Patubas is an Ilonggo word for "product" or "fruit". It is a fitting description for this multidisciplinary research journal which is indeed, a product or fruit of our labors as researchers or the "seekers" of truth in its varied dimensions.

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PATUBAS
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   a. Title Page
   b. Abstract (150 words or not more than one page)
   c. Introduction
      c.1. Background, Rationale and Related Studies
      c.2. Objectives
      c.3. Theoretical/Conceptual Framework and Hypotheses (if applicable)
      c.4. Significance of the Study
      c.5. Scope and Limitation of the Study
   d. Methodology
   e. Results and Discussion
   f. Conclusions and Recommendations
   g. Acknowledgment
   h. References
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PREFACE

Congratulations to the University Research Center and the authors of all research studies published in Patubas! This is indeed a wonderful harvest of your hardwork and dedication to academic improvement.

The act of research may be tedious to some but the joy of discovery at the end of the process is a great reward in itself. That and the fact that the results can be life-changing make research a very satisfying and important part of academic life.

Let us be challenged to keep on producing excellent research work not only to maintain the University's accreditation status but to be used a tool for improving the quality of life of our fellow Filipinos.

To God be the glory!

Teodoro C. Robles

DR. TEODORO C. ROBLES
University President

BRIQUETTING OF BIOMASS AND URBAN WASTES USINGA HOUSEHOLD BRIQUETTE MOLDER

Aries Roda D. Romallosa and Kristofer John C. Hornada

ABSTRACT

This study was conducted to produce briquettes as alternative source of energy from abundant biomass and urban wastes using a locally fabricated household briquette molder which is composed of molders, handle and frame. The mixtures used were the following: Briquette 1: paper (100%); Briquette 2: carbonized rice husk or CRH (71%) + cornstarch (29%); Briquette 3: Sawdust (71%) + cornstarch (29%); Briquette 4: paper (50%) + CRH (50%); Briquette 5: paper (50%) + sawdust (50%); and Briquette 6: paper (50%) + CRH (25%) + sawdust (25%). Smaller sizes of balled homogeneous materials were placed into each of the molder of the machine. The materials were compacted by closing and pressing down the movable upper half portion of the molder then the briquettes produced were placed on trays for sundrying until ideal for fuel use. Briquettes 1 (Paper), 5 (Paper + Sawdust), and 6 (Paper + CRH + Sawdust) were found to be the most viable mixtures. This is based on practicality of production requirements and high production rate, better quality of fuel produced, fast operating performance in terms of boiling water and cooking rice and potential earnings that may be gained when adopted as an income generating project.

Keywords: Briquetting. Briquette molder, Briquette, Biomass utilization, waste to energy

INTRODUCTION

Philippine government agencies such as the Department of Energy (DOE), Department of Environment and Natural Resources (DENR), Department of Science and Technology (DOST) and other entities are currently promoting the development and widespread use of biomass resources through pilot testing, demonstration and commercial use of technologies such as biomass charcoal briquetting. The production and use of briquettes from abandoned resources like biomass and urban wastes are growing due to increase in fuel prices. Converting them, among others into briquettes, gives an opportunity to dispose of wastes and at the same time cleans the community of unwanted wastes, conserves the forest and reduces greenhouse gas (GHG) emissions and provides alternative/additional livelihood to the urban and rural poor communities (Banconguis, 2007).

The process of briquetting involves the compression of a material into a solid product of any convenient shape that can be utilized as fuel just like the use of wood or charcoal. The conversion of combustible materials found in the waste stream was found to be a better way of turning waste into wealth (Adegoke, 2002). In addition, if briquettes are produced at low cost and made conveniently accessible to consumers, it could serve as supplement to firewood and charcoal for domestic cooking and agro-industrial operations, thereby reducing the high demand for the latter two (Olorunnisola, 2007). Hence, these materials which were of low density prior to being converted into briquettes is compressed to form a product of higher bulk density, lower moisture content and uniform size and shape making these materials easier to package and store, cheaper to transport, more convenient to use, and better in combustible characteristics than those of the original waste material.

In many developing countries, large quantities of agricultural and forestry residues produced annually are mostly under-utilized. These residues are either left to decompose or just dumped at the back of the processing mills or along the roads. In worst cases, these wastes are burned inefficiently in loose form contributing more problems to the air quality of the environment. However, when these wastes are properly managed and utilized for cooking operations, they could become a renewable alternative source of energy. Previous studies have shown the potential of these residues when processed into upgraded fuel products such as briquettes. One of these locally available materials briquetted for fuel energy production is sawdust (Adekoya, 1989; Ajayi & Lawal, 1995; Olorunnisola, 1998).

Biomass is any organic matter that is available on a renewable or recurring basis, including agricultural crops and trees, wood and wood wastes and residues, plants (including aquatic plants), grasses, residues, fibers, and

animal, municipal, and other waste materials (from http://www.epa.gov/sustainability/pdfs/Biomass%20Conversion.pdf). Almost any biomass can be briquetted either individually or in combination without using any binder (from http://www.lehrafuel.com/briquettes-manufacturing-process.html). In the Philippines, being an agricultural country, production of biomass wastes has not been a problem at all.

One third of the agricultural lands in the Philippines are cultivated for crop production (FAO, 2000). With the country's increasing population, the demand for rice is also increasing. During rice milling, the outer covering of paddy, known as rice husk, has to be removed before it can be processed further for human consumption. Rice husk accounts for 20 to 25% of the paddy's weight. According to data, the total rice husk potential of the country is estimated to be 3.14 million metric tons in 2005. The Province of Iloilo, which is the leader in terms of rice production in the Western Visayas region of the Philippines generates about 165,000 metric tons annually (from http://www.aseanenergy.org/download/eaef/105-2004%20Project%20%20Summary%20for%20web.pdf). Rice husk, however, has to be converted in carbonized form before this can be made as pure material or mixture in briquette production. This can be attained by subjecting the materials to carbonization or pyrolysis or the carbonized rice husk (CRH) can be obtained directly as a by-product when rice husk is used as fuel in direct combustion stoves or in gasifiers.

Another important source of biomass waste in the Philippines is sawdust which comes from logging and milling operations. The 2.06 million hectares established forest plantation in 2005 is projected to even increase in the next ten years. Wood production from new plantations is also estimated to increase thereby increasing the generation of an abandoned biomass waste in the form of sawdust. This waste material, however, is seldom used as fuel for cooking stoves because of its high moisture content, but it can be utilized as an added material for briquetting.

Based on the 20-day segregation test run conducted by Paul, et. al. (2007), the volume of wastes brought daily to the materials recovery facility (MRF) of Iloilo City located in Brgy. Calajunan varied from 3.85 to 13.48 tons. These wastes were first segregated mechanically. Then all materials of oversize fraction were further segregated manually by local waste pickers. Results of the study further revealed that 4554 kg of paper were collected or a daily production of 227 kg. These waste papers are presently sold by the waste pickers at Php1.50 per kilogram. Based on this test, which tackled only around 20 tons of the daily delivered 170 tons of domestic type waste at Calajunan, more than 2500 kg of waste paper per day could theoretically be recovered. This recovered waste paper could be an alternative and viable

material in binding the biomass residues for binder-less and perhaps smokeless briquette production (Grigorion, 2003; Demirbas & Sahin, 1998).

The high generation of biomass wastes like rice husks and sawdust including high-energy material like waste paper found in the waste stream is a significant way of properly utilizing them as fuel by converting them into briquettes. This study evaluated the potential of converting these wastes into briquetted fuel by verifying the quality of briquettes produced using pure and combined mixture of biomass and waste papers after preliminary tests have been made on their mixing ratio.

Objectives of the Study

The objective of this study was to produce briquettes from abundant biomass and urban wastes using a hand-press briquette molder primarily designed for household or small-scale level of production as alternative source of energy. Specifically, this study aimed to determine the following:

1. Viable combination of pure biomass and urban wastes in briquette production;
2. Production requirements such as briquetting time and number of briquettes produced out of total materials used;
3. Quality of the briquettes produced based on their physical dimensions and appearance, bulk density, ash content, and heating value/calorific value;
4. Operating performance of briquettes when used for boiling water and cooking rice;
5. The significant difference among briquettes produced when analyzed according to production rate, boiling time and cooking time;
6. Economic analysis of briquette production; and,
7. The impact of briquetting biomass and urban wastes in terms of the potential daily production and earnings.

Significance of the Study

The conversion of biomass and urban wastes is an environmental way of recycling them into useful fuel briquettes to help reduce the dependence of the households on charcoal, a still commonly used fuel for cooking in the country. Less dependence in the use of charcoal would mean less cutting down of trees which has an impact on the depletion of forest resources. With the significant volume of waste paper collected at the Calajunan dumpsite,

then the conversion of these wastes into briquettes may become a viable business enterprise and a source of income for Uswag Calajunan Livelihood Association (UCLA). The informal waste pickers of UCLA can become experts in recycling waste products like paper and other biomass wastes for profit, thereby providing the populace with a new and cheap alternative source of cooking energy. Other organizations and offices producing a lot of these wastes can also venture on the idea of producing and selling their own briquettes. The utilization of carbonized rice husks produced as by-products of rice husk stoves and gasifiers together with sawdust would find their value as an essential add-on mixture for briquette production, whereas, waste papers that cannot be sold as recyclable materials may still be utilized and molded properly as briquettes increasing their monetary value when sold as fuel for cooking.

Time and Place of the Study

Purchase of materials and fabrication of the household briquette molder that was used for production of briquettes started in the first week of December 2010. The machine was fabricated by a local shop in Leganes, Iloilo. When the machine was done, production of briquettes and its evaluation followed at the Appropriate Technology Center, College of Agriculture, Resources, and Environmental Sciences (CARES), Central Philippine University, Iloilo City from January to the first week of February 2011.

