Wageningen University – **Department of Social Sciences**

MSc Management of Agro-Ecological Knowledge and Social Change

Specialization :

Chair Group : **Technology and Agrarian Development (TAD)**

Realistic Evaluation of Stove Design Process

August 2008

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ACKNOWLEDGEMENT

This study is a collection of the efforts of people from whom I received support to realize this study. My gratitude goes to the following:

My supervisor, Dr. Paul Richards not only for the guidance of this study but for generating knowledge in the TAD and Thea Hillhorst for being the second reader of the evaluation phase of the research. My classmates and friends in MAKS 21 whom I have shared wonderful memories of school and of friendship .

My Filipino friends who gave me company and encouragements, among which are Connie, Lowella and Laurence. A special gratitude goes to my friend Joebel Gurang whom I shared the energies and inspiration of the student life through deep friendship and music. My thanks also goes to Claudia who gave the encouragement, tools and expanding my vision of my career in the future and to Inge Ruisch of TAD who has not only diligently performed her task but who has also become a good friend.

To the stove technicians, Tata Rogel, Tata Apin, Kuya Pati , Bay and my colleague Sammy for generously giving their knowledge and skills; to my Belgian friends in Githo and Sint Calasanz and Bert Peeters for the providing me the "seed" of participatory technology development in my practice; to Aries Romallosa, Ron Paguirigan, Atty. Ben Ramos, Ameng, and to all other interviewees for providing a good exchange of information and technologies.

To the Ford Foundation International Fellowships programme and the Philippine Social Science Council, for providing me the support and guidance for the entire studies.

And to all others whom I failed to mention who has been part of this study, I give my deepest gratitude.

My gratitude goes to my wife Catherine for the unconditional support of the entire studies; and my children Sandino and Mirasol who shares my joy of being a family. My deep gratitude goes to my parents from whom I received the nurturing that I needed that enabled me to pursue higher goals in life.

Finally, I dedicate this study to the poor families of my home province Camarines Norte particularly the participants who generously gave their time, efforts, knowledge and skills. I humbly submit my knowledge for their use so it may become one of their instruments in facing to their own challenges of confronting the fuel crisis.

And to Almighty God, who comes in many names and forms, I humbly offer this knowledge and seek the guidance to put all these into practice.

ABSTRACT

In spite of the abundance of cheap biomass for fuel, poor families of the province of Camarines Norte still rely on fuels that are either expensive or difficult to gather. There are existing novel models of the traditional stoves that are still in use and there are several other prototypes that local technicians have introduced to the province. However, stoves are being designed and built without the benefit of learning from the past experiences and the socio-technical context of the technology. There remains poor utilization of the abundant and cheap source of fuel such as rice hull, coconut husks and coconut shells which also breeds environmental pollution. The study describes the extent of the fuel crisis and the reasons why. It also explains how families can create their own stoves through a participative and interactive design process. The study produced forty miniature models of cook stoves and five prototypes of stoves. It includes a hybrid model of a stove made of clay, cow manure and coconut fiber and with a steam injection mechanism.

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CHAPTER 1: INTRODUCTION

1.1. Introduction

Cook stoves have been part of my childhood. My parents are always struggling to have the cheapest fuel for cooking and have used wood, charcoal, gas, and coconut husk and rice hull. I clearly remember how I struggled myself to cook rice with coco husk amidst the nagging temper of my mother. I was so full of smoke, dust and heat while trying to cook with the single burner rice hull stove without any chimney.

Twenty two years after that, I already collected work experiences with NGOs in the southern island of the Philippines. My fresh insights for rural development gave me a renewed vigor to solve practical but lingering problems of food, energy, waste and sanitation, water among many other basic needs of the families in my home place.

The author with the rice hull stove and Jun Oyardo, a working youth who received skills training for the fabrication of the stove under the ILO-IPEC program, Daet, Camarines Norte, 2003.

Beginning in 1995, I had the resolve to confront the practical problem of fuel for cooking. In the same year I got a design of a cook stove from the engineering department of the International Rice Research Institute (IRRI). I created several improvements from the design and produced a new model. But before the model was fully tested by other users, everyone around was nagging to have my design patented before even selling any unit.

Patenting any design was too complicated for a struggling designer as me. Instead of following their advice, I kept on building new prototypes and experimenting with other

kinds of fuels such as coconut husk and green coconut shells. By the end of 2006, I have already developed six models of cook stoves with different applications and fuels. As of this writing, my workshop already received more than a thousand visitors who are very enthusiastic to learn from my stoves. However, after more than a decade of that experience, my prototypes remained in my workshop and in my own house. I still could not see the expected impact of my work to the problems of the poor families. Those who are living right beside the rice mills and mountain full of rice hulls still rely on wood, wood charcoal and petrol for fuel. Families at the coconut farming communities still do not use their coconut husks for cooking.

In a place called Contod (meaning "hill"), I once interviewed a mother whom I saw drying some pieces of wood at the front of her small nipa house. During the short conversation, I learned that she spends about Php 12 every two days to buy fuel wood for cooking. Under the local context, the amount is already good for an adult's two meals of rice or a family's week's supply of laundry soap.

A house between the road and the rice farm at Sitio Contod Barangay Guinacutan. (by the author).

There are no coconut farms near this village where dried palm leaves could have been a good fuel. However, there is at least three rice mills nearby spewing mountain heaps of rice hull. In September 2007, I hired a researcher to conduct a preliminary survey among ten families of this village. My small research concluded that among the ten families interviewed, eight are using wood


A typical medium sized rice mill. (by the author).

charcoal, one is using gas, one is using wood and none are using rice hull for fuel.

This exploratory study was an investigation that seeks to understand why the past models are failing if not taking off. It investigated the tensions between the need of the farming families for fuel, the abundance of the alternative kinds of fuel and the absence of appropriate models stoves. It tried to answer the question by holding a series of stove design workshops which ended with the creation of miniature models of the stoves. It was a product of direct participation unto the design process. The said processes culminated with plans to create village stove production projects.

Preparations for the thesis began on September 2007. The field research was conducted for five and a half months January 2008 to May 2008. Writing the manuscript was from June to August, 2008 at Wageningen University.

This master's thesis consists of 6 chapters. The bulk of the discussions are embodied in Chapters 3 to 5. Chapter 3 presents the Context, Chapter 4 the Mechanisms and Chapter 5 the Outcomes. It ends with concluding statements that explains the prevailing fuel crisis and about the discovery of pool of possible solutions.

In many instances, I used the first person point of view because of the high level of my personal involvement in the entire conduct of the study. Aside from designing, organizing and facilitating the stove design workshops, I also personally fabricated the stove models from the past which I also used to stimulate the field research. All the while I had to keep my second but primary role as the researcher.

1.2. Research Objectives

1.2.1. Addressing Development Problems

This study worked to provide a pool of answers to the prevailing environmental and poverty complex of the poor families of Camarines Norte as manifested in their capacities in coping with poorly designed cook stoves and poor access to fuel for cooking.

1.2.2. Understanding the Problem

- To identify the actors and investigate their roles, interests and resources in the domain.
- Explain why the existing stoves are helping or not helping the poor resolve their problems with fuel.
- To identify, interpret and evaluate the constraints and challenges facing the full development of the cook stoves of the province of Camarines Norte.
- To provide recommendations to address the results of the research.

1.2.3. Improving Conceptual and/or Methodological Frameworks

- To understand the prevailing technological system of cooking stoves and explain how poor families are using or not using them and why.
- To create a design process where mechanisms can be identified to support or prevent the success of the technology.
- Propose a system of designing stoves that may be able to confront the problem.

1.2.4. Personal Objectives

- To learn to do a realistic evaluation.
- To design evaluation programs for other technologies in the province such as recycling centers, rain water tanks, composting systems, gardens, among many others.
- To create appropriate technology design programs for such projects.
- To formulate policy agenda that will support the results of this study.

1.3. Conceptual Framework

1.3.1. The Activity Theory. This theory argues that activities happen in a social context. People organize the situations of every activity by integrating and being integrated as subjects to the object and the instruments becoming a unified whole. Operations become meaningful from a meaningful set of meaningful actions within complex societal activity systems. Situations are constructed as people organize themselves to attend to and give meaning to figural concerns against the ground of the ongoing social interaction (4). Thus study will investigate the processes of designing stoves in five contexts of different communities – rice farming, coconut farming, fishing, food vendors and urban poor. These five situations will be an integration of the actors and their relations, their knowledge and skills, and the materials and instruments available. Please see Section 3.3 for further discussions.

1.3.2. The Realistic Evaluation Cycle

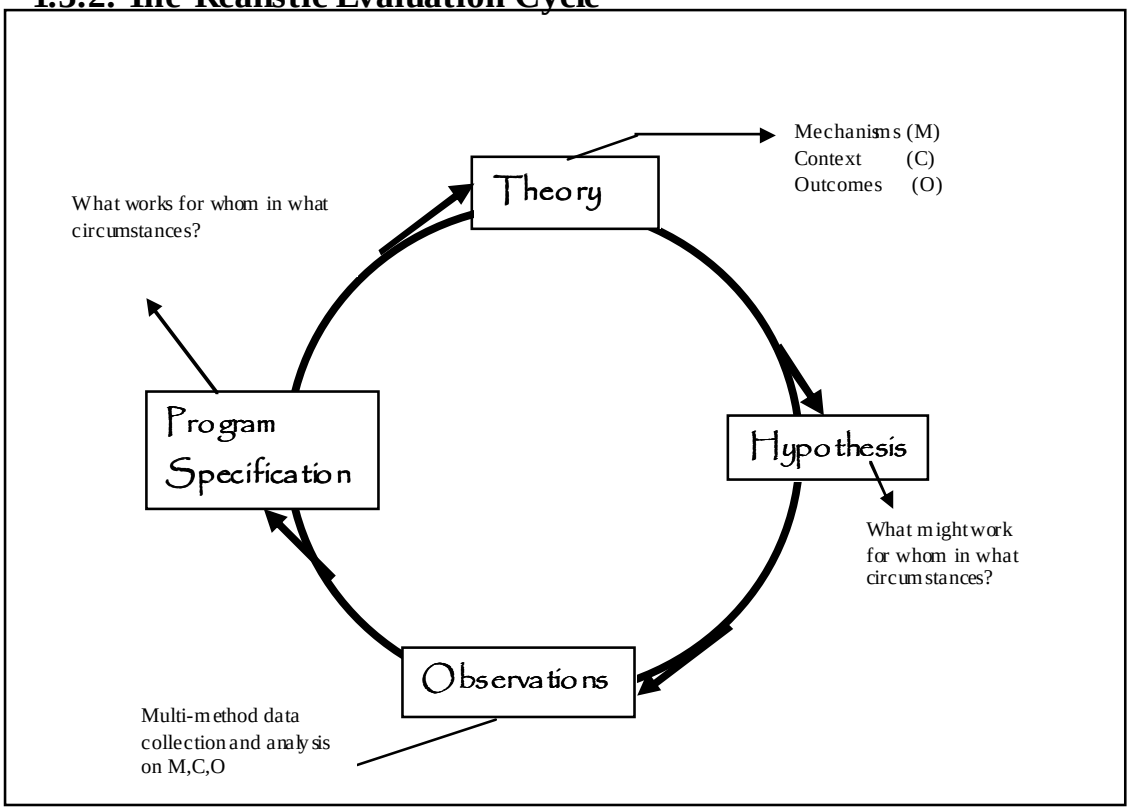


Exhibit 1. The Realist Evaluation Cycle
Source: Pawson and Tilly, 1997

This cycle follows the basic logic of inquiry as those of social and natural sciences (5).

Theories are constructed in abstract terms. Hypothesis that would explain its regularity are then created from these theories. Observations are then undertaken to see the validity or not of the hypothesis. Finally it tries to see how such hypotheses are embedded in the program. New theories are then created out of the first cycle (5).

Taking off from the Realistic Evaluation Process, this study organized the components the domain of stoves into the C-M-O configuration. There are at least five political-economic and social domains that are affecting designs of the stoves. From these domains come the candidate mechanisms that can make the stove designs a success or

failure. Table 1 presents the candidate mechanisms for specific contexts and the possible outcomes.

This is my hypothesis. There are five domains covering the context of the stove design process and there are candidate project and social mechanisms that embedded in the given context that can produce the potential outcomes.

Table 1. Candidate Mechanisms.

Domain	Context	Project Mechanism	Social Mechanisms	Possible Outcome
Technology	Institutes have developed different models. Local models by local artisans	Improved technical performance Improved access to the manufacturer	. Provision of warranty and after sales service	Failure of some models because of inaccessibility. Patronage of locally produced models but on a limited scale.
	Patenting systems for inventions and innovations	Improved access to the stove designs. Participation and ownership of the technologies.	Inclusion of other potential manufacturers	Limited popularization of stove units. Slow maturation of stove designs.
Environment	Increased vulnerability from natural hazards due to deforestation		Legal and social pressure against wood charcoal production	Reduced production of wood charcoal or shift to alternative fuel sources
	Emissions of noxious gases Risks from burning in open dumps Air pollution from open dumps and indoors	Improved cook stoves that draws smoke out of the house.	Legal and social pressure against open dumping and burning of rice hulls	Reduced risks from accidents Reduced indoor air pollution
Economy	Increasing prices of gas The decreasing demand for gas and increasing demand for wood charcoal Increased poverty incidences And reduced food security	Design and mass production of low cost and appropriate stove models.	Creation of small scale village enterprises on stoves and fuel.	Reduced pressure to cut forests for wood charcoal Improved family income New employment opportunities for fabrication of stoves and supply of fuel

governance	Existing laws for Air, Water, Renewable Energy , Solid Waste and Biofuels Laws for forest protection		Penalties for violators Incentives for projects that support the law	Reduced cutting of forest wood for charcoal Reduced dumps of rice hull
Community Relations	Highly centralized and controlled rice mills and coconut mills	Non participation in designing the houses	Open Access to agricultural wastes from the mills as fuel	Quick shifts to agricultural wastes for fuel Birth of village livelihood enterprises on stoves and fuels.

During the field research, I was on the watch and carefully selecting the mechanisms that can be triggered on a context that is also slowly evolving as the field research progresses. During the field research, I have decided that among the mechanisms that are existing in the study area, the strongest mechanism that I can use are (1) participation and (2) open access to stove building technologies. From what I collected, I rearrange this configuration and is presented in Section 6.1.3.

1.3.3. Two Opposing Models of Stove Design Process

For this study, I believe that stoves in the province of Camarines Norte are being and have been designed to follow the **Consumerist Model** of the stove design process(6). It is a model that is supported by the highly centralizing tendencies of the market. It assumes that the outsiders know better than the locals. It forces the consumers to adapt their demand to the product. It alienates the local inventiveness of the population and ends up with a very few and uniform product.

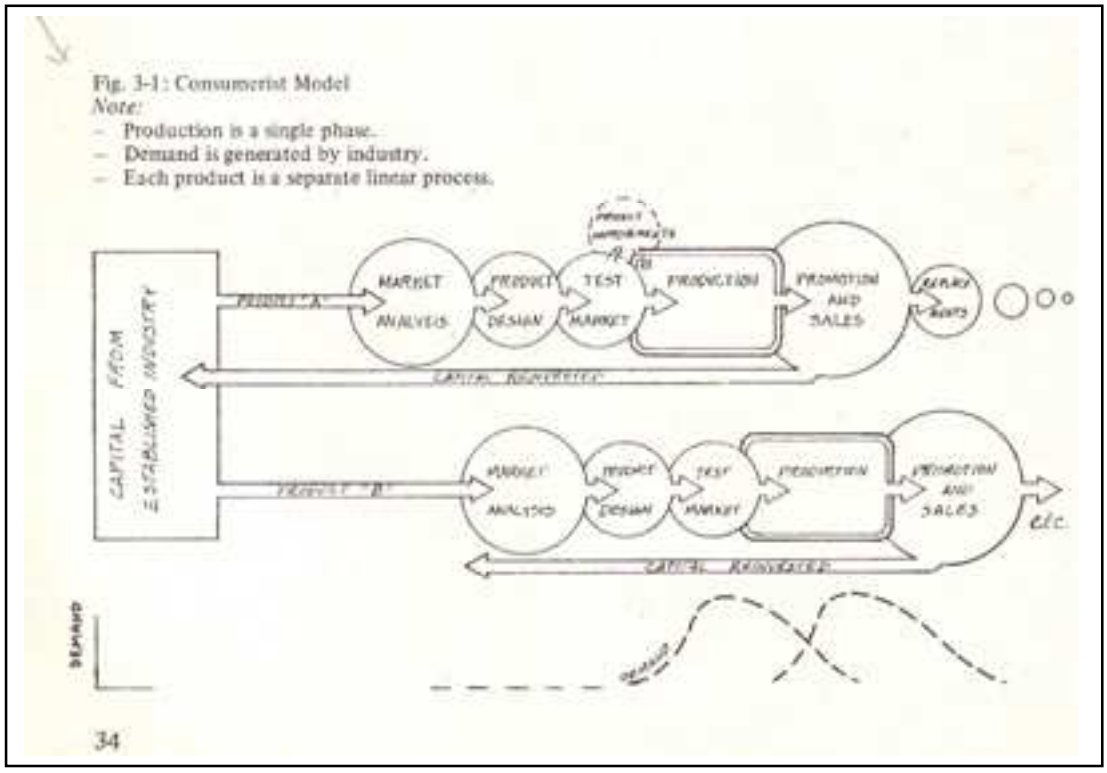


Exhibit 2. Consumerist Model of Stove Design Process, Approvecho Institute.

It can be fast but would exclude the poor families from using the product and will drain the local economy of their resources in favor of the manufacturing industries. Going further, stove design will be successful if it follows the Grassroots Approach as demonstrated by the **Design by Evolution Model** (6).

This model stimulates local inventiveness, participation and mobilization of local resources. People will gain the sense of ownership. Relevance to their needs are enhanced thus, they are likely to support it. It allows the creation of multiple products that will suit to the wider range of needs.

It adapts well to rural areas and neighborhoods with close family or social organization and for small village workshops or home production. Production can be much slower.

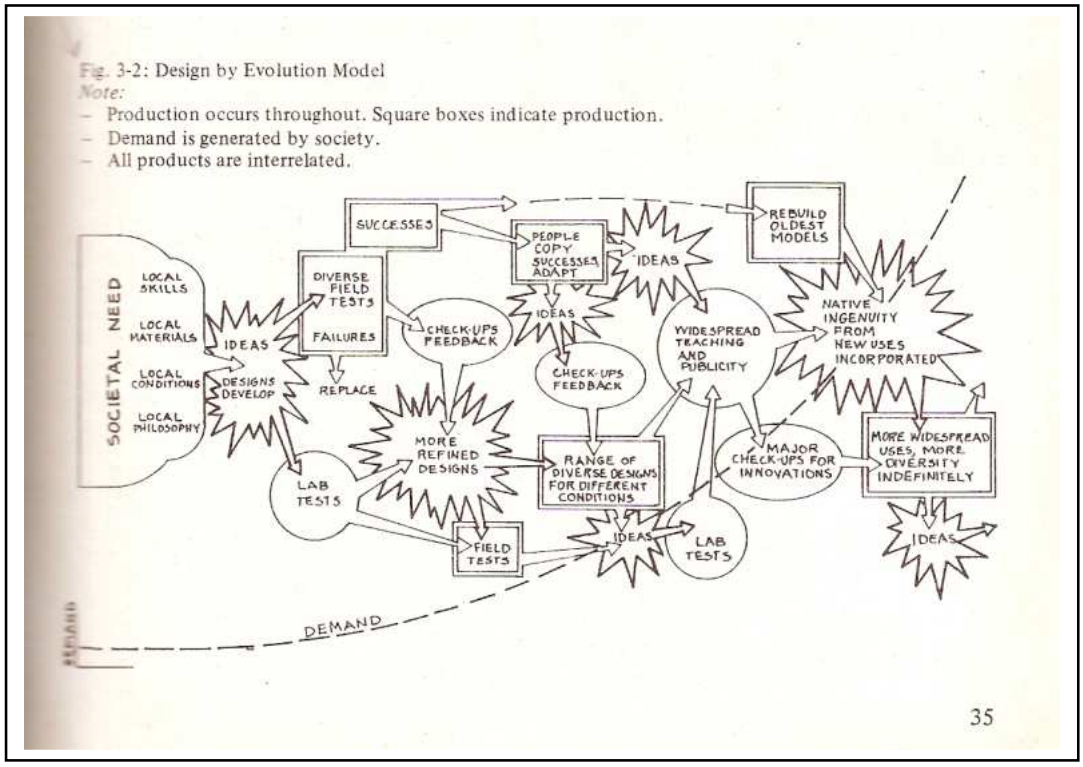


Exhibit 3. Design by Evolution Model of the Stove Design Process. Approvecho Institute.

The model begins with the mobilization of the local skills, materials, conditions and philosophies. Driven by the needs of the society, these elements produce ideas and designs are developed. Some interest groups or individuals may work on laboratories; others will conduct field tests and produce successes and failures. Along the way, feedbacks will be solicited and can be checked with the results of laboratory trials to produce more refined designs. Along the way, people may copy the successful designs and create more diversified designs for different conditions. The designs are widely open for public access, thus are promoted widely and openly through teachings and promotional activities.

Throughout the process, people will find mechanisms to fire up on the new sets of conditions, be it a result in the laboratory or field tests or new interests and applications. Each time there will be points for decisions and selection of certain features, designs and innovations.

1.3.4. Principles of Self Regulation

The purpose of a functional and self-regulating design is to place elements or components in such a way that each serves the needs, and accepts the products of other elements.

A pollutant is an output of any system components that is not being used productively by any other component of the system. Extra work is the result of an input not automatically provided by another component of the system.

Bill Mollison
Permaculture: A Designer's Manual, 1992

Bill Mollison uses the chicken to illustrate the argument. The chicken has need such as food, water and shelter. It also has products such as meat, eggs, feathers and manure. It has behaviors of scratching, foraging, flying and fighting. The chicken has intrinsic characteristics according to its breed such as color, tolerance to climate, among others (7). A permaculture system would create a design that will provide the chicken of its needs and

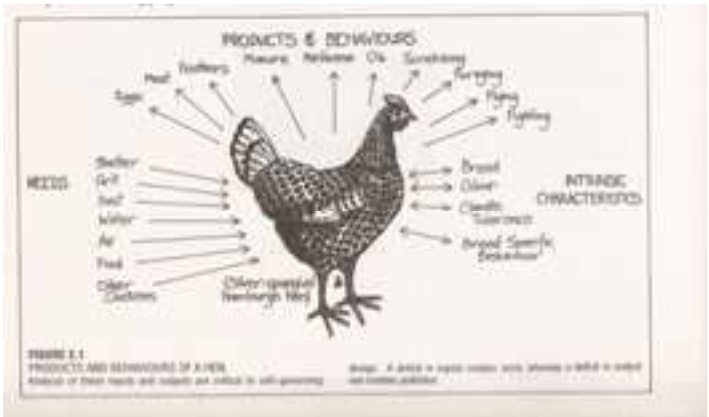


Exhibit 4. The Chicken in a Permaculture System. Source: Permaculture Designer's Manual. Mollison 1992.

will use it products in full consideration of its intrinsic properties. From this evolved designs which places chicken in orchards, in mobile cages, near the pond and pasture. In contrast, commercial poultry production would place chicken in small cages which immobilizes them, just enough to feed and give meat and eggs(7).

Using the preceding principle of self-regulation, stoves should be designed under a strict connectivity to the other elements in the system, namely the kitchen, the house, the household members, the garden, the farm and the sources of fuel in the community. They should support the needs of the family not only for cooking but should also support the health of the family and the social relations in the household and among the immediate neighbors.

Stoves require fuel. They should be designed in a way that will enable the users gain access to the nearest and cheapest source of fuel. In the same way, the sources of fuels such as mills, farms and gardens should be designed to provide the families easy access to these fuel sources. Mobile micro rice mills are excellent examples of appropriate design of rice mills because the rice hulls will remain within the vicinity of the rice farm.

Stoves give off heat. Excess heat coming from the chimney can be utilized by creating hot air box dryers. The stoves should provide facilities where heat will be utilized for productive purposes such as drying fruits, vegetables, fish and meat products. This is especially helpful in places like Camarines Norte where the climate has high amount of rainfall in most parts of the year.

Stoves give off carbon, dust and smoke. They should be designed to utilize the carbonized fuel for improving the soil of the garden or the farm. Carbon from the spent fuel can be harvested by letting it fall on a bucket of water placed beneath the stove. Please see Exhibit 8 . The harvested carbon is an excellent soil ameliorant for farms and gardens. It also reduces emissions of carbon dioxide. Without this simple technique, stoves will cause too much indoor pollution.

Stoves that are designed in isolation from these elements are likely to be more expensive, will cause pollution; will demand too much fuel and energy inputs.

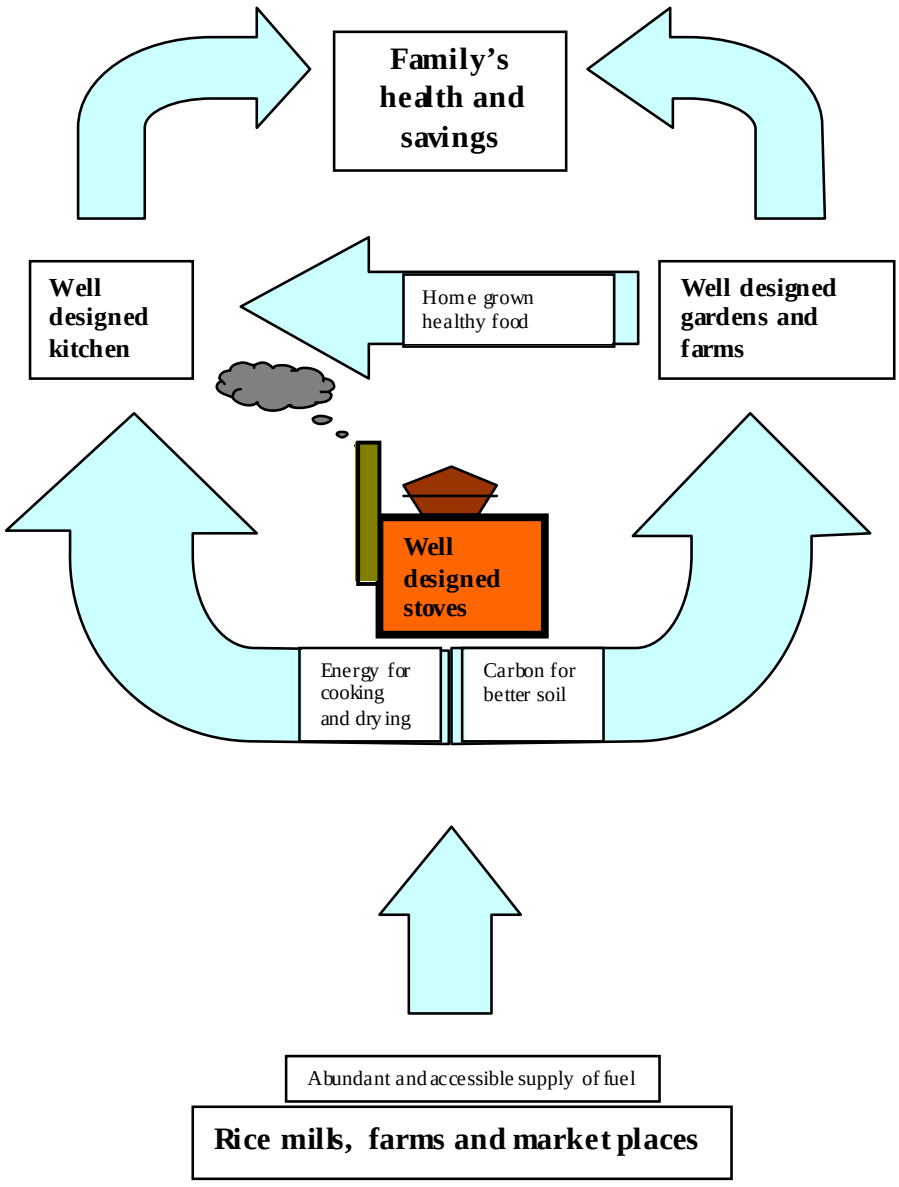


Exhibit 5. The Household Scale Fuel System (by the author).

This model explains the interconnectedness of the stoves to the other elements of the energy system in the household. A well designed stove will utilize the abundant and

accessible supply of fuel from the nearest farm or mill. It provides energy for cooking and for drying. It also provides carbon for improving the soil of the gardens and farms, which in turn provides the food supply to the kitchen. The kitchen, gardens and farms must also improve on how they are designed and must support the other elements in the system as well as benefit from the properties of the other elements. The farms, mills and market places should also improve on their designs towards those that provide the families better access to fuel. The expected outcome of the stove design would be improved health and savings of the household.

