples were not normally distributed. Normally the range of both measures had to fall between a value of -1 to +1.
All three zonations were elaborated down below:

- In the sample of the Multiple use Zone a Skewness was found of 2.382 and a Kurtosis of 7.652, therefore the outcomes exceeded the range value.
- In the sample of the Buffer Zone a Skewness was found of 1.986 and a Kurtosis of 3.836 which indicated a similar situation as with the Core zonation.
- The Core Zone had a Skewness of 2.054 and a Kurtosis of 4.274, therefore none of the zones had a normal distribution *(See Appendix S).*

Because there were more than two samples and the samples were unmatched the Kruskal-Wallis test was chosen for the analysis and was performed in the program SPSS. This test is a non-parametric technique that compares the averages of several samples (*Fowler, 1998).*

To strengthen the argument that a non-parametric test was suitable a non-parametric Lavene's test was chosen to compare if Variance Homogeneity could be rejected (*Nordstokke, 2010*) To make this comparison a One-Way Anova was used. The test revealed a significance of 0.00 This indicated that the Variance Homogeneity is rejected, because the P-value is less than 0.75. *(See Appendix T)*
The Kruskal-Wallis test indicated a difference between the three different groups. The groups were constructed as follow:

- *Group 1* is similar to the *Multiple Use Zone*
- *Group 2* is similar to the *Buffer Zone*
- *Group 3* is similar to the *Core Zone*

When looking at the rank table The Multiple use Zone's Mean rank (60.02) was clearly different from the Mean rank of The Buffer Zone (50.35) and The Core Zone (49.98) *(See Table 15).* In addition the P-value (Asymp.Sig) was less than 0.75 which indicated that the 0 hypothesis (that no differences are found between the populations) can be rejected *(See Table 11).*
Because the test does not makes differences between zonation's separately but combines the three zonation's into 1 comparison post-hoc testing had to be applied. To analyse the differences between 2 at a time instead of 3, the ''**Select Case Utility''** in SPSS was used *(Keselman, 1979); (Green, 2005).*

Table 15: Charcoal Consumption Kruskal Wallis results Total Number of Respondents

Ranks

	zones	N	Mean Rank
charcoal	1	72	60.02
	2	20	50.35
	3	20	49.98
	Total	112	

Test Statistics[a,b]

	charcoal
Chi-Square	2.991
df	2
Asymp. Sig.	.224

a. Kruskal Wallis Test

b. Grouping Variable: zones

The ''Select Case Utility'' tool validates that the Kruskal-Wallis test with the 3 zones were legitimate. The results were set out below:

- Comparison between The Multiple use Zone and The Buffer Zone:
  The outcomes of the first test indicated that large differences are found between the ranks of The Multiple use Zone and The Buffer Zone. The Multiple use Zone (48.23) is much larger than The Buffer Zone (40.48). The P-value confirms this with a number of 0.192.
- Comparison between The Buffer Zone and The Core Zone:
  This comparison revealed no significant difference between the two zones. The Buffer Zone (20.58) and Core Zone (20.43) were in fact almost completely equal. The P-value indicated the same with a number of 0.960.
- Comparison between The Multiple use Zone and The Core Zone:
  This outcome was comparable with the first test. The Multiple use Zone (48.93) was much larger than the Core Zone (40.45). The P-value of 0.177 gave a similar indication.

To conclude this analysis revealed that Charcoal Consumption in the Multiple Zone was slightly different in comparison with the Buffer/Core Zones.

2. Number of Charcoal Consumers:

The test results of the Skewness and Kurtosis revealed that all the zones had a asymmetric distribution. The test results were listed and explained by each zone:

- For the Multiple use Zone the Skewness was 1.807 with a Kurtosis of 5.193.
- The sample of the Buffer Zone gave a Skewness of 1.369 and a Kurtosis of 2.500.
- The Core Zone had a Skewness of 1.519 and a Kurtosis of 2.859 *(See Appendix U).*

In addition the One-way Anova Test was done with a P-value of 0.000 which means that no Variance Homogeneity could be detected and affirmed that a Kruskal-Wallis was appropriate for the analysis.

Surprisingly the test results from the Charcoal Consumers were in contract with the test results of the Total Fuel Consumers. It seemed that the Ranks were almost completely analogous with a only the Core Zone (22.42) slightly different then the Buffer Zone (23.67) and the Multiple use Zone (23.66). Additionally the P-value was very high; 0.977 which means that the P-value falls within the confident range of 95%.

Table 16: Charcoal Consumption Kruskal Wallis results of Charcoal Consumers

Ranks

	zones	N	Mean Rank
charcoal	1	34	23.66
	2	6	23.67
	3	6	22.42
	Total	46	

Test Statistics[a,b]

	charcoal
Chi-Square	.047
df	2
Asymp. Sig.	.977

a. Kruskal Wallis Test

b. Grouping Variable: zones

To be certain that the results were correct the post-hoc analysis was done with the ''Select Case Utility'' tool. The outcomes are discussed and ordered down below:

- The test between the Multiple use Zone (20.51) and the Buffer Zone (20.42) unfolded a comparable results as the test with the 3 zones combined. The P-value attested this results with an outcome of 0.985.
- The outcomes of the comparison between the Buffer Zone (6.75) and the Core Zone (6.25) was slightly lower, but the Mean Ranks were still very comparable. The P-value affirmed the Mean Ranks with a number of 0.799.
- The last test between the Multiple use Zone (20.65) and the Core Zone (19.67) revealed again a very close match. With a P-value of 0.848 there was no significant difference *(See Appendix V).*

In consummation the three tests performed with the ''Select Case Utility'' revealed that no significant difference between the Multiple use Zone, the Buffer Zone and the Core Zone could be found. This meant that the distributions of the three samples (although asymmetric) were very similar.