METHODOLOGY

Technical Description of the Machine Used for Briquette Production

A simple briquette molder was developed to produce briquettes at the household level. The briquette molder was constructed using locally available materials. It was fabricated at a local welding shop making it easier for adoption should a local community decide on small-scale production of briquettes using any ideal material for briquetting. The machine, as presented in Figure 1, is composed of the briquette molders, a handle, and frame.

Briquette molders. Five symmetrical molders, connected on both sides by a hinge creating a movable top that could be raised, were used to contain

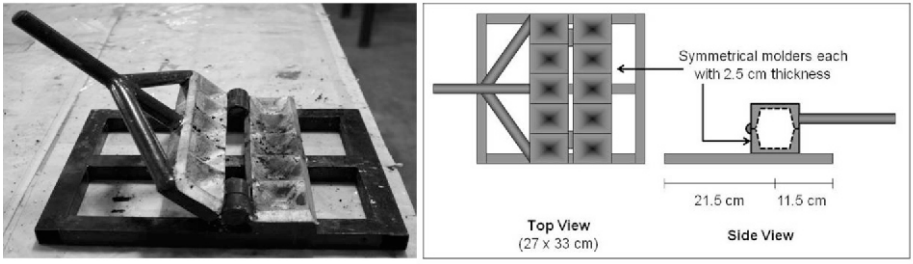

Figure 1. Household briquette molder used for briquette production, showing from left to right: the pictorial view of the machine and the schematic drawing showing its dimensions

the prepared mixture for compaction. Each molder was 5 cm long, 5 cm wide and 2.5 cm high. A cutting allowance was provided giving a total length and width of 27 cm and 6 cm, respectively. The molders were fabricated using a 1/8 in. thick flat bar and were welded together to attain the pillow-shaped briquettes.

Handle. This is the part of the machine that maneuvers the movement of the upper half of the molder. This is also responsible in creating the pressure needed in the compaction of the mixtures. A 3/4 in. (schedule 20) galvanized iron (GI) pipe with a length of 20.5 cm was welded at the center of the upper half of the molders and was braced with two similar pipes each having a length of 14 cm.

Frame. A 1/8 in. thick, 1 in. wide square bar was used as frame of the briquette molders. One side of the frame was used as support during compression of the prepared mixtures while the handle was being pushed downward to create more pressure.

The operation of the briquette molder works on the principle of compacting the prepared mixture through the two symmetrical molders fastened together by two hinges on one side and with a handle on the other side. The movable upper half of the molder is lifted so the mixture can be placed into the molders in the fixed bottom part. The mixtures are compacted by closing down the upper half molder. The pressure created on the mixtures depend on the control and power of the user of the machine and this can be created by pushing the handle down using one hand while the other hand holds the frame for stability.

Preparation of Materials

Three materials were prepared for this study namely, paper, carbonized rice husk (CRH), and sawdust. The papers used were wastes generated from the office of the Appropriate Technology Center of CPU CARES. These papers were a combination of mostly computer print outs and corrugated paper (cartons) that were soaked and pulped for 4 to 10 min. Pulping was done to disentangle the fibers using a locally developed pulping machine driven by a 1 Hp electric motor. Excess water from the pulped papers was squeezed using a plastic net bag.

The biomass wastes, on the other hand, were made available in sacks. The CRH and sawdust were smaller in size (0.1 to 0.6 mm). Cornstarch as the binding material was mixed when pure CRH and sawdust were used.

Cornstarch was weighed first using a 2 kg-compact scale then was carefully mixed with tap water in the container. The mixture was boiled to produce a gelatinous material. After cooling the binder, this was mixed with the materials (CRH and sawdust and its combination) by hand until a homogeneous state was attained. For mixtures that contained paper, cornstarch was not needed for tests because the papers already served as binding material.

Production and Evaluation of Briquettes

Six different types of briquettes were produced using biomass and urban wastes. Presented in Table 1 are the different mixing proportions of the tested materials. Briquette 1 was produced using 100% paper that was pulped prior to briquetting. Briquette 2, on the other hand, was made of 71% carbonized rice husk (CRH) with 29% cornstarch as binding material. Briquette 3 has also the same percentage of materials as Briquette 2 except that sawdust was used as biomass. Briquettes 4 and 5 were produced from a combination of 50% paper and 50% CRH, and 50% of paper and 50% sawdust, respectively. Briquette 6 was made of 25% sawdust, 50% paper and 25% CRH. Only Briquettes 2 and 3 utilized cornstarch as binding material. The rest of the briquettes had paper in the mixture that served as a binder at a higher percentage. In a study conducted by Demirbas and Sahin (1998), it was found out that waste paper maybe used as a partial binding material alone. With the mixing compositions used, briquettes mixed with paper were even more compact than the briquettes produced without paper.

Table 1. Mixing Compositions of Tested Mixtures

Briquette	Briquette Components							
	Paper (P)		CRH		Sawdust (SD)		Cornstarch	
	g	%	g	%	g	%	g	%
1	1,000	100	-	-	-	-	-	-
2	-	-	1,000	71	-	-	400	29
3	-	-	-	-	1,000	71	400	29
4	500	50	500	50	-	-	-	-
5	500	50	-	-	500	50	-	-
6	500	50	250	25	250	25	-	-

The dry weight of biomass and urban wastes and their combinations was fixed at 1000 g. A 20-kg Fuji spring-scale balance was used in measuring the weight of the materials. However, the total fresh weight of briquettes produced per type varied due to the added weight of water after the papers used underwent pulping. Once a homogeneous mixture was attained, smaller sizes of balled materials were placed into each of the molder of the machine. The materials were compacted by closing and pressing down the movable upper half of the molder. One hand of the operator holds the handle while the other hand to prevent the machine from tipping down. Excess water especially in mixtures with paper was also removed during compaction. After compaction, the movable top was lifted to take out the briquettes produced. The briquettes were then placed on trays and were sundried for more than 5 days. Once dried, the fuels were weighed again and the dimensions of the briquettes were measured using a vernier caliper. Figure 2 shows how briquetting of materials was performed.

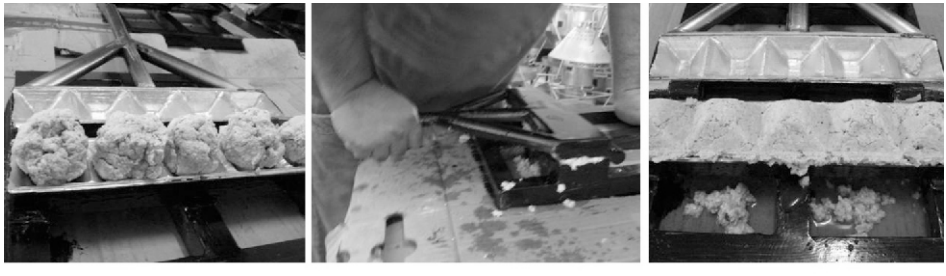

Figure 2. Briquetting of wastes, showing from left to right: placement of balled mixtures in the molder, compaction of the materials, and the pillow-shaped briquettes produced.

The following parameters were analyzed for this study:

1. Production rate. This refers to the quantity of briquettes produced per unit time expressed in pieces per hour and in kilograms per hour.
2. Bulk density. This represents the ratio of the weight of briquettes produced per unit volume. This was determined by dividing the weight of one briquette with its volume.
3. Ash content. This is an approximate measure of the mineral content and other inorganic matter in biomass. This was measured by getting the ratio between the weight of ash produced and the initial weight of fuel used multiplied by 100.
4. Heating value/calorific value. This represents the amount of heat released during the combustion of a specified amount of fuel. This was determined using a bomb calorimeter found in the laboratory facility of Victorias Milling Company, Inc. in Victorias City, Negros Occidental.

The summary of the procedure in briquette production is presented in Figure 3. This involved four major steps, namely: preparation of materials used (pulped and squeezed waste paper, carbonized rice husk, and sawdust), mixing of the prepared materials by hand, compaction of the materials using the developed briquette molder, and sundrying of the briquettes to produce the finished products.

Performance Evaluation

Performance evaluation of briquettes was done in three test runs. Boiling of water and cooking of rice using the six different types of briquettes produced and with the use of charcoal as fuel were performed simultaneously using an ordinary charcoal stove found in the market. At the start of every boiling and cooking operation, the number of briquettes and charcoal was set to twelve (12) pieces. The fuel was gradually added to the stove until the required operation was performed. Two liters of water was used for the water boiling test while 750 g of rice with same amount of water was utilized for the cooking test. The total weight of fuel used and the total number of briquettes used as fuel were then noted including the total time of operation. An Oakton thermocouple thermometer was used in monitoring the temperature of the water during the water boiling test. After every boiling and cooking test, the weight of ash produced was measured.

All data presented in the results are averaged figures after the test was performed in three runs.

Statistical Analysis of Data

The average of all parameters analyzed was computed using the arithmetic mean. One-way analysis of variance (ANOVA) was used to determine whether the means of parameters of the performance of the molder based on the different briquettes produced analyzed were significantly different from each other. Significant differences between/among the means were determined using the Duncan's Multiple Range Test (DMRT) to further compute the numerical boundaries that allow for the classification of the difference between any two means as significant or non-significant. This was presented using the alphabet notation, *a* being the highest, followed by notations *b*, *c*, *d*, and *e,* the latest, being the lowest.