1.3. Statement of the Problem

In spite of the abundance of cheap biomass for fuel, poor families of the province still rely on fuels that are either expensive or difficult to gather. They are burdened by collecting wood fuel for cooking and more of them have to spend for fuel, such as gas and charcoal. The forests of the province are also under threat because of massive production of wood charcoal as induced by the rising cost of gas.

There are existing novel models of the traditional stoves that are still in use and there are several other prototypes that local technicians, including myself, have introduced to the province. However, there is no study about the effectiveness or ineffectiveness of the stoves designed. Thus, stoves are being built without the benefit of learning from the past experiences and the poor families are still not able to utilize the abundant and cheap source of fuel such as rice hull, coconut husks and coconut shells in a wide and sustainable scale. Appendix 1 Tables 1 and 1.2 present the volume of coconut production in Camarines Norte from 2005 to 2007. Table 3 presents the volume of rice production in the province. Both presentations shows that with the population of the province of Camarines Norte of 470,654, each family could more than twice enough fuel of rice hull and coconut husks.[1]

[1] The province produces 637,970.53 nuts per day thus could provide the population of 470,654 more than twice they need based on my personal experience of using my coco husk stove. The province can also provide 0.17 bags of rice hull per family per day from the required 0.3 bags per family per day.

Table 1 presents the patronage to different kinds of fuels of selected sectors. It shows the families of different sectors that are living in close proximity to the abundant source of fuel. It also shows the extent of use and non-use of these abundant sources of fuel. Table 2 presents the prices of different kinds of fuels.

The burden of collecting wood for fuel at the study area falls even on children. (By the author).

Table 2. Volume of Consumption of Different Kinds of Fuel per Sector, Camarines Norte, October 2007.

Sector		Fuel												
			Wood		Wood Charcoal		Cocoshell charcoal		LPG		Rice Hull		Coconut Husk	
	Population of the sector	Total Number of Respondents	Number of Users	Volume of consumption per month (bags)	Number of Users	Volume of consumption per month (bags)	Number of Users	Volume of consumption per month (bags)	Number of Users	Volume of consumption per month (cylinders)	Number of Users	Volume of consumption per month (bags)	Number of Users	Volume of consumption per month (bags)
Rice Farming Contod, Guinacutan, Vinzons	2681	10	1	2	8	17.75	0	0	1	1	0	0	0	0
Coconut Farming San Antonio, Labo	1159	10	2	8	5	15	2	7	1	0.5	0	0	0	0
Urban Poor 2Brgy Awitan, Daet	6666	10	2	4	3	14	1	6	2	3	0	0	0	0
Coastal community Mangcamagong	1242	10	2	5	6	13	2	8		0	0	0	0	0
Food Vendors In Front of City Square	20	10	0	0	7	42	1	1	2	18	0	0	0	0
Food Vendors	35	10	0	0	9	333		0	1	3	0	0	0	0

Table 3. Comparative Prices of Different Fuels, Camarines Norte, 2006.

Source: , Consumer Price Index, National Statistics Office, Daet, Camarines Norte.

MONTH		PRICE (IN PESOS)		
	LPG Petron Gasul, 11 kgs.	LPG Shellane, 11 kgs.	Chacoal, Coconut, Sack	Firewood, chopped branches
				100 piece bundle
January 2006	513.50	515.17	128.33	125.00
February 2006	533.67	532.50	123.33	125.00
March 2006	535.25	539.25	125.00	125.00
April 2006	504.42	504.42	125.00	125.00
May 2006	448.00	457.75	125.00	125.00
June 2006	473.08	478.25	124.17	125.00
July 2006	475.33	480.25	122.50	125.00
August 2006	489.50	494.75	123.33	125.00
September 2006	502.33	510.58	123.33	125.00
October 2006	498.00	504.17	124.17	127.50
November 2006	479.00	484.67	125.00	125.00
December 2006	479.00	482.17	126.67	125.00

1.4. Research Questions

1.4.1. What models of stove are now available in the province of Camarines Norte and how were they developed?

- Who owns the designs and how are they accessed by the users?
- Are there existing exclusivity protections to these designs? What are they?
- How were they popularized?

1.4.2. Why does poor families use or not use rice hulls and coconut husks for their fuel for cooking?

- What are the attitudes of the families about these stoves?
- How does this affect their quality of life?
- How does this affect the environment?
- How does it affect their community?

1.4.3. What are the prevailing modes of design process of technologies of cooking stoves?

- Who are the actors and what are their motivations?
- What is the social structure of the domain of fuel and stoves?
- Where is the fuel coming from and who owns it?

1.4.4. What are the mechanisms that would make the technology of the stoves become successful or not successful?

- Under what context do these mechanisms work or not work?
- What are the outcomes of these processes?

1.4.5. How do these mechanisms work in a particular context?

Chapter 2 : Review of Related Literature

This chapter looks into eight literatures that provided the study with the necessary philosophical and theoretical foundations. Chapters in the references relevant for the study were reviewed and analyzed within the framework of the objectives of this study.

2.1.1. Realism and Social Science

By Andrew Sayer

Sayer in this article defends realism and goes further in defining critical realism. He made references to the works of Roy Bhaskar who pioneered critical realism. His opening paragraph makes a strong statement about the independent reality about the world. He says that there is a world that exists and will exist that is independent or anyone's interpretation. It can only be interpreted under certain descriptions within a particular discourse and some descriptions are better than the others. No one has the privilege of having an access and holding the truth.

He presented the critiques of positivism on arguments that it explains the society on matters of predictable regularities. He argues that the society is an open ended entities and that it is continuously evolving and cannot be equilibrated. Realists respect the open and tangible social systems that are, in many situations, unpredictable and remain changing but not consider this as a constraint.

Sayer discussed further the key features of critical realism by presenting the transitive and intransitive dimensions of knowledge and its real, empirical, and causal dimensions. He discussed causation and makes a clear distinction of how it happens from a positivist point of view to one of a realist. The former anticipates regularity as soon as a cause was triggered and producing an effect. The realist would respect the social structures in a given context and the mechanisms that make the context evolve. As soon as another mechanism was triggered, then a new event will happen, still with the given previous context.

Among the examples of realist research was the work of Ray Pawson and Nick Tilley on the evaluation public policy programmes such as crime prevention measures.

2.1.2. Small is Beautiful by E.F. Schumacher (8).

This book has four parts and a total of nineteen (19) chapters. Among the chapters, the following chapters are most useful for this study.

Chapter 1: The Problem of Production

This chapter describes the paradigm of the human conquest over nature with the purpose of controlling nature to feed the human consumption fuelled by science and technology. Technological and scientific progress was meant to use up all the available natural resources. It describes the battle where humans do not regard themselves as part of nature but a total separate entity that was meant to acquire dominion nature. The modern economists would declare that the problem of production has been solved by the conquest of nature with the aid of science and technology. There is total disregard to the capital as provided by nature which is far greater than the capital produced by man. This thinking neglects to regard natural resources as essential capital to production and instead treat them as incomes thus; there is very little concern about conservation.

The chapter argues that the squander of nature means the squander of life itself. Although seemingly defenceless, the repercussions from nature are very dangerous. It may not hit back but the consequences accumulate, come in bulk and are very devastating as soon as it strikes.

Chapter 2 : Peace and Permanence

This chapter describes the aggressiveness of the rich and about why they are restless because of the constant living in fear. The author argues that it is the rich man who would always go to war.

The chapter went further by presenting some remarks from Lord Keynes, an economist in 1930. Keynes was quoted as saying that *"Fair is foul and foul is fair. Avarice and usury and precaution should be held on a little bit more still."* This way of thinking has lead to justify greed and envy as fuel towards prosperity.
The author argues against this notion with three propositions :

- Human greed and envy is systematically cultivated and encouraged leading to the collapse of intelligence.
- It makes people loose their capabilities to solve everyday problems.
- It disintegrates opportunities for action leading to paralysis and loss of cooperation.

Gandhi was also quoted "Earth provides for every man's need but not for every man's greed." Thus, economics of permanence requires the reorientation of science and technology. It opens the door for wisdom unto the very structure towards the organic, the gentle, the non-violent, the elegant and the beautiful.

The chapter defines methods and equipments necessary with the following criteria :

- **They should be cheap enough so that they are accessible virtually to everyone.** They should be within the scale of the income of the local population.

- **They should be suitable for small scale applications**. Small scale enterprises are less likely to be harmful because the owner is the local people themselves. The smallness in size also provides space for the recuperative forces of nature. The damage caused by the local people could be a result of ignorance while

the damage caused by the gigantic companies are driven by greed, envy and the lust for power and has devastating effect.

- **It should be compatible with man's need for creativity**. Gandhi was quoted that the recognition of the soul apart from the human body and the permanent nature of the soul leads to a living faith. The worker should be seen as a being composed of the body and soul. This line argues against the dehumanizing effect of work through automation and anonymity. The soul can be destroyed by a monotonous, moronic work. This kind of work rejects wisdom and is replaced by cleverness. The loss of wisdom in the workplace leads to violence and demise of the system.

The book then outlines ways on how to disarm envy. It asserts that people should learn how to transcend luxuries with needs to make simple and reduced demands. They may also support those who are not afraid of being denounced as deviants.

Chapter 4: Buddhist Economics

This chapter presents the unity of religion and economic progress in Buddhism. Being consistent with the notion of the humans with the body and soul, it asserts that any kind of work should allow for joy of work and the bliss for leisure. It defines further the three functions of work:

- Develop faculties
- Overcome ego-centeredness and work with a team to achieve common tasks
- Produce goods and services needed for a becoming existence.

J.C. Kumarappa was quoted as saying :

"If the nature of the work is properly appreciated and applied, it will stand in the same relation to the higher faculties as food is to the physical body. It nourishes and enlivens the higher man and urges him to produce the best he is capable of. It directs

the animal in him into progressive channels. It furnishes and excellent background for man to display his scale of virtues and develop his personality."
(9)

While modern economics measures progress by the amount of consumption as a measure of economic growth, the interest of the Buddhist is on liberation of the human character over goods. That is to achieve well being with a minimum set of consumption. This will allow anyone to have more time for artistic creativity.

Chapter 5: Scale

The author argues against the theory that prosperity can only come in bigness. He presents a picture of a dual society where there is one central and highly developed city and a periphery of very poor provinces that feeds the daily consumption of the cities. The center is a highly advanced unit while the provinces are in extreme poverty. Millions of people are moving out of the rural areas and into the big cities into a pathological pattern of growth and breeds unemployment and misery. The author used the word megaloplolis (instead of metropolis) to describe what is already an extremely huge phenomena.

Modern economists would say that there is efficiency in scale automation. They want to eliminate the human factor in favor of the machines because machines are more efficient. And they would grow the industries much larger without necessarily employing people. However, the author argues against this because it leads to the idolatry of giantism.

Viability was defined not in terms of achieving efficiency in the production of goods process because this path leads towards employing machines instead of people thus creating a growth of social drop outs. The author argues that what are needed are numerous quasi firms of well synchronized, active and vibrant units that have their own coordinated interdependence. The bigness requires order among the smaller units which is essential to achieve synchrony while the smallness provides the space for autonomy and freedom. While maintaining autonomy, there would be one common

sphere or unity among the smaller units which is the ideas of principles or ethics, the indivisibility of peace and ecology. And on this end, the role of science and technology would be to help confront human misery and human degradation and with an intimate contact with actual people, with individual families and small groups.

Definition of the Intermediate Technology

Intermediate technology, simply put is the technology that comes in between the advanced and sophisticated foreign technologies developed by modern science and those of the indigenous and traditional technologies.

It has the purpose of creating employment, providing the needs of the poor at the place where they live, while preserving the social cohesion of the region or the district. It prescribes to create cheap workplaces in the same place where the workers live and the use of appropriate technology. IT has the task of selection of science and technologies which may fit the local needs as well as organized the traditional and scattered pieces of knowledge.

Intermediate Technology argues against the use of high external capital which requires expensive machineries and processes as well as highly skilled workers. Instead it creates employment with a modest level of mechanization. An example used was an earth moving project. Instead of using expensive machines, it argues for the use of manual labor and the production of tools for earth moving like wheel barrow and other hand tools.

It can be developed in three means. Complex technologies may be adjusted to the local situations or the traditional technologies be upgraded. A third approach is through experimentation with materials from both ends of the knowledge spectrum. The third approach offers wide range of possibilities of finding new knowledge.

This book helped the research on several points.

1. Describing and explaining how the LPG drains the local economy of its resources depriving the local communities of opportunities to find their

own initiatives. It guided the research in finding and integrating traditional technologies in the study area as well the advanced technologies in the research institutions.

2. It helped set the criteria about selecting the poor households to be the subject of this research. The study have selected the areas which have intense fuel crisis and under different sets of ecosystems. It reinforced the concern of the research for the conservation of the forest which is under threat because of wood charcoal production.

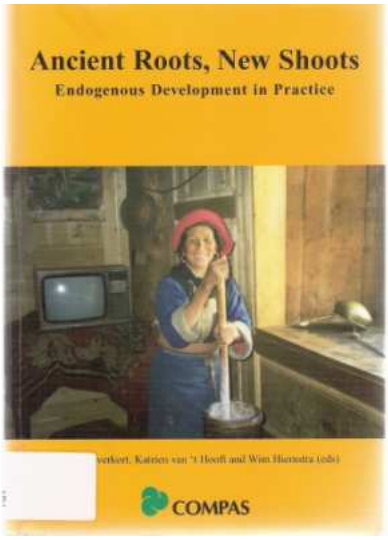
3. To describe the kind of work involved in the charcoal trade. To see all signs of dehumanizing effect to the worker. A section describes the toils of a charcoal producer and a transporter.

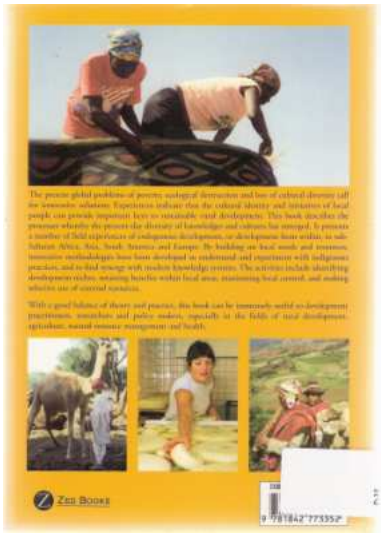
4. It guided the research in creating local village enterprises which are cheap and will enable the communities resolve their own fuel crisis.

5. It guided the research methods in allowing the participants create the own stove designs under a leisurely atmosphere of the workshops. How to enable the participants recreate stoves that will enable people to do teamwork instead of competition, and perform artistry over the economic mechanisms of prices which may lead to the extraction of natural resources like wood charcoal.

6. Facilitate any patterns of cooperation, village enterprises that may emerge during the course of study. Help them create stoves that will enable them to preserve the natural capital as well as support the community spirit of cooking and dining together. See the scale of the emerging project concepts and how it shall connect to the revival of local initiatives.

2.1.3. Ancient Roots New Shoots: Endogenous Development in Practice by COMPAS.





The book is a collection of insights into some culture and knowledge systems from the people of the project areas of COMPAS. It clearly states that there is no attempt to neither romanticize nor reject either of the knowledge systems. Instead, it carefully presents the possibilities of creating mechanisms by which the traditional knowledge systems can unite with the modern knowledge systems to produce endogenous development.

Historical Perspectives

The book opens with an outline of the evolution of world civilizations and religions and about how different civilization has interpreted the world. It describes old civilizations having strong spirituality and how they were able to connect their concepts to the natural world. It describes the birth of religions from the basic to the diverse of each continent. There are the animistic and totemic practices in Africa, the Hinduism, Jainism Budhism and Shiksm in India, Taoism, Confucianism and Shintoism in china; the Zoroastrianism, Judaism and Christianity, Islam and Bahai Faith in the Middle East, the traditional worldview of the people of South and Central America and the animistic religions of Europe.

The colonization by the western societies used its economic and military power with the strong link to religion. All other religions by the local civilizations were declared inferior and were later subdued. Those who practiced local religious traditions were declared demonic, prosecuted and killed. Through education, a new breed of local elites was created who likewise denounced their traditional practices.

Every colonization campaign was followed by geologists and botanists who tested new instruments in charting the new found societies and bring home species of exotic plants, animals, minerals, among many other materials. It also gave a boost to sciences of meteorology, geology, chemistry and applied mathematics. The diffusion of knowledge from the conquering societies was met with assimilation by some colonies and rejection by others. While the Muslim leaders in the Middle East integrated Western concepts, the Chinese and Japanese resisted the diffusion.

The book described how the church controlled educational systems and science according to its dogmas and concepts of life. It presented the debates with Galileo and the revolutionary ideas of Bacon, Isaac Newton and Descartes who were considered the fathers of modern science. It shifted the world view of the world being controlled by God to a world that is operates like a machine. After the rapid industrialization of the western societies for the following centuries, the General Systems Theory emerged 1980 which argues that a living and organic system cannot be considered a machine because it is in fact a combination of living, interacting and self-organizing elements.

Endogenous Development Defined

This led to the emergence of endogenous development which challenges the approach of applying fixed technological solutions. It promotes diversity on matters of values, scientific concepts, technologies, development approaches, farming styles, biological systems, cultural expressions, and lifestyles. It upholds diversity and co-evolution as key concepts. It upholds the need not to apply fixed technological solutions but to find the critical mechanism that will lead to the unity of tradition and modernity. It respects the indigenous knowledge, recognizes its limitations and is open to the global knowledge systems. This argument agrees with the definition of Intermediate Technology as defined by Schumacher.

Development out of the use of local resources defined as the balance between the spiritual world, the natural world and the human world. The natural world provides the natural resources namely, the land ecosystem, climate, plants and animals. The human resources come in the form of knowledge and skills, local concepts, ways of learning, teaching and experimenting. Humans also produce resources such as buildings, infrastructure and equipment. Economic - financial resources were defined as markets, incomes, ownerships, price relations, credit. Social resources are the family, ethnic organizations, social institutions and leadership. Cultural resources are the beliefs, norms, values, festivals, and rituals, art, language and lifestyle. Endogenous development defines the access to these resources and about how the people can use them to their advantage. People need to have an access and use of the three domains of resources to achieve a balance development.

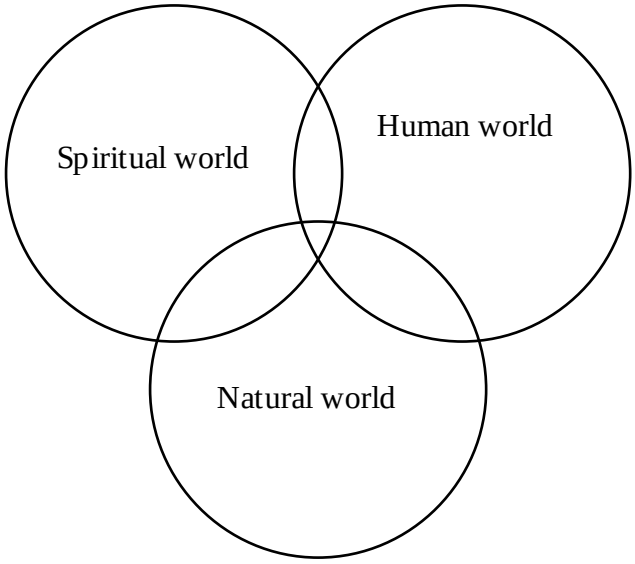
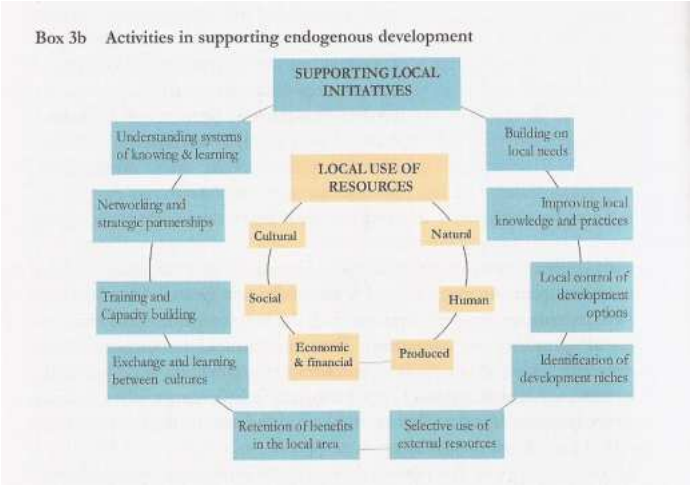


Exhibit 6. Indigenous Worldviews (1).

2.3.3. The Cyde of Activities

Page 32 of the book illustrates a cycle of activities that supports endogenous development.

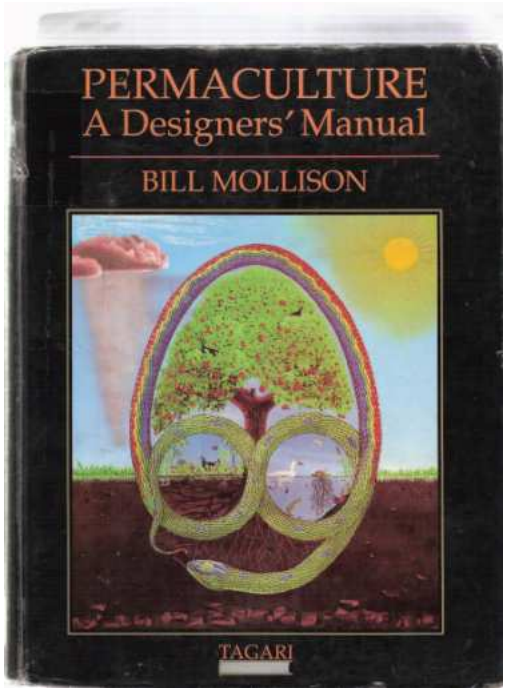


The book also presents an outline about the manner of conduct of field work within the definition of endogenous development. It upholds that field workers should respect the local ways of reasoning, methods of experimentation, and systems of learning and communication to which they are based. This means that the field staff has to keep an open mind for every engagement in the communities.

2.3.4. Reflections from this book

The approach leading to endogenous development set the guidelines for this research for the following points

1. The perceived superiority of the modern stove technologies may have pushed aside, neglected or rejected the novel and local traditional stove building technologies among the communities.
2. It is imperative to observe from a holistic view of the communities their worlds – the human, natural and spiritual worlds. A appropriate methodology is needed to capture these three sets of information.
3. The stove design process should take into considerations all the information gathered about their three worlds. It should consider the house design, local skills, gender relations, household structures, the cultural practices, the natural resources, cooking habits, and even aesthetic preferences of the household members.
4. And be keen in seeing any knowledge pattern emerging. The research should be able to revive any knowledge systems that exist in the study area as well as access knowledge from the research institutions. The study should be able to create a new knowledge from the union of the knowledge from both ends.



2.1.4. Permaculture : A Designer's Manual by Bill Mollison

Tagari Publication 1988Tyalgum, NSW, 2484 AUSTRALIA

This is a 576 page book consisting of fourteen chapters. Among the chapters in the big book, the chapters on Concepts and Themes and Designs as well as the Methods of Design are most useful for this research .

The author defines permaculture as "the conscious design and maintenance of agriculturally productive ecosystems which have the diversity, stability and the resilience of natural ecosystems. It is the harmonious integration of landscape and people providing their food, energy, shelter, and other material and non-material needs in a sustainable way. Without permanent agriculture, there is no possibility of a stable social order. It is a design system of assembling conceptual, material, and strategic components in a pattern which functions to benefit life in all its forms.

The philosophy behind permaculture is one of working with, rather than against nature, of protracted and thoughtful observations, rather than protracted and thoughtless action; of looking at systems in all their functions, rather than asking only one yield of them; and allowing systems to demonstrate their own evolution (2)."

Concepts Themes and Design.

The chapter presents the three basic ethical concepts of permaculture design ; (1) Care of the Earth, (2) Care of the People and (3) Setting Limits to Population and Consumption .

This chapter also presents the Mollisonian Permaculture Principles

1. Work with nature, rather than against natural elements, forces, pressures, processes, agencies and evolutions, so that we assist rather than impede natural developments.
2. The problem is the solution; everything works both ways. It is only how we see things that make them advantageous or not. A corollary of this principle is that everything is a positive resource; it is just up to us to work out how we make use as such.
3. Make the least change for the greatest possible effect.
4. The yield of a system is theoretically unlimited. The only limit on the number of uses of a resource possible in a system is in the limitation on the information and the imagination of the designer.
5. Everything gardens, or has the effect on its environment.

These sets of principles helps find the context for the stove design workshop. Principle 1 guides the design process to see the abundant materials from nature that is available for fuel as well as for the construction of the stove. The principle 3 provides that such materials should be changed at the very least for the greatest possible heat output. Sections 3.12 to 3.14 describes the abundance of rice hull and coconut husks in the study areas in their raw and unprocessed form which can be readily be used for fuel.

The chapter also makes several categories of the resource:

- those that increase with modest use
- Those unaffected by use
- Those that disappear or degrade if not used.
- Those reduced by use.
- Those which pollute or destroy other resources if used.

Category 5 would refer to the production and use of wood charcoal. Category 1 would refer to rice hull, coconut husks and buko shells.

Methods of Design

This chapter presents four elements in the design process namely (1) social components, (2) site components, (3) energy components, and (4) abstract components.

The site components consist of water, earth, landscape, climate and plants. The energy components consist of technologies, structures, sources, and connections. The abstract components consist of timing, data and ethics. The social components consist of legal aids, people, culture, trade and finance. This categorization of the elements helped the study to seek the information necessary for the design workshops.

In the analysis stage of the design process, it prescribes to see the elements according to their characteristics, the output, and the inputs. The book presents the chicken as

an example. The chicken was analyzed according to its intrinsic characteristics such as breed, color, reaction to climate, among many others. The chicken also needs inputs such as food, water, shelter, dust and other chickens. Finally, the chicken also produces primary products such as eggs, feathers, manure, sound and many others. It may also produce derived products such as fertilizers, beddings from feathers, or methane from the manure for cooking.

This method of analysis was also used for the design process of the stove. Section 2.22 on Methodology presents a conscious analysis of the designs which is embedded in every step of the design process. Section 3.9 also presents the intrinsic characteristics of the fuel.

There are also discussions on the materials needed for the construction of the stove, the behavior of the stoves and fuels when fired and the output in terms of the heat provided, efficiency, the smoke, the time required for cooking, the comfort and the pleasure of using their own creations.

The design method described by the book agrees with the need for the careful analysis of the context under the CMO configuration. This book helps break down the CONTEXT into four components namely site, energy, abstract and the social components.

The permaculture design process goes further in making the connections between the components. Each element should have its best place in the system in order to achieve the greatest possible effect. It requires a careful thinking about what are the requirement of each element that can be supplied by the other elements in the system and about how this particular element could also provide for the other elements. The chicken house therefore should be placed where there is least requirement for attention and where it also gives all it products to the fullest.

Exhibit 7. Impetus to Design (2,3).

The stove was designed according to the resources in the community such as the skills among the people to build them, the kind of fuel that is available.

The method also guides the design process to anticipate the possible products (outcomes) that the stoves can give – ash, carbon, heating, drying, and dehydration. It may also provide abstract outputs such as opportunities for social bonding by means of cooking together, livelihood projects, reduced cutting of forests, among many other possibilities.
The book presents a summary of the outcomes of what a permaculture design process can provide (outcome) for a society.

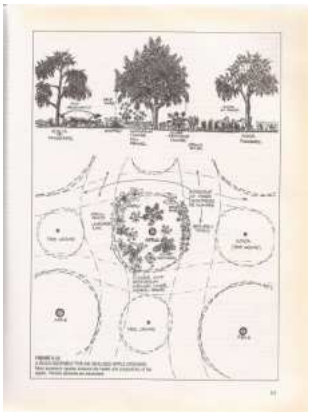


Exhibit 8. Guilds in Nature and Design(2)

The Concept of Guilds in Nature and Design

This section of the book describes how guilds in nature exist and how they can be created in a permaculture system. The book defines a guild as a harmonious assembly of species clustered around a central element (plant or animal). This assembly acts in relation to the element to assist its health, aid our work in management or buffer adverse environmental effects. A figure was presented and the guild was described accordingly.

The section gives a detailed description of the connections of the elements in a guild in three categories; (1) those that go along fine, (2) those that assist others and (3) those that are antagonistic to others. It would always be necessary to put them into a test of co – action in order to determine their compatibility or competition under the guild would achieve stability. The choice of the species and the placement would therefore be of utmost importance.