5.2.3 Burning Sites Field Survey

Although the Burning Site Survey was done in the two major charcoal producing areas, the survey had delivered only a few results. This was due to the difficulty of approaching charcoal producers and the vast study area. In total 5 sites were found within the whole study area. Two sites were located close to the village of Sugod 1 while two others are found near the village of Tagnipa. The last site was found in the South-West area of Cabayugan near the village of Nasueduan *(See Appendix J).* Unfortunately the data about the charcoal piles, diameter measurements of the burning site and total N of charcoal Piles was lost, because of a system failure of the computer. Therefore the data could not be further analysed for the results of this research.

6. Discussion

In this chapter the results have been scrutinized in a consequent way to provide a good basis for the conclusion. Furthermore solutions were being provided to resolve the identified problems that resulted from the research. Examples of results were the provision of sustainable alternatives for the destructive Kaingin practices and the traditional charcoal production within the study area.

6.1 Forest Conversion (Kaingin):

Land use Types:
After looking at the 4 different land uses *(Permanent Land, Kaingin, Residential/Homegarden and Managed Land)* found in the study area some interesting points did emerge. The permanent land area was clearly the most abundant form of land use found in the study area. This results indicated that much of the land already had been cleared for quite some time which was being affirmed by the GIS inventory in 2010 *(Palao, 2010).* The change from 4% of forest conversion (1972-1989) into 0.5% forest conversion (1989-2005) clearly indicated that the development into permanent land seemed to stagnate. When looking at the other three land uses they are significantly less represented. Although the residential/home garden area was only 24.5 hectares other reports indicated that this type of land use was slowly growing. This was clarified by the change from 0.03% (1972-1989) to 0.07% (1989-2005). The development of Kaingin was on the other hand less clear when looking on a time-scale. However this analysis could not be done, this research clearly revealed that the practice was still performed although it is illegal in the Philippines (*Philippine Department of Energy, Consulted on 25th August 2012)*.
Unfortunately one of the downfalls of this research was that clear statements could not be made, because there was no spatial or periodical support for the outcomes of the social research. However the research was clearly incomplete still the data serves as a clear indication how the development takes place in the study area.

Kaingin Actors:
The survey showed that a large variety of different stakeholders groups can be found in the study area. However when looking closely the groups could be simply divided into three distinctive groups; firstly the '' migrants'' secondly the '' indigenous tribes'' and thirdly ''Palawan residents'' . The indigenous tribes were basically found in the more remote areas away from the highway, driven into the mountainous areas while migrants in the meanwhile mostly only live in the lowlands (which is not surprisingly along the highway). This division could be illustrated by the fact that most permanent land was owned by the migrants (128.2 hectares) which was mostly found in the lowlands of the study area while the indigenous tribes owned 85.8 hectares. In the case of Kaingin (that was most commonly found in the highlands) the indigenous tribes seem to have a smaller amount of land (13,8 hectares) in comparison with the migrants (16.8 hectares), although more Indigenous perform Kaingin *(See Table 3)*. These outcomes are illustrated by looking at the stakeholder map and the map with Kaingin practices *(See Appendix G,H and I)*.

Comparison between Permanent Land and Kaingin
To learn more about the Kaingin process and the underlying causes comparisons were made between the amount of hectares and the monthly income rate per household. When looked upon the outcomes some differences could be seen. The average income seemed to be higher under the respondents who do not do Kaingin, but instead grew their crops on permanent land although this difference is diminutive.
An interesting aspect that stood out was the fact that in the Core Zone (3925 PHP) the monthly income seemed higher for Kaingin practisers then for people who have permanent land (2400 PHP).

Similar the Amount of Permanent Land seems lower (4.2 hectares) in comparison with the Kaingin Area (4.4 hectares). While if looked at the Buffer Zone the average amount of Permanent Land (3.4 hectares) is lower than the Kaingin (1.1 hectares). The same account for the income: Permanent land (2594 PHP) than the Kaingin income (2444 PHP).
These differences could be due to the fact that in the Core Zone only 4 people were interviewed (for Kaingin) and 13 for Permanent Land. In addition the variation is larger in the Kaingin sample than when looking at the Permanent Land sample.
For the buffer zone the frequencies were more equal; for Permanent Land the amount of people was 17 while for Kaingin this was 9. The variation was therefore less extreme then in the case of the Core Zone. Although it is difficult to link income rate to Kaingin intensity a report revealed that money resources can be a very important reason to perform Kaingin *(Ketterings, 1999).*

Kaingin Intensity:
To understand how the Kaingin intensity was spread throughout the study area (between the three different zone) the Kruskal-Wallis test was used to unveil if there is a difference or not.
Based on the results produced by the two Kruskal-Wallis tests in the results chapter, the conclusions would be:
The tests were conducted to evaluate differences between the amount of Kaingin Area on Median change between the three zones in the study area. The first test (complete sample population of land owners) revealed a large difference between the Multiple use Zone and the Buffer and Core Zones. This was found in both scenario's: the comparison of the Multiple use Zone and the Buffer Zone (P – value of 0.000) and the comparison of the Multiple use Zone with the Core Zone (P-value of 0.000) *(See Appendix P).* This difference seemed to be caused by the large difference in Zero's (0) found in the field data. These Zero's represented the number of people that do not perform Kaingin. To give a comprehensive overview the second test was done that only uses the number of Kaingin practitioners. In this case the Multiple use Zone was only different from the Buffer Zone (P-value of 0.023) but seems to be comparable with the Core Zone (P-value of 0.418) *(See Appendix R)*. The results gave the impression that the main difference was caused by the people that do not perform Kaingin and most of these respondents can be found in the Multiple use Zone.
This statement seemed to be underpinned by looking at comparison between at: *''table 5: comparison between the Permanent Land and Kaingin''*. The ration Permanent land/Kaingin users in the Multiple use Zone is much stronger than in the Buffer and Core Zone: Multiple use Zone=47/3, Buffer Zone=9/17 and the Core Zone=13/4.