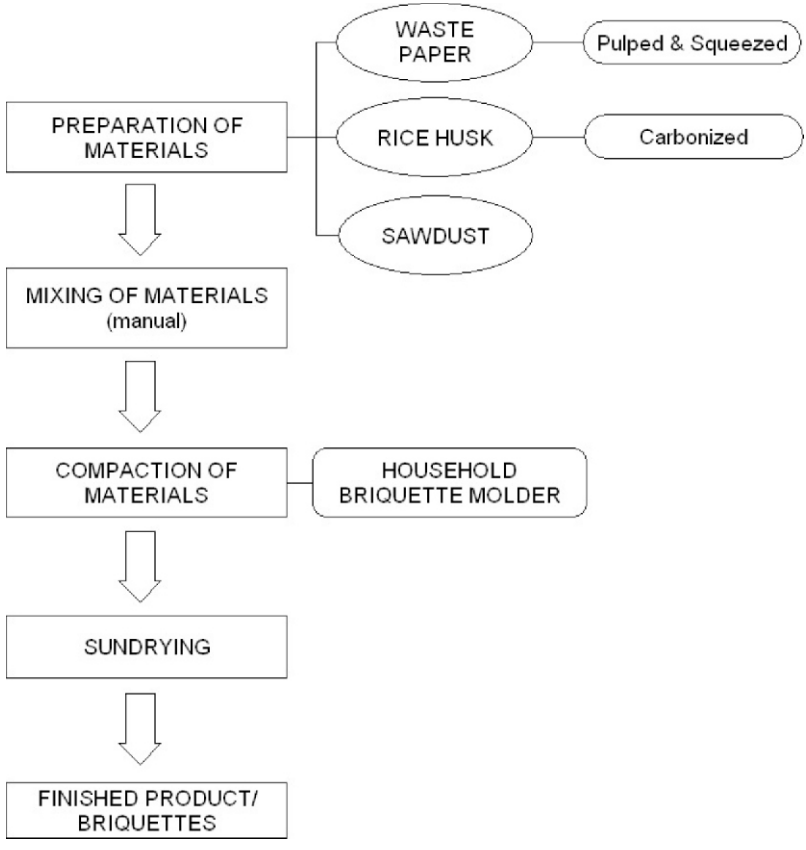

Figure 3. Summary of procedure for the production of briquettes.

RESULTS AND DISCUSSIONS

Production Requirements

Shown in Table 2 are the production requirements during the briquetting of wastes. All briquettes had the same total dry weight of 1,000 g except for Briquettes 2 and 3 which had 1,400 g because the 400 g weight of the binding material (cornstarch) was included in the mixture. Mixing time for all briquettes was at almost 4 min, except for paper, which did not require any mixing since the material utilized was just the same.

Table 2. Average Production Requirements During Briquetting of Wastes

Parameters Measured	Briq 1 (P)	Briq 2 (CRH)	Briq 3 (SD)	Briq 4 (P+CRH)	Briq 5 (P + SD)	Briq 6 (P+CRH+ SD)
Total dry wt. of mixture, g	1,000	1,400	1,400	1,000	1,000	1,000
Mixing time, min	-	4	3.3	3.6	4.1	3.8
Pulping time, min	8.6	-	-	4.2	6.3	5.5
Briquetting time, min	33	30.8	54	22	26.3	26.3
Briquettes produced out of dry materials, pcs	82	54	93	59	81	64
Fresh wt. per briquette, g	50.7	52.1	36.33	53	43	48.7
Dry wt. per briquette, g	12.8	26.2	11.3	18.5	12.1	15.8
Fresh wt. of all briquettes, g	4,427	2,790	3,358.3	3,091.6	3,420	3,088
Dry wt. of all briquettes, g	1,053.3	1,423.3	1,042	1,081.7	996.6	1,008.3
Drying time, days	9	7	6	5.7	5.7	5.6
Production rate, pcs/hr[1]	150 [b]	106 [c]	105 [c]	153 [b]	185 [a]	147 [b]
kg/hr[2]	1.92 [c]	2.78 [a]	1.18 [d]	2.97 [a]	2.28 [b]	2.31 [b]

[1] cv = 41.71%

[2] cv = 8.93%

[abcd] Any two means on the parameter measured (in a row) followed by the same letter superscript are not significantly different at the 1% level of probability

For pure paper briquettes, it took 8.6 min to pulp the 1,000 g dry material, while it was around 4 to 6 min for Briquettes 4, 5 and 6 since all made use of the same amount (500 g) of paper. Results on briquetting time revealed that among the six briquettes, Briquette 3 made of pure sawdust was the most difficult to mold because it took 54 min for the prepared dry mixture to be molded into briquettes. The paper and CRH combination (Briquette 4) was the fastest at 22 min while for the rest, briquetting was completed after 26.3 to 33 minutes.

Numerically, more briquettes were produced for Briquette 3 at 93 pieces out of the dry materials used. This was followed by Briquettes 1 and 5 with 82 and 81 pieces, respectively. For production rate in terms of pieces per hour, results showed significant ($P<0.01$) difference with Briquette 5 (P+SD) having the highest at 185 pcs/hr followed by Briquettes 1, 4 and 6. The briquettes made from pure biomass (Briquettes 2 and 3) resulted in lesser number due to the difficulty in removing intact molded briquettes from the molder. Instead of producing five briquettes in one compaction, there were instances where only 2 or 3 intact briquettes were formed making the rate of production lower. As to the four other briquettes with paper acting as binding material, more were produced because the briquettes were compact, thus, these can be easily taken out from the molder. However, when the production rate was converted to weight per hour, Briquettes 2 and 4 produced the highest ($P<0.01$) due to the high content of silica in carbonized rice husk and also due to the heavier dry weight per briquette at 26.2 g and 18.5 g, respectively. This was followed by Briquettes 5 and 6 with 2.28 kg/hr and 2.31 kg/hr, respectively. Third was the pure paper with 1.92 kg/hr. The least was the pure sawdust with 1.18 kg/hr. The main reason why they had the least production in terms of weight per unit time was due to the lighter dry weight per briquette of the fuels compared to the other single-material briquettes produced.

Quality of Briquettes

Table 3 and Figure 4 present the quality of briquettes produced. The six types of briquettes were pillow-shaped and the colors of the briquettes varied depending on the main material used. Briquette 1 appeared to be white due to the quality of waste papers utilized which were mostly computer printouts. The fuels produced were hard and bulky with uneven surfaces. Briquette 2, which was made of pure CRH was black because of the carbonized materials. The resulting fuels were hard when pressed by hand and had an even surface with fine texture. The color of the pure sawdust briquettes (Briquette 3) is rust with crumbly rough texture. For Briquette 4, the fuels produced were porous with slightly bulky and dusty surface. White was the dominant color due to the pulped paper used with accents of black because of the CRH mixed. The combination of paper and sawdust (Briquette 5) produced slightly uneven and dusty surfaces. The briquettes were light brown with white spots and the fuels appeared to be porous. Briquette 6, which was a combination of paper, CRH and sawdust, were slightly bulky and porous with uneven surface. The briquettes were darker brown than Briquette 5 due to the presence of CRH, a black material, in the mixture.

The briquettes had approximate length and width of 5 cm and a height

close to 4 cm. In terms of bulk density per briquette, the pure CRH briquettes (Briquette 2) had the highest at 0.3 g/cc primarily because of the addition of cornstarch as binding material which has a higher bulk density at 0.67 g/cc (from http://www.powderandbulk.com/resources/bulkdensity/material_bulk_density_chart_c.htm). This was followed by Briquettes 4 and 6 with 0.2 g/cc while briquettes which did not contain any CRH had a bulk density of 0.1 g/cc. Results revealed that all briquettes containing CRH (Briquettes 6, 2 and 4) produced numerically the highest ash content at 55.5%, 44.4% and 29.8%, respectively. This was expected since ash was already present in the material after undergoing pyrolysis. The high generation of ash in these types of briquettes could become a problem during cleaning of stoves and eventually during its disposal. Briquette 3 which contained only sawdust produced lower ash at 24.3% since most of the organic content of the materials used were completely combusted. Briquettes 1 and 5 had almost the same concentration of ash at 11.1% and 12.2%, respectively. The presence of paper in Briquette 5 decreased the ash by almost 50% when compared to Briquette 3 which was made of pure sawdust.

Table 3. Quality of Briquettes Produced

Parameters Measured	Briq 1 (P)	Briq 2 (CRH)	Briq 3 (SD)	Briq 4 (P+CRH)	Briq 5 (P + SD)	Briq 6 (P+CRH+SD)
Color	white	black	rust	black with white spots	light brown with white spots	dark brown with black and white spots
Length, cm (~)	4.9	4.8	4.7	4.5	5.1	4.5
Width, cm (~)	5.1	5.0	4.9	5.2	5.1	5.2
Height, cm (~)	4.2	3.8	4.0	3.6	4.2	4.2
Bulk density, g/cc	0.1	0.3	0.1	0.2	0.1	0.2
Ash content, %	11.1	44.4	24.3	29.8	12.2	55.6
Heating value, Btu/lb	6,500	5,284	10,999	5,685	6,683	7,061

Figure 4. Types of briquettes produced using biomass and urban wastes, from left to right: paper, CRH, sawdust, paper and CRH, paper and sawdust, and paper, CRH and sawdust

A heating value of about 5,000 Btu/lb or greater is needed to sustain combustion (Lee, 2007). Results of laboratory analysis revealed that Briquette 3 (pure sawdust) gave the highest heating value at 10,999 Btu/lb with Briquette 2 or the pure CRH having the lowest at 5,284 Btu/lb. It can also be noted that briquettes with sawdust as add-on material also gave higher heating value. The heating value of the fuels produced implies a promising potential for the briquettes as substitute fuel. Charcoal has a heating value of 8,267 Btu/lb (from http://erdb.denr.gov.ph/publications/denr/denr_v10.pdf) whereas bituminous coal, a commonly used fuel in industries, has a heating value ranging from 10,500 to 15,500 Btu/lb (from http://www.ket.org/Trips/Coal?AGSMM/ agsmmtypes.html).