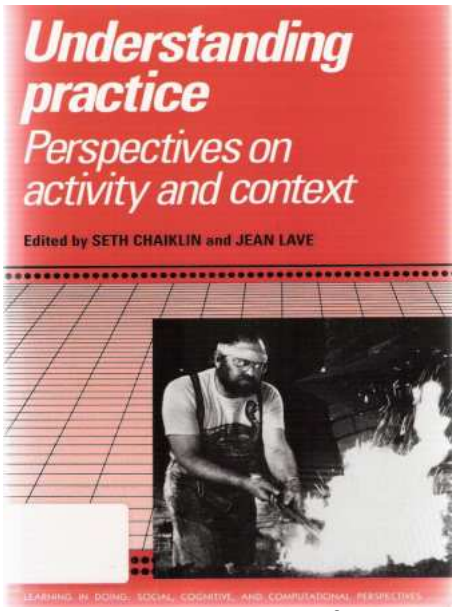
An element in the ecosystem, be it a plant or an animal species, if thriving alone, as in a monocrop plantation ecosystem are susceptible to pests and diseases and requires high external inputs of protection and nourishment. A plant or animal species has higher chances of survival through the interdependence with the other elements.

The stove that was created in total isolation from the rest of the elements in the community will be very expensive, difficult to use and repair and will perform badly. A stove will have to be created along with the other elements in the society. And this is best achieved through the participation of the users themselves.

Very much like the guild, the central element which is the stove is best created within the comprehensive context of all other elements of social, cultural, economic, ecological and technical parameters. Stove builders guild can also survive if it contains the other supporting actors. They would be a guild of household members, the food processor, the coconut and rice farmers, the rice mill operators, the transporters and the technicians as well as the scientists and the engineers.

2.1.5. **Understanding Practice : Perspectives on Activity and Context** (10)

Edited by Seth Chaiklin and Jean Lave



The book presents the importance of the context and about how it shapes the human activities. It presents the activity systems in different contexts of daily human activities to portray the relational, historical and situated conceptions of social practice. Featured are the practices of psychotherapy, medicine, blacksmith, artificial intelligence, and research.

Yrvo Engestrom discussed the three principles of activity theory. First, a collective activity system can be taken as a unit of analysis.Second, the activity system can be understood historically. Third, the activity system can be analyzed as the source of disruptions, innovations and change and the development of that system including the individual participants. He writes about the case of the primary health care as a test bench of the activity theory.

The activity system as a unit of analysis can be created. Although there is no direct association to the individual actions at a specific point in time, the activity system

should be understood as a collection of individual actions in the past thus, it is something that can be influenced and changed.

The context is an activity systems consisting of the **subject** which refers to the individual or subgroups, the **objects** refer to the raw material that is transformed by the instrument to produce an **outcome**. All these components form as a single entity. It is a heterogeneous unit that is continuously evolving under a set of rules which are followed and may also be reformulated through human action.

Activity systems is a dynamic pool of actors have both its historical roots as well as buds for the emerging future. It is filled with internal conflicts, disruptions, innovations and troubles. These set of contradictions are ever evolving (primary contradictions) but would react further upon the injection of another strong novel factor (secondary contradictions).

This theory helped this study on several fronts:

- To interpret the study area as an activity system. It is continuously evolving unit of analysis comprised of multitude of actors with strong recollection of the past and ideas about their future.
- To see and anticipate the complexity of the study area
- To prepare the necessary tools and instruments to analyze the components of the activity system.

It anticipated the multitude of actors in every study area namely the household members, the rice mill operators, the wood cutters, the environmental department of the government, the village officials, the traders, and the stove technicians, among many others. The study also was conducted in five different eco zones thus, consists of a diverse set of resources (objects).

Chapter 5 of the book comes very close to the experience in this field research . It is entitled Thinking and Acting with Iron by Charles Keller and Janet Dixon Keller. The article presents the activity theory in response to the 1957 Mandate of Ward

Goodenough of anthropological society to come up with an account of knowledge and action in tandem so as to dissect their complex interrelations.

as it was put into the practice of a blacksmith who was commission by the the national museum to make a skimmer handle. A skimmer is a long handled kitchen utensil with shallowly dished, perforated bowl for removing residue from the top of bubbling cooking liquids.

The blacksmith was Charles Keller himself and the method used was participant observation with introspection. The activity fully describes the context in the form of an umbrella plan consisting of the following:

- The idea of the 18th to 19th century skimmer handle
- The specifications of the museum
- The income and cost of production
- Aesthetics

As the activity progressed towards the fabrication, the blacksmith would have to put more detail unto the umbrella plan through the next set of considerations –

- his own internal representation of the plan,
- his skills,
- the materials to use.

And in the final stage of fabrication, the blacksmith have to create a balance between the utility of the skimmer, and the tools and techniques for its refinements. At each level, the knowledge takes a transformative reorganization at every level of action.

This chapter provides the study an understanding about the knowledge that transpires during the stove design workshops. Section 5.5 presents my activity as a stove designer in making a hybrid model of a stove.

2.6. Green Revolution or What?

by Paul Richards TAD Wageningen University

The article was written by Prof. Dr. Paul Richards of the Technology and Agrarian Development Group of the Social Science Department of the Wageningen University. Richards argues that there is so much knowledge that are emerging in the realm of unsupervised learning that are being neglected because of supervised learning process. He uses the Hopfield Network Theory which explains how the neurons have their mechanism of producing outcomes which may be useful or not. The neurons have their mechanism of selecting the more useful outcomes by using the related memories from the past. There would always be distributed cognition and that is the production of knowledge would always come from the interaction of the group within a specific set of context and not from a total isolation of the individual ((11).

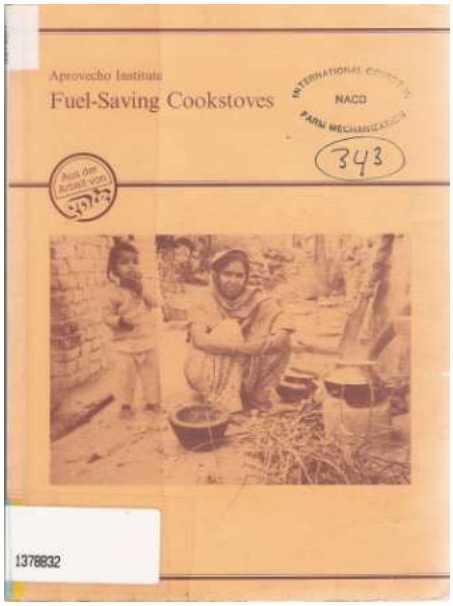
The article puts value to the knowledge that are emerging from the realm of unsupervised learning which may in fact may be being neglected because of the supervised learning process from the top (12).

In the course of the design process of the stoves for this study, the participants have undergone in a series of supervised design process on matters of describing their own context. It showed how the participants can create their own designs without supervision? This literature can be used to interpret how designs can evolve with or without supervision.

Within the design workshops, the Hopfield Network theory can be used to understand how the participants create their pattern of selection of the good and bad components of their stove designs. There is a strong interaction among them making peer comments on one another.

2.7. Fuel Saving Cookstoves

By Aprovecho Institute



This is a monograph consisting of 126 pages and seven chapters. It opens with the global fuel crisis and some models of stove design process. There are two models that the book presented – the Consumerist Model and the Design by Evolution Model. Please see Section 1.3.3.

The monograph is a guide for development workers in building stoves with the full participation of the local people. The role of the development worker was presented. There are specific guides on how to find the information using a technical as well as socio- cultural checklists. There are more chapters on how to promote and disseminate the stoves and how to measure the technical performance.

Towards the end of the monograph are chapters on stove building techniques. The chapter presents models coming from many parts of the world, made from different kinds of materials such as clay, metal, and concrete. They also present different stove models for different kinds of fuels.

2.2 METHODOLOGY

This section presents how participation, being the strongest mechanism was operationalized by the interactive design process with the context. It presents the evolution of knowledge at every stage of the study. Methods used and the research team were also presented as well as the major activities undertaken.

2.2.1. Participatory Technology Development (PTD)

The ILEIA, in its 1989 proceedings of the Workshop on Operational Approaches of Participatory Technology Development in Sustainable Agriculture defined Participatory Technology Development as :

"Activities aimed at, or resulting in a change in existing technology in a direction considered desirable by the different users of that technology and which are carried out by networks in which the users of the technology play an active role. It is the practical process of bringing together the knowledge and research capacity of the local farming communities with that of the commercial and scientific institutions in an interactive way.

It involves activities in which local producers and traders work together with external actors in the identification, generation, testing, application and diffusion of new technologies and practices. Participatory Technology Development therefore seeks to strengthen the existing experimental capacity of farmers and will sustain on-going local management in the process of innovation."

This methodology was used by this study in the belief that it is consistent with the theories and concepts of the study. Participation is among the strongest mechanism

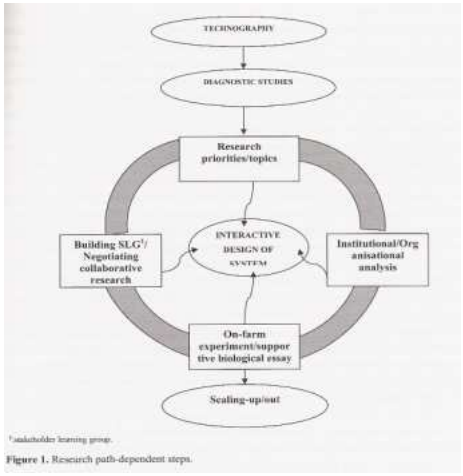


Exhibit 7. Research path-dependent Steps, Facilitating Learning Toward Sustainable Cotton Pest Management in Benin: the Interactive Design of Research for Development by

that this study has triggered. It is embedded in all the stages of the Interactive Design Process that is there is participation in defining the Context, in triggering the Mechanisms and in defining the Outcomes.

2.2.2. Interactive Design Process

In operationalizing the PTD in this study, an Interactive Design Process was used. It made references to the Interactive Design of a System was used by Antonio C. Sinzogan in his Phd Thesis entitled Facilitating Learning towards Sustainable Cotton Pest Management in Benin. The methodology used democratized the analytical paths by being transparent in the identification of research priorities. The study incorporates the brief technographic report of Richards and summarized the approach.

This study of stove design process consists of seven stages wherein the Context was defined, the Mechanisms triggered and the Outcomes observed. The Context provides the situations which either facilitates or prevents the Mechanisms to produce an expected Outcome. The Mechanisms are sets of stimulus in the form of scenarios, information or innovations that creates a new situation in the context thus, producing an outcome.[2] The following summarizes the configurations.

Table 2. The C-M-O Configuration as Hypothesized in the Beginning of the Study.

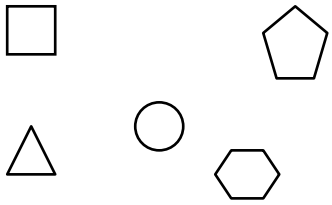
Context	Mechanism	Outcome
A province of high rainfall, dwindling forest cover and high poverty incidence. An increasing price of gas causing an increasing demand for wood and wood charcoal.	Open Access to the Supply of the Alternative Biomass Fuels	Miniature Stove Models Built by the Participants and the Potential Shifts in Fuel Consumed. An evaluation of the urgency of the fuel crisis and a set of agenda for policy reform.
Pollution caused by open dumping and poor utilization of alternative	Open Access to the Supply of the Alternative Biomass	A discovery of solutions to the growing garbage problem of the province.

[2] In the exemplars presented by Pawson and Tilly, this study follows the first exemplar of property marking conducted by Laycock (1985)

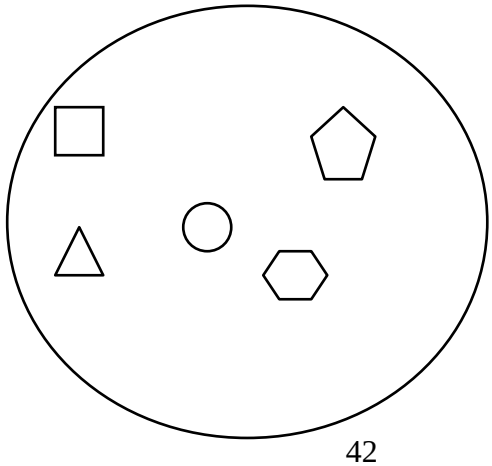
biomass fuel.	Fuels	Reduction of green house gas emissions by biomass as wastes –rice hull and coconut husks. Reduction Health Risks Caused by Indoor Air Pollution.
Context	**Mechanism**	**Outcome**
The lack of access to information and the skills to innovate and utilize the alternative biomass fuels	Open Access to Stove Building Technologies	A discovery of potentially huge deposits of clay which are excellent for stove building. Unsupervised innovations in stove designs among the participants (Richards 2007). A hybrid stove model between the local models and the scientific models.
The lack of access to information and the skills to innovate and utilize the alternative biomass fuels	Cost of Stoves and Access to Stove Building Materials, Tools and Equipments	A diffusion of innovations of stove designs.
A group of people with low income and poor education with a strong drive to find cheaper fuel.	Participative Technology Development Through an Interactive Stove Design Process	A revival of the local and fading knowledge of the stove technicians. A discovery of huge potential capabilities of the poor families to build their own stoves which will suit their needs at the lowest possible cost. A network of stove builders and users.
A group of people with low income and poor education with a strong drive to find cheaper fuel.	Conceptualization of Livelihood Enterprises	Reduction of cutting of forest trees for wood charcoal. Potential Village enterprises of many forms : Fabrication of cook stoves out of clay. Refineries and production and delivery of clay for stove building. A production enterprise for producing stove liners. A production enterprise of steam box A production enterprise of fuels Revitalizing the food processing projects

The Mechanisms (1) Open Access to Alternative Biomass Fuels and (2) Cost of Stove Building Materials and Tools are there all the while and are embedded within the Context. All that was done was to facilitate the discovery of this mechanism through the focus group discussions to make the participants realize its existence. In contrast, I have a strong supervision in Mechanism 3 and a facilitating role in Mechanism 4.

2.2.2.1. Stage 1. Exploratory Research. In the months preceding this research, a study was conducted to validate the existence and magnitude of the fuel crisis in the study area. A preliminary survey and a series of field observations were conducted on the selected villages to determine the fuel they use, the prices and volume of the utilization. Table 8 and 9 on Section 3.1 presents the results of the survey. This stage sets the initial efforts to define the Context.



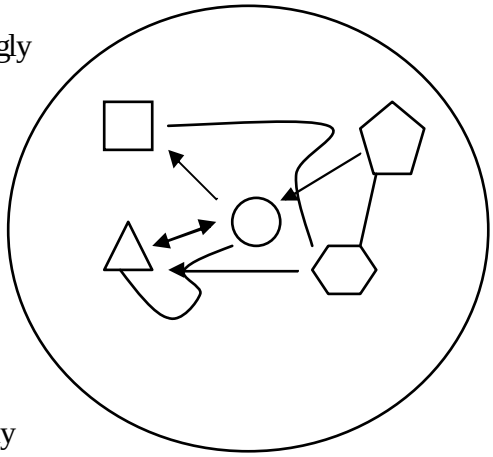
2.2.2.2. Stage 2. **The actors are identified in the field**. A survey was conducted to thirty (30) respondents in every village selected. The selection process of set of actors used criteria for evaluation of the attitudes and willingness of the respondents to the survey to participate in the workshop series. Results were ranked in a manner that the study groups will consist of a diverse set of actors as represented by the different symbols. This stage defines further the Context by identifying the actors, their behaviors, the stove and fuel technologies existing in the field and the magnitude of the crisis.



2.2.2.3. Stage 3. The intervention of this study created a sphere of interactivity within which the selected actors were included and excluded those that did not meet the criteria. This sphere came in the form of the semi structured interviews, the interactions of the research

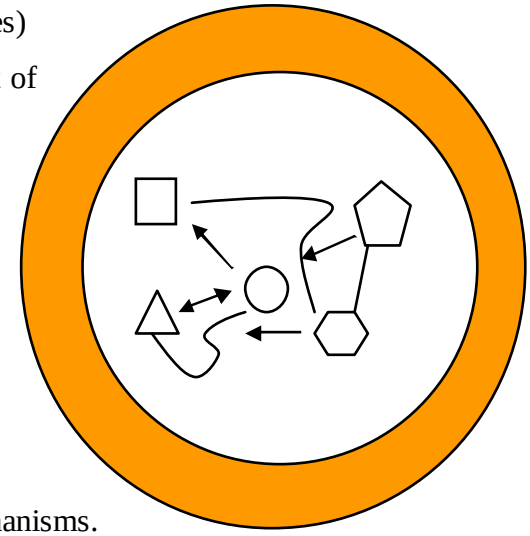
teams with the participants and Session 1 of the design workshop series.

This stage sets the perimeters of the Context and thus creating an arena to which the Mechanisms will be triggered.



2.2.2.4. Stage 4. The sphere of interactivity was strongly situated in the context of the particular village. The elements of participation were triggered to enable the participants jointly created their own description of their own Context. This happened in Session 2 (Context) of the design workshop series.

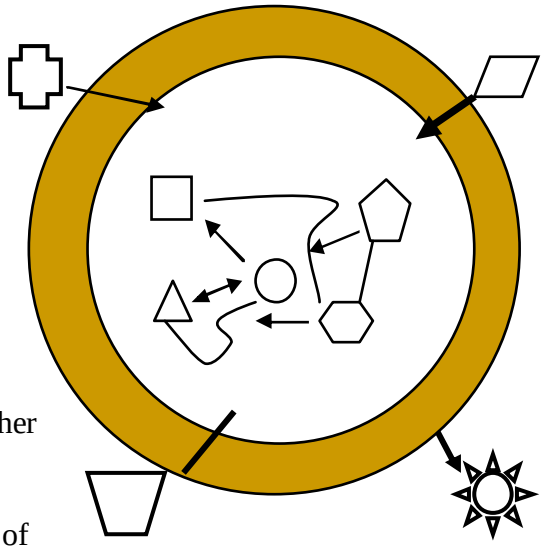
The manner and magnitude of the interaction are highly diverse as represented by different lines and arrows. Appendix ___ presents the drawings of the participants that describe their villages on themes of environment, economy, technology and organizations. The transcripts of the semi structured interviews are also presented on Appendix 2.



2.2.2.5. Stage 5. Session 3 (Tools and Techniques) stimulated a new set of interactions thus, new set of consciousness between them. This refers to the causality of the activity theory and a new set of knowledge was created as represented by the outer ring. These are the discoveries of the indigenous knowledge, skills, resources, and networks.

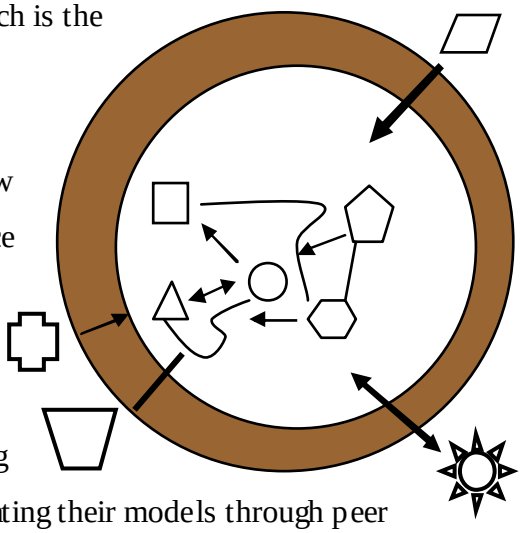
It is at this stage that I began triggering the Mechanisms. Through the Mechanism of (1) participation, I made the participants realize the (2) Open Access to Stove Building echnology and the (3) Open Access to Fuel and finally (4) facilitated the formulation of plans to scale up their stove technologies in preparation for their Livelihood Enterprises.

2.2.2.6. Stage 6. The study went further by reinforcing the Mechanism of the Open Access to Technology. I stimulated the entry of technologies coming from outside of every study unit (the village) and presented them on the study sessions through video presentations, photo exhibits and technology demonstrations. These external elements also have different attitudes, magnitude, and effects to the internal actors as represented by the different line and symbols. Appendix 2 presents the transcripts of the interviews of other external actors.



Again, the outer ring representing the new set of knowledge have evolved because of the new mechanism triggered. It then represents an interface of the local and outside pool of knowledge. This area represents the scrutiny of the participants to the incoming technologies and the decisions that they made.

2.2.2.7. Stage 7. This stage is the Session 4 which is the workshop to create the miniature stove models. During this workshop, the participants are then interacting with one another with an entirely new set of knowledge that came off from the interface of the external an internal pool of knowledge. It is also at this stage that I was able to create the hybrid model of the clay stove.



Interactions were transpiring as they are creating the miniature models and until they were presenting their models through peer reviews. Such interactions come in the form of support, disagreement, rejection, appreciation, commitment, declaration, inquisitiveness, criticism, hesitation and affirmation.

Table 18 on Section 5.1presents the descriptions of the miniature stove models.

Going further, the outer ring represents the outcome of this study. It is a pool of knowledge that evolved from the interaction of the actors among themselves within the sphere of the study and its interaction with the elements outside of the local

context. Outcome of this study would show that the Interactive Design Process allows the creation of miniature stove models a success. It changed the attitudes of the participants to shift to alternative fuel and create better stove designs. A hybrid model of the stoves that came out from the outcomes in the workshops confirms that the stove models have good chances that they will work. Description of the prototype is presented in Section 5.5.

2.3 Activities Undertaken.

2.3.1. Preparations. Preparations for this research began in September 2007. I had to dig up the files that I collected from my engagements with my NGO and in appropriate technology. In trying to verify the intensity of the problem, I had to hire a researcher to do a small exploratory research about the magnitude and intensity of the problem in my homeplace. The data collected formed part of the thesis proposal. I went further in designing another rice hull stove while at the Netherlands and asked my colleague stove technician to build the working model out of it. We named it Pugon Solo.

2.3.2. Thesis Proposal

The presentation for the thesis proposal happened 3 June 2007 the Social Science Department of this university. Strong comments focused on the magnitude of the research and the lack of focus on certain themes. I was cautioned against the intention of actually building the stoves as part of the field research. I finally reduced the intention to the creation of miniature stove models but could not prevent myself from creating one working prototype hybrid model.

2.3.3. The Field Research

2.3.4. Prototype Development. Coming home from the Netherlands, i have the Pugon Solo already built. However, it was not yet in use. I gave it to my colleague Sammy Yarte as a gift so he may use the stove in his neighborhood. For the weeks of

January, he was using the stove in the middle of scepticism and sometimes mockery of his neighbors about the strangely designed stove. Soon enough, during the heavy rains of February, our efforts paid off and was able to make a very strong statement – that rice hull stoves can be improved and it is urgent that everyone in the neighborhood use rice hull. It was the time when one of his neighbors started tearing down some walls of their house just to have fuel for cooking. Sammy had another conclusion and that is, the rice hull stoves would hold fire best with the aid of coconut husks or small pieces of wood. The supplemental fuel provides a constant heat inside the furnace thus, prevents the erratic fire. This mechanism is very much like that of a flywheel that conserves the momentum of the engine to keep a smooth run. After this model, another model was built upon the request of a soy curd businessman. It was made bigger to receive heavier loads.

2.2.5. The Research Team

A researcher was hired in September of 2007 to make the preliminary survey and gather secondary information for the preparation of the thesis proposal. Two enumerators were hired for the survey plus one who volunteered. One of them was hired full time from January to April 2008. One of them was hired again in July 2008 to retrieve some missing information with another friend who volunteered. All the while my wife supports my supervision of the researchers and enumerators.

An interview conducted by Eden Sanchez. (by the author).

Aside from being the researcher, I also prepared the workshops designs, organize them and be the facilitator of all the sessions. I also personally fabricated the prototypes of the stoves,

some with the help of Mr. Rogelio Abilgos, the stove technician. Please see Section 5.4.

An interview conducted by Lilibeth Ravida. (by the author).

2.2.5. Schedule

Preparations began on December 2007. Surveys were done on the month of January. Sessions 1 to 5 were conducted on the months of February to May.

Table 5. Schedule of Activities during the Field Research.

Sessions/ Villages	Bulala	Bagasbas	Bagasbas Second group	Daet Food Vendors	Guinacutan	Mangcawayan	Mangca magong
Survey	26 January	25 January		19 January	15 January		1 January
Sessions 1	27 February	20 February			26 February	17 April	25 FEbruray
Session 2	5 March	14 March	20 February	8 April	4 March	17 April	25 February
Session 3	12 March	28 March	20 April		11 March		10 March
Session 4	28 March			20 April	18 March	18 April	
Session 5	6 May	6 May	6 May	6 May	6 May	6 May	6 May

2.2.6. Site Selection

With reference to the related literature, there would be deeper understanding of the crisis in the context where the crisis is most intense. Thus, the sites were selected on the basis of three major reasons.

- The village represents one unique ecosystem among the rest of the villages under study.
- There is an evidence of prevailing crisis in fuel among the people or their immediate environment.
- There is enough magnitude in terms of the size of the population or the intensity of the crisis.

After a brief scan among the candidate villages, five villages were selected.

Table 6. First Set of Villages Selected.

Name of Village	Town	Ecosystem	Nature of Fuel Crisis	Cooperating Local Organization
Bulala	Santa Elena	Forest and Upland	Cutting of trees from the protected forest to make wood charcoal	None
Bagasbas	Daet	Urban	High level of Consumption of wood charcoal. Poverty reinforced by the need to buy charcoal fo cooking	None
Mangcamagong	Basud	Forest and Upland/ coastal	Cutting of trees from the forests to make wood charcoal. High incidence of Indoor Air Pollution	None
Guinacutan	Vinzons	Lowlands and Rice Lands	Poverty is reinforced by the need to buy wood charcoal. High incidence of indoor air pollution	None
Barangay IV	Daet	Urban sector and mobile food vendors	Highest rate of consumption of wood charcoal.	None

During the course of the workshops however, two of the villages produced poor participation among the invited residents. This prompted me to put up a fourth criteria and that is there are enough actors who are willing to participate in the design workshops. To ensure good participation, I had to find some local people's organization that is present and active in the candidate villages.

Table 7. Second Set of Villages Selected

Village	Town	Ecosystem	Nature of Fuel Crisis	Cooperating Local Organization
Mangcawayan	Vinzons	Lowlands and Rice lands	Pollution caused by open dumping and burning of rice hull	SINAG[3]
Bagasbas	Daet	Urban	Pollution at the beach caused by natural drift of agricultural debris from the farm brought down by the flood waters.	Bagasbas Builders' Club[4]

2.2.7. Survey. A clustered multiple visits were used for the survey. The enumerators had to visit more than twice every village identified to get the target number of respondents. A **purposive random sampling** was done to select the participants to the survey. Thirty respondents were sought at each village of the first set of study area. A total of one hundred eleven persons were interviewed. Each interview lasted for less than ten minutes. A summary of the results of the interviews is presented on Tables 8 to 13.

From the respondents of the survey, the responses were evaluated using the following criteria :

- Level of Education 25%
- Skills 25 %
- cooperation 25 %
- fuel crisis 25 %

[3] SINAG –This is an organization that was initiated by Mr. Rommel Cayno, a member of POMCAT . The members are the parents of the school children of the primary school. POMCAT and the school had some cooperation in the past on projects concerning permaculture gardens and appropriate technology.

[4] Bagasbas Builders'Club was initiated by Mayor Tito Sarion of Daet in February 2008. It is a voluntary organization which is more visible in making the Bagasbas Beach clean. Its members are residents of the village of Bagasbas as well as from the other adjacent villages. During the progress of this field work, I have seen them trying to get rid of the big debris of coconut husks that piled on the beach because of flood waters.

The responses were ranked and the top fifteen respondents from every village cluster were selected. The purpose of the ranking is to measure their potential willingness to participate in the design workshop as well as measure the potential value of their contribution to the process. Fifteen persons were selected for every village to create a pool of highly diverse sectors possible. They were invited to join the stove design workshop. This forms the study group which is manageable in size considering the activities within the stove design workshop.

2.2.8. Participant Observation. I used a lot of participant observation methods during the course of the field work. More than half of the observations I collected were from my previous engagements in these villages in the past. I personally knew some people in most of the villages or some of them knew me.

I spent many hours observing the people on the village on every visit. More observations were done with the charcoal producers of Bulala and the food vendors of Daet, the fisherfolks of Mangcamagong, the rice farmers of Guinacutan and the beach cleaners of Bagasbas. I also spent more time in the fabrication of the prototypes of stoves. I began developing the prototypes of the stoves that was used for this study as early as 2004. They were the coconut husk stove and the rice hull stoves of different models. The rice hull stove was further improved during the course of the field research.

2.2.9. Narratives. The participants to the workshops were asked to prepare narratives to the Technical and the Socio-Cultural Diagnosis of their stoves and fuels. It has strong reference to the diagnosis of the Approvecho Institute. Summary of the narratives are presented on Appendix 6 in a series of tables.