Although this difference seemed to be very clear the results had to be looked upon carefully and objectively, because the results were only based on an interview. The respondents seemed to be aware of the metric unit of hectare, but answers were always given as estimations (no official land data is present), so odds could be very high when looking at their answers.
Another aspect that may bias the results was the fact that the zone/village selection was chosen from field experience and looking upon the provided GIS data from the Puerto Princesa government. These maps are not definite borders, but are approximately drawn zones with the main purpose to identify different land uses on the island of Palawan.

Problem analysis:
Many problems seemed to arise in the case of Kaingin performance. This was not only stated in various reports (concerning the subject) (*Briones, 2007),* but was also a concern among various respondents who identified 13 problems. Loss of vegetation was clearly the most devastating consequence provoking a trigger reaction for the development of new problems (water system disruption, erosion, flooding).
This became clear when looking at the geography aspect of the Philippines; two thirds of the country's total land area consists of hilly and mountainous areas.

When performing slash and burning in an unsustainable way vegetation is removed and the soil layer will be exposed, making these affected areas then susceptible to soil erosion. This process again inflicts a numbers of negative impacts for the agriculture. Examples are low crop productivity, reduction of the capacity of water conveyance structures, destruction of wildlife habitat and destruction of standing crops (these impacts are identified under various worrying farmers. In addition due to the monsoon climate these soil become even more susceptible during the rainy season. In total about 9 million hectares had issues with various forms of erosion *(Briones, 2007).* Although these objectives were identified many respondents stated that most problems are on a minor scale and that the situation has improved tremendously since a major part of the study is under the regulations of the PPSRNP. Furthermore the swift from coercive management towards integral community based management has similarly improved the situation concerning the management of natural resources *(Palao, 2010).* Of course this argument should not be used as a reason to stop improvement.

6.2 Charcoal Collection

6.2.1Charcoal Production

Charcoal Production Resources
Due to the fact that only 15 respondents were found in the entire study area the number of conclusions that could be drawn were very limited. Still some interesting conclusions could be drawn from the gathered data. Eight species of trees were identified and named scientifically that were used as a direct source for charcoal production. More species of trees were mentioned, but due to miscommunication during the interviews (constant translation was necessary from Tagalog into English and vice versa) data was in some cases misunderstood which lead to false notification of tree names. The trees that were identified were all completely used by the locals and gathered in the adjacent forest areas or on their own piece of land for production. An interesting aspect to mention is why 2 species; Tristania decorticata and Elmerallia platyphylla. They were used quite frequently while the other 6 were only used 1 to 2 times.

Charcoal production Rates
Of the 15 people that were interviewed data was gathered about their monthly production. It seemed that the average charcoal production per household was around 9000 kg of charcoal per year. The range between the different villages was in addition very wide 2520-11760 kg of charcoal per year. Some questions could be raised when looking at these results. What is the reason that this range was so wide among the different villages? Is 9000 kg a common production rate for the entire Philippines or was it more regionally based?
Regrettably the data that was collected is not suitable to make statistical comparisons, because no sample size was used to collect the data, because most people are quite cautious about the subject. Yet the data was still usable as an indication. At least it reveals that charcoal is still applied and that it seemed that differences could be seen between the different villages when looking at the rates in charcoal production per village *(See Appendix H).*

Problem Analysis:
When looking upon the results from the previous chapter it could be noticed that a variety of problems was identified by the locals. Similarities could be drawn with the Kaingin activities *(See Paragraph 6.1).* Again the loss of forests was the most identified problem with almost half of the respondents (46.7%) identifying this cause as the most import one as environmental destructor. A new problem that was identified is the loss of natural resources. In total about ¼ of the respondents (26.7%) identified this problems as a big concern *(See Table 11)*.

Although this problems was regarded as a serious threats it seemed that while charcoal-makers used their local environment they continue this traditional way of charcoal production.
Even though they noticed the changes and know that the practice is illegal. A reason why they still continue seemed to be in particular the lack of income, this caused the fact that they still continue with their practices. Moreover when charcoal and fuel wood resources are considered as ''illegal'' it means this fuel market with its producers goes underground and will catalyse the destructive and uncontrolled production of charcoal. Proper management and supervision of production procedures is then completely precluded. A research done in Mauritania and Kenya revealed this negative trend whereby charcoal production processes became uncontrollable due to policies that banned the production *(FAO, 1993).*
Some marginal notes had to be made; first of all the amount of representatives for the interview was very low in comparison with the total population of the study area. Therefore it was difficult to draw conclusions. Secondly although the practice is forbidden, some (local) governmental officials seemed to tolerate it, because they also consumed charcoal and know that people may be depended on the income source (in accordance with statements made by a few respondents).
Although charcoal production is still done, some respondents said that due to the better management and regulation it improved in comparison with 30 years ago.