Operating Performance

The operating performance of the briquettes are presented in Table 4. The briquettes were tested based on their potential when used as fuel for boiling water and for cooking rice. The same type of concrete stove was used for this specific test. The data gathered were compared with that of charcoal, one of the most common fuels used by households in the rural areas of the Philippines. Initially, 12 pieces of briquettes and charcoal were placed on the stove at the start of every operation. This was the initial number of pieces used because the stove can only accommodate this much. The fuels were gradually added until the required operation was performed; thus, the data in the table show different number of briquettes both during the boiling of water and cooking of rice test. Results in Table 4 revealed that briquettes containing paper had the fastest start-up time of 1.2 to 1.8 min, whereas, the pure sawdust and charcoal can be started at 2.0 min. Start-up time for the pure CRH was 5.5 min. When the briquettes were being started-up, smoke was emitted but once the fuel was already glowing, smoke gradually dissipated. For Briquettes 2 and 4, however, significant amount of smoke was emitted during the entire operation.

Statistical analysis showed that among the six briquettes produced, Briquettes 1, 3 and 5 boiled 2000 g water the fastest ($P<0.01$) at 12.6 to 13 min followed closely by Briquette 6 at 15.6 min. Boiling time for these four briquettes was not significantly ($P>0.01$) different from each other but those of Briquettes 1.3 and 5 were significant faster than that of charcoal which boiled water at 19.3 min. The weights of briquettes used, which ranged from 265 g to 300 g, were also numerically comparable to that of charcoal which has a value of 245 g. The two briquettes with the least performance as to boiling time were Briquettes 4 and 2 which took more than 30 min to boil the

water. For the cooking test, 750 g of rice was used because this amount represented the usual quantity cooked by a typical household having 4 to 5 members. Results revealed a significant ($P<0.01$) difference. Briquettes 1 and 5 had the fastest cooking time of 17 to 18 min. This was followed by Briquettes 3 and 6 at 23 min. Charcoal at 25.5 min was the third best followed by Briquettes 4 and 2 which had a cooking time of 33.3 and 46.7 min, respectively. The difference in the tested parameters can be explained by their differences in heating value. Due to the low heating value of Briquettes 2 and 4, more briquettes were used for boiling water and cooking rice and longer time was needed to perform the two operations. With these measured parameters, Briquettes 1, 5 and 6 are the recommended fuels because these fuels were able to boil water and cook rice in a shorter period using lesser amount. It was also observed that more blazes were produced in these types of briquettes which had little or no amount of CRH. Charcoal when used as fuel produced more glow than blaze.

Economic Analysis

The economic analysis in producing briquettes is shown in Table 5. The briquette molder costs Php6,000.00. Components of the fixed cost has a similar value of Php13.38, whereas, those of the variable cost differed because there were briquettes which made use of electricity for pulping of paper (Briquettes 1, 4, 5 and 6) while Briquettes 2 and 3, although no electricity was used, made use of cornstarch as binding material. Among the six briquettes, the pure paper (Briquette 1) incurred the highest total cost per day at Php194.84 followed by briquettes that made use of starch (Briquettes 2 and 3) at Php187.48. The briquettes which used a combination of paper, CRH and sawdust (Briquettes 4, 5 and 6) had a total cost per day of Php179.16 only. Dividing the total cost with an assumed 8-hour briquette production per day also gave the same trend for operating cost. Results further revealed that for every hour of operation, Briquette 1 obtained the highest cost at Php24.36 followed by Briquettes 2 and 3 (Php23.22/hr) and Briquettes 4, 5 and 6 with a value of Php22.40.

Potential Daily Production and Earnings

Table 6 presents the potential daily production and earnings of the different briquettes produced. Results on the briquette production for dry weight materials were achieved based on the production rate determined during the test and based on the assumption that when adopted as a project, production time would be managed in 8 hours. Results showed that when the

Table 4. Operating Performance of Briquettes as Fuel

□□□□ □□□□□ □□□□□□□	□ □□□ □□□	Briq 2 (CRH)	Briq 3 (SD)	Briq 4 (P+CRH)	Briq 5 (P + SD)	Briq 6 (P+CRH+SD)	Charcoal
A. Boiling Test							
Wt. of water used, g	2,000	2,000	2,000	2,000	2,000	2,000	2,000
No. of briquettes used, pcs	17	21	21	27	17	18	20
Wt. of briquettes used, g	298.3	546.7	370	470	265	268.3	245
Start-up time, min	1.2	5.5	2.0	1.8	1.4	1.4	2.0
Boiling time, min [1]	13.4 [a]	54.7 [d]	13.0 [a]	32.3 [c]	12.6 [a]	15.6 [ab]	19.3 [b]
Total operating time, min	31.9	60.1	23.0	60.3	22.7	25.0	44
B. Cooking Test							
Wt. of rice cooked, g	750	750	750	750	750	750	750
No. of briquettes used, pcs	15	23	20	21	18	21	16
Wt. of briquettes used, g	305.0	563.3	347.0	383.3	300.0	310	200
Cooking time, min [2]	17.3 [a]	46.7 [e]	23.0 [b]	33.3 [d]	18.4 [a]	22.7 [b]	25.5 [c]

[1]cv = 9.76%
[2]cv = 5.30%
[abcd]Any two means on the parameter measured followed by the same letter superscript are not significantly different at the 1% level of probability

fuels are sold at Php15/kg, a sales or revenue of Php28 to Php44 per kg may be earned for all briquettes except for Briquette 3 which can only earn Php17.40/kg. Due to the different operating cost of briquettes, the savings gained for every hour of operation also varied. Briquettes 2 and 4 could earn a savings of Php18 to Php21 while Briquettes 5 and 6 could generate Php11 to Php13. The pure paper briquette can have a savings of only Php4.44/hr while the pure sawdust incurred a negative value since the operating cost is higher compared to the revenue. The same trend is attained when the savings are computed on a daily basis for an assumed 8-hour operation. The data computed for the economic analysis is for one person only doing the job. Higher earnings are possible, therefore, if more members would work together as an organized association making this as part of their income generating project.

Table 5. Economic Analysis of Briquette Production

Parameters	Briq 1 (P)	Briq 2 (CRH)	Briq 3 (SD)	Briq 4 (P+CRH)	Briq 5 (P+SD)	Briq 6 (P+CRH+SD)
Investment Cost, Php	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00
Fixed Cost, Php/day						
Depreciation[1]	7.40	7.40	7.40	7.40	7.40	7.40
Interest on Investment[2]	3.95	3.95	3.95	3.95	3.95	3.95
Repair & Maintenance[3]	1.64	1.64	1.64	1.64	1.64	1.64
Insurance[4]	0.49	0.49	0.49	0.49	0.49	0.49
Total	13.48	13.48	13.48	13.48	13.48	13.48
Variable Cost, Php/day						
Labor Cost	150.00	150.00	150.00	150.00	150.00	150.00
Cost of Electricity[5]	31.36	0.00	0.00	15.68	15.68	15.68
Starch[6]	0.00	24.00	24.00	0.00	0.00	0.00
Total	181.36	174.00	174.00	165.68	165.68	165.68
Total Cost, Php/day	194.84	187.48	187.48	179.16	179.16	179.16
Operating Time, hrs/day	8	8	8	8	8	8
Operating Cost, Php/hr	24.36	23.44	23.44	22.40	22.40	22.40

[1] Straight line method with 10% salvage value and life span of 2 years
[2] 24% of investment cost (IC)
[3] 10% of IC
[4] 3% of IC
[5] 1.12 kW/hr @ 2 hrs pulping operation/day for Briquette 1 and 1 hr for Briquettes 4, 5 and 6 @ Php14/kW-hr
[6] For whole day production

The conversion of the 4,554 kg of paper or a daily production of 227 kg collected based on the 20-day test done in Calajunan dumpsite in Iloilo City (Paul, et. al., 2007) into briquettes would create more income especially to the members of UCLA. When the collected waste papers are sold at a current rate of Php1.50 per kilogram, it would only give an approximate income of Php338. When the waste papers are converted into pure paper briquette, a gross income of as much as Php3,405 could be earned. More income may also be earned if paper is mixed as an add-on material to biomass wastes like CRH and sawdust.

Table 6. Potential Daily Production and Earnings in Briquetting of Wastes

Parameters Measured	Briq 1 (P)	Briq 2 (CRH)	Briq 3 (SD)	Briq 4 (P+CRH)	Briq 5 (P+SD)	Briq 6 (P+CRH+SD)
Production rate, kg/hr	1.92	2.78	1.18	2.97	2.28	2.31
Operating cost, Php/hr	24.36	23.44	23.44	22.40	22.40	22.40
Sales, Php/kg[1]	28.80	41.70	17.40	44.55	34.20	34.65
Savings, Php/hr[2]	4.44	18.26	(5.74)	21.11	11.80	13.94
Potential earnings, Php/day[3]	35.52	146.08	--	168.88	177.00	209.10

[1] Revenue for briquettes when sold at prevailing price of Php15/kg
[2] Sales less operating cost
[3] Savings multiplied with 8-hr production per day

Summary of Recommended Briquettes

Briquetting is one alternative method that may be utilized in achieving the utilization of biomass and urban wastes into a useful product. Among the different mixtures tried in producing briquettes for fuel use with the aid of a hand-press type molder, Briquettes 1, 5 and 6 are the most recommended mixtures because of their practicality, high rate of production and performance when used and compared to charcoal as fuel for boiling water and cooking rice. Produced fuels having high potential earnings per day like Briquettes 2 and 4 are not recommended because of their low performance as cooking fuels and also the difficulty in preparing and molding them. Presented in Table 7 are the three recommended mixtures of briquettes for easy identification including the outcomes of the corresponding parameters measured.