2.2.10. Semi Structured Interviews. Interviews were made for the actors in the field not participating in the workshops. Appendix 1 shows the list of the persons interviewed. Appendix 2 presents the full transcripts of the interviews.

2.2.11. Stove Design workshops. There are four levels of workshops at the villages and one coming together workshop.

Level 1 : Orientation. The sessions were meant to introduce the research to the selected participants. It was also used to organize the practical matters of the succeeding sessions.

Level 2 : Context. The sessions stimulated the participants to know more about their community. The discussion workshops were meant to quickly assess their village. The participants were made to form smaller discussion groups on themes of (1) environment, economy, technology and governance. They were made to draw symbols on large brown papers and present to the whole class for discussions.

In most of the sessions, the points of discussions focused on the environment and the prevailing fuel crisis and how all the issues in each village are connected. It was also on these sessions that actors were identified particularly those involved in the manufacture of stoves.

Level 3 : Tools and Techniques, Technology Demonstrations, Excursions.
The sessions stimulated a discussion on the prevailing stove models that the participants are currently using. They were made to recall their experiences. The stove technicians among them were also made to describe the stoves that they built and allowed everyone to react. They also made a criteria for evaluation of the stove models that they are about to see. This session introduced the participants to the different stove models through several forms. There were video presentations and photo exhibits being close to the fabrication workshop, participants from Bagasbas and Daet were brought to the workshop where the demonstrations were held. There was also technology demonstrations of the prototypes of the stoves built earlier.

Among the stove models presented were

- The natural draft barbeque grill
- The improved rice hull stove
- The experimental coconut husk stove

- The Rice Hull Stove with Side in Steam Injector
- The Turbo Quasi Gasifier Rice Hull Stove

Because of the lack of time to conduct the interviews individually, they were asked to fill in the interview questionnaires at home.

Level 4 : Workshops to Create Miniature Models. There was a brief review of the discussions of the previous sessions CONTEXT. It was summarized in the way of jointly creating an evaluation criteria for the stoves models that they are about to create.

The participants jointly created their individual stove models with clay. It is a representation of the stove design that they want. Everyone had the free choice of the stove design that they wanted. They worked on the models mostly on the same table and were allowed to freely give their remarks on anyone's work during the construction. Afterwards, everyone was made to present their work to the whole session to receive remarks from their peers.

Level 5 : Federating . Each study group selected their own two representatives to the Session 5. It was not clear to me at that time what and how Session 5 will go but had the strong urge to connect the separate study groups under one session. It was more of an exploratory move to see where and how the connections will evolve.

Aside from the representatives from the study groups, I also invited some visitors from the Municipal Government of Daet and from the TESDA[5] to stimulate what ever process there would be. There were more invitations from the CENRO[6], the media and other government agencies. Each of the representatives was asked to describe their village and the process that they have undergone. They were then asked to construct the actual stove using clay. It is also at this session that the study group representatives met with the master technicians of the Daet group.

[5] Technology Enhancement and Skills Development Authority
[6] Community Environment and Natural Resources Office

2.2.12. Summary of Methodology

The literatures provided the philosophy, ethics, theories and operational framework for the methodology of the research. This study was done with the attitude of a critical realist. It investigated the activity under a context of permanent change and conflict and a pool of knowledge that transpires in every interaction of the elements in the context. This realism is supported by the ethics advocated both by Schumacher as expressed in his definition of Intermediate Technology and the design methods of permaculture by Mollison. Both Schumacher and Mollison puts value unto the care for the earth and the natural resources and twin responsibility of the human civilization for care for the people and care for the earth. Ygestrom puts the operational concepts unto the context by defining how the activity evolves within it. Mollison has the design methodology and methods in making very detailed and protracted observations in the context under the principles of permaculture. Finally, Approvecho provides the field operations guide for stove designers and development workers through their monograph.

The field research was conducted under the methodology of participatory development that was operationalized by the interactive design process. The principles of care for the earth and people was operationalized in the study by holding a rich amount of discussions on the effects of wood charcoal in the stability of the forest to the climate. The tenacity for details of the permaculture design methods was integrated in the socio-cultural and technical narratives of the participants about their stoves, fuel, house, gender, culture and the technical performance of their stoves. Going further the practice of COMPAS with endogenous development projects provided the backdrop for the mechanisms of open access to technology and participation. Intermediate technology and endogenous development jointly supported the said mechanisms thus, produced several outcomes, one of which is hybrid clay stove model.

Chapter 3 : THE CONTEXT

3.1. The Province of Camarines Norte

The province of Camarines Norte is among the five provinces of the Bicol Region. It lies at the southwestern part of the capital city of Metro Manila and is facing the Pacific Ocean. Among the other provinces of the region are Camarines Sur, Sorsogon, Masbate and Catanduanes. In 2000. Camarines Norte has a total population of 470,654 and a land area of 2,200 square kilometers thus, a population density of 1:2.5 hectares (13). Bicol Region ranks second among the regions in the country that has the highest poverty incidence. Camarines Norte is the 11th poorest province in the entire country out of 72 provinces (14).

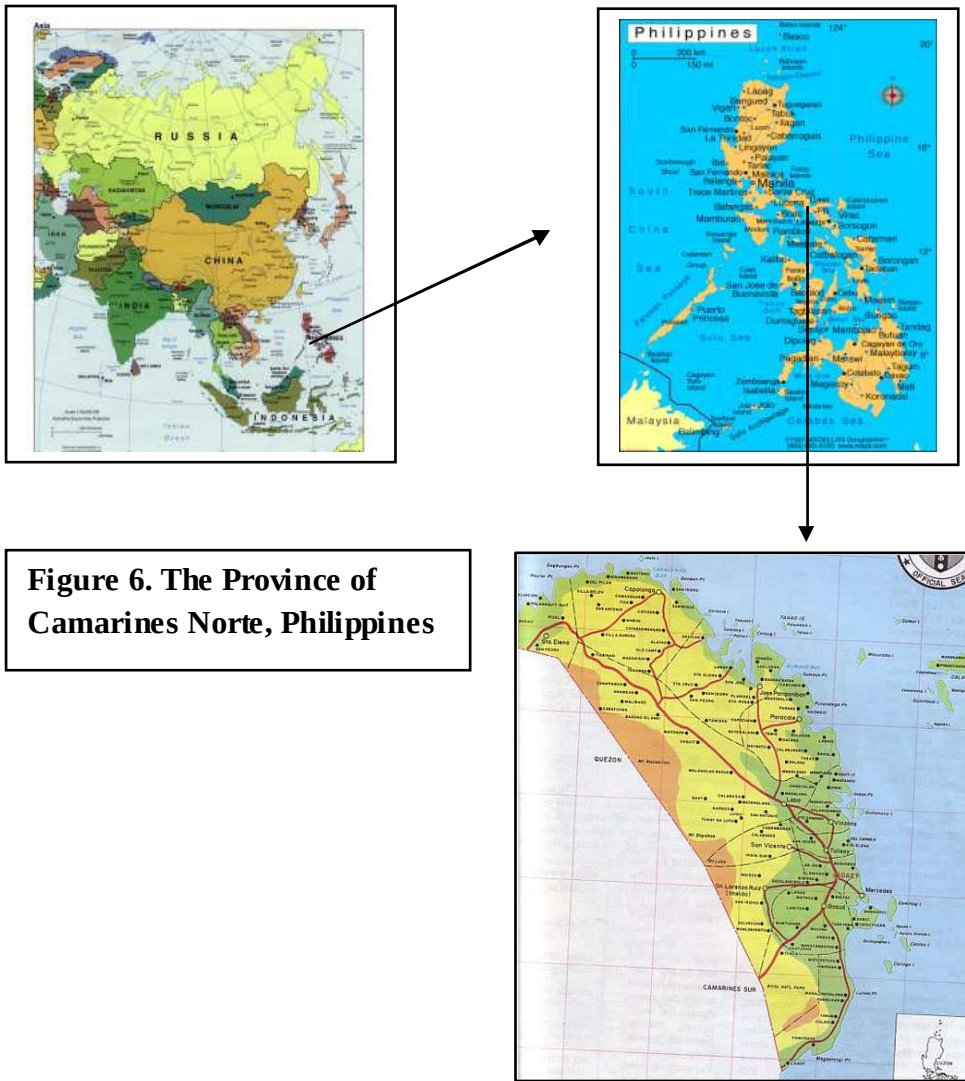


Figure 6. The Province of Camarines Norte, Philippines

1.1.1. Climate

The Bicol Region lies in a typhoon belt. It is affected by typhoons during the months of April, June, July, October, November and December (15). This study was conducted coinciding the wet months of the year, demonstrating clearly the effect of the climate to the domains of stoves. The Province of Camarines Norte has an average temperature is 27.87 degrees Celsius and a very wet climate. In 2003, it recorded an average amount of rainfall of 283.76 mm. with peak on the months of October to December.

This context results to the difficulties of the families to gather dry fuel. The burden falls to the poor families who can hardly afford to buy wood charcoal thus had to rely on wood. Considering the very wet climate of the province, poor families suffer in most of the months of the year.

In this province, there are 966.097 hectares of rice fields representing 4.81 % of the total land area(15). Total rice production in 2006 is 16,829 metric tons and 11,266 metric tons from January to September of 2007 (16). Please see Table 2. To date, there are 103 rice mills in the entire province with a total milling capacity of 726 metric tons of rice per hour (BAS, 2007) Please see Table 3.

It also has 103,931 hectares of coconut farms representing 51.76 % of the total land area (15). In 2006, there is an estimated 57,413,347 nuts produced in the entire province. Between January to September 2007, there are 61,110,114 nuts produced (17). Please see Table 2 and 2.1 of Appendix 7.

According to the CENRO of the province, there are 753.40 cubic meters of charcoal produced that were documented from 2006 to 2007. And between these period, the volume of confiscated wood charcoal which are subject for administrative verification and proceedings jumped from 3.03 m3 to 50.9 m3 (18). Please see Appendix 6.

3.2 Major Agricultural Crops

In this province, there are 966.097 hectares of rice fields representing 4.81 % of the total land area(15). Total rice production in 2006 is 16,829 metric tons and 11,266 metric tons from January to September of 2007 (16). Please see Table 2. To date, there are 103 rice mills in the entire province with a total milling capacity of 726 metric tons of rice per hour (BAS, 2007) Please see Table 3. It also has 103,931 hectares of coconut farms representing 51.76 % of the total land area (15). In 2006, there is an estimated 57,413,347 nuts produced in the entire province. Between January to September 2007, there are 61,110,114 nuts produced (17). Please see Table 1 and 1.2 of Appendix 7.

3.3 The Study Area

The study focused on the villages and on the sectors where fuel crisis is intense. The intensity of the crisis was manifested in terms of high cost of wood charcoal and difficulty in finding dry fuel. In was also expressed in terms of cutting the forest for fuel to ease the pressure of price and access. These villages are of entirely different ecosystems and economic activities. They are the villages of Barangay Bagasbas, Bulala, Guinacutan, Mangcamagong, Mangcawayan and at the town center of Daet.

3.3.1. Barangay Bulala is within a forest and upland ecozone. It is among the villages of the town of Santa Elena and lies next to the forests of Mt. Cadig. It has 382 households and a population of 1,986. Coconut is the primary agricultural crop of this village (13). To date, wood charcoal production has become an active part of its economy economic activities in the village aside from native handicrafts from materials from the forest. This research has a particular interest on this village because

Wood charcoal production at the forests of Barangay Bulala. (by the Author).

it demonstrate an intense debate between poverty of the villagers and the conservation of the forest of Mt. Cadig while there is an abundance of coconut husks for fuel (13).

3.3.2. Barangay Guinacutan is a lowland and farland ecozone. Rice farming as among its important economic activities. It lies down the flat plains that receive the drainage of the mountains and uplands of the towns of Labo. It has a population of 2,681 and 524 households (13). This research has a particular interest in this village because of the intense fuel crisis among the farm working families in the midst of the abundance of rice hull for fuel(13).

Sun drying rice at the mills of Barangay Guinacutan. (by the Author).

3.3.3. Barangay Mangcawayan is a village at the town of Vinzons. It has a population of 1,242 persons and 241 households (13). Among its economic activities are rice farming, coconut farming and trading. The research, much like the village of Guinacutan has an intense fuel crisis amidst the abundance of rice hull for fuel. The added feature in this village is the presence of a community organization which organized the workshop series for the field research. There was no community organization that supported the workshops at Barangay Guinacutan.

3.3.4. Barangay Mangcamagong is a fishing village that lies in the southeastern part of the province. It has a population of 1,242, and 241 households. It lies between the Pacific coast and the mountains of Mercedes. Among its

Traditional fishing activities at Barangay Mangcamagong. (by the Author).

important economic activities are fishing and coconut farming (13). This interest of this research for this village is the fuel crisis among its residents while there is an abundance of coconut husks and biomass debris at the beach.

3.3.5. Barangay Bagasbas is a village of the town of Daet. It is coastal village and at the same time, a peri urban area. Among its major economic activities is fishing, trade, work at the business at the town center and skilled labor. It has a population of 4,201 persons and 857 households (13). This research took up this village as a study area because of its high population density, fuel crisis and the abundance of rice hull and biomass debris at the beach.

Piles of debri of coconut husks at the beach of Barangay Bagasbas. (by the Author).

3.3.6. Barangay 4 P*oblacion* (town center) of the town of Daet. It has a population of 6788 persons and 1386 households. This is the center of economic activities of business and trade (13). It is also where there the highest rate of fuel consumption by the restaurants and food vendors. It is where the wood charcoal of the neighboring towns is delivered mostly under illegal channels.

Mobile food vendors at the streets of Daet. (by the Author).

3.4. The Participants

The study involved a total of one hundred eleven (111) participants for the preliminary survey and thirty three (33) participants in the workshop series. Table 8 - 5 shows the demographic features of the participants, namely the ages, gender, marital status, education, and skills. The participants have an average age of forty four (44) years, eighty four (84) are female and thirty eight (38) are male. The average size of the

The participants of the workshops at Barangay Mangcamagong. (by the Author)

household is five persons. Thirty eight percent (38 %) had primary education, forty percent (40%) have secondary education, and twelve percent (12%) have university education. Skills that were identified are of farming, fishing, carpentry, masonry, construction work, metal works, transport, sewing, and cooking. Forty percent (40%) get their income from livestock production, fifty five (55%) have skills from farming and forty five (45%) from trading.

Table 8. Personal Profiles Summary of Results of Survey, January 2008.

Village	Number of	Average	female	male	Average size	Educational Level						
	Respondents	age			of household	Primary	Secondary	College	Others	livestock	farming	trading
Bagasbas	25	45	19	6	4	7	13	5		11	12	16
Bulala	29	42	19	10	4	13	11	2		11	14	12
Guinacutan	30	38	22	7	4	11	12	4	1	13	18	13
Mangcamagong	28	46	17	11	4	16	10	1		11	18	9
Mangcawayan	11	47.63	7	4	5	1	6	3	2	5	9	7
Daet	5	43.4										
TOTALS and AVERAGES	128	43.67	84	38	4	48	52	15	3	51	71	57
Percentages						37.5%	40.6%	11.72	2.34	39.84	55.46	44.53

Table 9. Personal Profiles Summary of Results of Preliminary Survey, January 2008

Village	Skills and Forms of Livelihood								Estimated Average
	fishing	carpentry	masonry	metal works	making stoves	handicrafts	driving	sewing	Cash Income per month
Bagasbas	1	2	1	1			1	1	5257.27
Bulala		2	1			5			2,219.
Guinacutan	1	2		2					4,943.57
Mangcamagong	5	3	2	3	1				no entry
Mangcawayan		2	2						
									no entry
Daet		1	1		1		1		
									no entry
TOTALS and AVERAGES	7	12	7	6	2	5	2	1	
Percentages of Skills	5.46	9.37	5.47	4.68	1.56	3.9	9.37	0.78	

3.5 Cooking Habits

Every household has their own kitchen where all the cooking and the stoves are located. Meals for each day consist of breakfast, lunch and dinner. Breakfast and dinners usually come with coffee thus the regular need for hot water. A regular meal would consist of rice, fish and vegetables. Rice in water are brought to a boil in a strong fire and then simmered in slow fire as soon as the water got dissipated until about 15 minutes. Vegetables are cooked in a variety of means such as sauté, with coconut milk and garnished with spices, fish and meat usually in medium fire. The most common dish in fish is frying in oil which requires strong fire. Dishes with meat are prepared during special occasions. Adobo, lechon are among the top favorites. Everyone prefers to remain standing. They work with only one fire prepared during every cooking. Cooking time ranges from half to one hour for every meal.

Families celebrate big events at least once in every year. Among the events of value are baptism, wedding, and fiestas. These events happen once or twice in a year for every family. During the event, they are obliged to prepare a big meal for a big number of guests. At the extreme end, a family may decide to cut down a whole tree in the yard for the fuel. An average banquet in the village may range from twenty to two hundred persons depending upon the occasions and the members in the family network. In these situations, the family prepares a kitchen outside the house, usually in the garden. Tables, chairs and big cooking utensils are brought outside. A three corner stone is set on the ground for the big utensils. A big fire is needed and wood is the most common to use in these occasions. Dishes of meat are prepared such as pork, goats' meat and beef.

There are no critical behaviors in preparing food. However, majority of the respondents expressed the utmost importance of unity in the family in performing the tasks by helping one another. Prayer before meals is given importance. One respondent told about the bad habit of singing while cooking. It is believed that she, if in case she is single, will be bound to marry an old widower. Pregnant women are also cautioned while cooking. They have to be extra careful about their wombs receiving too much heat.

3.6. Gender and Roles in the Kitchen

The average family size of the households among the respondents is six persons. It consists of the mother, the father and the siblings. In many situations, it also includes the grandparents who stay with the family until they grow very old.

There is a clear division of the tasks in the households according to gender. The respondents expressed that men are expected to haul the water (51 %), prepare the fuel (81 %) , fix the house (33 %), provide for the family (33 %), and help cook (75 %). The females are expected to clean the house (71.42 %) cook the food, (85.71 %) care for the children, and do the laundry (28.57 %) . The father is joined by the son and the mother is joined by the daughter in carrying these tasks. One respondent acknowledged her belief that men are better cooks. Majority of the respondents expressed the importance of helping one another in every household chores but it was not clear how it happens. Please see Summaries of Narratives in Appendix 7.

Table 10. Socio-Cultural and Technical Checklist - Gender and Household Tasks Summary of Narratives, March 2008

Village	Expectations from men							Expectations from women					
	hauling	help	preparing	feeding	house	regular	preparing	cleaning the	repairing	caring for the	laundry	cooking	treasurer
	water	cooking	fuel	the animals	fixtures	job	the fuel	house	house things	children			
Bulala	6		5		2	4		7	2	3	3	6	
Mangcamagong	5	3	5		3	3		4		1		6	
Mangcawayan	3	6	7	1	2		2	4				6	1
TOTALS	12	9	17	1	7	7	2	15	2	4	3	18	
Total Number	21	21	21	21	21	21	21	21	21	21	21	21	
of respondents													
Percentage of													
Response	51	75	81	4.7.	33	33	19	71.42	9.5	19	28.57	85.71	4.7

3.7. The Pool of Technical Skills among the Respondents

Skills found among respondents to the survey are farming (55.46%), raising livestock (39.84 %), trading (44.53 %) and fishing (5.46 %). There are also skills of carpentry, masonry, metal works, and stove making which belong to the males. Skills training programs provided by external organizations are micro lending, handicrafts, food processing, soap and candle making, fisheries, building wiring and organizational skills. There are no skills training program provided for stove design or fabrication. Please see Appendix 7.

3.8. The Prevailing Use of Fuel

There are three most commonly used kinds of fuel identified in the research area namely the gas (14.84 %) , wood (34.37 %), and wood charcoal (68.75 %). Only very few are using rice hull (3.12 %), *buko* shells (0.78%) and electric stove (0.78%). The respondents consume a monthly total of 1,605 bundles of wood, 158.75 sacks of charcoal, 105 sacks of rice hull, and 8.58 cylinder of LPG. [7] Please see Table 2.

The respondents gave different complaints about the fuel. Majority of the complaints is about the high cost (25.78%) and the difficulty of acquisition (21.09 %) because of rains. Families relying on wood and charcoal have difficult times in gathering and using the fuel during rainy days which happens in most of the times of the year. There are those that have a relatively higher level of comfort on the acquisition of fuel (19.53 %) and majority of the are the respondents from Barangay Bulala which is adjacent to the forests of Mt. Cadig. Difficulty in the cost and acquisition of fuel is among the respondents of Barangay Bagasbas and Barangay Mangcamagong. Please see Table 12.

[7] One bundle of wood weighs about 5 kg and has a selling price of about Php 5 per bundle. One sack of charcoal weighs an average of 28 kilograms and has a market price of Php 100. One cylinder of LPG weighs about 11 kilograms and has a selling price of Php 620. Prices are as of May 2008.

3. 8.1. Liquefied Petroleum Gas (LPG)

The prices of LPG have increased sharply and will most likely keep on increasing. More families will thus shift to other alternative fuels and wood charcoal is the next available alternative. The gas stoves come from the commercial manufacturers. A regular kind of stove are sold at Php 2,000. They are the two burner stoves and are fed with liquefied petroleum gas (LPG). There are two popular brands of LPG, that is the Island Gas and by Petron, a oil company. The Petron Gas are sold at the town centers while the Island Gas have their retail outlets at the villages.

Table 11 illustrates the selling prices of LPG in two shops in the study area. It shows the rapid increase of prices from December 2007 to May 2008. This rapid increase in prices of LPG would also manifest a high demand and price of wood charcoal.

An LPG cylinder of a mobile food vendor. (by the Author).

Table 11. Prices of Liquefied Petroleum Gas by two Selles of Daet, Camarines Norte, December 2007 to May, 2008.

Seller	**Evelyn Ting**		**Kings Land Gas Dealer**	
Months	Number of Cylinders Sold	Prices (Php/cylinder)	Number of Cylinders Sold	Prices (Php/cylinder)
December 2007	450	600	250	600
January 2008	300	630	250	620
February 2008	250	640	250	650
March 2008	400	660	250	650
April 2008	400	670	250	650
May 2008	300	680	250	665

Table12. Fuel Consumption Results of Survey, January to May 2008.

Village	Description of the Fuel Situation									
	easier to use	accesible	manageable	difficult to acquire	expensive	food not delicious	far distance	poor supply	heaavy sooth andn smoke	poor quality
Bagasbas				9	13					
Bulala			18		6					
Guinacutan	2	2	3	8	11	1		2	1	
Mangcawayan	1	3		1	1		1			
Mangcamagong	2		4	9	2			4		1
Daet										
TOTALS	**5**	**5**	**25**	**27**	**33**	**1**	**1**	**6**	**1**	**1**
Percentages	3.9	3.9	19.53	21.09	25.78	0.78	0.78	4.68	0.78	0.78

3.8.2. Wood

Being a tropical country, Philippines have a lush re growth of secondary forests relative to other ecological regions. Forests recover fast because of strong rains and sunlight. Secondary forests re grow after a period of denudation. Coconut farmers always have the preoccupation of clearing the farm with bushes and weeds to prevent the competition with the nutrients with the coconut palms. This gives them an ample yield of fuel in the form of sticks, branches and coconut leaves to fuel. It however, requires a lot of work and a place to store the fuel from rains. Gathering fuel wood is even more difficult during days with rain.

Hardwoods have higher heating values but are rare to find. Most likely hardwoods are now endangered species and are only thriving at the protected forests. Mangroves have an excellent heating value. For a time , mangroves were cut to make fuel including for the bread ovens of the commercial bakeries (Llanto 2008).The old models of bakery ovens were however, responsible for severe damage to the coastal ecosystem by depleting the natural habitat of marine creatures.

A stack of wood fuel at the market place. (by the Author).

The respondents are using wood in combination with wood charcoal which they gather from their own farms or from the forest. Relative to the other villages, Barangay Mangcamagong has the highest incidence of users of wood for fuel. They are among the poorest families of the villages who use wood and charcoal intermittently. They complain about the difficulty in firing the wood especially when wet, the black sooth in the pots and the house, and the indoor air pollution (IAP) caused by the heavy smoke in their kitchen that causes eye irritation and difficulty in breathing. Please section 3.10 of this chapter.

3.8.3. Wood Charcoal

Before the sharp rise of petroleum products in 1995, the most common form of charcoal are of coconut shells. They are mostly used for grilling barbeque, for the traditional hot flat iron for ironing clothes. They are much more solid and give higher amount of heat than wood charcoal. It is for this reason that it is preferred by blacksmiths.

Wood charcoal at the barbeque grills at the streets of Daet. (by the Author).

The use of charcoal gained its popularity in when the prices petroleum products increased sharply. Families who are using kerosene and gas shifted to the use of charcoal. Prices of wood charcoal also rose dramatically almost alongside with the rise of prices of LPG. It ranges from Php 60 to Php 90 for the soft kind of wood charcoal and Php 100 to Php 120 for the hard kind of wood charcoal at the village of Bulala. Meanwhile, the same kind of charcoal would be sold at Php 100 to Php 120 for the soft wood charcoal and Php 200 to Php 220 for the hard wood charcoal at the town center of Daet.

Charcoal is made either from wood or from coconut shells. Wood charcoal are classified further are the *barit* (hardwoods) and the regular soft wood. *Barit* is more preferred because it gives more heat and lasts longer. A *barit* kind of charcoal may come from any kind of hardwood such as narra, mahogany, apitong, dirigkalin among many other tree species. However, these kinds of wood are at the same time an

excellent material for creating furniture. *Narra*, for one is a prime kind of wood which is primarily used to make excellent furniture that can last for generations. I have a very fine dining table myself that I inherited from my father which he bought from a furniture maker in 1968.

On one occasion in 2005, one friend of mine, Rogelio Barbaran of Barangay San Pascual came to the office and was so furious. He have just found out that his narra tree, which he is saving to make very nice wooden doors out of it, was turned into wood charcoal by no other than his wife's cousins (19).

On the summer of year 2006 and before coming here to the Netherlands for my masters studies, I observed that wood charcoal is discreetly sold at the market place. Producers at the upland communities would get them on to the passenger jeepneys and hide them underneath the seats of the passengers. Check points of the DENR are installed at the only road leading to the urban town of Daet. Loads that are spotted upon during the inspections are confiscated and the owners are penalized heavily. If successful, the transporter of the charcoal will pass on the merchandise to another trader waiting at the market place. The load is transferred to a *pedicab* (a three wheel bicycle) and is organized at a legitimate stall at the market place. It is from here that consumers can buy the charcoal at will. Please see Appendix 6 for the list of cases filed in court by the DENR against charcoal producers and traders.

Table 13. Average Consumption of Wood Charcoal by Barbeque Vendors, Daet. April 2008.

Respondents	Consumption per month	Source	Purchase Price
Lito Naire	10 bags	Town market	P140.00 per bag P10.00 per packet
Leo Racelis (Lechon Manok Vendor)	12-13 bags	Town market	P220.00 per bag
Imelda Ong	30 bag	Town market	P140.00 per bag
Jessie Samuya	15 bags	Town market	P140.00 per bag
Emerito LaMadrid	5 bags	Town market	P160.00 – P170.00 per bag
Rana's BBQ	90 packets	Town market	P25.00 per 3 bags
Marilyn Azur	15 bags	Town market	P120.00 – P140.00
Jeffrey Eboña	30 bags	Jeepney terminal	P140.00

Respondents	Consumption per month	Source	Purchase Price
(Alveno's)			
Mina So	90 packets	Town market	P10.00
Lilibeth Valeros	2 bags	Town market	P130.00
Marites Rojo	8 bags	Town market	P150.00

Table 14. Average Consumption of Wood Charcoal by Banana Que Vendors, Daet. April 2008

Respondents	Consumption per month	Sources	Purchase price
Raymond Aguilar	2 bags	Town market	P150.00-barit P100.00-soft
Lucila Ulila	60 bags	Town market	P10.00 per packet
Esmael Riantazo	90 packets	A store nearby	P5.00 per packet
Araceli Botiz	10 bags	Town market	P220.00
Lizel Asiao	60 packets	Neighbor store	P10.00 per packet
Delia Lureto	4 bags	Store nearby	P220.00
Mercy M. Obusan	10 bags	delivered	P140.00
Agnes Salayon	2 bags	Town market	P220.00
Ruel Paciano	3 bags	Town market	P220.00
Marilyn Samonte	2 bags	Town market	P130.00-semi barit
Merly Tugadi (malapit sa may tulay)	30 bags	Town market	P160.00 – P170.00

CENRO Jun Ramos of the DENR expressed the tricky situation of the trade. They are actually allowing wood charcoal to be produced and transported provided that they come from private lands and not at the protected forest of the province. It is this grey area that charcoal traders and producers exploit to produce and sell the illegal kind of charcoal (20).