6.2.2 Charcoal Consumption

Charcoal Groups
The gathered field data identified a complex system of the charcoal market.
It seemed that a variety of groups is included in the production, trading and buying of the charcoal. The supply was not only coming from inside the study area, but likewise coming from different Barangays that lay adjacent to the study area. Some sources were directly brought to the consumers while a huge amount was sold indirectly at a local Sari-Sari store that sells the charcoal then to local buyers. While the control in the study area (due to the rangers of the PPSNRP and the local Barangay Police) had reduced the amount of charcoal production, this control seemed less in the adjacent Barangays (in accordance with the interviews).

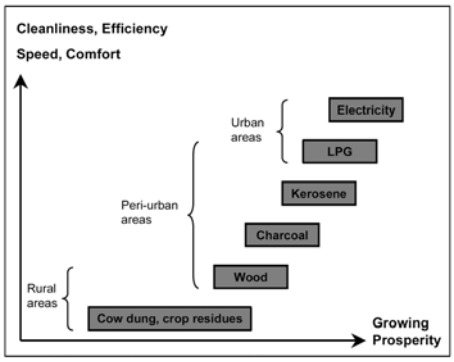
The charcoal suppliers in the study area were in particular Indigenous tribes (Tagbanua Tribe) while outside the study area nearly all the local residents make and supply the charcoal *(See Table 12).*
The transport of charcoal was done either by boat (if the villages are far away and close to the shore) or by Karbouw (Asian Waterbuffel) over the small bush paths.
Almost all the bigger villages had one or two Sari-Sari stores (mainly in the Multiple use Zone) where charcoal is being traded. Only in the more remote villages charcoal was not sold via stores.

In principle two types of fuel were dominant in the region. These are firewood (which is used mainly) and charcoal. Another interesting outcome was that farmers/fishermen seemed to have more an intention towards the consumption of firewood then charcoal. In comparison local vendors (Sari-Sari stores) were the main consumers of charcoal *(See Table 13)*. In comparison in the whole Philippines Charcoal Consumption is still a major type of fuel in the Philippines in combination with firewood. Around 30% of the total Philippine Population depended on these fuel resources that derived from the adjacent rainforests *(Remedio, 2009).*
Two questions arose when looking at these results; what is the main reason why farmers/fishermen use firewood instead of charcoal while the vendors have the intention to do the opposite? How is the charcoal consumption in the study area related to the charcoal consumption in other areas in the Philippines?

During the interviews it became clear that the most important reason was that firewood usage is related to low-income rates (most farmers and fishermen have a low monthly income), although no significant correlation was found between income rise and charcoal consumption rate.

However the correlation could be misleading, because most income were estimations (most people did not had a permanent income) which implicated that a relation was more difficult to make then when exact income rates were given. But the low-income rate statement could be affirmed by a research conducted in India, where a 10% increase in household income is associated with a 7% decline in firewood use. This means that when the income rates increase a preferred shift can be seen from firewood (inferior fuels resource) to bottled gas or kerosene *(Alam, 1985).*
In addition the same happens to charcoal if incomes increase, people have more the desire to swift to more efficient, clean energy sources as LPG, kerosene and eventually electricity. This pattern is well-illustrated in next figure *(See Figure 5).*

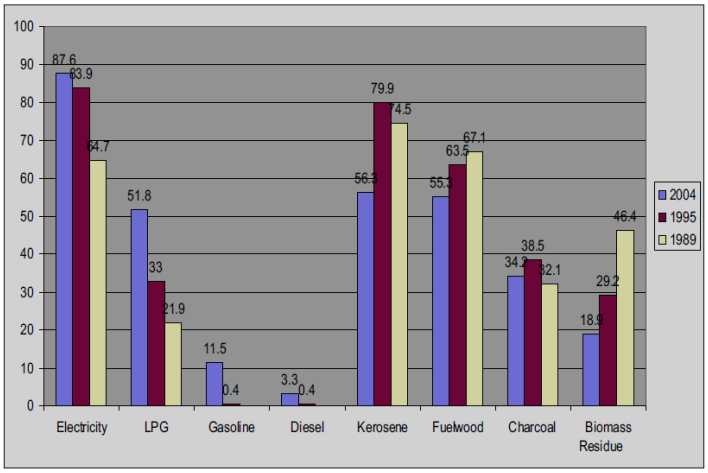
Figure 5: The Energy Ladder



Source: Alam, 1985

Within the Philippines this trend from fuel wood/charcoal resources towards more convenient and comfortable energy sources became increasingly more important. From 1989 to 2004 the total fuel wood and charcoal consumption rates has decreased while more expensive energy resources as electricity and LPG have gained in popularity (*See Figure 6).*

Figure 6: Philippine Household Energy Consumption Survey 1989, 1995 and 2004



Source: *Alam, 1985*

Charcoal Consumption Rates

Looking at the results from the charcoal consumption rates it became clear that most charcoal is consumed in the Multiple use Zone where most of the developed villages are located (3882.4 kg) while in the Core (908 kg/yr) and Buffer Zone (1008 kg/yr) only 1/3 of the total charcoal was consumed *(See Appendix J).* Within the Core Zone 2 villages did not used charcoal (Nanad and Bayatao), similar with the Buffer Zone (Kayasan, Lasgas) while in the Multiple use Zone only 1 village did not consumed charcoal (Liang) *(See Appendix J)*.