Table 7. Summary of Highly Recommended Briquettes

Parameters	Highly Recommended Briquettes		
	Briq 1 (P)	Briq 5 (P+SD)	Briq 6 (P+CRH+SD)
Production rate, pcs/hr	150 [b]	185 [a]	147 [b]
kg/hr	1.92 [c]	2.28 [b]	2.31 [b]
Heating value, Btu/lb	6,500	6,683	7,061
Boiling time, min	13.4 [a]	12.6 [a]	15.6 [ab]
Cooking time, min	17.3 [a]	18.4 [a]	22.7 [b]
Potential earnings, Php/day	35.52	177.00	209.10

[Abcd] Any two means on the parameter measured followed by the same letter superscript are not significantly different at the 1% level of probability

CONCLUSIONS AND RECOMMENDATIONS

Converting wastes like waste papers, carbonized rice husks and sawdust using a simple technology such as the hand-press briquette molder has great prospects when utilized as fuel for household use and eventually as substitute fuel to charcoal.

The following are the conclusions derived from this study:

1. The most viable mixtures for the production of briquettes based on practicality and high rate of production, and performance when used and compared to charcoal as fuel in boiling water and cooking rice are Briquette 1 (100% Paper), Briquette 5 (50% Paper + 50% Sawdust), and Briquette 6 (50% Paper + 25% CRH + 25% Sawdust).

2. The six mixtures tested varied significantly in their production rate. In terms of production rate expressed in pcs/hr, Briquette 5 produced the most followed by either of Briquettes 1, 4, and 6. When expressed in kilogram per hour, Briquettes 2 and 4 obtained the highest followed by either Briquettes 5 or 6. Pure CRH (Briquette 2) and sawdust briquettes (Briquette 3) are difficult to form using the household briquette molder.

3. The briquettes produced using the briquette molder were pillow-shaped with dimensions of approximately 5 cm length x 5 cm width x 4 cm height. More ash is produced from mixtures with CRH. All the briquettes produced were analyzed to have a heating value of more than 5,000 Btu/lb, a value that is needed to sustain combustion. Briquette 3 (sawdust) had the highest heating value at 10,999 Btu/lb while Briquette 2 or the pure CRH had the lowest at 5,284 Btu/lb.

4. Briquettes 1, 3, 5 and 6 had the fastest boiling time while Briquettes 1 and 5 had the fastest cooking time.

5. Briquette 1 generated the highest operating cost followed by Briquettes 2 and 3. Briquettes 4, 5, and 6 obtained the lowest cost.

6. A potential net daily earnings ranging from Php35 to Php209 may be gained by one person in producing briquettes. The 227 kg daily waste paper collected at the dumpsite in Iloilo City could earn an income of Php338 when sold as paper only at the current rate of Php1.50/kg. But when converted as pure paper briquette it could earn a gross income of as much as Php3,405. More income may also be earned if paper is mixed as an add-on material to biomass wastes like CRH and sawdust. In addition, waste papers that cannot be sold as recyclable materials would have the potential to be utilized as briquettes increasing their monetary value when sold as cooking fuel.

7. Production of briquettes can be a viable business enterprise and source of income; members of an organization doing the job can become experts in recycling waste products like paper and other biomass wastes for profit,

thereby providing the populace with a new and cheap alternative source of cooking energy.

8. CRH produced as by-product of rice husk stoves and gasifiers together with sawdust would find their value as an essential add-on mixture for briquette production.

Based on the findings and conclusions of the study, the following are the recommendations for the improvement of this briquette molder:

1. The handle should be lengthened to improve hand compression during operation, thereby, improving the compactness of the briquettes.
2. A part should be added for bolting the frame to properly fasten the briquette molder for more compression during operation.
3. More molders should be added to increase the number of production.
4. Manual operation should be shifted to mechanical means for better compaction and faster operation.
5. Other binding materials should be used as substitute for cornstarch such as bentonite or other fruits with glutinous property.
6. Conduct further studies on optimizing production and operation parameters using Briquette 1 (100% Paper), Briquette 5 (50% Paper + 50% Sawdust), and Briquette 6 (50% Paper + 25% CRH + 25% Sawdust).

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KNOWLEDGE ABOUT, ATTITUDE TOWARDS REPRODUCTIVE HEALTH AND HEALTH SEEKING BEHAVIOR OR ADOLESCENTS IN ILOILO CITY

Nenalyn D. Abioda and Carolyn L. Yoro

ABSTRACT

The main objective of this study was to assess the knowledge of and attitude towards Reproductive Health (RH) and their relationship to the health seeking behavior of adolescents in all high schools in Iloilo City. This is a descriptive-relational study that used the one-shot survey design. The respondents were the 332 randomly selected fourth year students enrolled in private and public high schools supervised by DepEd and Higher Education Institutions with high school department in Iloilo City for SY 2007-08. Results revealed that the majority of the students belong to the younger age group, are females, enrolled in public high school and residing within Iloilo City; had average level of knowledge about RH, had neutral attitude towards RH, and with good health seeking behavior. A significant relationship existed between: the type of school where the students are enrolled and their knowledge about and attitude towards RH; students' sex, type of school where they are enrolled, location of residence, attitude and their health seeking behavior; knowledge about and their attitude towards RH. No significant relationship existed between: the students' age, sex and location of residence and their knowledge about and attitude towards RH; students' age and knowledge about RH and health seeking behavior; and knowledge about RH and their health seeking behavior when attitude was controlled.

Keywords: Reproductive health, health seeking behavior, adolescents

INTRODUCTION

Background/Rationale of the Study

Adolescents mature and become sexually active but most of them are not aware of sexual and reproductive health and related risks (Population Report, 1995).

Neglect of these needs has a major implication for the future, since sexual behavior during adolescence has far reaching consequences for later life. More often than not, young people learn about sex from each other but sometimes, the information shared around is not accurate and can be harmful. Most of them face these risks with too little factual information, too little guidance about sexual responsibility, and too little access to health care. However, a study conducted by Lou, et. al. (2006) in Shanghai, China showed a high level of knowledge about sexual and reproductive health among young male and female participants.

In terms of attitude towards sex and sexuality, studies revealed that more boys than girls had liberal attitudes towards sex and sexuality (YAFS, 2002). Furthermore, survey result revealed that young women and men think that it is alright to live together even if they have no plans to marry, confirming the liberal attitudes of a growing number of our youth (from http://www.popcom.gov.ph/appr/spps02/chap03a.html).

Adolescents often lack basic reproductive health information and access to affordable confidential reproductive health services (PATH, 1998). Remaneses' (2007) study revealed that there is a need for the provision of medical services to address adolescents' reproductive health needs and support from all sectors of the Local Government Unit (LGU) is important.

Public health policies and programs have focused on the sexual and reproductive needs of adolescents, particularly in the developing countries. This is a result of recognition that adolescents constitute large segments of developing countries' populations that they are disproportionately affected by negative reproductive health outcomes and that services for adults are not responsive to the needs of adolescents (Erulkar, et.al, 2004).

The review of related literature and studies emphasized the importance of reproductive health among adolescents. During adolescence, young people develop their adult identity, move toward physical and psychological maturity, and become economically independent. It was evident from the

study of Njau, et.al. (2004) that adolescents were not well informed about their biology, reproductive health organ, physical growth as well as their normal growth and development issues. It is at this stage when the young are vulnerable to risks such as unwanted pregnancies, the health risks associated with early pregnancy, unsafe abortions, Sexually Transmitted Infections (STIs), and Human Immuno Virus (HIV). It is essential that adolescents and students know how to make informed choices and must be equipped with adequate knowledge about reproductive health, as well as to develop positive or favorable attitudes so as to adopt safer sexual behaviors. Focusing on adolescent reproductive health is both a challenge and an opportunity for health care providers.

The findings of this study will be beneficial to the Health educators/service providers and allied professionals. This may stimulate them to generate ideas and facts on sexuality-related and reproductive health issues vital in the practice of their profession. This will serve as basis for planning programs/ interventions, and activities addressed to the reproductive health needs and problems of adolescents.

Objectives of the Study

This study was conducted to assess the knowledge about and attitude towards Reproductive Health (RH) and their relationship to the health seeking behavior of adolescents in Iloilo City High Schools. Specifically, this study aimed to: (1) determine the students' level of knowledge about RH; (2) describe the students' attitude towards RH; (3) describe the students' health seeking behavior; (4) determine if there is a significant relationship between the students' characteristics in terms of age, sex, type of school and location of residence and their level of knowledge about RH ; (5) determine if there is a significant relationship between the students' characteristics and their attitude towards RH ; (6) determine if there is a significant relationship between the students' characteristics and their health seeking behavior ; (7) determine if a significant relationship exists between the students' level of knowledge about RH and their attitude towards RH; (8) determine if a significant relationship exists between the students' level of knowledge about RH and their health seeking behavior; (9) determine if a significant relationship exists between the students' attitude towards RH and their health seeking behavior; and; (10) determine if there is a significant relationship between the students' level of knowledge about RH and their health seeking

behavior controlling for attitude towards RH. The relationship among variables is shown in Figure 1.