In an interview with Paz Yanto, the Forester III of the CENRO, she interprets the illegal production and trade of charcoal as having its roots to the socio-economic problems, particularly poverty. Their office have already closed their project named Community Based Forest Management Project for the forests of Mt. Cadig at Barangay Bulala and is now expecting the local people's organization to be the main actors who will pursue the protection of the forests and the sustainability of the projects earlier built in cooperation with local government organizations (3).

In another interview with Marizon Vega of the same office, the prevailing threats to the forests are timber extraction, swidden farming, land conversion, mining, housing. There is now an aggressive production of wood charcoal because of the prevailing poverty. Among the sources are the Bicol National Park and at the villages of Cabungahan and Tigbinan of the town of Labo. Among the reasons fo the wood charcoal producers is the far distance of the CENRO office to their place, making it very expensive to seek the charcoal production permit (21). All the while, there is an active wood charcoal production at the village of Barangay Bulala. There are about seven traders and three of them agreed to provide an interview.

Table 15. Sales and Remarks of Wood Charcoal Traders at Barangay Bulala, Santa Elena.

Name of the Trader	Average Sales per month	Patterns of Supply and Prices	Remarks Towards the Trade	Attitude Towards new kinds of stoves
Eleonor Lanuza	20 bags	Behaves parallel to oil prices (Php 90 to 120 per bag)	Government is not very strict	Most welcome because they have so much coconut husks
Damian Refran	20 bags	Behaves parallel to oil prices (Php 120 to 150 per bag).	Strict knowing that it is illegal to produce charcoal from Mt. Cadig.	Welcomes the shift to other fuel.
Rowena Josol	50 bags	More expensive during rainy months (Php 100 to 120 per bag)	Government is strict.	Welcomes the idea because she know that they are loosing the forest.

Coming back to the town of Daet in December 2008, I was astonished to find an aggressive production and trade of charcoal in the town center. Everyday, I would see at least three *pedicabs* full of charcoal. A *pedicab* could carry as much as six full bags of charcoal. It is openly sold and delivered at the houses of the customers.

Furthermore, there is now a growing scarcity of coconut shells for charcoal. Several years back traders of copra shifted their preference of merchandise. From copra, manufacturers of coconut products began buying the whole coconut without the husks. There is a growing industry of processed coconut products which include the shells (22). Farmers incur less cost and effort by selling the whole nuts in the rainy months when making copra is very difficult (23). This leads to the dwindling supply of coco shells coming from the farms, the pressure on the forests for the wood charcoal has been greater.

The wood charcoal stoves are the most popular stoves among the respondents. It is built with cement, sand, possibly agricultural lime and a few pieces of iron bars in a mold of used metal tin containers. They are sold at the market centers ranging from Php 65 to Php 100. These models may last from six months to two years of regular use. The charcoal is placed on top of the metal grate and is lighted up with a matchstick or cigarette lighter. As fire starters, households use a variety of materials such as a piece of plastic paper, a piece of worn out sandal and pieces of plant fibers.

A pedicab operator on his routine of deliveries of wood charcoal to the household consumers of Daet. (by the Author).

Wood charcoal is preferred for the following reasons:

- it burns without heavy smoke
- does not produce black sooth to the utensils
- readily available
- can give strong fire
- does not require too much attention when cooking

Complaints against the use of wood charcoal are as follows:

- very expensive
- burns poor and slow
- crumbles too easy
- very difficult to
- produces smoke and fumes

Going further, wood charcoal has only one third of the heat value that a wood will provide. Much of the heat of the wood was lost during the carbonization process (24) . A simple shift of use from wood charcoal to the use of wood would already reduce cutting of forest by as much as two thirds.

3.8.3. **Rice Hulls**

There is very limited number of people using rice hull. Only four out of forty four respondents are using rice hull for fuel Table 2. In the town of Daet, out of twenty five restaurants, there is only one using rice hull in their Lorena flat bed stove. The rest have phased out the use of rice hull and shifted to the use of LPG. Out of four hospitals, only one is using rice hull for fuel. There are three houses beside the rice mills at Barangay Borabod who uses rice hulls in their Lorena Flat bed stove. In 2004, the Camarines Norte Water District (CNWD) distributed the single burner rice hull stoves to the villagers of Barangay Guinacutan. It was meant to reduce the consumption of this village of wood charcoal. The source of wood charcoal of this village is the farms and forests of the town of Labo which are adjacent to the watershed forests serving the eight towns of this province.

3.9. Intrinsic Properties of Rice Hull and Coconut Husks

3.9.1. **Rapid Smoldering of the Hulls in the Furnace.** Rice hulls contain 4,416 to 6,222 BTUs (British Thermal Units) (25). Being a small material, the heat in every grain dissipates in less than a minute. It is therefore imperative in every rice hull stove

that there is a regular and frequent discarding of spent fuel and the reloading of fresh fuel at the feeder. Discarding the spent fuel requires sweeping the bottom of the furnace with a flat stick and letting it fall below. The ember transforms quickly from a red hot ember to a black and hot charcoal to white ash.

In order to maintain a strong and steady fire, this process will have to be repeated in every less than two to not more than three minutes. Otherwise, the fire stops and the stove loose the momentum of keeping the fire going. The spent fuel remains in the chamber and turns into very fine white ash. Discarding the white ash is even more problematic. The fine ash could fly and float into the air even with a gentle movement. There are also strong chances that it will get unto the food. The ash contains very fine particles and poses health risks to the members of the households.

3.9.2. Coconut Husks

Coconut husks have a higher heating value of 8,030 BTUs, that is twice as much as that of rice hull (26). With a very loose fiber, it smolders very quickly thus, makes an excellent material for starting the fire. It however, has a much lower density than wood or charcoal. It would easily collect water if left in the rains.

In comparison to rice hulls, coconut husks remain at the coconut farms. After de husking, part of the pile is used to fuel the copra dryer. Still, more than two-thirds of the pile remains. Thus, there is no problem of access to the husks and they are easily available for every household in the community.

Coconut farms create a big pile of coconut after every harvest of 45 days and leaves the pile to rot. (by Sandino Guinto).

The coconut husk is excellent water absorbent. Coconut husks holds water very well, thus would be very difficult to dry as soon as it is soaked in rain water. The dust, called the coco peat can hold up to 400% water of its volume. To date, the enterprise of coco fiber and coco dust have become an international business by Coco Technologies Corporation. The dust is used as water absorbent for container gardens and the fiber for many other applications. As an example, four (4) liters of water added to a liter of compacted cocopeat can fully expand to 7-8 liters in just 20 minutes (27).

The challenge, therefore, on matters of the fuel supply is how to provide the families with a dry and ready to use coconut husks. It require a creation of a system of drying, storage and delivery of the husks at the village level. Please see Appendix 5 for the description of the solar dryer.[8]

6.1.1. Pollution caused by open dumping and poor utilization of alternative biomass fuel. There are now families complaining about the continuous burning of rice hulls at the open dumps. Burning rice hulls in open dumps also contributes to the green house gases in the atmosphere. Burning them while harvesting the char cuts carbon dioxide emissions to half and at the same time provides a good material for improving the soil.

3.10. Indoor Air Pollution

Poor families suffer the most because of indoor air pollution. With the house small and poorly ventilated, it magnifies the poverty complex because of having poor health.

[8] In 2004, I was using coco peat as an ingredient to my potting mix, the planting medium I made for container gardens. It is mixed with carbonized rice hull and compost and can already support a season of growing vegetables in containers. I get my supply from a big pile of coco peat at an abandoned coconut decorticating project at the village of Daculang Bulo.

Among the fuel that is in prevalent use, wood is the cheapest kind of fuel. Respondents can pick them up wherever it is available. However, they have more difficulty in acquiring the wood in the rainy season. The respondents using the wood are those that fall among the lowest income bracket among the respondents.

The highest number of users of wood for fuel is at the villages of Barangay Mangcamagong and Barangay Guinacutan. Although they like the strong fire that the wood gives, the respondents complain about the difficulty in firing the wood especially when it is wet. The ashes fill up their entire kitchen making everything messy. They also complain about indoor air pollution (IAP) as manifested by eye irritation and difficulty in breathing. The smoke fills up the entire kitchen and creates sooth and odor to the entire house and the clothes.

Mildred Azur in her kitchen at Barangay Mangcamagong. (by the Author).

Teresita Abay, Mangcamagong. in her kitchen. (by the Author).

The stoves are made of pieces of rocks, cement and iron bars, which was built by one of the family members. If they are to build a new stove, they prefer to have a stove that will allow them to use different kinds of fuel, will allow them to cook simultaneously and one that will create less dirt and sooth.

3.11 Local Skills and Knowledge on Stove Building

Constructing the old stove, particularly the rice hull stove models belong to the old stove technicians. There is very limited diffusion of the knowledge and skills to the younger generations. The younger stove technicians are working on stoves using wood charcoal and with electric operated blowers.

There is no production of stoves that uses rice hull, coconut husks or green coconut shells. There is only active production of stoves that we found during the field research, and they are both using wood charcoal. They are as follows :

3.11.1 . Noel Rito of Barangay Bulala. He is 25 years of age and began making the charcoal stove in 2004. He learned the skills from his father. He makes the stove out of sand, cement, a few pieces of iron bars and tin metal containers. He sells them at the town center at a cost of Php 100 to 110 each. He estimates that each stove would last for two years. He can make a more durable model with a higher mix of cement at a selling price of Php 200 to 250.

3.11.2. Mercy Salve of Barangay Bulala. She started the business in 2006. She bought one model from the town of Lopez, Quezon and ahs been replicating from then on. She uses cement, galvalon, metal plate, clay bowl, AC power adapter and miniature air fan. She buys the materials from the province of Quezon and sells each unit for Php 1300 if paid in cash or Php 1500 if paid in installment. She sold one hundred units since 2006 at an average rate of 2 units each month. She takes pride of the stove that it saves on charcoal and cooks fast.

3.11.3. Jonathan Candelaria of Barangay Mangcamagong. He started fabricating the stove in 2007 out of what he saw in a blacksmith shop in a mining operation in the town of Buenavista, Quezon. He understood the necessity of the forced air unto the charcoal to make the iron bar red hot for shaping. He only built 4 and sold two of them at a selling price of Php 800 pesos each. It inspires him to know that the stove will perform better than LPG stoves and will help reduce the consumption of wood charcoal.

3.11.4. Sancho Rieza. Mangcawayan. He built his stove using an old electric stove where he fitted with a metal bowl to hold the charcoal and fix the air fan unto it. This is his first and only model. He would not tell how he learned about the design.

3.11.5. Ron Paguirigan of Barangay Bagasbas, Daet. He is not fabricating, but selling from a fabricator at the City of Lucena. He sells the stove at a cost of Php Php 1,500 to Php 3,000. he takes pride of his stove being the pioneer and the best in design compared to all other models in the province. Please see Appendix 2 for the full text of the interview.

There are three other stove technicians that were identified – Mr. Serafin Llanto, Mr. Rogelio Abilgos and Mr. Patricio Villabrosa. All of them are seniors and seldom fabricates their own kind of stoves.

3.12 Environmental Problems Caused by Fuel Crisis

3.12.1. **Deforestation**

3.12.2. There was an abnormally heavy downpour of rain from November 2007 to February 2008. On February 2008, the abnormally high rainfall has caused its peak and has caused severe damage to crops particularly rice that are due for harvest and those that are newly planted. Production dropped to more than 50 percent from the previous levels while newly planted seedlings died of suffocation by being submerged under water for several days. There were major landslides on the coastal villages of the towns of

Basud and Mercedes that isolated several villages from transport. After a week of isolation, people had to travel by boat to seek food aid from the Provincial Government. On 10 March 2008, the latter responded by sending truck loads of rice but the food aid had to be transported on boats at the port of Barangay Mangcamagong. It was also during this period that this research was on the series of second session for all the villages including those at Barangay Mangcamagong. Several sessions had to be cancelled because of flooding.

There was heavy flooding at the town center of Daet for several days. Families have to be evacuated to the schools where they are relatively safe. Photos of the Daet River that I took during those days revealed thick and heavy soil erosion coming from the uplands. I have never seen this kind of erosion since I moved to this town from 1998. I would like to believe

Images of flooding at the town of Daet and deliveries of rice aid Barangay Mangcamagong to the isolated villages of the town of Basud and Mercedes because of massive landslides. (by the Author).

that the heavy erosion from the uplands were caused both by heavy rains and the deforestation in the uplands.

This images that I personally observed and took photos of have been very useful to reinforce my advocacy, that is consumption of wood charcoal causes massive deforestation. I showed the images to the participants during the succeeding sessions and connect such images to their own situations.

3.12.3. **Gerry Villosa,** The Wood Charcoal Producer of Barangay Bulala, Santa Elena

Upon my request, the participants of Bulala organized an expedition to the forest of Mt. Cadig so I may see the actual production of wood charcoal. For more than two hours, we walked up to the mountain on landscapes of coconut farms, denuded forest, newly cut swidden farms, a trace of a major landslide in the past, and two other charcoal production areas.

Wood charcoal production from a prime forest is an illegal activity. The expedition however was meant to understand how and why it happens. One of the strongest reasons is the poverty complex to which the families are embedded. Wood charcoal production is induced from the combination of landlessness, the lack of enterprising skills, relative open access to the forest, poor implementation of the law and the growing demand in the market for the wood charcoal.

3.12.4. Pollution Caused by Open Dumping of Rice Hull from the Mills

On the 17th of April 2008, a resident of Barangay Calangcawan Sur filed a complaint at the village council. He is complaining against the continuous dumping and open burning of rice hull on the adjacent open lot by his property. He is complaining against the non stop smoke coming from the burning hulls that has already caused his asthma to exacerbate (28).

Similar complaints were expressed by the residents of Happy Homes Subdivision at Barangay Mantagbac, Daet about the continuous burning of rice hulls by Prosperous Rice Mills. On several occasions, the fire truck of the Fire Department had to come and extinguish the flames with their big hoses. Danilo Bigasa, one living close to the rice hull dump complains about the recurrence of his asthma and its effect to the health of his children (29). The same complaint came from Jocelyn Lukban. She complains about the bad odor of the smoke from the dump of Prosperous Rice Mill which triggers the asthma of her step father and her child (30).

The owner of the rice mill, Mrs. Nida Tang admitted that they are burning rice hulls at their own property and have been doing so long before there were houses nearby. She is aware about the pollution that it is causing but has no other options. She takes pride of the favor that it gives to those who wants to take the hulls for fuel and other uses. She also has the idea about making a big pit on the ground where they will burn the hulls (31).

Smaller rice mill operators are also constrained by the lack of space to dispose off their garbage. Mr. Manuel Factor owns and operates a rice mill at Daet. His mill however is right within the residential area of the village and does not have any storage facility of the hulls. To cope with the situation, all the hulls while milling are kept inside the rice bags and neatly stitched and delivered to clients. The clients are those business establishments that have rice hull fed stoves.

Mr. Rodolfo Heraldo, Jr. owns and operates one of the biggest rice mills in the province and also has this kind of problem. In 2006, I have observed him dumping and burning his rice hulls at the rice fields next to his mill. He dumps and burns more to other vacant properties and road sides of the village. There are complaints as well about the smoke it produces and had caused some irritations and tensions among some residents (32).

On February 2008, the rice field where he used to dump his rice hull now has become his property. Built on it is a concrete pavement for drying rice with high strong fence of barbed wires. He was also glad to inform me that he just made some recent deals with the a horticultural company at the city of San Pablo, Laguna (up north of Camarines Norte). The company began taking his rice hulls on their trucks thus partly solving his problem of disposal (33).

At the village of Calangcawan sur, Vinzons, Mr. Abilgos who takes rice hulls from the mill of Mr. Heraldo and turns them into carbon as soil amendment. The rice hulls are taken to a vacant lot about 4 kilometers away where it is processed into carbon with improvised carbonizers. He voluntarily gives Php 1 for every sack to Mr. Heraldo. It was not explained for what was the money for but it could work both as a token of appreciation and at the same time a bondage to ensure the latter of the access to the hulls.

3.13. Risks and Pollution by Open Dumps of Coconut Husks

In 1998, I supervised the farm operation of a two-hectare coconut farm of my family. Dehusking is manually done to separate the husks from the nuts. We transport the nuts right after to the trader on a carabao pulled cart. The pattern of selling the nuts as whole is stimulated by the higher buying price of the whole coconut compared to the buying price of copra. The husks are then left behind in a big pile at the farm. Considering the wet climate of Camarines Norte, the husks will eventually be soaked

in rain water. Coconut husks have an excellent water holding capacity. The dust, also called coco peat can hold as much as 700% water by its volume. [9]

For every harvest season, I am prompted by my co-worker to burn the husks immediately after dehusking. I refused every time. It was because of the anticipation of decorticating (threshing) the husks and extracting its fiber for many uses. The fibers have numerous and important uses ranging from ropes, rags, nets, baskets and even carpets to stabilize erosion prone slopes (27). However the project did not happen at those times and had further delays. And so I was stuck with a growing pile of coco husks every harvest period.

Wet piles of coconut husks are a menace to the farm. I was warned by my co workers that a big and wet pile of coconut husks is an ideal habitat for snakes and rats. It was a hot summer day and I was standing by the big *santol* tree with my son. I was caught by surprise by a big snake, about two and a half meters long, creeping past my left foot silently and again past my sons. I held back my surprise and was able keep on frozen state, being aware that snakes are equally scared of people and some sudden motion or sound may prompt it to attack. And so, the snake went by silently, and us, standing there still safely.

The colleague of the author, Emil Paz helping haul coconut husks for the tests of the prototype of the coco husk stove. (By the Author).

There were more incidents of snakes being caught or killed by my co-workers and it is always coming from the big pile of wet coconut husks. But then, there is nothing I can do about disposing off the pile. It cannot be burned or buried. This experience is common to every coconut farmer in my region.

[9] I use coco peat in combination with compost and carbonized rice hull to make a very rich and healthy planting medium for container gardens. It is with a ratio of 1:2:2.

This experience even more prompted me to persevere in designing stoves for the coconut husks. In 2005, I was able to build my model with the help of my colleague Rogelio Abilgos. It cooks well and since then, I had more than enough supply of fuel from my coconut farm.

3.14. Pollution Caused by Open Dumps of the Green Coconut Husks

Buko vendors have to pay workers to dispose off their empty shells. (by the Author).

At the corner of J. Lukban St. and Bagasbas Road, there are ten *buko* vendors selling everyday. The disposal of the green coconut shell is their nagging problem. Everyday, there would be about a thousand pieces of the shells for disposal (34). The vendors, after filling their sacks with the shells have to hire a laborer to bring the shells to his cart and lift it up to the garbage truck of the municipality. He is paid Php 5 for every sack. The vendors would spend a daily average cost of Php 60 for this errand.

The shells will be brought by the truck to the garbage dump site at Barangay Bibirao of the same town. The shells are dumped unto the soft part of the road as fillers against the mud. Not long after, the truck drivers realized that they are making the matters worse. The shells are actually causing their tires to loose their grip on the road (35).

Not long after, in the summer of 2008, Santiago Mella, the newly installed Environmental Officer of the local government unit of Daet issued an order not to receive *buko* shells into the dump anymore. It is also a part of the bigger problem of the town of Daet about closing the dump. They have recently received a closure order

from the DENR obliging them to stop the operations of the dump. This order is part of the implementation of the Republic Act 9003, the Solid Waste Management Act which mandates local government units to install proper waste management systems. Garbage dumps are supposed to be converted to sanitary landfill. There are more discussions in Chapter 4 Mechanisms and the Outcome on Chapter 5.

3.15. Poverty as Reinforced by Climate and the Fuel crisis

The peak of the fuel crisis reached on the months of January and February 2008. It was then when the rains are heavily pouring since November of 2007. The downpour reached its peak on the 28th of February with a recorded rainfall of 270.3 mm. for the single day (36). Heavy rains that extend until the months of January and February are not normal.

Table 15. Rainfall Data in Four Months.
Source: PAG-ASA, Daet Weather Station.

Months	**Rainfall**
November 2007	870.1 mm.
December 2007	987.8 mm.
January 2008	483.0 mm.
February 2008	1006.6 mm.

With everything else soaked in rains, there is other fuel available for cooking except wood charcoal and gas. During this period, prices of wood charcoal shoot up from Php 150 per sack to Php 220 per bag.

Sales of wood charcoal in smaller quantities changed from small plastic bags of half a kilogram sold at Php 5 each to those weighing 700 kilograms sold at Php 10 each. One of the neighbors of Sammy Ravida, one of the participants to the workshops,

began tearing the wooden planks walls of his house to make some fuel to cook. This is incident was shared by at several other participants in every session.

Expenses for wood charcoal get as much as Php 30 per day. This is about one fourth of the normal daily family income which deprives them of the money to buy food. At the Urban Poor Housing Project at Barangay Alawihao of the town of Daet, the fuel crisis manifests in the form of neighbors asking for hot water from the other neighbors. The hot water was meant to simmer the noodles which can be bought in cheap ready to cook packets. After buying this noodle packet which costs about Php 12, the poor families have no more money to buy fuel to boil water (37).

At Barangay Guinacutan, poor families living in between the road and the rice fields and over the canal experience the daily struggle to buy fuel. Without any forest to cut, they have to buy small packets of wood charcoal daily and in some of the time, during every cooking time.

In January, we came upon the family at the cluster of houses in a place Contod within the village of Barangay Guinacutan. We have found a man carrying a big piece of a dead tree trunk which he pick up about a kilometer away. He was chopping the trunk to smaller bit for fuel at the side of the road. On February, the same family had to evacuate their house because of the floods. Several days of heavy rains made the Labo River swell and the Banawang River was not big enough to receive all the incoming water. Flooding in this community is a yearly occurrence. With their house built on stilts, they had to move to the evacuation center at the school at the center of the town. For four days, they stayed there subsisting on food aid of rice, sardines, and noodles. They cook their meals on a charcoal stove but had to wait for several hours for their turn because of the crowded situation.

3.16. Summary List of the Context

- A province of high rainfall, dwindling forest cover and high poverty incidence.
- Pollution caused by open dumping and poor utilization of alternative biomass fuel.
- An increasing price of gas causing an increasing demand for wood and wood charcoal.
- Indoor air pollution from using wood for fuel and possibly with using wood charcoal.
- A group of people with low income and poor education with a strong drive to find cheaper fuel.
- The lack of access to information and the skills to innovate and utilize the alternative biomass fuels.
- A very limited pool of technicians who can build stoves but with their fading knowledge and skills.

CHAPTER 4 : MECHANISMS

This Chapter presents the mechanisms that were used to stimulate the design process:

(1) the Open Access to Alternative Biomass fuels, (2) The Open Access to Stove Building Technologies, (3) Cost of Stoves and Access to Stove Building Materials, Tools and Equipments, (4) Interactive Stove Design Process, (5) Interconnectivity Among Learners and (6) Conceptualization of Livelihood Projects. It is for the mechanisms (2) and (4) that me, as the facilitator of the process provided a high level of intervention. For the rest of the mechanisms, all that was required was to facilitate the group discussion to enable the participants the mechanisms that were already embedded in their own context.

4.1. Open Access to the Supply of Alternative Biomass Fuels

This mechanism was triggered by motivating the participants to the workshop to realize how abundant are their alternative fuel is, particularly rice hulls, coconut husks and *buko* shells. The processed however, required presentation of stove models that are actually working, thus the technology demonstrations and video clips. This allowed them to gain be fully convinced about the shift of the use of fuel that is from wood, wood charcoal and gas to rice hull and coconut husks. There are still those who remained in their preference to charcoal who later changed their minds to shift to coconut husks upon the prodding of their fellow participants with an assurance that they will have an abundant and cheap supply of the fuel.

4.1.1. Rice hulls

Rice hull is being given away for a very minimal cost that is for the cost of transportation and bagging. During every harvest season, the mills are full of rice hull which also been a nagging problem on their operations. The mills always have to find a way to dispose off the rice hulls. Please see Section 3.12. The common practice is to find a vacant lot, dump it and burn. A more friendly arrangement is to find anybody

needing the hulls and have it delivered by their truck. The Millenium Cooperative of Daet is among those who regularly get their rice hull under this arrangement. It is a cooperative of plant lovers who grow and sell ornamental plants. They have a big demand for the rice hull and regularly receive a delivery. Their capacity to receive is however, is too small relative to the volume of rice hulls available (28).

The cost however is also relative. Village households would incur the same cost of transportation in hauling back their rice hulls from the mills back to their farms, almost in the cost as the brining the raw rice to the mills. Negotiations have to be made with the rice mill operators for the delivery of the hulls by the truck. But smaller mills do not have the vehicle for such.

A much smaller rice mill is owned and operated by Mr. Factor. It is located in Daet with a capacity of 40 to 50 bags per day and 10 bags per day during lean months. The mill has no facility or area to either store or dump the hulls (38). While milling, a worker would be busy filling in the bags with the hulls. Another worker hauls them up to a pedicab and delivers them to clients. I find it convenient to take the rice hulls from this mills for my stoves because they are ready in bags and just about a kilometer away from my workshop. On several occasions, I would take the hulls myself and transport them either on a tricycle. A tricycle can carry six sacks of rice hulls per trip which I pay Php 15. I should, however be ready with my empty rice bags to leave them in exchange of the containers that I took.

4.1.2 Proximity to the mills as a Connecting Mechanism to the Access.

It strongly applies to the rice farming families because their hulls are taken away to the mills and it stays there. Getting the hulls back for their use requires a lot of effort. To get their hulls back home, the farmers will again have to spend for the cost of transportation. They would load them unto their buffalo carts, or tricycle of even hire a jeepney.

I'm living in the town center thus; I have the advantage of the access because my shop is less than 20 meters from the nearest rice mill. I have a means of communication line through a mobile phone or a house phone. Another mechanism would be the

effect of the carbonization to the neighbors. Although it cuts the carbon dioxide emission by harvesting the carbon in the form of charcoal, still it produces heavy smoke because of continous operation. It must not be done right in my house yard, lest I will irritate my neighbors. I had to do it somewhere at the outskirts of the town center where there are less people.

Disposal of the hulls would therefore work out in places where there are less people and where it is most needed, that is back to the farming communities for two big reasons. First, CRH can improve productivity of the farmlands. Rice hulls contain silica, an element needed by rice to recreate another shell of the grain for the next fruiting. A simple logic would be to put back what is taken. If the farm is producing 150 cavans per hectare per season, then it is the same amount of rice hull that has to be returned to the soil in the form of CRH. A farmer would need more if he has not done this before and bring his soil back to a balanced state. As to how much would that be, it would then require a good scientific soil analysis. Carbonization should be done right at the rice farms.

The second big reason is to provide farm families the easy access to rice hulls as fuel. The full development of the stoves is only as good as the full development of the supply chain of the rice hulls. This brings the argument about the scale of the rice mills in matters of bringing prosperity to the farming communities. In terms of the access to rice hull for soil improvement and productivity and for fuel, the bigger size of rice mills is a negative mechanism to achieve this. There is a concentration of the rice hulls to the big rice mills thus a deprivation of the access.

A positive mechanism would then be the total reverse. That is having rice mills that are small and mobile and those that can mills the rice right at the village level. Such a mill will spew out rice hulls and have them carbonized by the farmers themselves. It will also boost the development of rice hull stove designs by providing households a built in supply of fuel within their own community. There are much smaller mills located in villages serving a cluster of other villages. These mills benefit from the initiative of the local villagers who take them bit by bit. However, with the convenience of not irritating any neighbors nearby (unlike those in the town center), they do not install a big warehouse as rice hull depot. The hulls are dumped in the

open area and left to be soaked in the rain. Thus, as soon as the rain comes and hulls are already wet, nobody picks them up thus creating a big, wet, and messy pile (39).

4.1.3. Coconut Husks

Unlike the rice hulls, coconut husks remain at the coconut farms. After de husking, part of the pile is used to fuel the copra dryer. Still, more than two-thirds of the pile remains. Thus, the mechanism of the distance does not apply to the families at the coconut farming areas. There is no problem of access to the husks and they are easily available for every household in the community. At Bulala, the landscape provides them ample supply both of wood for making charcoal and coconut husk from the farm. Thus, relative to the other sites, there is generally a higher level of contentment with the supply of the husks and charcoal, although, with the charcoal, the producers are always on the caution of persecution by the government.

There is a traditional method of drying the husks. The husks are simply clumped on top of one another on a stake with the inner fibrous part facing down. This simple method allows the rain water to slide off the skin while protecting the inner part which are fibrous and which absorbs water strongly (40). Adelia Balce, another participant of the same village wants to go further by putting a plastic cover on top of the entire clump to protect it totally from rain water.