Based on the results produced by the two Kruskal-Wallis test in the charcoal consumption results, the final results would be:

The tests were conducted to evaluate the differences between the amount of Charcoal consumed on Median Change between the three zones in the study area. The First Test (Complete sample population of Fuel Consumers) revealed a similar trend where a bigger difference could be found between the Multiple use Zone in comparison with the Buffer/Core Zone which have a more similar distribution. Looking upon the comparison between only the Multiple use Zone/ the Core (P-value of 0.192) and the Multiple use Zone/Buffer Zone (P-value of 0.177) this trend stayed the same *(See Appendix T).*

This variation between the three zones could be based upon the fact that a large portion of the total sample population that uses firewood (72%) instead of charcoal (46%). The firewood users represent the Zero's (0) in the collected field data.

The second test (Sample Charcoal Consumers) seemed to affirm this statement due to the fact that no significant differences were found anymore between the Multiple use Zone and the Core and Buffer Zones. In this case the Multiple use Zone was very much identical to the Buffer Zone (P-value of 0.985) and slightly different in the comparison between the Multiple use Zone and the Core Zone (P-value of 0.848), but still statistically seen homogeneous.

Although these results seem to provide a clear difference they have to be taken with precaution. Charcoal consumption rates were in many cases only estimates of what they use in reality. Furthermore a lot of the respondents use firewood and charcoal together which made it more difficult for them to make a good estimation for charcoal consumption.

6.2.3Burning Sites Field Survey

Although the expectation of the field survey was very high, limited results could be achieved from the survey. The prospect was that an sufficient amount of burning sites could be visited during the field project, however unfortunately this was not possible because the research area is too large and local residents were reluctant on providing straight answers because of the illegality of the activity. Fortunately still a few burning sites could be identified and some interesting patterns could be seen. When analysing the location of the burning sites it seems that they are found close to the settlements. On the other hand interviews revealed that because of the illegality some respondents prefer to perform charcoal burning more into the forest areas.

7. Conclusion

The objective of this research was to evaluate the present status of Kaingin and Charcoal Collection in the Municipality of Puerto Princesa. This objective was answered by summarizing the results given from the discussion.

7.1 Forest Conversion (Kaingin)

Within the study area Kaingin is still a practice that can be found, but then only in low quantities. Although the practice is officially considered ''illegal'' throughout the study area, Kaingin is still being done, especially more in the remote area.
From the identified stakeholders all of them performed Kaingin, but differences could be seen in the intensity that the groups perform it. More indigenous seem to perform Kaingin at the map: ''*Stakeholders groups Kaingin per village''* in the mountainous areas of East Tagabinet and South East Cabayugan this practice is most dominant. Furthermore The Migrants mainly perform Kaingin along the coastal areas of Cabayugan. Luckily only a minority of the people out of the population sample perform Kaingin (18.6 %) and the majority prefers the use of permanent land *(See Table 3).*

Although the Central Government and the PCSD have introduced the ECAN framework with the purpose to manage the different land uses properly when looking at the research this has only partly succeeded. Because the Core and the Buffer Zone were originally introduced to prevent or minimize human activity and the negative impact on the environment related to these activities.
The Kruskal-Wallis test (in combination with table 3 & 5) revealed that most Kaingin practitioners are found in the Buffer Zone and then the Core Zone. Even in the Multiple use Zone (where most activity takes place) the Kaingin Area is very high, although the number of practitioners is lower than in the Buffer and Core Zone. The reasons for the Kaingin seemed to be lack of (money) resources and Indigenous livelihood habits *(Ketterings, 1999)*
Therefore the objective of the Philippine Government to tackle the reduction of the Natural Resources of Palawan has only partly been achieved and a new concept of community based management should be considered if the government wants to tackle the problem completely.

7.2 Charcoal Collection

7.2.1 Charcoal Production

The practice was still found in the study area although the practice is considered forbidden. The practice was found in a few more remote areas located in Western Cabayugan and North-East Tagabinet in a total of eight villages *(See Appendixes K).* The Burning Sites that were found with the Burning Site Survey mainly were found close to the settlements and Respondents told that they get the fuel resources mainly from the adjacent forest *(See Appendix J)*.
Two main groups are involved in the charcoal production; one group are the Indigenous Tribes (Tagabanua Tribe) near Sugod 1 and the other group are local residents close to Tagnipa-Bayatao *(See Appendix K).* Eight different trees were distinguished that were used to make charcoal and of these trees two species were used frequently; *Tristania decorticata* and *Elmerallia platyphylla*. Trees in the adjacent areas were cut down and then used completely for the Burning of making charcoal. An average of 9000 kg of charcoal was produced per year when all the 15 respondents are compared with each other. Unfortunately this number does not provide a significance, because no sample size was used. Therefore additional research should be necessary.
Different problems were identified with the main problems loss of forests and the loss of natural resources. A literature search underpinned that loss of forests is a main problem that can inflict erosion and other environmental issues *(Briones, 2007).*

Although the respondents seem to be aware of their impact they still produce charcoal. The main reason in accordance with the interview was the lack of money resources and alternative jobs.

In summary it can be said that although the charcoal production is forbidden it still occurs, but apparently in low numbers. The charcoal producers are spread throughout the study area, but more located in the remote regions. Although problems still can be seen, respondents state that the environmental effects have decreased in comparison with 30 years ago due a new approach of community based management and improved regulations set up by the DENR. But to stop the illegal production completely some alternative measures should be looked upon that are of benefit for the local communities.