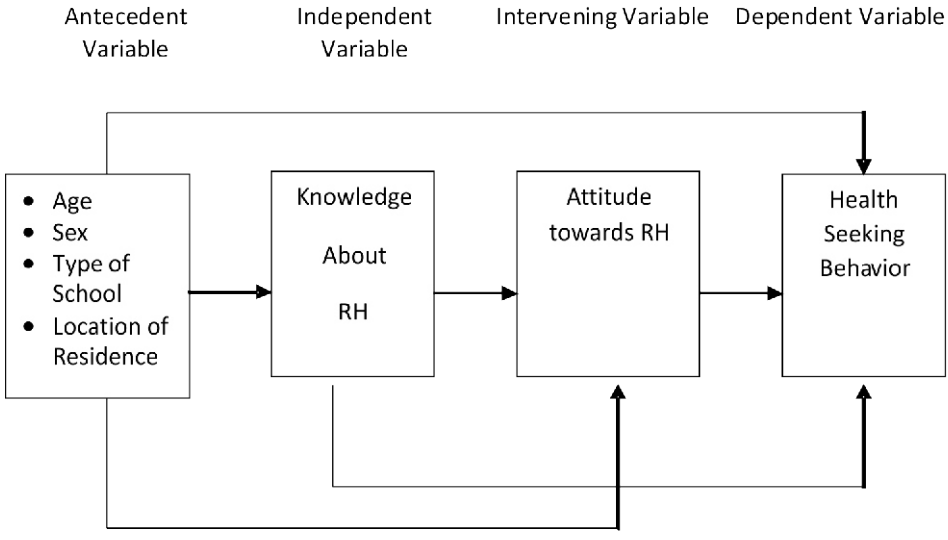

Figure 1. Assumed flow of relationship among variables

METHODOLOGY

The descriptive-relational method of research using a one shot survey design was employed in this study. The respondents of this study were the fourth year students enrolled in private and public high schools supervised by DepEd and Higher Education Institutions with high school department in Iloilo City for SY 2008-2009.

To gather data for the study, two published data- gathering instruments were employed. These were the Attitude Scale (Kelly, 1995), and a 12 item questionnaire on knowledge about reproductive health answerable by "true" or "false", adopted from Teen Outreach: Youth Development Through Service and Learning (Association of Junior Leagues, 1994). The questions on the health seeking behavior were researcher made. An information sheet intended to obtain data on the students' age, sex, type of school and place of residence was included. The researcher-made questionnaire was submitted

for face and content validation to a panel of three jurors. Their suggestions were considered to improve the items in the questionnaire. To determine the reliability of the data gathering instruments, the same were pilot tested to 5 percent of the sample size in another school not included in the data gathering.

Prior to data gathering, the researchers sought approval from the Ethics Committee of DOST/PCHRD. This is to assure that the rights of the respondents against undue impositions are protected.

All high schools identified were considered. There were forty seven (47) government and private high schools. A list of fourth year students from the different high schools was obtained from the principal's office. Sample size (363) was computed based from the total number of students. When the desired sample size was obtained, stratified sampling using proportional allocation for each school was employed. Respondents per school were selected using simple random technique. However, there were six (6) Private High Schools which were not included in the study because they refused to participate. This reduced the sample size to three hundred thirty two (332).

To determine the level of knowledge of the respondents, scores obtained from the 12-item questions were added and categorized as follows: 9-12" High knowledge" ; 5- 8 "Average knowledge"; 4 and below "Low knowledge".

The attitude questionnaire was composed of 15 attitude statements. The instrument requires the respondent to react to each item, as to whether they; 1= strongly disagree, 2= somewhat disagree, 3= relatively neutral, 4= somewhat agree, and 5= strongly agree. Generally speaking, the higher the obtained total score, the more liberal the attitudes (highest possible score = 75). To interpret the obtained scores, the following scale of scores and their corresponding interpretations were utilized: 51 75 "Liberal"; 26 50 "Neutral"; 25 and below "Conservative".

To gather information on the health seeking behavior of the students, 10 statements that are meant to determine the health seeking behavior of the students about problems and symptoms pertaining to RH were used. The instrument required the student to indicate in each item, whether they; 1= never, 2= sometimes, 3= often, 4= always seek for professional help.

To interpret the obtained scores, average score was computed. The following scale of scores and their corresponding interpretations was utilized: 31-40 "Very Good" 21 - 30 "Good"; 11-20 "Fair"; 1 - 10 "Poor".

Frequency counts and percentage analysis as descriptive statistics were used to present the distribution of respondents as to their characteristics, level of knowledge and attitude towards RH as well as their health seeking behavior.

To determine the relationship between levels of categories, the Chi-square, Cramer's V, Pearson's r, and Partial Correlation set at .05 alpha level were used. Data were processed and analyzed using the Statistical Package for Social Sciences (SPSS) Software.

RESULTS AND DISCUSSION

Characteristics of the Respondents

Data in Table 1 revealed that majority of the respondents were 16 years old and younger, female, enrolled in public high school and residing within Iloilo City.

Table 1. Distribution of Students According to Certain Demographic Characteristics

Characteristics	f	%
Age		
17 years and older	38	11.4
16 years and younger	294	88.6
Total	332	100.0
Sex		
Male	151	45.5
Female	181	54.5
Total	332	100.0
Type of school		
Private	92	27.7
Public	240	72.3
Total	332	100.0
Location of Residence		
Within Iloilo City	298	89.8
Outside Iloilo City	34	10.2
Total	332	100.0

Level of Knowledge about Reproductive Health

As shown in Table 2, majority of the respondents had average level of knowledge about reproductive health while about three in every 10 adolescents had high level of knowledge. Findings of this study support the findings of Abioda (2002) that majority of the students had average level of knowledge about sexuality.

Table 2. Distribution of the Students as to their Level of Knowledge about Reproductive Health

Level of Knowledge about Reproductive Health	f	%
Low	6	1.8
Average	205	61.8
High	121	36.4
Total	332	100.0

Attitude towards Reproductive Health

In terms of attitude towards reproductive health, 184 (55.4 %) of the respondents had neutral attitude while 148 (44.6 %) had liberal attitude (Table 3).

Table 3. Distribution of the Students as to Their Attitude towards Reproductive Health

Attitude towards Reproductive Health	f	%
Conservative	0	0.0
Neutral	184	55.4
Liberal	148	44.6
Total	332	100.0

Health Seeking Behavior

As to the students' health seeking behavior, two-thirds (66.9%) of the students had good health seeking behavior while one-fifth (22.0%) had fair health seeking behavior. On the other hand, only eleven percent (11.1 %) had very good health seeking behavior (Table 4). The result of the study contradicts the findings of Njau, et.al (2004) that only a few adolescents sought health services from health centers, clinics and hospital. Furthermore, it was mentioned in the study that other adolescents sought treatment from traditional healers and herbalists.

Table 4. Distribution of Students According to their Health Seeking Behavior

Health Seeking Behavior	f	%
Fair	73	22.0
Good	222	66.9
Very Good	37	11.1
Total	332	100.0

Respondents' Characteristics and Knowledge about Reproductive Health

Among the antecedent variables identified, only the type of school where the respondents were enrolled was significantly related to their knowledge about reproductive health. However, findings do not support the results of the survey conducted by IYARHS (Indonesia Young Adult Reproductive Health Survey, 2002-2003) which revealed that the schools have not been recognized as a key source of information on reproductive health knowledge of students. Result of this study negates the findings of Abioda (2002) that students' level of knowledge about sexuality differs significantly according to age. However, findings of Begum (2006), Das (2007) and Bhuiya (2004) found that level of knowledge among mid adolescent girls was higher than that of boys. Data is presented in Table 5.

Respondents' Characteristics and Their Attitude towards Reproductive Health

Among the selected characteristics, only the type of school where the respondents were enrolled is significantly related to their attitude towards

Table 5. Distribution of the Students as to Certain Characteristics and Their Level of Knowledge about Reproductive Health

Characteristics	Level of Knowledge about RH						Total	
	Low		Average		High			
	f	%	f	%	f	%	f	%
Age								
16 yrs. old and younger	3	1.0	182	61.9	109	37.1	294	100.0
17 yrs. old and older	3	7.9	23	60.5	12	31.6	38	100.0
r = -.097 (not significant at the 5% level of probability)						p = .077		
Sex								
Male	5	3.3	91	60.3	55	36.4	151	100.0
Female	1	0.6	114	63.0	66	36.5	181	100.0
X^2 = 3.565 (not significant at the 5% level of probability)					df = 2		p = 0.168	
Type of School								
Private School	-	-	41	44.6	51	55.4	92	100.0
Public School	6	2.5	164	68.3	70	29.2	240	100.0
X^2 = 20.976 (significant at the 5% level of probability)					df = 2			
p = .000	Cramer's V = 0.251							
Location of Residence								
Within Iloilo City	6	2.0	189	63.4	103	34.6	298	100.0
Outside Iloilo City	-	-	16	47.1	18	52.6	34	100.0
X^2 = 4.836 (not significant at the 5% level of probability)					df = 2		p = 0. 089	

RH (Table 6). The results of the study are supported by the findings of Abioda (2002) that the type of school where the students are enrolled is a significant factor that may influence the students' attitude towards sexuality. However, age, sex, and location of residence were not significantly related to their attitude towards RH. The result of the study negates the findings of YAFS (2002) that both male and female have liberal attitude towards RH.

Selected Characteristics of the Respondents and Health Seeking Behavior

Data in Table 7 show that sex, type of school and location of residence were significantly related to the respondents' health seeking behavior. The Population Council (2001) reported that more females seek reproductive health services than males. This may be because most of the reproductive health services are focused on women.