4.2. The Energy Density of the Fuel.

Rice hulls and coconut husks are too bulky kind of fuel for those at the town centers. Coco husk has an heat value of 8,030 BTU/lb. while rice hull has 4,416 to 6222 BTU/lb (26,41).

For the households and the food vendors in the town center, these fuels will fit but only to a limited extent. Well off families would have a bigger house and a bigger yard, thus allowing them to use the bulky kinds of fuel. Bigger food businesses also have the advantage of space. The poorer town center families and food vendors, however have much smaller houses and do not enough house yard to build an

extended kitchen. The food vendor, on the other hand is highly mobile. A popular form is to fix everything in a bicycle with a cart. They would need a fuel that is compact, light weight and has a much higher fuel/density ratio.

My efforts to get some food vendors to join this workshop were failing Section 2.3. During one of the sessions with the food vendors sector, we agreed to go to the town center and find a mobile food vendor for interview. And so we found Jovy Maiza on a street corner at the Central Plaza complex selling an assortment of food on his tricycle we call *pedicab*. He sells fried plantain with a variety of styles. There are rice cakes and also cold drinks. Looking closely at his bicycle cart, _ we discovered that it still has about 0.75 m3 of space between the floor of the cart and the stove on its top. Mr. Maiza would some of the time allow his son to sleep inside this space while he is busy selling food stuff. He agreed and does not mind carrying two bags of dried *buko* shells for fuel, which, to our best estimate will be enough for a day of operation. Anyway, Arnel Corral, the market manager assured Mr. Maiza that the *green* buko shell will soon be regularly available at the market place because people like Simon Fuentebella have already began drying the shells and will soon have a regular supply. And so with this discovery, the challenge we then faced is how to design a *buko* shell stove that is compact and lightweight.

A mobile food vendor of Daet. (by the Arnel Corral).

4.3. Open Access to Stove Building Technologies

Open access also means that anybody, regardless of the level of the expertise can create stoves on their own. For this, open access has its downside because it will also allow the proliferation of stoves of poor quality and even dangerous. The steam box as a case in point can blow up if there is poor welding of the metal parts or by simply having the steam holes clogged with dirt. We had this experience ourselves during the technology demonstration at Bulala. While the fire at the furnace of the stove was going strong, the steam from the box is not yet squirting out. We tried to pull it off from the pocket but it would not budge. We had to stop the fire before we were able to pull it out. There we found out that the box have become bloated because of the pressure. By simply pricking the holes with a needle was it able to spew steam. We arrived at the conclusion that some elements in water can crystallize more so if it is dirty and cause the clogging. For this reason, there has to be a system among the stove technicians that will ensure that the quality and safety of the stoves will be preserved. Please see Chapter 6 Recommendations.

A technology demonstration session at Barangay Guinacutan. (by Eden Sanchez).

The author explaining to the participants of the techno demo sessions how the steam injection mechanism works. (by Eden Sanchez).

4.3.3. For each technology, there was no existing patents thus provided everyone a free access for its use. The ATC-CPU has also abandoned the drive to have a patent over their models. Instead, they made a strong drive to have them popularized through magazines, journals and conferences. By triggering this mechanism, the design workshops were able to use all the available technologies thus creating diverse models of stoves for different functions and kinds of fuel. It also

preserved the spirit of sharing what everyone knows to the fellow participants, thus preserving the spirit of cooperation.

There is a proliferation of stove designs for different kinds of fuel and these technologies can be accessed by anyone. There is no active patenting system for such models and anyone can copy or innovate from other designs. This section presents the evolution of these models and how people are improving, renovating, adopting or rejecting these models.

4.3.1. Rice Hull Stoves

4.3.1.1. The Old Model of the Single Burner Rice Hull Stove.

The traditional model of the rice hull stove with step ladder grate. (by the Author).

This particular model has a step ladder mechanism that allows the fuel to fall on a ladder like series of flat metals. On one side, the fuel receives primary air and on the other side it burns into flame. During an interview with Efren Raro, he mentioned that he already sold fifteen (15) units of the stove at a price of Php 800 each. Again the technical problem with the stove (as I have used the same model as a boy) has been the attention it requires when cooking. With a piece of stick, the person has to aid the fuel to fall unto the ladder, scrape off the ashes from the bottom of the burning chamber and in most of the time, scrape off a few more spent fuel from the series of ladders. To my best estimate, the stove would require an attention of about fifteen seconds for every one and a half minute. This requirement ties up the person to the stove and not being able to do anything else in the kitchen.

4.3.1.2. Ipa Azul

I began building this model in 1996. I was strongly moved by the to 1998 until I finally decided to abandon it. It is almost the same model as the Mayon Turbo Stove

with some innovation. I was able to partially solve the problem of smoke but not the attention that it requires during cooking. Still the bed fire would eventually ignite after about 20 minutes that is after the first meal was cooked. It is the time when the metal have already became so hot that the rice hull on the hopper burns prematurely.

During this period, I was able to fabricate 75 units and sell them. I sell the basic model for Php 1,300 and the bigger model for Php 1,650. There were very enthusiastic clients every time I make demonstrations. The flame is impressive at the beginning of the cooking. A clean yellow and blue flame goes gushing out the burner with very little smoke. However, after 15 minutes of cooking, the smoke begins to build up very strong. The stove turns out very hot and flames ignite on the fuel bed. No client recommended the product to any other potential customer and the sales and inquiries dropped to a halt.

4.3.1.3. The Mayon Turbo Stove

The ending of the project with Ipa Azul is also shared by the member of the PDG . On 28th of February 2008, I made an interview with Ms. Generelyn Jalico of the Paghida-et sa Kauswagan Development Group Incorporated (PDG) at their office located at Sitio Mojon, Barangay Binicun of the town of Kabangkalan, Negros Occidental (42).

Ms. Jalico related some lessons on two stove models that they fabricated the Rice Hull Stove (RHS) and the Mayon Turbo Stove (MTS). The following is an excerpt from the interview.

> *Can you tell me what was with the project when you began?*
>
> First is the marketing of the MTS, how to sell the MTS. So the production has already began, in 2002, beginning January. It began with simple rice hull stove RHS. MTS began in maybe April 2002. Round with cylinder with feeder. RHS – we distributed it to the Pos. first year, all were disposed to the outlets. 3,485. Sold at sharing cost 300 plus 350 at the dealer. PO buys at 300.
>
> *What was the story with the RHS. Why did it stop?*
>
> The problem was the consumer acceptance. Wood is easier for them to use. People at the urban areas find it difficult to use rice hull. "The attention requiring feature of the Mayon Turbo Stove have cause people to stay away from the stove. It requires too much tapping. ….

Does it have a chimney?

No chimney and yes, smoke is a problem. There are holes on the side and the smoke gets out on the side. With poor burning, the smoke is thick. There is a fuel hopper and a ladder. There are problems and suggestions. A tube was installed at the bottom to minimize the smoke. With little tapping, the sooth is inhaled by the children, causing some asthma.

So when we advertise.. it has also disadvantage.

So while all these improvements are undergoing, marketing is underway and you received some negative feedbacks. How did you correct these?

We advised people not to use inside the house but outside. We also corrected the design in the model. Then MTS came in. there is a tube under and the fire is continuous and bluish. Even though …… there are others who are not fully convinced.

So when we advertise.. it has also disadvantage.

So while all these improvements are undergoing, marketing is underway and you received some negative feedbacks. How did you correct these?

We advised people not to use inside the house but outside. We also corrected the design in the model. Then MTS came in. there is a tube under and the fire is continuous and bluish. Even though …… there are others who are not fully convinced.

In the development of RHS, did you have a fabricator or a shop?

Yes.

About the Mayon Turbo Stove, MTS. It began at about April 2002, fabrication June to September.

The MTS, Richard Samson, the Canadian and he got a technician from UPLB.. First it came from UPLB. Engr. Florentino Dagaas.

Then you set aside the RHS?

So I was then at the RHS then to MTS for the marketing. Here, our task is to fabricate and dispose the stoves. We have our own shops. We fabricated 536 units MTS.

What did you see with the MTS?

For me who uses, until now I'm using. It's good, much better than the RHS.

Better quality. The RHS has too big feeder, MTS has smaller feeder and uses less rice hull.

Photo by REAP Canada.

Is there smoke?

Not much. The advantage of the MTS has too white agiw (fine white dust). It means there is very minimal dust, less than the RHS whenever you tap it. MTS is hotter.

So you still have this with you?

Yes, only one but very old.

But how long does it last? (I'm concerned about the) metal.

The one with me is an old model. Since 2003 and still good until now. I only had to remodel it. Put it in a (platform) so I can stand on it.

That is good news.

Metal as long as you use it often lasts long.

So how about the 536 units of MTS, What was your program?

We disposed them all. But the project stopped. Atty Ramos also told you why.
On the operations , all the 536 were disposed. And still more are looking for it. But the fabrication stopped. Because there are still old models which were remodeled to become MTS. However, with the old stocks rusting, we had to sell them to junk. We were even able to sell to Pagadian City to Cyrus Sacal. But we had to sell him to a very low price to as low as 250 each from 300.

What were the responses among the beneficiaries?

The intended .. MAPESAN still they prefer to use the more comfortable models like those of wood charcoal. It would need longer time to get them convinced.

But in your case you have been using this all the while….

Yes, I have to do that because I am the one promoting it. For me it ok to use. Convenient to use, helps reduce fuel required. But I must admit that it requires your full attention until your done cooking with it.

Yes it was mentioned by Mr. Ramos

You cannot leave it…… its dangerous because it is rice hull because the fire easily spreads. It also requires adult to use it because it is dangerous for children. With wood, even a 10 year old child can use and the mother does something else. This is the usual feedback of the consumers. They agree that it saves a lot of fuel and that we do not have to get wood.

So after you got this feedback about the convenience of using compared with wood, what was your corresponding action?

We stopped convincing the people.

So what I understand is that there is a resistance among the people and you also stopped in renovating the stove design. Is that correct?

There is something we have done. We added the holes of the MTS to make bigger to respond to the needs of the consumer. It will receive more fuel and requires less reloading. Another problem is the flame is too strong. Their rice cooks too fast thus burning the rice. Not all problems have technical solutions It rests upon the user to correct the operation. So we just advice them to put a metal sheet over the burner. This problem keeps on recurring, so we advice them to improve in their method of using.

So what I now understand is that you did not change the design of the model but instead gave advice on how to use it. And after this advice, was there a change in attitude?

No, the attitude remained. This is after getting feedbacks. We would see upon visiting their house that the stove is kept on the side.

Please see Appendix 2 for the full text of the interview.

4.3.1.4. Pugon Solo

On September 2007, while here at the Netherlands, I asked Tata Rogel to build another rice hull stove. This was in response to the improvements that I realized would be necessary to integrate in the traditional step up ladder rice hull stove coming from the province of Albay. The first component was a chimney and the second component was a flapping metal floor.

He built the stove from the design that I sent through the mail. We built a chimney unto it so it may draw out the smoke from the sides of the burner. It solved the problem of smoke coming unto the user and also created a stronger flame because of the sucking effect for primary air by natural draft. The flapping metal floor replaced the scraping motion with a stick with a simple pull on the metal plate. The char falls clean unto a bucket below.

On 13th of February 2008, we made another model as an improvement to the Pugon Solo. It was a much bigger and durable model what we created for bigger loads. The chimney also had to move 45 degrees closer to the fuel hopper. This transfer provided the user with more space for movement during cooking. Instead of a flapping metal plate at the bottom, Tata Rogel decided to make a sliding metal plate. The stove had

the same performance of the older Pugon solo model. In fact, one business person making a *taho* business bought one unit for cooking the sugar syrup for his business. He was carrying a heavy cost from buying coconut shells and decided to use rice hull instead. After showing him the improved model, he wanted it revised. He wanted a model without a chimney and the cooking pot raised about two inches from the furnace. After construction, it gave a much stronger fire. However, it carried a strong smoke and sooth unto the cooking pot. Still he preferred the stronger fire and did not mind the smoke coming close to his worker.

Two months later, Tata Rogel, realized that our Pugon Solo Model could be further improved by boring a hole on the part of the stove facing the furnace to allow primary air to come into the furnace. Sadly, I am at the end of the period of the field research and could only postpone the construction until I am back after my studies.

Mr. Rogelio Abilgos and the rice hull stove models that we jointly designed. (by the Author).

The third problem which the stove did not resolved was again the same problem of too frequent poking and tapping with a stick. The big reason for this, I believe is because the design process of the Pugon Solo did not have the participation of the user. It was me and Tata Rogel both acting as technologist and the *taho* business person acting as the manager who designed the stove.

4.3.1.5. Coco Husk Stoves

Among the one hundred eleven respondents covered by the survey, there was only one who uses coconut husk or *buko* shell for fuel. It was Simon Fuentebella who also learned using *buko* shells from my previous experiments. And so my work with *buko* shells and coconut husk stove is a pioneering effort. With the property of coconut husks as bulky and producing heavy smoke, I designed a stove that has a big furnace, two burners and a chimney. I jointly built the stove with Tata Rogel in February 2004 with sand, cement, some rice hull ashes, agricultural lime and salt. We got a 200 liter metal oil drum and cut it into half. The stove is really heavy and requires three persons to move it from the shop to my outdoor kitchen.

The prototype of the coconut husk stove that the authore jointly designed and fabricated with Rogelio Abilgos. (by the Author).

Starting the fire is somewhat difficult because there is heavy smoke. As soon as there is enough ember and heat in the stove the fire becomes strong. With coconut husks, the stove burns good. In fact the flame climbs up to half a meter up the chimney. Dried *buko* shells works equally well in this stove. I use it in after the husks have earned enough embers in the stove.

The door had to much wider than the usual wood stove. Loading the husk is done by pushing it one by one unto the grate. The furnace can only receive the most two chunks of husks each reloading. But the grate would need an enclosure so as no to loose too much heat. Tata Apin offered his services for free to fix this.

On December 2007, I decided that I have to create a mound in the furnace so the fire can “kiss” the pot by making it “jump”. And so with bricks, sand, soil and ashes, the desired effect was achieved. My family spends less than four whole husks in every meal. My two neighbors also cook in this stove.

4.3.1.5. Wood Charcoal Air Fan Stoves

I first saw this stove in 2006 in an exhibit during the Pineapple Festival. Mr. Ron Paguirigan and his father, were demonstrating and

selling a stove which he calls the Super Pugon Saver. It was built with metal and uses coconut shell charcoal for fuel. The main feature and engine of the stove is a fan that runs on twelve (12) volts of electrical power. It is the same fan that from the desktop computer. With a gush of air that is pushed into the ember, the coal burns steady and strong.

I again made an interview with Mr. Paguirigan on 2nd of March 2008 that is two years after our first interaction. The following is the transcript of the interview.

Good morning Ron. Can you please introduce to me this stove?

We call this the Super Pugon Saver. It saves so much that the monthly expense – ranging from 200 to 300 pesos a the maximum cooking expense including the charcoal and electricity. The duration of cooking and frequency this is definitely saves a lot

How did this stove come to you?

I have a friend in Lucena and I got a unit from him . From then on I have been selling these units. I myself can attest to this for the past 3 years of use and more. Until now, I still hold on to it. My gas stove, im only using as reserve. Now gasul[10] costs 600 and still going up. I still have a baby so I have to boil bottle fed drinks for my baby. If I should use gas, I will to use two tanks a month.

Can you please explain the components of the stove?

The components are the adaptor of 220 volts transformed down to 12 volts of .22 amperes consumption divided 6 volts consumption. Like this, this is an open wire even if the open wires touch each other, there will be no spark or even if I touch it, I feel nothing because of the very low voltage passing through.

Can you estimate in a month the consumption of electricity ?

We estimated it to be 10 to 14 pesos a month cooking at 6 hours per day.

What was the response to you with the clients?

The response was great because it saves a lot. The big problem now is the manufacture and repair of the stoves. Because this is actually not that durable because of the coal, the (metal) gets holes on them, or the adaptor gets broken or the wires get cut…. Things like those…those little things. In my case, although I did not study electrical engineering… the big concern is the cone. But it can be easily be repaired. In general terms, you don't loose that much because it really saves a lot.

How many units have you already sold? When did you begin?

A long time ago… .2004 and we have sold 150 to 180 units.

What models were those ?

There are two models. The first one is the heavy one. Then the innovation is this light weight. The heavy one is 18 kg. made of cement. This light weight is 5 kg or less.

Why is the heavy one created?

[10] liquefied petroleum gas

It was designed for the restaurants. It is more durable actually but you cannot move it from place to place. It will need men. A woman cannot lift it up. They cannot. Then this light weight model was innovated. this is most recommended for household use but not if you are not to cook meals for a hundred persons.

In the past when there are heavy rains, you would need a good stock of charcoal. You must prepare some money and buy good supply of charcoal. Otherwise, you will run out of stocks. Unlike the gas, there is always a store that sells the product. And there are hardly any cheating with the gas and there are grave cheating among charcoal suppliers.

Have you experienced any?

Oh yes. We had that kind of experience. We bought wet charcoal and we weighed it really wet. But it was alright even though. My stove can burn nice even with a wet charcoal as long as there is a dry charcoal as a starter. It will still burn good.

How much did you buy the charcoal for?

We used to buy about 6 -7 pesos per kilo at Basud. That was two years ago. I now have a good stock of one ton of charcoal. I got them in bulk. There is a person who assembles at the village. We have one trader assembler there at Belwang multipurspose coop.

You told me before that coco shell charcoal is now dwindling. How is that?

Yes that is a concern. Before, farmers make copra out of the coconut. So they can get the charcoal for fuel. Nowadays, the nut itself is sold as whole. The buyer gets income from the coconut meat, the oil and the shell. And the shells are exported to the coal powered plants of other countries. I was told that our shells are sold all the way to Manila and exported. So, by purchasing coconuts from the farmers, the traders tend to gain more. The husks give fiber, the shells gives charcoal and arts and crafts . And the meat becomes copra and gives oil. So if I have a coconut farm, I will simply have to take off the husks then sell it off immediately.

The old practice was to keep the husks so you can use it to dry the copra and then make fuel from the shell. But now, everything is taken because it gives more profit to the traders. So if you can see at the Bagasbas (beach during every rainy season) there would be at least a thousand coconut husks piled at the beach. It only shows that the husks have no purpose because the husks are now no longer used for drying copra. Now why is it so? So I asked myself why are people consuming wood charcoal while it is sold so expensive at 10 pesos per bag for fuel?

Nowadays, so much trees are being cut for fuel while there is so much coconut husks to use instead.

The model greatly improves the flame because of the air fan. But the cost is greatly excluding. During the second session at Barangay Guinacutan, I posed the question to everyone while Mr. Cereno was there. What is the maximum price that you are willing to pay for a good stove that you like ? After 10 minutes of discussions among them, they came up with a figure : Php 300.

And I threw the conclusion to Mr. Cereno, the stove technician. "*How about you, Mr. Cereno, are you willing to make a stove that they like for the cost of Php 300?"*

"Well…. Uuhhmm…. Yes, only if today is 1995. Then that I can do."

The challenge is therefore how to make a very nice stove with the air fan at a cost of less than Php 300 (at least for the participants of Guinacutan).

4.3.2. The Natural Draft Barbeque Grill : From Renkum to Daet.

In many nights at the town center of Daet, I would spend an hour and half after work just to observe people and food vendors get busy in selling and buying cooked food. The side walk of this particular spot, fronting the City Square Shopping Center is filled with mobile food vendors with their shops fixed on wheels. They are selling *lutong ulam*.[11]

On one section of this busy street, there is a row of barbeque carts. Anyone who approaches this section will be met by a heavy barbeque scented smoke. And in every stall is a person busy selling barbeque and at the same time briskly fanning the charcoal with an *abaniko* to keep the charcoal burning.

The food vendors in this street, like in many other small food shops, consume wood charcoal heavily. With an appropriate design of a barbeque grill, I always believed that it will greatly reduce their consumption of wood charcoal and at the same time eliminate the need for fanning.

In September 2006, I was on a welcome party which was hosted by Mrs. Nora van der Does a Filipina married to a Dutch. Ate Nora, as we fondly call her has been living in the Netherlands for almost thirty years.

One of the menus for the big dinner is grilled chicken. And then I volunteered to do the task. It is with a black metal barbeque grill with a cylinder that acts as a stand. At the same time the cylinder stand allows air to pass from the base and up to the bottom of the grill. While working on the grill, I was amazed how quick and strong the fire

[11] Literally it means cooked (lutong) ulam (viand). A viand is a generic name almost any kind of food that goes with rice. It could be meat, vegetables or fish.

built up. In fact, I got some of the chicken burnt black because of too much charcoal that I put.

With the recollection of the mechanism of this stove, I built a prototype on February 2008. The charcoal bowl, instead of metal is a clay bowl meant for hanging plants. I got the bowl for Php 30. I drilled holes on them with a sharp knife. The cylinder stands are used milk tin cans. I got one of my plants planted on the cylinder milk tin cans which I created two years ago. I took out the plant and transferred it to the ground. After taking out the planting medium, I punched in three more holes at its base to let the air flow in. I got a few more tin cans from my neighbor to achieve the proper height. I immediately place the clay bowl on top, dropped a few chunks of wood charcoal over it and lit it up. And so without any blowing or fanning, the charcoal lit up to red hot ember.

The author during the on the spot assembly of the natural draft barbeque grill. (by Eden Sanchez).

The following day, I went on to the little shop in the neighborhood selling barbeque. The grill that they are using is made of a flat metal box that holds the charcoal. At the bottom of the box is sand that was meant to protect the metal base of the grill thus, it is closed for any air. And so the man had to briskly fan the charcoal with a big *abaniko*. There is heavy smoke all the while that engulfs everyone including the customers. [12]

12 *abaniko* – a piece of anahaw (a palm leaf that was braided to create a handle and make it more pliable.

Coming to the man, I asked for twenty pieces of barbeque, which is abnormally too much for a regular purchase. But I made it on a condition that I will cook the barbeque on my own grill. There was big reluctance on their part. They could not understand why, I have spend for a big purchase, buy from them the charcoal for my grill and not insist that they buy my product.

Finally, they agreed to grill my barbeque on my grill right beside their own grill. We placed equal amounts of charcoal at the same time and placed over it five raw barbeques. While the man was briskly fanning his charcoal, I was busy chatting with my daughter who was all the while sitting on my lap.

And so in the end of the "barbeque race", the man had to use three loads of charcoal and was all the while busy fanning the charcoal to keep it burning. I only used one load of charcoal and then was able to make a list of names with my daughter for her pet kittens.

Wilfredo Golez and his new model of the natural draft barbeque grill. (by Froilan Rempillo).

The following day, my daughter with three other girls, in the neighborhood with ages between 7 and 11, decided to sell their own barebeque by the road side. They used the new natural draft barbeque grill. At the end of the day, they were so happy to have a good sale. They were also very glad about not having to fan the charcoal and use less than half of the charcoal that they prepared.

While writing this thesis, I got news from the Philippines, that Mr. Wilfredo Golez, one of the participants of the workshop series built his own grill of the same design. It was an instant attraction on a barbeque home coming party of a friend. His friend was so amazed that he asked Pidong for the grill to become a homecoming gift.

4.3.3. The Side In Steam Injector Rice Hull Stoves of the The Appropriate Technology Center (ATC – CPU)

In the same manner, the Appropriate Technology Institute of the Central Philippine University does not impose exclusivity over their technology. During an interview with Engineer Aries Romallosa of the center 27th of February, 2008, she declared that their policy of an open access to their technology also calls for the protection of their work. They (they center) do not anymore rely on the affectivity of the patenting systems in the Philippine context. The process would take too long and by the time that they were able to get the license, there would too many copies and innovations in the market that took off from their own work. Instead they ask the client to acknowledge their name whenever their technology is in use.

They also exerted considerable efforts to distribute publicly the schematic designs of their models on newspapers and journals. The public announcement allows them to achieve two things. First, their work would reach a good number of potential clients. Second it reinforces their claim over their technology thus and by having it known by the readers, it protects the technology from any false claims.

Engr. Rommalosa is pleased with their work. They had a good number of clients and are still growing. I was then particularly interested to buy two units of the rice hull stove, one is the Rice Hull Stove with a Side in Steam Injector and the second is the Rice Hull Quasi Gasifier Stove. She sold them to me at Php 1,500 and Php 3,500, respectively and gave me full consent to have them reproduced and improved at my own free will. I paid an extra of Php 1,800 for the freight to have them delivered to my home.

Furthermore, they are preparing for a big event. It is a contest of outstanding project ideas called Panibagong Paraan 2008. The event pools together organizations and funding partners in trying to match the best project proposals with the willing sponsor. They are hoping to win the prize of as much as Php 1.5 million which they will use to fabricate more stoves in partnership with a local government units and recipient village organizations. Please see Appendix 2 for the full text of the interview.

4.4. The Master Stove Technicians and their Knowledge and Skills

4.4.1. Mr. Norberto Cereno

He was among the participants to the workshop series at Barangay Guinacutan, Vinzons. He is a master stove builder and has built eighteen units of the big flat bed stoves and fifty units of the smaller single burner stoves for rice hull. Along with him is his son who has also learned his skills and has been building rice hull flat bed stoves himself.

The stoves consist of the furnace with a fuel feeder made of metal, a step ladder grate for the furnace, and one or two burners which ends with a chimney. He uses fire bricks, concrete hollow blocks, cement, sand, salt and soil for construction.

Several years back, he constructed the smaller single burner rice hull stoves and was able to sell several units within the village. However, with the coming of the gas stoves, families shifted to the use of gas and when the gas prices went up, they shifted to the wood charcoal stoves but not to the rice hull stoves. Participants to the workshops who happened to be among the clients of Mr. Cereno's single burner stove complained about the difficulty of lighting up the fire, the attention it requires, the heavy smoke it emits and the ash that fills up their kitchen during every cooking.

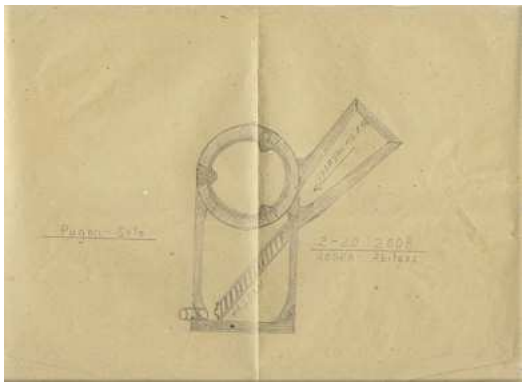
Meanwhile, his son still has a rice hull stove at his house. It is a two burner flat bed stove which he constructed himself and still very much in use. The wife is very glad to have the stove because they save a lot from fuel which they get from the rice mills not more than 200 meters along the road.

4.4.2. Mr. Rogelio Abilgos

I fondly call him Tata Rogel is another master stove builder. On September 2007 we jointly created a stove which we call Pugon Solo. It is my own design in response to the technical improvements which I deemed necessary for the older version of the rice hull stove. During every project, Tata Rogel would be joined by his son Marlon who also learned his skills. Together plus some of my colleagues in the NGO, they built

several stoves for the villages that POMCAT serves. They built a pottery kiln at the village of San Pascual, a fruit dehydrator and a bigger four burner stove with oven, another Lorena flat bed stove at the village of Cabusay at the town of Labo, another bread oven at the villages of Alawihao and Tawig. These projects were mainly design by our team in the NGO with very little the benefit of the design process embedded in this thesis. [13]

After all these projects, Tata Rogel remains open and generous in sharing his knowledge. Aside from making his own improvements unto the stoves that he builds, he makes his own drawings and sketches about his designs and shares them with me.



Tata Rogel intends to bore a hole through the chamber of the rice hull stove to improve air supply as expressed in his drawing.

4.4.3. Mr. Patricio Villabrosa

More known as Kuya Pati is the husband of Ate Nelly Villabrosa who is also a parcipant at the village of Bulala. On 5 March 2008, while waiting a their house until the participants arrive, our cordial conversation ended up with me asking if he know of anyone in the village who knows how to build stoves. And Ate Nelly exclaimed : you are speaking to the person already!! He knows how to build stoves and you built one before, did you not?"

[13] After my studies, I will go back to these villages and "repair" everything that needs fixing, this time with the benefit of mynew education. I decided not to take up these projects as subjects for my thesis because I will loose the external validity of the materials. There has been a very high intervention of my NGO POMCAT unto these villages thus, lessons that I will draw from them will not be valid to most other villages with very little or no NGO intervention.

And Kuya Pati replied “Uuhhhmmmm….. yes, but that was a very long time ago.”

I said, “it does not matter. If you still recall how you did it, then I will be very interested to listen. ”

And so the conversation led me to make an interview right on the spot. Here is the transcription of the full interview.