7.2.2 Charcoal Consumption

A complex system of charcoal consumption is found in the study area a variety of actors is involved. On the one hand are the producers and on the other hand the consumers. Most producers sell the charcoal to a Sari-Sari store in the different villages. This Sari-Sari than sells the charcoal sacks again to the local villagers. If not sold to a local Sari-Sari store the producers would sell their product directly. The people that are supposed to consume the charcoal are mainly vendors (Sari-Sari Store) that have an average income *(See Table 13).* In total 46% of the sample population consumes charcoal. The majority however consumes firewood (72% of the sample population) gathered from the forest edges. In addition almost no people use more convenient or green energy resources. This trend can be explained with the energy ladder *(Alam , 1985).* If money resources are limited people tend to use cheap, less environmental-friendly resources. Most people in the study area have a low monthly income (below 10.000 PHP) therefore many people rely on 'cheaper' natural resources that have the intention to be destructive. Charcoal is normally for the more 'fortunate' inhabitants and firewood for more marginal communities. This trend was seen in the study area when the different zones were compared. Most charcoal was consumed in the Multiple use Zone (where most villages are located) and most firewood was consumed in the Core and Buffer Zone (with more small settlements) *(See Appendix L).* The Kruskal-Wallis confirms this trend, because a significant difference was found between charcoal consumption of the Multiple use Zone in comparison with the Core/Buffer Zones.
To come to the point it seemed that almost half of the sample population uses charcoal as a fuel resource while the majority is depended on the use of firewood due to a low income rate. As long as this demand remains the charcoal production will remain, because a lot of money is involved. Therefore if the government wants to counter charcoal production the demand should be handled with alternatives.

8. Recommendations

8.1 Forest Conversion (Kaingin)

Possible Solutions:
Despite the fact that there already has been a shift towards more community based management and the willingness to change is great, changes are going slow and are implemented inefficiently *(Suarez, 2010)*. Policy instruments are there as the AFMA (The Agricultural and Modernization ACT) of 2007 which has identified and delineated a Network of PD's (Protected Areas) for Agriculture and Agro-Industrial Development (NPAAAD). But these instruments are hard to implement because of the lack of resources and political will to implement these changes. In addition local communities make it even harder by favouring livelihood activities instead of environmental protection due to a lack of money resources *(Briones, 2007)*
Therefore a solution should be an extensive land/resource use planning approach in combination with explicit/definite goals for alternative land use. Four elements of such a framework could be identified namely;

1. initiation of enhanced community-based/participatory land-use planning approaches
2. socio-economic support to improve the capacity to manage natural resource efficiently
3. increased investment in information/communication technology (provision of education/training) in more environmentally-friendly production methods
4. assessment/monitoring and evaluation of the on-going process and the environmental impacts on the whole system *(Briones, 2007)*

To transform these 4 elements into more tangible solutions some examples were given that serve as down-to-earth approaches.

1. One interesting example is the usage of an agroforestry system identified called " The *Sisipan System''* from the island of Sumatra, Indonesia. This traditional system is where no Kaingin practices are being used, but rather selectively less profitable trees are removed and being replaced with rubber seedlings. This system serves as economic quite profitable and a permanent alternative for slash-and-burn practices. Other advantages are; pest damage is reduces, family labour is enough, it is a simple management activity, it can be practiced with little/no capital resources *(Wibawa, 2005).*
2. In Barangay Ducligan in the Cordillera Administrative Region in Luzon, Philippines Kaingin practices play an important role. But because this practice becomes a problem an initiative was introduced by CHARMP (Cordillera Highland Agricultural Resource Management Project) that involves the introduction of an high-valued agroforestry system. This system introduces high value trees (Rambunta, Lanzones, Durian and Guayabano) and is then intercropped with banana and pineapple with vegetables in between. This farming system is a good way of using indigenous tree species as cash crops and in the meantime growing vegetables, fruits for household usage. This project is therefore very interesting, but may be very intensive (because training, seed material, monitoring and supervision are high necessities for the success of such a long-term project); *(National Economic and Development Authority, Consulted on 27th August 2012)*

Going into detail the focus should be put on The Indigenous Tribes and the Migrants in the far outskirts of Western Cabayugan and Eastern Tagabinet. Some projects are already going on:

1. Community Based Micro Enterprise Project implemented by the NGO ELAC where extractive activities as agriculture, NTFP collection, souvenir shop, livestock dispersal and a retail store are increased and supported via financial capital. These activities are organized under different association namely; The Cabayugan Community Tourist Association (CCTA), The Tagabinet Community Tourism Association (TCTA).

Both associations are involved in tourist activities as the production of bags, baskets and other souvenir items that are saleable on site that provides jobs for local *people (The Global Environment Facility, Consulted on 27th August 2012).*

2. Market development for NTFP forest products in the catchment of the PPSRNP. This program has been identified by the PCSD and implemented via the Palawan Tropical Forestry Protection Programme (PTFPP), a project financed by the European Union (EU) and started in 1995. NTFP's include *rattan, almaciga resin, bamboo, honey, medicinal plants and more.* The programme tries to establish a more professional trade that they do via; strong reactivated cooperatives and local associations, shorter market channels, increase supply of finished products, introduction of support services (infrastructure, financial capital) and a coordinative system where profits are equally shared *(Food and Agricultural Organization, Consulted on 27th August 2012).*

Although these project are already going on not everybody is involved in these projects, especially more marginalized communities who live on the outskirts of the study area (Batak tribe, Migrants in Western Cabayugan). To guarantee that illegal Kaingin is stopped these people have to be involved. To start an education program on how to plant NTFP's via an agroforestry *system (in combination with the present slash and burn system)* would be beneficial for these communities *(See the CHARMP and Sisipan examples)*. This program can be executed by an organization as ELAC. Furthermore these marginalized people should be grouped into community associations to strengthen their voice. Thirdly regular monitoring should be done by an independent NGO that is not involved in the local political system to guarantee a transparent process. In addition land use rights should be considered, because marginalized people do not have official documents and problems may arise if this matter is not taken into consideration.