Table 6. Distribution of Students as to Certain Characteristics and Their Attitude towards Reproductive Health

Characteristics	Attitude towards Reproductive Health				Total	
	Neutral		Liberal			
	f	%	f	%	f	%
Age						
16 yrs. old and younger	161	54.8	133	45.2	294	100.0
17 yrs. old and older	23	60.5	15	39.5	38	100.0
r = 0.004 (not significant at the 5% level of probability)				p = 0.949		
Sex						
Male	80	53.0	71	47.0	151	100.0
Female	104	57.5	77	42.5	181	100.0
X^2 = 0.668 (not significant at the 5% level probability)			df = 1	p = 0.414		
Type of school						
Private School	42	45.7	50	54.3	92	100.0
Public School	142	59.2	98	40.8	240	100.0
X^2 = 4.917 (significant at the 5% level of probability)			df = 1	p = 0.027		
Cramer's V = 0.122						
Location of Residence						
Within Iloilo City	166	55.7	132	44.3	298	100.0
Outside Iloilo City	18	52.9	16	47.1	34	100.0
X^2 = 0.094 (not significant at the 5% level probability)			df = 1	p = 0.759		

Table 7. Distribution of the Students as to Certain Characteristics and Their Health Seeking Behavior

Characteristics	Health Seeking Behavior						Total	
	Fair		Good		Very Good			
	f	%	f	%	f	%	f	%
Age								
16 yrs. old and younger	61	20.7	200	68.0	33	11.2	294	100.0
17 yrs. old and older	12	31.6	22	57.9	4	10.5	38	100.0
r = -0.028 (not significant at the 5% level of probability)							p = .613	
Sex								
Male	38	25.2	88.0	58.3	25	16.6	151	100.0
Female	35	19.3	134	74.0	12	6.6	181	100.0
X^2 = 11.606 (significant at the 5% level of probability)					df = 2		p = 0 .003	
Cramer's V = 0.187								
Type of school								
Private School	8	8.7	70	76.1	14	15.2	92	100.0
Public School	65	27.1	152	63.3	23	9.6	240	100.0
X^2 = 13.739 (significant at the 5% level of probability)					df = 2		p = 0.001	
Cramer's V = 0.203								
Location of Residence								
Within Iloilo City	70	23.5	199	66.8	29	9.7	298	100.0
Outside Iloilo City	3	8.8	23	67.6	8	23.5	34	100.0
X^2 = 8.202 (significant at the 5% level of probability)					df = 2		p = 0.017	
Cramer's V = 0.157								

Level of Knowledge and Attitude towards Reproductive Health

Knowledge about reproductive health is significantly related to the respondents' attitude towards reproductive health (Table 8). This result is supported by the findings of IYARHS (2002-2003) and Jaffer and Afifi (2005), that adolescents' reproductive health knowledge is associated with their attitudes.

Table 8. Distribution of the Students as to Their Knowledge about RH and their Attitude towards RH

Attitude towards Reproductive Health	Level of Knowledge about Reproductive Health						Total	
	Low		Average		High			
	f	%	f	%	f	%	f	%
Neutral	5	83.3	116	56.6	63	52.1	184	55.4
Liberal	1	16.7	89	43.4	58	47.9	148	44.6
Total	**6**	**100.0**	**205**	**100.0**	**121**	**100.0**	**332**	**100.0**

r = 0.118 (significant at the 5% level of probability) p = .032

Level of Knowledge and Health Seeking Behavior

Data in Table 9 shows that the respondents' level of knowledge about reproductive health is not significantly related to their health seeking behavior. The result of the study corroborates with the findings of Njau, et.al. (2004) and Bhuiya, et.al. (2004) that despite adolescents' awareness on the health care facility, they do not seek reproductive health services.

Table 9. Distribution of the Students as to Their Knowledge about RH and their Health Seeking Behavior

Health Seeking Behavior	Level of Knowledge about Reproductive Health						Total	
	Low Knowledge		Average Knowledge		High Knowledge			
	f	%	f	%	f	%	f	%
Fair	4	66.7	45	22.0	24	19.8	73	22.0
Good	2	33.3	139	67.8	81	66.9	222	66.9
Very Good	-	-	21	10.2	16	13.2	37	11.1
Total	**6**	**100.0**	**205**	**100.0**	**121**	**100.0**	**332**	**100.0**

r = 0.038 (not significant at the 5% level of probability) p = 0.494

Attitude towards RH and Health Seeking Behavior

As shown in Table 10, attitude of the respondents toward reproductive health is significantly related to their health seeking behavior. The result of the study contradicts the findings of Moronkola and Uzuego (2006) that in spite of the students' positive attitude towards menstruation only a few consulted with the doctor whenever they experience menstrual symptoms.

Table 10. Distribution of the Students as to Their Attitude towards RH and their Health Seeking Behavior

Health Seeking Behavior	Attitude towards Reproductive Health				Total	
	Neutral		Liberal			
	f	%	f	%	f	%
Very Good	15	8.2	22	14.9	37	11.1
Good	118	64.1	104	70.3	222	66.9
Fair	51	27.7	22	14.9	73	22.0
Total	**184**	**100.0**	**148**	**100.0**	**332**	**100.0**

r = 0.143 p = 0.009

Level of Knowledge about RH and Health Seeking Behavior Controlling for Attitude towards RH

Level of knowledge about reproductive health is not significantly related to the health seeking behavior of the respondents when their attitude was controlled (Table 11). This means that given the same level of knowledge, when students are not bothered by their attitude towards RH, the students will still show good health seeking behavior.

Table 11. Distribution of the Students as to Their Knowledge about RH and Their Health Seeking Behavior Controlling for Attitude towards RH

Health Seeking Behavior	Attitude towards Reproductive Health												Total	
	Neutral						Liberal							
	Level of Knowledge						Level of Knowledge							
	High		Average		Low		High		Average		Low			
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Very Good	7	11.1	8	6.9	0	0.00	9	15.5	13	14.6	0	0.00	37	11.3
Good	41	65.1	76	65.5	1	20.0	40	69.0	63	70.8	1	100.0	222	66.8
Fair	15	23.8	32	27.6	4	80.0	9	15.5	13	14.6	0	0.00	73	21.9
Total	**63**	**100.0**	**116**	**100.0**	**5**	**100.0**	**58**	**100.0**	**89**	**100.0**	**1**	**100.0**	**332**	**100.0**

Partial r = 0.0212 (not significant at the 5% level of probability) p = 0.700

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Majority of the respondents belong to the younger age group, females, enrolled in public high school and residing within Iloilo City.

Majority had average level of knowledge about reproductive health, had neutral attitude towards reproductive health, and with good health seeking behavior.

Significant relationship existed between the type of school where the respondents are enrolled and their knowledge about and attitude towards reproductive health.

Significant relationship existed between the respondents' sex, type of school where they are enrolled and location of their residence and their health seeking behavior.

A significant relationship existed between the respondents' level of knowledge about reproductive health and their attitude towards reproductive health.

A significant relationship existed between the respondents' attitude towards reproductive health and their health seeking behavior.

Recommendations

Since the students had average knowledge about reproductive health, it is recommended that extra effort should be done to improve the students' level of knowledge especially in the areas of male and female sexuality, STDs and methods of contraception. The strategy could vary from the conduct of seminars, symposia, lectures, group discussions, experiential learning, film showing or inviting resource persons considered as authority in RH, so the students can be reminded of the need to maintain a healthy life.

Early education and information sharing for adolescents' information service providers: the parents, teachers, community, church, health staff, media, and NGOs on adolescent health concerns and intensified and responsive counseling services shall be done. Education programmes need to tailor some of their messages to suit the needs of adolescents.

Teachers and guidance counselors should be trained to deal with topics in human sexuality because many of them are not comfortable with such topics. Their attendance to trainings, seminars, and workshops concerning sexuality among adolescents, their problems, attitudes, behavior/practice is highly recommended. The school administrators are encouraged to develop a curriculum wherein topics related to sexuality can be integrated. This should be ideally implemented before the adolescents become sexually active.

The students' "neutral" attitude towards RH may indicate that sooner or later they will become sexually active. Health educators, teachers and guidance counselors should understand that sexuality is a part of human existence and that proper understanding of one's sexuality could be helpful in dealing with one's attitude and will eventually lead to desirable health seeking behavior. By this, they will be properly guided and treated promptly thus preventing complications.

Health care providers, teachers, guidance counselors, and parents should take extra effort to inculcate values to young adolescents which will lead them to positive attitude towards reproductive health and eventually desirable health seeking behavior.

Health care providers, guidance counselors, and teachers should develop positive and a welcoming attitude to adolescents who may need these services in terms of problems about sexuality and reproductive health as a whole. It should also be emphasized that confidentially should be strictly observed in dealing with the sensitive and personal problems of the adolescents. Service providers can work with other sectors to collectively address adolescent health issues especially reproductive health.

Although the students had good health seeking behavior especially among the females, it is still recommended that the students should participate in activities that the DepEd will implement concerning reproductive health through seminars, film showing, and lecture forum.

Program planners should involve young people in designing, planning and implementation, monitoring and evaluation of activities and programs to ensure that it is acceptable, appealing and relevant to them.