Jed : Good afternoon to you again. May I know your name again?

Good afternoon too.

Ate Nelly (the wife) : He is called Pati. Pati is the way he is called.

Kuya Pati, where did you get this clay ?

At the nursery.

Is there a lot?

Yes there is a lot.

Have you tried using this?

I use it with my ilohan

Ilohan?

It is a stove.

Stove of what?

Tamis…. For milling and cooking sugarcane. This is what I use. I form it with a mixture of ash, carabao manure,

So you have sugarcane field?

Yes one hectare.

Ate Nelly : Yes, but that was a long time ago.

Ilohan, the sugarcane mill.

So how do you make it?

First you grind this. Then you mix it with ash, carabao manure, molasses a
Then you mix them all. You can even use the manure while fresh but if you need a strong gut.Now, we do not have dried manure so fresh manure will do. The tamis is the one you call pulot (molasses).

So what it the mixture ?

It depends on the size. So if we have one sack of clay……If you have one sack of clay then, you will use one bag of manure. With the molasses, u will use about one gallon. More if you will create a bigger stove.

What is the role of molasses?

It was meant to make the mixture very sticky.

But can we not use the regular sugar?

Oh no…. it's not necessary. It would be a big waste. As long as you don't omit the carabao manure, which is very important…….

The ilohan, this means this is the one where you cook the sugar.. .turned to sangkaka.

So what fuel did you then use?

Wood.

So are you satisfied with the strength of your stove?

Yes. But do not neglect fixing it with a mixture of ashes every after use to make it strong and mixed with manure. Ashes it makes it tough. (We use manure) because that is grass. We do not have to be disgusted about it. They are just milled grasses.

Oh yes… actually. I agree. Grass milled by the carabao and spewed out of its ass.

Actually, in my sugarcane mill. I even pick up fresh manure and paste it on my stove. I only use my bare hand.

What is the mix?

Just with water, the same mix and with water. Then wet the stove a bit to make it tough. Grasses make the stove tough. But I cannot make one for my kitchen because I'm so busy. I'm planning to build one for my pan.

Let me show you the stoves that I built. These are stoves for coconut husk and there are more for rice hull. First we look at those for the coconut husks. These are made from cement, sand, lime and salt. Now, what I want to know from you is.. …if it is possible to build these stoves made of these clay.

Yes.

Can it really be done?

Yes, but it will require some kind of a mold. I did it with a frame of a chicken wire and then I plastered the cement over it.

This saves a lot, I agree. ….. These are the husks that I'm drying…. This is the dryer that I made. This is the stove that I built for rice hull. Do you think we can build this one with clay?

Yes.

Will it not break down?

We simply mix it with……sahara? And a some sand…… to reinforce.

Can we invite you to our next seminars?

Oh no… im too busy.

He is too busy.

That's allright. If you like, together, we will make a stove made of clay for coconut husks. Is that allright with you?

Uuhh hhmmmm (yes).

Do you think this clay would be good?

I think so. This is good. It looks very much like the clay coming from San Pascual which they use for making earthen jars. But we will still have to refine it…take out the impurities to make a good quality clay out of it.

So this is great !! I'm very happy !! You got good clay and you have someone who knows how to make it. Thank you very much, Kuya Pati.

You're welcome.

4.4.4. Mr. Serafin Llanto

Tata Apin as we fondly call him, heard my announcement over the radio. Without hesitation, he came over to join the design workshop. He has the energy of a younger man and has been over zealous to share his knowledge and techniques to everyone in every session. The following is the transcript of the interview made on the 18th of April 2008.

When did you begin making stoves ?

I guess that would be in 1960.

Are you still making stoves? How many have you built since then?

Yes. I can not really count.. maybe more than a hundred.

What kind of stoves do you do?

I can make those that are fed with rice hulls, those that are fed with wood, coco husks, coco shells, green coco shells… all kinds of stoves I can do. They do not get black sooth and they are very clean.

What are the basic building materials that you use ?

I use sand, cement, mineral lime….it depends upon the kind of stove that I'm building.

How about salt?

It is not advisable. You will only use salt in the bakery oven. It is lined unto the sides of the oven. It is meant to keep in the heat. One week after firing the oven in the brick oven and the heat is still strong. I learned all these from my father in law. His name is Buenaventura Bacalla. He is fondly called by everyone as Bay. He built the bread ovens of Washington, Times, Sanitary, Yummy and the Louie's Restaurant. I was his apprentice.

Would you know where did he learn this?

I do not know. What I know is that here in the town of Daet, there are only two of them who knows how to build stoves. The other one is Mr. Malangyaon.. the father of Jessie Malangyaon who is also now a stove builder. His father died. Aside from me, some other cousins and his grandson also learned from my father in law. We built stoves for the chips business.

Among your own children, is there anyone who also learned this expertise from you?

That is my disappointment. No one among them had the interest in this line of work. But maybe they have the skills to build the smaller stoves but not those for the bakery.

When you work in the bakery ovens, are you in a team?

Yes. The least number of persons in my team would be four to five persons.

Are these persons still around?

Yes, they are still around. One is the brother of my wife and the other is the grandson of my father in law. I do not get any other persons after them.

What can you say about the situation of fuel in our province?

With the charcoal, it is so much expensive. While there is an abundance of free fuel which people take for granted and neglect. The LPG that we use are too expensive. It is sold for at least 500 pesos. That is too much.

In your opinion, why, in spite of the abundance of this fuel, people still use gas and wood charcoal?

I believe people still go for convenience. They want stoves that they can leave and do other things. These stoves that I'm building, I must admit requires attention. If you neglect them, they can burn everything that is cooking. In spite of the free fuel, people do not want to work for it and get into the problem of finding money to buy fuel.

So in this research what do you think you can still contribute? .

I just want to help…. To help people so people can build and repair stoves on their own.

So on the stove models that we discussed… do they have the potentials?

These models need to be constructed and see if they would really work. Then we will know.

May we invite you to help us build these?

Yes, of course. Just prepare the material and I will gladly help. I can even fix your coconut husk stove and install a door to the furnace so you don't loose too much heat.

Thanks a lot ! I appreciate that . About this seminar, what can you say about it ?

I really appreciate this seminar. I believe it will really help people get over the crisis. I am very much willing to help them.

4.5. Costs of Stove and the Access to their Corresponding Building Materials, Tools and Instruments

The knowledge about the cost of the building materials, tools and instruments as well as the selling prices of the stove models served as a mechanism for the participants to decide which stove models should they follow. Metal stoves were seldom admired while there was strong excitement about building their own stoves from the clay in their own village.

Considering the price over function and lifetime ratio, rice hull stoves made of metal are the most expensive to purchase or construct among the models. The ATC – CPU model having one burner costs Pp 1,500 to Php 3,500. The Lorena flat bed stoves have two burners and one oven at a cost of Php 5,000 and may last up to fifteen years.

The cheapest among the models would be the clay stove which they can build on their own without having to buy anything at all. Animal manure and coconut fiber are available in all villages. Clay are relatively accessible to most of the villages. The villages of Mangcamagong, Guinacutan and Bulala have their own local sources of clay. The tools commonly present in the villages are gardening tools such as shovel, machete, pallete, hoe and other carpentry tools like saw, hammer, and chisel.

Table 16. Comparative Costs of Different Stove Models.

Fabricator	**Description of the Model**	**Selling Price**
Ron Paguirigan (seller only)	Charcoal stove with Air fan	Php 1,200 to 3,000
Ronnie Candelaria of Brgy. Mangcamagong	Charcoal stove with Air fan	Php 800
Serafin Llanto	Charcoal stove with Air fan	Php 600 to 800
Rogelio Abilgos with Jed	Rice hull stove single burner with chimney and carbon dispenser	Php 900 to 1,100
ATC-CPU	Rice Hull Stove with Side In Steam Injector	Php 1,500 at the Center Plus freight of Php 800
ATC-CPU	Rice Hull with Turbo Steam Injector	Php 3,500 plus freight of Php 800
Norberto Cereno, Serafin Llanto, Rogelio Abilgos	Lorena flat bed rice hull stove, 3 burner with oven	Php 5,000 to 10,000
by Jed Guinto, experimental model	Coconut Husk Stove, two burner with chimney made from concrete	Cost of production only : Php 600
Jed Guinto	Hybrid Clay Stove two burner with steam box of ATC-CPU design	Materials: clay: Php 150 Chimney Php 50 Steam box : About Php 200 Total : 400 Plus two days of work

Noel Rito, Barangay Bulala. More are available at the market place.	Conventional wood charcoal stove	Php 100 to 200

4.6 Interactive Stove Design Process

The design workshops maintained the spirit of cooperation and free access of knowledge among everyone. All the existing stove models were subjected to their own manner of evaluation and allowed them to create their own from what they found relevant for their own needs. The contextualization stage of the workshop series allowed appreciation of everyone's situation and initiatives to confront their own kind of fuel crisis. It also acknowledged their local knowledge, skills and stove designs without prejudice to the other better models.
There are four levels of sessions on every workshop series. Session 1 : Orientation to the Research , Session 2 : Contextualization, Session 3 : Tools and Techniques, Session 4 : Creating the Miniature Stove Models. Please see Chapter 2 Methodology.

The workshops were designed according to the following notions:

- The participants are important. What they know and what they have are important and people from other parts of the world are willing to learn from them.
- The use of charcoal, illegal as it was, happened under a context of the lack of information and better alternatives.
- We including me as a technologist and them as the local villagers have our own problems, mistakes and solutions.
- There are options that were developed by people from other areas and within other context and they are worth looking into. Nobody holds the absolute solution to a given problem. Problems are always dynamic and evolving and so are the solutions.
- There are already initiatives that evolved right in the same province and even during the course of my field research.

- They can and must build their own designs and their own stoves support and can built them using local resources and skills..
- I will be most willing to support them long after my study is done.

The workshops at the villages took off with heavy discussions on the context. There were discussion workshops about the fuel crisis, its effect to the environment, health and poverty. The participants were made to describe their village, the technologies, the livelihood activities, and the social and political organizations existing. I used local materials as much as possible. I used photos, video clips, anecdotes and stories from other villages, most of which I collected during the course of the field research itself. Among the strongest materials I used was the collection of photos and videos of heavy rains and flooding in many parts of the province. There were images of houses and rice field underwater, people carrying rice as food aid on boats, the chocolate colored rivers and stories of people tearing down their houses so they may have fuel to cook with. The interview with the charcoal producer of Barangay Bulala was also featured in every session.

The participants would immediately agree to the materials presented. There were no violent arguments about the notion of the destruction of the environment because of the consumption of wood charcoal. Everyone agrees about the urgency of shifting their use to other fuels such as rice hull and coconut husks.

There was strong enthusiasm among the participants at every workshop. The momentum however was lost in some of the villages, particularly Guinacutan because of the heavy rains and flooding. It disrupted the flow of thought and enthusiasm of the participants. The sessions dragged on to the harvest time when the men have become so much busy for the rice harvest.

Presentation of the stove models, tools and techniques came on the third session. There were video clips, photos and discussions of different stove models from many parts of the country and from other parts of the world. Interviews with the old stove

technicians were also presented. The work of Patricio Villabrosa with clay stoves inspired the participants to explore their own sources of clay.

The sessions came to discuss their past experiences with the old stove models. The complaints expressed fall against the price of charcoal, the poor quality of the stove that they buy at the town market. They lament the increasing price of wood charcoal which rises in parallel to the prices of LPG. They complain about the poor performance of the old models of rice hull stoves, the difficulty using them, the heavy smoke, the heavy black soot and the fire that is difficult to control. The technicians of the rice hull stove would reply that the stoves were built only for hardworking people, implying that anybody who complains against it are not hardworking enough.

Demonstrations of the stove were held at the third sessions. They were done under the spirit of providing the participants new information and options to choose from, but not to convince them to adopt any of the models presented. We had to bring all the stoves that we can carry for the demonstrations. We presented the (1) improved single burner Pugon Solo, (2) the single burner coconut husk stove, (3,4) the two metal rice hull metal stoves from ATC – CPU and (5) the natural draft barbeque grill. We lighted up each of the stove and observe the reactions from the crowd.

The demonstrations attracted big crowds every time. The biggest crowd was at Guinacutan where about a fifty persons. There were excited reactions among the men who are particularly interested with the single burner rice hull metal stoves. There are good metal workers at the village and have two metal workshops right across the street where the sessions are being held. Immediately, there are seven observers, all men, who wanted to copy the designs and were asking about the price and the manner of construction. There were requests for to leave the stove with them. Indeed, the steam injection stoves of ATC-CPU gave an impressive flame of a strong yellow to blue hot flames and without any smoke. However, among the crowd, there are only very few among

them who joined the design workshops.

The technology demonstrations drew a big crowd every time but tends to promise only technological solutions. (by Eden Sanchez)

I therefore decided not to encourage them to copy the stoves and wait until the fourth session when the participants of the workshop would have already made their design. I was too careful not to preempt the essence of the design process by another technological solution and preempt the coming out of the local knowledge.

Session 4 was devoted to the creation of the miniature stove models. There was a review of the context, the criteria for evaluation of the stove designs. There were also inspiring words about the stoves that they will eventually build by themselves will solve their own problems. It was also during the time of heavy rains. Although there were several postponements on the schedules of the sessions because of the heavy rains, the calamity was able to drive them a strong lesson – that is their consumption of wood charcoal is connected to the floods in their own village.

The technologies that I used to stimulate the design process of the entire research were obtained without any restriction from its authors. This open access enabled the study to utilize these technologies at will. With these technologies on hand, I was able to stimulate discussion on how they could adopt the stove design or a part of it. It went further by allowing them to evaluate the models and find its relevance to their own needs. And so, among all the forty miniature stove models that were created, none followed the design of the single burner rice hull metal stove.

At Bulala, the participants were able to compare the rice hull stoves and the coconut husk stoves. Although they were equally impressed with the steam injection rice hull stoves, they preferred the simple coconut stove. They remained convinced that the fuel supply is more decisive than the performance of the stove. Bulala has an abundance of coconut husk. There is one participant, Jun Garcia, who remained convinced with building a Lorena flat bed rice hull stove. He could foresee it extra benefit of being able to produce carbonized rice hull for fuel which he can use or sell as a soil additive for farms and gardens. Bulala has a heavy clay soil thus; carbonized rice hull would greatly improve the soil texture.

4.7. Interconnectivity Among Learners

There was poor participation in the mobile food vendors of Daet, at Bagasbas and at Guinacutan. I realized it was because the people that I am inviting are completely strangers to one another. Therefore, I deemed it necessary to use this mechanism for another village. I got requests from the friends at the village of Mangcawayan as early as the beginning of the field research to conduct a skills training on stove fabrication. The requests came through my colleague in the POMCAT, Mr. Rommel Cayno who organized the SINAG, an association of parents in the primary school run by the missionary nuns. The nuns have a strong presence among them. Upon more prodding from the president, Emily Leano, we quickly organized a two - day training for all the four levels of sessions. It was not easy for them to abandon their farm work considering that majority are busy in harvesting rice. The SINAG officers organized everything including the venue, the foods and additional seminar materials. The design workshops were successful with eleven stove models produced.

This connectivity was also present in the small study group that I was able to organize in Daet. To correct the situation of the absence of participants among the food vendors, I made an announcement over the Bay Radio station, a local FM station calling for participants for the workshop series. I got eight participants the following day. Five of them happen to know each other personally, some as early as childhood days. Two of them are officers of the market vendors association, one is a master stove technician, one is an enthusiastic innovator, one is a *buko* vendor and one is colleague of mine. There was an easy feeling among each other and the exchange of information was intense throughout the exercises. I had to completely revise the workshop designs because information from them is coming out very fast and with a strong substance.

4.8. Conceptualization of Livelihood Projects

This mechanism stimulated their realization that creating stoves can and should support their efforts to create livelihood projects. It is a positive mechanism that,

instead of exerting the pressure of guilt of the use of wood charcoal causing deforestation, it allowed them to create positive projects ahead while trying to achieve the same outcome of preserving the forests.
They were made to choose from among the four themes for livelihood namely (1) Fuel Supply, (2) Fuel Trading, (3) Stove Fabrication Project and (4) Food Processing. However, it was only the study groups of Barangay Bulala and Mangcamagong who had the enthusiasm to go this far.

The study group at Bulala discussed about getting the rice hull from the nearest rice mill, which is about five kilometers away from their village. It will have to be transported by a jeepney and stored in a shed. Jun Garcia, who heads this team recognizes the limited demand for rice hull but he is hopeful that the demand will pick up among the gardeners for the carbonized rice hull instead. Monico Tillado another member of the Fuel Supply team decided he will focus on the supply of coconut husks. He will have to build a bigger shed that will keep the husks dry and ready for transport. He does not see any difficulty with transportation because the husks are almost everywhere and there is enough horses to carry them. Edna Villosa followed the team of fuel trading project. She will make a regular check with the household for the demand of the fuel and relay them to the fuel production team for proper response. Jun Garcia, again joined the stove fabrication team because he has equipment for metal works. But the women argues that they would not need much help from a local metal workshop because soon enough, everyone in the village will learn how to build their own stoves using clay and recycled tin cans. Jun Garcia conceded in the end that a stove fabrication workshop is a loosing business. Finally more women joined the team for food processing. They are full convinced about the need of learning to process and preserve their own food in anticipation of the heavy rains and typhoons every year. The big question posed unto me, as a researcher is “Now, tell us, Mr. Guinto. Now hat we will have our own stoves, how can we have enough food to cook on it? ”

At Barangay Mangcamagong, Jesebel del Puerto of the Fuel Production Team decided to have a regular supply of coconut husks ready. From the farm, they will load them in bags and will be brought to a shed for safe keeping against the rains. They will use bicycle with carts. Edna Jardinero of the Fuel Trading Team will trade coconut husks

and rice hull with the households of the same village. They estimate that each sack of the fuel will cost Php 20. It would be much less if the owner will give it away for free. Rice hull will definitely be cheaper.

The Stove Fabrication Team will build stoves made of clay, animal manure and coconut husks. Javier Sacriz of the team intends to build a workshop by their house and will offer services of stove fabrication of different designs as well as repair services. Linda Caballero of the Food Processing Team prefers to use rice hull for fuel that will be built with cement, iron bars with chimney. She wants to cook rice cakes and fish in sweet and sour sauce and gave a detailed list and costs of the ingredients.

Chapter 5: OUTCOMES

This chapter presents the Outcomes that I have identified on two categories. First are the empirical outcomes that were evident during the conduct of the field research. Second, because of the limitations of this study, are the potential outcomes that are likely to manifest as long as the mechanisms are in kept in place.

5.1. **Miniature Stove Models Built by the Participants and the Potential Shifts in Fuel Consumed.** There were forty (40) miniature models created by the participants. It represents their problems, needs and solutions to their own fuel crisis. These are conceptual designs that still have to undergo refinements before the actual construction. Table 18 describes the features of each model. The design workshops

yielded a total of thirty six (36) miniature models made of clay. Twenty five (25) of these were created by women and eleven (11) by men.

Table 17. Comparative Number of Users of Every Kind of Fuel Between the Prevailing Practice and During the Workshop Series.

Fuel Used	Prevailing Fuel Consumption		Potential Consumption	
	number of users *	Percentage of users (%)	number of users **	Percentage of Users (%)
Rice hull	4	3.12	8	20
Coconut husks	1	0.78	18	45
Buko shells	1	.078	4	10
Wood	44	34.37	15	37.5
Coco Shell Charcoal	18	14.06 %	1	2.5.
Charcoal	88	68.75	9	22.5

* From a total of 128 respondents
** From a total of 40 respondents

The prevailing practice indicate that three percent (3.12 %) from the total number of respondents use rice hulls, less than one percent (0.78%) of coconut husks, less than one percent (0.78%) with buko shells, about thirty four percent (34.37%)of wood, fourteen percent (14.06%) of coconut shell charcoal, and about sixty nine percent (68.75%) eighty eight of wood charcoal.

During the workshops, twenty percent (20%) decided to use rice hull, forty five percent (45%) on coconut husks, ten percent (10%) with *buko* shells, about thirty eight percent (37.5%) with wood, two and a half percent (2.5%) with coco shell charcoal and about twenty three (22.5%) with wood charcoal. It is further expected that there will be less consumption of wood and wood charcoal because the designs that the participants created will use these kinds of fuel in combination with either rice hull or coconut husks.

The participants generally expressed:

1. The decision to shift from wood charcoal to rice hull, coconut husk and *buko* shells.

2. The use of concrete, iron bars, clay, buffalo manure and coconut fiber for the construction.
3. The need for the flexibility in terms of the fuels used. Several of them created models that will use any fuel in combination with other fuels. A minority of them still maintain the patronage to the use of wood charcoal
4. The need for (1) multiple burners, (2) the need for an oven and an extra shelf for the utensils.
5. The patronage for *buko* shell is only limited to those from Daet, where the shells are available.
6. All the designs have their chimney. There chimneys that were made straight up while there are those that are slanted. The slanted chimneys represent their plan not to bore a hole through the roof but to fix it between the ceiling and the roof.
7. One participant designed a barbeque grill using a natural draft mechanism by fixing two cylinders.

Table 18. Summary Description of the Stove Models Built During the Workshop Series.

Village	Total Number of Stove Models	Building Materials		Burners			Oven	Chimney		Collars	Side Furnace	Extra Shelf	Ash Ports	Carbonization
		clay, manure and coco fiber	concrete and metal	single burner	double burner	triple burner		straight up	slanted					
Bulala	8	7	1	1	7		1		8	2	1	1	1	1
Bagasbas	3	2	1	2	3		1	3				1		
Guinacutan	4	2	2	1	3			4						
Mangcamagong	7	4	2	2	6			5	1					
Mangcawayan	12	9	3	2	9		1	6	3					
Daet	6	2	4	4	1	1	1	6				1		1
TOTALS	40	25	13	12	29		4	24	12	2	1	3	1	2
Percentages		62.50	32.50	30.00	72.50	2.50	10.00	60.00	30.00	5.00	2.50	7.50	2.50	5.00

5.2. Some Unexpected Novel Outcomes from the Design Process

Some participants maintained their patronage to the wood, wood charcoal while some have a complete shift to the use of rice hull, coco husks and *buko* shells. There were also un anticipated designs as follows:

- wood stove changeable to grill
- double burner two furnace stove with air fan
- the bread oven stove
- the double cylinder natural draft grill

There are also innovations in the drying process of the coconut husks and *buko* shells.

Very much like the system of seed selection, the design process is a means of supporting, complementing, despising or diffusing a design of their peers through a flow of positive or negative remarks or better yet making complementary designs in their own stoves. The use of *buko* shells in the stoves of the Daet group supports the initiatives of the producer of dried *buko* shells. There are negative remarks of the Mangcawayan and Bulala group against use of charcoal and there are favourable remarks on the use of coco husks in the Bulala study group. The diffusion of the air fan stoves have gone through an unsupervised design process. T

5.3. **An evaluation of the urgency of the fuel crisis.** This study is an evaluation comprising of the environmental, economic, technological and social parameters. It is from the social science point of view which I believe has its own kind of strength in pushing for program and policy reforms. It offer a set of strong arguments which policy makers and programs designers can use as a reference for their own advocacy. The study can also stimulate the design of developmental projects on renewable energy and forest conservation. The study describes the context

from multi dimensional perspectives. It also was able to demonstrate the mechanisms responsible for the outcomes to emerge.

5.4. A revival of the local and fading knowledge of the stove technicians.

The process of participative technology development allowed the discovery of the local talents and skills of the technicians just in time before they were lost. This knowledge can serve as among the pillars by which new stove technologies can be built. The active participation and the resulting commitment of the old stove technicians to the process have disclosed their fading knowledge, because of their age, which is now very relevant for the solutions to the fuel and poverty complex of the province. During the last session of the field research, the two technicians came together and pledged their commitment to support the movement that is brewing.

During the last merging session, Tata Apin and Tata Rogel handed me a copy of the drawing that they made individually out of the reflections from the stoves that we earlier built.

5.5. A hybrid stove model between the local skills and the scientific models. The combination of the mechanisms for participation and open access to technology allowed me to develop a hybrid kind of stove. It demonstrates that open access to technology and by facilitating participation, there would be an endless combination of designs.

From the lessons and design ideas that I collected during the entire research period, I was able to create a prototype of another stove model. It came from different sources namely :

- Patricio Villabrosa, the old man of Barangay Bulala who built his own clay stove – for the use of clay and animal manure.
- Reference books about the stoves and beehives in Tanzania made of a mixture of clay, grass and animal manure.

- Gina Reyes of Barangay Bagasbas, one of the participants of this research who earlier designed a bread oven out of clay during one of the workshops that I conducted.
- Aprovecho Institute of Colorado for their design of the Rocket Stove.
- The Appropriate Technology Center of the Central Philippine University for the steam injector mechanism in a form of a metal box.

5.6. Building "Bridges" between the University Research Center and the Village Stove Technicians. The hybrid model also creates hybridity in terms of the people participating in the design process. It has become a strong statement that village people can actually join the scientists in the universities to create novel stove designs. This approach will produce two very important outcomes. First, it will preserve the technical efficiency and safety of the stoves because of the science of stove design and construction. Second, it will preserve the social affectivity of the stoves. It will ensure that the stoves will be built with the optimum use of local resources and will

stoves will be built with the optimum use of local resources and will suit the needs of the users. Going further, the combination of the two outcomes will then produce a technically sound and socially acceptable stove model.

5.7. A diffusion of the stove designs. There was an active diffusion of all the stove models. Anybody can copy, innovate and improve on any of the designs available.

There is no formal mechanism that regulates the entry of anyone in the

The hybrid clay stove model is an outcome of the local skills and knowledge and the scientific knowledge from the ATC-CPU. Notice the metal box (right) that was integrated unto the prototype (upper photo). The metal box is filled with water, pushed into the flame and shoots a jet of dry steam unto the flame making it burst like a blow torch.

manufacturing of stoves. On one hand, it allows innovations to flourish and new designs to be created at any time. However, not all were successful. The single burner metal rice hull stoves did not prosper and the Lorena flat bed multi burner stove has very limited adoption. Among all the designs, it is the charcoal stove that has a wide rate of diffusion. The coconut husk stove also has a potentially high rate of diffusion because of its much simpler design yet gives a strong fire. There is no regulatory mechanism that neither regulates nor upgrades the stove designs and manufacturing. Without this, there is also a high possibility of spreading the mistakes of the original design with a cost multiplied as soon as it enters the mass production phase. There is a big delay between the

feedback phase and the moment the mistake was corrected and the designs revised.

5.6.1. My own metal stove, the Ipa Azul. During the course of this study, I have seen the diffusion of my old metal stoves to three other stove fabricators. One of them is Mr. Sac of Barangay Santa Elena who built fifteen units of those kind of stoves in 2003. He gave some of them as gifts and some he sold at Php 1,500 each. It began when I was promoting Ipa Azul to the adjacent village of Mangcruz. On one afternoon, I invited people in the village to come to the rice mill where I made a demonstration of the stove. The people were impressed by the fire. I decided to leave the stove with the owner of the rice mill and encouraged them to use the stove for some time. Mr. Sac however, also assimilated the problems with my stove. During the interview in April 2008, he complained about the very fine ashes that fly everywhere and more up to the food every time the stove needs tapping to reload the fuel. He also complained about the very strong fire that is difficult to control and the strong heat of the stove after long periods of cooking. Finally he complained about the rapid wear of the burner frustum which I made of a flat metal sheet.

Another person who adopted the Ipa Azul is Mr.Oscar Lebres. I used to fabricate my stoves at this shop at the village of Calangcawan Sur at the town Vinzons in 2002. We became good friends eventually and I gave him the consent to start copying my stove design. During the period of this research, he proudly showed me the stove that evolved from our cooperation in the past. He is proud to have been using it all the while during the year of 2007. His advantage however is that of having a big open space in the garden as his kitchen. By the stove is a big pile of white ash from burnt rice hull. His project has invited potential customers. He claims to have made fifty units from our cooperation. The project however stopped because of the high price of the stove which is Php 1,500.

5.6.2. The Charcoal with Air Fan Stove

I first saw this model with Mr. Ron Paguirigan back in 2004. Within the area of the study, this model have already become popular and there is at least one fabricator of this model in the villages of the study area. There is one at Barangay Bulala, another

at Barangay Mangcawayan, and another at Barangay Mangcamagong. Mr. Serafin Llanto also built his own. The fabricators would say that they learned about the design from a person in the town of Lopez of the province of Quezon, that is the next province north of Camarines Norte. Mr. Paguirigan himself, declared that his source of the stoves is from the province of Quezon, specifically from the city of Lucena. While Ron Paguirigan sells them at Php 1,500, other locally made models sell their own at Php 600 to Php 800.