In the future other livelihood resources as ecotourism can be introduced, but experiences from the past revealed that the Indigenous people did not greatly benefitted from these projects. This is due to the economic environment where they are not used to. Furthermore Indigenous people do not have the technical skills and western attitude to implement these project. Many projects therefore failed and people started Kaingin practices again. Therefore if introduced this process should go slowly and understandable for the local communities to be a success *(Cola, 2007)*.

8.2 Charcoal Collection

8.2.1 Charcoal Production

Possible Solutions

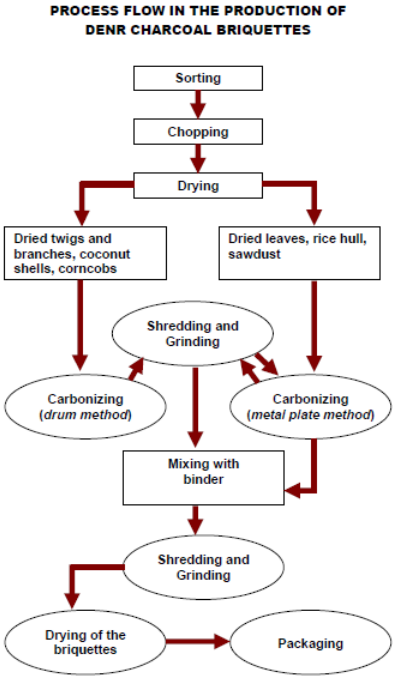
Sustainable production is not an easy task. Especially not because at the present state not much focus is given to sustainable charcoal production in the study area. This production has to be managed and planned properly in combination with proper trade and marketing infrastructure and efficient use. But to introduce such as system many obstacles have to be over won due to lack of financial resources, institutional capacity and unskilled people.
In the next paragraph some alternatives are provided that might tackle the present charcoal issue:

1. One way of countering the problems encountered in the study area is the usage of more efficient charcoal stoves. At the moment people are burning the charcoal on a burning site made of natural products (wood is put in dug-out earth pits and then covered with earth). Instead of this method a more productive technology can be used namely the usage of earth kilns with chimneys made from oil drums and/or by the introduction of small-scale steel/brick kilns. The benefit is that this method improves the yield significantly.

Instead with the traditional method (1 kg of charcoal from 8-12 kg of wood) this method produces two times the amount (1 kg of charcoal from 6-8 kg of wood).Unfortunately expenses for this method are high, so less accessible for traditional charcoal makers (*Stassen, 2002);(Adam, 2009).*

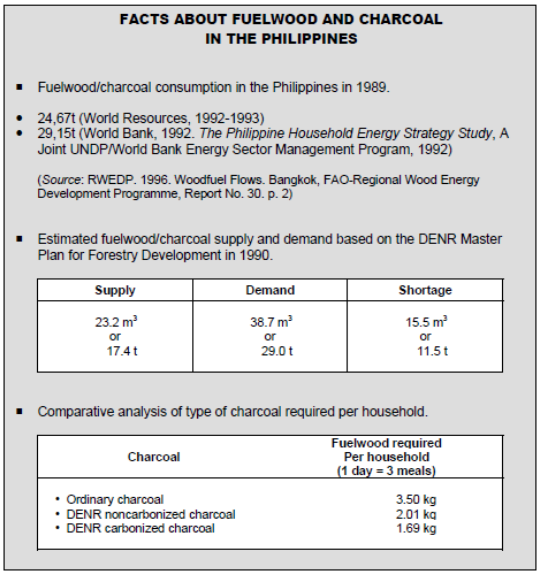
2. An interesting alternative is the introduction of eco-friendly charcoal briquettes. The Aurora State College of Technology (ASCOT) in Baler, Philippines has introduced such a system. A mixture of leaves, twigs, coconut waste and rice hull is used here as a basis for charcoal. The process involves a slow burning of the raw materials, grinding and bind them into cassava starch. It ends with pouring the mix into a moulder and let it sun-dry *(See Figure 6)*. A ton of waste is needed to produce 250 kg of charcoal briquette and although the yield is lower, they burn much longer than regular charcoal piles. An execute field survey by ASCOT revealed that production of nearly 80 tons can save up to 7000 trees per *year (Loqap ph, Science and Education, www.loqal.ph/science-and-education).*
   Another example is the DENR Charcoal Briquettes Project that was executed by the Ecosystems Research and Development Bureau (ERDB) and the Forest Products Research and Development Institute (FPRDI). This is a very similar project as the ASCOT, but the advantage is that their website provides an overview of the Briquette production process *(Department of Environment and Natural Resources, Consulted on 30th August 2012).* An analysis revealed that if normal charcoal would be used then 3.5 kg would be used for 3 meals. In comparison if carbonized DENR charcoal briquette would be used then only 48% (1.69kg) would be used of that 3.5 per 3 meals *(See Figure 8).*
3. The introduction of a tree plantation or an agroforestry system for the purpose of wood fuel production is a good option to counter the collection of slow-growing endangered tree species. A case study done in Cebu revealed although not much natural forest remains, charcoal production is still a common practice, but then the source mostly derived from types of wood fuel lands. Some species that are regarded for their quality are; Leucaena leucocephela, Leucaena glauca, Gliricidia sepium, Gmelina arborea and Swietenia macrophylla. Especially Leucaena leucocephela and Gliricidia sepium are very useful species. Dry Leucaena leucocephela has a calorific value of 4703 kcal/kg and Gliricidia sepium has ca calorific value of 4.569 Kcal/kg which is similar to that of other (more-slow growing) dry non-resinous hardwoods (with an average 4500 to 4770 Kcal/kg); *(Mainoo, 1996)*.
   This is because besides a fuel resource they provide a variety of purposes; they can be used for live fencing (hedgerows), fodder, green manure and rat poison. Especially in areas that are regarded as highly susceptible for erosion these trees are very good for planting to serve as a natural buffer system *(Remedio, 2012)*.
   After trees are coppiced from the land they can be processed either into charcoal briquettes or by the usage of a kiln.

Figure 7: Process Cycle of Charcoal Briquette Production



Source: Department of Environment and Natural Resources, Consulted on 30th August 2012

Figure 8: Fuelwood/Charcoal Supply and Demand Rates



FACTS ABOUT FUELWOOD AND CHARCOAL IN THE PHILIPPINES

- Fuelwood/charcoal consumption in the Philippines in 1989.
  - 24,67t (World Resources, 1992-1993)
  - 29,15t (World Bank, 1992. *The Philippine Household Energy Strategy Study*, A Joint UNDP/World Bank Energy Sector Management Program, 1992)

  (*Source*: RWEDP. 1996. Woodfuel Flows. Bangkok, FAO-Regional Wood Energy Development Programme, Report No. 30. p. 2)

- Estimated fuelwood/charcoal supply and demand based on the DENR Master Plan for Forestry Development in 1990.

Supply	Demand	Shortage
23.2 m^3 or 17.4 t	38.7 m^3 or 29.0 t	15.5 m^3 or 11.5 t

- Comparative analysis of type of charcoal required per household.

Charcoal	Fuelwood required Per household (1 day = 3 meals)
• Ordinary charcoal	3.50 kg
• DENR noncarbonized charcoal	2.01 kg
• DENR carbonized charcoal	1.69 kg

Source: Department of Environment and Natural Resources, Consulted on 30th August 2012

Although these alternatives provide a good basis for improving sustainable and more efficient charcoal production, socio-economic aspects should be taken into consideration if a charcoal project is implemented. A set of socio-economic actions might include:

- The establishment of Community Forest Management Programmes to avoid deforestation
- Making charcoal production marketable, this encourages makers produces permanently and eventually discourage illegal production. Appropriate policies and training should be considered for this action.
- Provision of a range of alternatives for sustainable charcoal production.
- Introduction and promotion of forest residues (palm leaves/coconut shells), plantation timber resources. This action can be achieved by policies and pricing.

To actualize the mentioned alternatives in a socio-economic action framework at first the charcoal production group has to be approached. The group is similar to the Kaingin practitioners: they are the marginalized people of the study area and live mainly in the remote areas. One project has already provided an alternative income for some of the charcoal producers (A tree nursery with indigenous trees near Sugod 1) , but still a lot of people are not involved *(Cola, 2007)*.
A project where a tree plantation or agroforestry system with qualitative charcoal species is being implemented is a good alternative for illegal charcoal production. Ipil Ipil *(Leucaena Leucocephela)* or Coconut *(Cocos Nucifera)* are good choices for a profitable burning value. These tree resources can then either be processed via Kiln burning or via the development of charcoal briquettes.
But to establish this, education should be provided, charcoal producers should be organised into professional associations and market access should be created. A local NGO (Centre for Sustainability or ELAC) may supervise and monitor the process of the project. A supervisor however should internalise an approach that is best suited to the cultural values of the charcoal producers otherwise the project might already fail after a short period.

8.2.2 Charcoal Consumption

If the charcoal consumption is countered affordable alternatives should be provided if before local communities will transfer onto another fuel resource. An interesting renewable energy resource is the use of wind energy. In accordance to the National Renewable Energy Laboratory (NREL) Palawan has one of the highest potential wind energy in the entire Philippines with 3,000 to 5,000 MW in comparison with the total 250 MW needed by the Palawan Population for 2011. A project developed in 1999 wants to realize the usage of renewable energy resources as wind energy to reduce long-term emission of greenhouse gases (GHG) in the Palawan. However many barriers have to be overcome before introduced; limited capacity Local Government Unites (LGUs), lack of awareness about renewable energy, lack of expertise to perform market-research, lack of financial support systems. To contravene these barriers the following solutions are proposed; project awareness campaigns, renewable energy services are provided by the Renewable Energy Development Centre (REDC). Financial incentives are provided by external parties and the provincial government *(Asenjo, 1999)*.
Another interesting solution (mentioned earlier) is the use of Biomass waste. Waste from rice hull, rice stalks, coconut shell and coconut husks have great potential as fuel resource in the form of briquettes.

To conclude there are a few options for alternative energy resources. At the present stage wind, water and solar energy resources are still under development and will take a longer time to be introduced. However the biomass waste potential is already realisable in a short-term period. On the one hand charcoal production may shift towards the more sustainable charcoal production via plantation resources and additional waste material while on the other hand individual household should be educated via campaigns that waste material from their rice paddies and coconut fields should not be thrown away but rather used as an easy fuel resource. The charcoal consumption interview revealed that some of the respondents already practice this system.

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Rob van Meeteren

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