5.6.3. The Coconut Husk Stove

On December 2007, I decided that I have to create a mound in the furnace so the fire can "kiss" the pot by making it "jump". And so with bricks, sand, soil and ashes, the desired effect was achieved. My family spends less than four whole husks in every meal. My two neighbors also cook in this stove.

While building the other hybrid stove model, I had a nice conversation with Khrisna Dipasupil, my neighbor about the old coconut stove that I built two years ago. Her father adapted the stove while I was away for my studies. His father, upon my advise, she said, built the furnace big so as to receive coconut husks. After some time, they are complaining about the size of the furnace because it uses too much fuel. And so I said, "*I should have known. Three months ago, I concluded that the furnace will have to have a jump off feature, so that the fire will come much closer to the pot before the heat goes off to the chimney. I just placed in bricks, sand and ashes unto the furnace making it smaller and more effective. The furnace does not have to be big after all lest it will really consume too much fuel. Please tell that to your father*."

This leads to my personal reflection that pen access to technology shares everything to everyone. It also diffuses the mistakes of the origins. I also feel pity about them having to assimilate the bad features of my own models in the past. There will have to be a mechanism on how to improve on this (more on Chapter 6, the Conclusion).

5.6.4. A discovery of undetermined but huge deposits of clay which are excellent for stove building.

The value of the clay has just become more important than before this study. As the fuel crisis grows, and so is the value of this clay. The study was able to bring the participants to this realization. They saw that the origin of the knowledge is a person who is among them. This provided them a sense of ownership to the knowledge because they have been part of the entire process.

As soon as the use of clay became part of the succeeding discussions in the workshops, participants of Barangay Mangcamagong, Bulala, Guinacutan, and Daet began talking about their recollection of clay deposits in their own villages. This is on top of the well known clay deposits of Barangay San Pascual and Caayunan, BAsud. Commercial companies of both villages are extracting their good quality clay for more than 10 years by now and sold the tile manufacturing companies of Batangas.

5.6.5. A discovery of huge potential capabilities of the poor families to build their own stoves which will suit their needs at the lowest possible cost.

The study also brought the participants to a sense of renewed sense of power – that is the power to change their own situations. This discovery was expressed in the form of the exclaiming statements like

- "I will do this as soon as I can".
- "With this stove, I can make the bread that I have always wanted to bake".
- "This stove can liberate us from the suffering from the indoor air pollution."
- "I had an argument with my husband. I have always been telling him that it is possible to make our own stove from clay and buffalo manure. He would not believe me until I showed him the clay stove that (Jed Guinto) built.
- "I will make my own stove, whether my husband supports me or not."

The fabrication of their own stoves requires a minimum set of skills which they can learn in a few days. The more critical skills it would require is the talent to design the

appropriate kind of stoves more than the skills in building them. Women participants already had the advantage over the latter.

5.7. A discovery of solutions to the growing garbage problem of the province.

This joy of this discovery was very evident with Mr. Arnel Corral, the president of the market vendors association. He came to join to workshop series not for the stoves but to ask for my help in making fertilizers out of the garbage at the market. He ended up meeting my most skilled and trusted worker Samuel Ravida who can supervise the entire operation of the production of compost. And more than that, he also found that solution with the nagging problem of disposal of the *buko* shells – and that is transforming them to become fuel and Simon Fuentebella is very thankful for being able to understand how to make a good business out of it. He now has big piles of dried *buko* shells at home and has stopped buying wood charcoal. He looks forward for my return so we can finally start creating the stove workshop with the members of the Daet study group.

5.7.1. *Buko* Shells –

My efforts to get some food vendors to join this workshop were failing (Section 2.3.) During one of the sessions with the food vendors sector, we agreed to go to the town center and find a mobile food vendor for interview. And so we found Jovy on a street corner at the Central Plaza complex selling an assortment of food on his tricycle we call *pedicab*. He sells fried plantain with a variety of styles. There are rice cakes and also cold drinks. Looking closely at his bicycle cart, we discovered that it still has about 0.75 m3 of space between the floor of the cart and the stove on its top. Jovy would some of the time allow his son to sleep inside this space while he is busy selling food stuff. And Jovy agrees that he does not mind carrying two bags of dried *buko* shells for fuel, which, to our best estimate will be enough for a day of operation. Arnel Corral, the market manager assured Jovy that the *green* buko shell will soon be regularly available at the market place because people like Simon Fuentebella have

already began drying the shells and will soon have a regular supply. And so with this discovery, the challenge we then faced is how to design a *buko* shell stove that is compact and lightweight.

As of this writing, Simon Fuentebella relayed the news that he now has a good pile of dried *buko* shells and have been totally no longer using charcoal for fuel. He looks forward for my return so I can supervise the fabrication of the stoves for his supply of fuel. In the same way, Arnel Corral of the market vendors association relayed the news that their market place is now organized and is operating at the town center of Daet. As we have planned earlier, it will be a shop that will demonstrate the use of *buko* shells in a stove, sell stove building materials like clay as well as the steam box. With the participation of the stove technicians, it will also provide services of building and repairing stoves.

5.7.2. Rice hulls

Families who gave interviews about the pollution of the open burning of rice hull look forward for a campaign to stop the open burning of the rice hulls thus, save their health.

On 13th of February 2008, we again made another model as an improvement to the Pugon Solo. It was a much bigger and durable model what we created for bigger loads. The chimney also had to move 45 degrees closer to the fuel hopper. This transfer provided the user with more space for movement during cooking. Instead of a flapping metal plate at the bottom, Tata Rogel decided to make a sliding metal plate.

The stove had the same performance of the older Pugon solo model. In fact, one business person making a *taho* business bought one unit for cooking the sugar syrup for his business. He was carrying a heavy cost from buying coconut shells and decided to use rice hull instead. After showing him the improved model, he wanted it revised. He wanted a model without a chimney and the cooking pot raised about two

inches from the furnace. After construction, it gave a much stronger fire. However, it carried a strong smoke and sooth unto the cooking pot. Still he preferred the stronger fire and did not mind the smoke coming close to his worker.

Two months later, Tata Rogel, realized that our Pugon Solo Model could be further improved by boring a hole on the part of the stove facing the furnace to allow primary air to come into the furnace. Sadly, I am at the end of the period of the field research and could only postpone the construction until I am back after my studies.

The third problem which the stove did not resolved was again the same problem of too frequent poking and tapping with a stick. The big reason for this, I believe is because the design process of the Pugon Solo did not have the participation of the user. It was me and Tata Rogel both acting as technologist and the *taho* business person acting as the manager who designed the stove.

5.7.3. **A network of stove builders and users**.

This network is embedded in their respective communities, which incidentally are among those with intense fuel crisis. This outcome simply needs another mechanism to be triggered to it may come unto another level of success. It now needs the stove workshops to be organized and operationalized. There is a forty (40) participants to the design workshops and this forms the core of the network of actors in the improved cook stoves movement. It will also include the institutions that I interacted with namely, the Aprovecho Institute, the ATC-CPU, TESDA and my colleagues in POMCAT.

5.7.4. Agenda for Policy Reform. There is now a rich pool of materials which can be used for policy reform and for project development. These set of materials can form as a reference in the localization of the Republic Acts on Waste Management and Clean Air. On May, 2008, while at the conclusion of the field research, I already received an invitation from SIBAT[14] to help them create a program for their

[14] SIBAT is Sibol ng Agham at Teknolohiya (wellspring of appropriate technology). It is one of the seasoned NGOs in the Philippines with the specialization on micro hydro power and wind turbines. Please see their website http://sibat.org However, their program on renewable energy is missing

institution on cooking stoves. On the 22nd of July, I also negotiated an appointment with the Haribon Foundation[15] to discuss the possibilities of a cooperation in making stoves for their villages.

The study can stimulate conversations for policy reforms such as implementation of the Clean Air Act, the Solid Waste Management Act of the Philippines and the vigorous implementation of laws and ordinances protecting the forests, and those that regulate the trade of wood charcoal. I will personally make representations to the council of both the Provincial and concerned municipal governments to seriously support the initiatives of the participants to this study.

5.8. CANDIDATE OUTCOMES

5.8.1. **Reduction Health Risks Caused by Indoor Air Pollution.** This will be particularly evident to those who are using wood and wood charcoal inside a poorly ventilated kitchen. One important contribution of this study is the low cost chimney made of used tin cans piled on top of one another.

5.8.2. **Reduction of green house gas emissions by biomass as wastes such as rice hull and coconut husks.** These materials give off noxious gases either by open burning or natural decomposition. Rice hulls in open dumps emit carbon dioxide, para dioxin and para furans (PhilRice 2008). I would work further after my studies to create stoves which have a carbonizing effect thus, eliminated if not reduced reducing the emissions of this gases. The carbon will be then used as an ingredient for the soil.

5.8.3. Village enterprises of Mny Forms

5.8.3.1. Fabrication of cook stoves out of clay. This will be a livelihood project which the participants can establish themselves with my continuing support. It would

the component of cooking stoves.

[15] Haribon Foundation is another big NGO specializing on conservation. They are more popular with the conservation of the forest and had a big project on the conservation of the Philippine Eagle, *phitechophaga jefferyi*. On the 22nd of July 2008, we agreed to meet in October to discuss matters on cooking stoves.

require an investment on my part in the form of organizing the enterprise and well as ensuring the flow of information and technical support that will come not only from me but from the rest of the actors in the network.

5.8.3.2. Refineries and production and delivery of clay for stove building. The villages of San Pascual and Caayunan in the town of Basud and the village of Bulala have an excellent kind of clay for stove building. An enterprise can be created to produce and at the same time regulate the extraction of this clay so as to outweigh the negative environmental effects with the positive environmental, social and economic effects to the communities involved.

5.8.3.3. A production enterprise for producing stove liners. The idea came up during the conversations with Jane Wanjiru of Kenya in June 2008.[16] The liners will facilitate the fabrication of the stoves for the families building on their own. The liners will have a standard prescribed dimensions and quality thus preserving the affectivity of the stoves they will build. The families can build around this basic component.

5.8.3.4. Reduction of cutting of forest trees for wood charcoal. The wood charcoal producers will be encouraged to produce fuel from coconut husks or rice hulls or both instead of cutting trees in the forest. With the eventual increase in the demand for the alternative fuel, I hope that this mechanism will encourage them to abandon charcoal production.

5.8.3.5. A production enterprise of steam box. This will reinforce the stoves as an additional option. I have commissioned Oscar Lebres to start manufacturing five units of steam boxes. As of this writing, he has not yet done so. He was discouraged by the high cost of the metal which he can only buy in one big whole piece. I will then have to personally supervise this when I get back home. But I will do that within the team of the stove shop that I will help organize.

[16] She is a masters student of the Larenstein University and have been working with the stove for about fifteen years as an employee of the Agriculture Department in Kenya.

5.8.3.6. A production enterprise of fuels. Whenever and wherever it is appropriate, the research hopes to stimulate a production enterprise of appropriate models of transport for the fuel. Dried coconut husks, dried *buko* shells and dried rice hulls in bags can command a good income for the unemployed people. The fuel enterprises will have to be built alongside with the enterprises of stove fabrication. I will use the same process of this thesis to again, design driers, fuel silos, buffalo carts, pedicabs and many other forms and its corresponding social structures for the transport of fuel.

5.8.3.7. Revitalizing the food processing projects

This will provide the families at the villages as an additional source of income. With the reduced cost and effort in cooking, the family enterprise on home cooking will be revitalized thus, stimulating better health and income while creating savings because of the cheaper and more accessible fuel.

Chapter 6: CONCLUSIONS AND RECOMMENDATIONS

6.1.1. The Fuel Crisis in the Study Area

The study was undertaken to investigate why, in spite of the abundance of alternative sources of fuel, and the proliferation of different stove models, the poor families of the province of Camarines Norte still suffer from the crisis of fuel. One distinct conclusion that this study have identified even at the very early stage was the absence of stoves that are appropriate for the needs of the poor families in the province of Camarines Norte. This absence is causing a severe and growing crisis in fuel which is manifested in several forms. Families had to exert hard labor to gather fuel wood and have to contend with the wet climate of the province. It also manifests in the high cost of wood charcoal thus depriving the poor families of fuel to cook to have their meals. The growing demand for wood charcoal have caused an active cutting of wood at the forests of the province thus, causing further soil erosion and landslides. This deforestation is a continuing pressure from the earlier timber cutting by the logging companies during the past decades. There are also incidences of indoor air pollution because of the poorly designed cook stoves. There are also incidences of outdoor air pollution caused by open burning of rice hull from the rice mills. Pollution problems to the environment are also caused by open dumping of coconut husks and green coconut shells from the market places.

6.1.2. The Actors in the Domain of Stoves and Fuels.

The study has identified several actors in the domain of the cooking stoves. They have their own unique sets of resources and play distinct roles in the domain. They are as follows:

6.1.2.1. The household members.

They are in a growing situation of fuel crisis as manifested in the difficulty in collecting fuel because of access and the wet climate of the province, the rising cost of fuel and indoor air pollution. There is an active production and trade of wood charcoal but is driving the families to deeper economic crisis as well causing massive cutting of forests. All the while, the abundant and accessible fuel, namely rice hull, coconut husks and green coco shells are not being fully used because of the absence of stove models that fits unto their specific needs.

6.1.2.2. **The rice and coconut farmers.**

Although they produce an abundant supply rice hull and coconut husks, they are also suffering from fuel crisis and are neglecting to use such a resource for fuel. Rice hulls become concentrated at the mills and ends up in the open dumps rotting or being burned. Coconut farmers have better access to the husks because they remain at the farms after harvest but likewise are not using the husks for fuel.

6.1.2.3. The stove technicians.

There are four categories of stove technicians identified. First are the old generations of technicians who build the bigger flat bed stoves for the bakeries, restaurants and high end clients. They have the skills to build the Lorena flat bed stove models with several burners and oven as well as the bread ovens for the bakeries. Their clients are very limited in number because of the high cost of initial investment. They are however, very open to innovate smaller and mobile models and have a good attitude of sharing their knowledge and technologies.

The second categories of technicians are the younger technicians who are building the smaller single burner wood charcoal stoves. They have limited skills compared to the older generation technicians and are focused on the air fan stoves which are now gaining popularity.

The third category would be those at the research institutions who create stoves more scientifically and with high technical efficiency. The ATC CPU belongs to this category and they do not claim exclusivity over their stove designs. They remain active in their efforts of developing new technologies and provide free access to the designs to innovators. They maintain they claim over their designs, however, through an active participation to exhibits and trade fairs and by having their work published on magazines and journals.

The fourth category would be innovators who have the passion to create hybrids of stoves from the prevailing designs through an active interaction with the stove technicians. They may have limited technical skills and access to novel stove designs but are embedded within the social context thus, play an important role in the process. They also suffer from mistakes and failures of their models and run the risk of creating poorly designed and unsafe stove models.

6.1.2.4. The food vendors.

They are the consumers of the highest volume among the sectors in the study area. They are clustered within the town centers and receive the supply of wood charcoal from the surrounding villages. They operate in very confined space at the food shops and do not have enough space for the storage of bulky kind of fuel. The mobile food vendors have their merchandise on improvised tricycles and consume high energy fuels such as gas and kerosene.

6.1.2.5. The wood charcoal producers and transporter.

They are at the risk of over fatigue because of hard work that the wood charcoal production and transport requires. They also get involved in cutting the protected forests and are at the risk of persecution by the government. With the growing demand for wood charcoal, they remain active. One of the respondents to this research however, would welcome the shift of the consumer to fuels other than charcoal and find other means of livelihood thereafter.

6.1.2.6. The government agencies.

They are mandated to protect the forests and mitigate the pollution through their regular programs and laws that were enacted. They face the constraints of the lack of personnel and other resources to cover a vast area of protected forests. They have already shifted their active functions of forest protection by soliciting the participation of the local people's organization through community based forest protection programs. Pollution problems caused by garbage and agricultural wastes and are now among the major concerns of the local government units. Laws have been ratified by the national congress to protect water and air from pollution and are now obliging local government units to enact such laws at the local levels.

There is no active effort in the study area to design stoves for rice hulls, coconut husk or green coco shells. The inefficiencies of the old models of rice hull stoves remain uncorrected and there are no efforts to create stoves for coco husks and green coco shells. Stoves that are being designed and built are mainly for the wood charcoal and are designed with a very poor participation of the users, especially the women and are being sold with very high prices.

6.1.3. The Realistic Evaluation Cycle and the Participatory Approach

The study used the Realistic Evaluation as a tool to see the context by which the crisis evolves. Mechanisms were also identified from the context and more were created to produce several outcomes. Throughout the process, there was an active participation from the study groups which was undertaken through the interactive design process. Participation was stimulated in describing and explaining the context, in identifying and triggering the mechanisms and in identifying and owning the outcomes of the entire process. The study began with a hypothesis of trying to identify the mechanisms in five different sets of context (Section 1.3.1.) After the field research, I have concluded that among the numerous candidate mechanisms that were set as hypothesis, there are only three very critical mechanisms among the five that needs to be triggered in order to produce the desired outcomes. The following are the lists of the context, mechanisms, and outcomes that were identified.

List of Context

1. An increasing price of gas causing an increasing demand for wood and wood charcoal.
2. Indoor air pollution from using wood for fuel and possibly with using wood charcoal.
3. A group of people with low income and poor education with a strong drive to find cheaper fuel.
4. The lack of access to information and the skills to innovate and utilize the alternative biomass fuels.
5. A very limited pool of technicians who can build stoves with their fading knowledge and skills.

List of Mechanisms

1. Open Access to the Supply of the Alternative Biomass Fuels.
2. Open Access to the Stove Building Technologies.
3. Cost of Stoves and Access to Stove Building Materials, Tools and Equipments.
4. Participative and Interactive Stove Design Process.
5. Conceptualization of Livelihood Enterprises.
6. Candidate Mechanisms
   - Improved Skills for the Fabrication of the stoves.
   - Stove Builders' Guild.
   - Legal Actions to Violations of Republic Acts.
   - Seed Fund Support for Livelihood Projects.

List of Outcomes

1. Miniature Stove Models built by the Participants.
2. An Evaluation of the Urgency of the Fuel Crisis.
3. A Revival of the Local and Fading Knowledge of the Stove Technicians.
4. A Hybrid Stove Model between the Local Skills and the Models from the University.
5. A Diffusion of the Stove Designs.
6. A Discovery of Potentially Huge Deposits of Clay which are Excellent for Stove Building.
7. A Discovery of the Strong Potential Capabilities of the Poor Families to build their Own Stoves Which will Suit Their Needs at the Lowest Possible Cost.
8. A Discovery of the Solutions to the Growing Garbage Problem of the Province.
9. A Network of Stove Builders and Users.
10. Agenda for Policy Reform and Project Development.
11. Potential Outcomes

- Reduction of Health Risks Caused by Indoor Air Pollution
- Reduction of Greenhouse Gas Emissions by Biomass as Wastes – Rice Hulls and Coconut Husks
- Village Enterprises of Many Forms
- Fabrication of Cook Stoves out of Clay
- A Production Enterprise of Fuels
- A Production Enterprise of Steam Box
- Revitalized Food Processing Projects
- Reduction of Cutting of Forests for Wood Charcoal.

6.1.4. The Pool of Explanations Crisis of Fuel in the Study Area

The study hereby offers a pool of explanations to the prevailing crisis in the study area.

6.1.4.1. The prevailing practice of stove design in the study area follows the consumerist model of design process. It promotes neglect of the abundant local resources and the access to other potentially novel ideas from the users and the technologists. It creates exclusion of the access to the technologies thus produces very limited number of stove models with very limited adaptations. It breeds pollution, health problems and contributes to the poverty complex among poor families.

6.1.4.2. There was also no mechanism to integrate local talents of stove technicians as well as other local materials towards a systematic and design process of appropriate stoves. While there is an open access to stove building technologies, both from the local people and technology centers, there was is not enough mechanism that tries to access these technologies and integrate them with local knowledge and materials to become more appropriate designs.

6.1.4.3. The women, who are the main users of the stove, do not have participation on the design of the stoves that they are using. The driving mechanism for the stoves that were built are convenience and for business thus, had only been the domain by a few entrepreneurs who are men and are only meant for wood charcoal.

6.1.4.4. Situations 1 and 2 leads to the neglect for the more abundant local resources such as clay, animal manure, coconut fiber and the open source of fuel such as coconut husks, rice hull and *buko* shells. The neglect on use of the abundant fuel also led to environmental pollution. \

6.1.4.5. The development of stove technologies in the study area have always been to the use of wood charcoal and that is how to reduce its consumption but not to entire shift to better kinds of fuel.

6.1.5. The Pool of solutions to the Prevailing Crisis

To resolve the fuel crisis, the study offers the following pool of solutions:

6.1.5.1. An interactive design process where there is participation of the users and there is an integration of the local building materials. This follows the Design by Evolution model as presented by Aprovecho Institute. This approach enabled the study to produce forty miniature models by the participants and one working hybrid clay model with the steam injection mechanism.

6.1.5.2. Actively utilizing the free and abundant alternative biomass fuel and the creation of village based enterprises of stove production and fuel production and supply. With the fabrication and eventual use of appropriate stove models, it is expected that families will begin to create their mechanisms to utilize this abundant resource. Schemes of transport, drying, storage and trade of these fuel may soon emerge thus, creating possibilities for additional livelihood enterprises for the families. In the extreme end, it will stimulate a new way of valuation of this openly accessed resource.

6.1.5.3. Creating a mechanism of access to the available technologies from other institutions and practitioners from many parts of the world. There are good spirited technologists who do not follow the attitude of exclusive claims over the stove designs. One active website on this is the http://info.bioenergylists.org/. It is a very prolific forum of technologists from many parts of the world which promotes an open sharing of information through the net.

6.1.5.4. Creation of stove builders' guild from among the technicians, fuel suppliers and households. This guild, under the Design by Evolution Model may take up the role of information exchange, maintaining the safety and technical

efficiency of the stove models. It may also provide the environment conducive to the evolution of novel ideas from the actors in the field.

6.1.6. A Pool of Reflections at the Theoretical Level

The study was able to verify that **the activity theory that was operationalized by the Realistic Evaluation Process was** able to provide the concepts for the Participatory Technology Development Methodology of this study. The study affirms that the stove design process that transpired in six different sets of contexts (upland and forests, coconut lands, rice farming areas, food vendors, and coastal areas) are possible because the activities respected the different sets of context and was able to trigger the participation as a mechanism thereby producing a rich collection of stove models from the very beginning of the design workshops.

Participation was already solicited in the describing their own context. It was also used to spot the mechanism that are embedded in their midst. It enables the development worker to jointly define the context with the participants and clearly see it in their most objective forms. It allowed the researcher to identify the mechanism that are likewise embedded in the given social unit and stimulate such mechanisms to create the desired outcomes.

The study further affirmed that the Design by Evolution Model enabled the participants to create a rich pool of solutions to their fuel crisis. There are forty stove models that were produced and more sets of solutions in the domain of the fuel supply. At the same time, the outcomes of the study proved that the Consumerist Model of stove design process had very limited applicability. There was no single stove design enterprise that was able to produce enough stove units in the study area in a long and protracted manner. All other stove production projects following this model have failed or simply evolved towards the Design by Evolution Model.

The Permaculture Principles offered by Mollison also facilitated this research in making the connections between the elements in the context as well as the technical

features of the stoves. The principles of self regulation provided the guideposts in seeing the stove as an artifact that is embedded in the context of the kitchen, the household, and the community. This principle supported the narratives of the participants under the socio-cultural and technical checklist provided by the Aprovecho Institute in their monograph. The connections presented in the model enlightened the participants to see the stove as an important element towards their food and health and the preservation of their environment.

The works of Schumacher, COMPAS, Chaiklin and Lave supported the a common argument about how the communities should create stoves that respects their culture, natural resources, human creativity and social cohesion. It inspired the study to respect the emerging possibilities of mobilizing local talents and resources and integrating them with those of the modern science. It also motivated this study to allow the participants undergo creative stove design activities under the climate of interconnectivity with each other. It is also in this respect that the study opened up more areas for future research in terms of creating village enterprises as presented in the list of potential village enterprises.

Finally, this study allowed me to reflect about my own role as a social scientist. It has been very clear that the society has always been and will always be open ended and evolving (43). And with this, I always believed that social scientists have the role of proactively participating in the social processes of a particular situation, however messy, unpredictable or undesirable the situations are. Social realities should be seen up close and with an open mind and without pre conceived interpretation and with the preparedness to unanticipated events. With this reality, the social scientist must be able to respond to the processes as they evolve, including the planned and unplanned as well as the supervised and unsupervised learning processes and outcomes (44).

6.2. Recommendations

The study focused only of the stove design process a have faced several limitations during the conduct of the field research. Nevertheless, it also opened up several themes for further studies and hereby presents the following recommendations.

6.2.1. Extension of the study to the Food Vendors Sectors and Urban Poor Households. The past field research faced some limitation in getting a substantial amount of participants among the food vendors sector. It is an important sector because their per capita consumption of fuel is the highest compared to the other sectors. They do not have however, the social connections among themselves compared to the participants from the rural villages. They are also under extreme pressure of making a daily income and would not want to voluntary join workshops that will take away their time from working. Another approach will have to be made to get their participation.

6.2.2. Deeper Analysis on the Context of House Designs. There is a growing pattern in the housing projects both in the rural and urban communities that builds small and congested houses. The congested house design deprives the household members of the opportunity to innovate with other kinds of fuel saving stoves. I believe, this will lead further to the increase in the consumption of wood charcoal. It is therefore imperative that a study be made on this theme in order to affect a change in the housing program. It could be another **Realistic Evaluation of House Design Process.** The study, in the inspiration of the permaculture design concepts, will connect the elements of the dwellers, the farm and gardens, the forest, among many other elements in the system (2).

6.2.3. Activate the candidate mechanisms unto the context. The following are candidate mechanisms that I anticipated during the entire course of the field research. Faced with the limitations of the study, these mechanisms remain to be tested in future studies.

6.2.3.1. **Improve the Skills of the Participants to fabricate the stoves they have designed and Fabricate the Stoves Immediately Thereafter.** After the stove models were created, the stoves will have to be built. They would, however require additional skills to build them. The pool of trainers will come from the participating technicians as well as the engineers of the university. A skills training to be designed will have to preserve the concepts of the study.

6.2.3.2. A Stove Technicians' Guild – a core of technicians and a multi-sectoral movement of patrons and enthusiasts. The Guild will enable the technicians to work together and help one another in improving their respective designs. It will be organized under the spirit of cooperation and open access to technology while being accountable to the quality and safety of the stoves that they designed and built.

6.2.3.3. A Mass Movement of Patrons of Improved Cook Stoves. A regulating mechanism for the performance of the technicians will be a pool of patrons who will serve as an evaluating team and will provide peer reviews to the technicians. The patrons may come from different sectors. To name some are the household members from the participating villages of different ecosystems, the coconut farmers, the rice mill operators, the small business sector, and the science and technology department of the government. Their representation will be built inside the guild to ensure that the technicians will have to acknowledge the importance of the feedback of the patrons.

6.2.3.4. Health and Environment Advocates against Pollution. There are already existing laws against pollution of both the open dumping of wastes as well as the open burning of rice hulls. These laws however are not yet fully enforced in any of the municipalities involved. This mechanism may be triggered by a movement of the affected families.

6.2.3.5. An Exchange of Materials among Participating Villages and a Seed Fund Support for Potential Livelihood Projects. Other villages have clay and others do not. Others have lime while others don't. This comparative advantage among the participating villages can be harnessed by creating a system of cooperation and exchange of their local materials for stove production. This will minimize the

outflow of the local capital and in the strengthening of cooperation among them. The livelihood projects that may emerge may also require a minimum amount of external support. After mobilizing their local resources, the participants may still need external materials such as metal, tools and equipment or even machines. A fund support as soon as this initiative was realized may be necessary.

6.3. Some Closing Remarks

Being embedded unto the context enables the researcher to see the realities as they unfold. It is with the intense and passionate interaction with the context that a social scientist would be able to come close to its objective reality thus, put a trust unto the actors in finding their own solutions. Finally, in trying to connect this thesis unto my roots as a development worker, let me end with an inspiring credo of rural reconstruction (45).

Credo of Rural Reconstruction [17]

Go to the people
Live among them
Learn from them
Plan with them
Work with them
Start with what they know
Build on what they have
Teach by showing
Learn by doing
Not a showcase but a pattern
Not odds and ends but a system
Not piecemeal but integrated approach
Not to conform but to transform
NOT A RELIEF BUT RELEASE

[17] The credo is among the pool of core values of the Philippine Rural Reconstruction Movement (PRRM), an NGO in the Philippines to which I am also a member.