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PRODUCTION PRACTICES OF THE NATIVE CHICKEN GROWERS IN WESTERN VISAYAS

Reynaldo N. Dusaran and Randy A. V. Pabulayan

ABSTRACT

This study was conducted to determine the production practices of the native chicken growers in the top three native chicken municipalities of all provinces in Western Visayas. This is a purely descriptive study that utilized the one-shot survey design. Multi-stage sampling technique was used to identify the study respondents. Face to face interview of the native chicken raisers was conducted. Data analysis was purely descriptive. Results show that there are specific areas in the region where the production of native chicken predominates. The income of the native chicken growers is relatively low since native chicken production is still a backyard family economic undertaking with limited marketable product volume. The growers have an average of 16.2 heads of hens and 4.4 heads of roosters for breeding. Their breeders, mostly home grown, were mostly upgraded native chicken, followed by Darag and Jolo. Native chickens are generally raised in free range. The usual feedstuffs consisting of corn/cracked corn, rice bran, home mixed ration, filled/unfilled palay and rice/milled rice were more or less the same for pullets, cockerels, hens and roosters but amount varies depending on the stage of growth of chickens. These feeds are generally broadcast on the ground. Higher incidence of mortality peaking in June was largely attributed to change in climate, diseases and pests. Generally, the growers did not vaccinate but they provided their native chickens with substances for disease prevention and control. More pullets and cockerels are sold and seasonality was also observed. The native chicken growers have plans for expansion.

Keywords: Native Chicken, upgraded native chicken, production practices

INTRODUCTION

Philippine native chicken has been the main source of meat and eggs for Filipino farmers (World Poultry, 2000 in Dusaran & Cabarles, 2005). Its unparalleled ability to produce meat and eggs under minimal management, intervention and inputs has led to its large population and popularity. The role of indigenous chicken in Philippine agriculture and the entire economy is well-recognized. It will, to a large extent, remain a significant contributor to the continuous supply of meat and eggs and extra income for many rural Filipino farmers. Its meat is highly preferred by many Filipino consumers because of its distinct taste, leanness, and pigmentation. As of 1996, more than 60 % of the total inventory of chicken in the Philippines consist of the pure native and upgraded native chicken which are mostly raised under backyard condition (Lambio, Bondoc, & Grecia (1996) in Dusaran & Cabarles, 2005). Demand for poultry meat was increasing every year that the projected demand will be around 570,000 metric tons in 2005. The Filipino domestic per capita consumption of chicken meat was also increasing from 3.33 kg in 1990 to 6.75 kg in 1998 (Dusaran & Cabarles, 2005).

For many years, the native chicken production in Western Visayas has been a common livelihood for many farmers. It provides them additional income as well as source of protein. It serves as a form of savings or insurance for the farmers against periodic shortages as well as for resource diversification.

Nowadays, native chicken is being displaced in the supply chain by hybrid chickens. This is, however, an opportunity for small-scale farmers to raise native chicken and generate incremental benefits by supplying the emerging market for this commodity.

In 2005, Dusaran and Cabarles conducted a study to determine the status of native chicken production in Calinog, Passi City, and Barotac Nuevo, the top native chicken producing local government units in Iloilo. On-the-spot-visit and interview were done to collect the needed data.

Results of the study showed that the respondents started the project with meager capital and had an estimated weekly income and profit of PhP 100.00 to PhP 500.00. Drastic change in climate was mentioned as the major cause of disease occurrence. Common cultural practices and even antibiotics and herbals were used to control the malady. Birds weighing 500 to 1,000 grams were the most in demand in the local market. High demand for chicken was observed from September to December while least demand was from July to August. Most of the raisers did not keep any record and had no consultant for their project. They encountered various problems and wanted to know more

about preparation of project feasibility studies and record keeping, and acquire basic knowledge on raising native chicken. They also believe that proper care and management of the birds is the key to successful native chicken production.

The native chicken has evolved in a way that it multiplied and survived in a marginal environment even with minimal management. More importantly, the meat of the native chicken has a unique flavor and texture which consumers prefer and for which they are willing to pay a premium price. The native chicken will, undoubtedly, remain an important source of high-quality protein food and additional income for many of our small rural farmers (Prodigo, Oren & Arostique, 2005).

This study was conducted to determine the production practices of the native chicken growers in the top three native chicken producing municipalities in the six provinces of Western Visayas.

METHODOLOGY

This is a purely descriptive study that utilized the one-shot survey design. The study focused only on gathering data that can establish the production practices of the native chicken raisers in the top three native chicken producing municipalities in the six provinces of Western Visayas.

Multi-stage sampling technique was used in this study. In the first stage, the top three municipalities with the most number of chicken population for the six provinces in Region VI were identified with the assistance of the respective Provincial Veterinary Officer. In the second stage, the top three barangays per identified municipality were chosen with the assistance of the respective Municipal Agriculture Officer. Finally, the native chicken growers raising at least 20 heads of native chicken were selected from each of the sample barangays.

The top three municipalities were identified with the help of the Office of the Provincial Veterinarians of the provinces covered by the study. The assistance of the Office of the Provincial Veterinarians of the different provinces were also solicited in identifying interviewers or data collectors from the different municipalities covered by the study. Face-to-face interview of the native chicken raisers, traders and processors was conducted. Data analysis was purely descriptive.

RESULTS AND DISCUSSION

Profile of Respondents

The native chicken raising-respondents were mostly from Antique (32.2%) and least from Guimaras (7.9%). They were generally above 30 years old (91.2%) with a mean age of 49.3 years. The respondents from Capiz appeared to be relatively older with a mean age of 51.4 years while the respondents from Negros Occidental seemed to be younger with a mean age of 47.0 years. They were mostly elementary educated (38.8%) particularly those in Negros Occidental (52.1%) or high school educated (36.6%) particularly those in Aklan (50.6%). In Iloilo, about one-third (32.9%) of the respondents were college educated (Table 1).

The major occupation of the respondents was generally (74.4%) farming. This was particularly true to all the provinces in the region but the greatest proportion (89.6%) of raisers were farmers in Capiz with the least (29.5%) in Guimaras. From their major occupation, the respondents received an average income of Php 4,155.8 per month but most (46.4%) received a monthly estimated income of Php 3,000.00 and below. The highest mean income per month (Php 5,689.40) was recorded in Guimaras while the lowest (Php 3,083.60) was in Negros Occidental (Table 1).

From their native chicken production, the respondents earned an average of Php 1,002.50 per month with most of them (43.9%) earning Php 500.00 and below. This is specific for Capiz, Iloilo and Aklan where most (40.0%, 51.4% and 63.2%, respectively) of the respondents were earning Php 500.00 and below. In Negros Occidental and Antique most raisers (58.3% and 45.0%, respectively) were earning Php501.00 to Php1,000.00 per month while in Guimaras, most (27.8%) were earning more than Php 2,000.00 per month (Table 2).

As observed, a greater proportion of the respondents in Aklan were on the lower income categories compared to those in Guimaras who were on higher income categories. This is consistent with the findings that respondents from Guimaras had the highest mean income (Php 2,143.30) as against those in Aklan with the lowest (Php 697.50).

On the average, income from native chicken has a potential to contribute about a quarter (24.1%) to the respondents' income from their major occupation. The propensity to augment income from native chicken was observed to be highest in Guimaras (37.7%) and lowest in Antique (18.4%).

The respondents had been into native chicken production for an average of 17.5 years with most of them (38.0%) involved for 10 years and below. Except for the Capiz respondents who were on the larger experience category, those from other provinces had mostly native chicken production experience 10 years or below. The Capiz respondents, had been raising native chicken for 21.1 years on the average, whereas to the Guimaras respondents had been at it for only 14.3 years (Table 2).

Native Chicken Production Practices

Breeding. The native chicken raisers had an average of 16.2 heads of hens and 4.4 heads of roosters for breeding or an average of 1 rooster to 4 hens. In terms of female breeders, most of the respondents (50.8%) had 11 to 20 heads of hens with those from Capiz having the largest (22.3 hens) and Aklan with the smallest (12.6 hens) mean number of hens. In terms of male breeders, more than one-third (37.3%) had 3 to 5 heads of roosters with the Antique respondents having the largest (5.7 roosters) and those from Negros Occidental having the smallest (2.9 roosters) mean number of roosters.

The female breeders were mostly (44.3%) upgraded native chicken followed by Darag (34.2%), Jolo (28.9%), and mongrels (18.8) while their male breeders were also mostly (40.9%) upgraded native chicken followed by Jolo (30.3%), Darag (25.1%) and Mongrels (15.6%).

Provincial comparison shows that in Capiz, the majority of the growers (55.2%) used mongrels as female breeders and most (46.9%) also used mongrels as male breeders (Table 3). In Negros Occidental, the majority (67.1% and 63.0%) used Jolo as female and male breeders, respectively. Similar practice was also done in Guimaras. In Antique, most of the growers used upgrades as hens (45.5%) and roosters (42.2%). In Iloilo, the majority (63.5% and 56.8%) of the growers used upgrades and darag hens, respectively, and upgrades (60.8%) and Jolo (58.1%) roosters (Table 3). These breeders were generally home grown (76.3%). The same trend was observed in all the provinces in the region (Table 4). Aklan, however, had the greatest proportion of growers (96.7%) with home grown breeders while Guimaras had the least (45.5%).

Means of raising. The native chicken raisers generally grew native chicken on free range basis (61.1%). This is most particularly true in Negros Occidental (90.5%) but not in Aklan where the majority (63.7%) of the growers were raising their native chickens under free-range and semi-confinement schemes (Table 4).

Table 1. Distribution of Respondents According to Their Profile (N=558)

Profile	Province												Total	
	Capiz		Negros		Guimaras		Antique		Iloilo		Aklan			
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Age														
Below 31 years old	2	2.1	11	15.1	4	9.1	18	10.0	6	8.1	8	8.8	49	8.8
31 to 40 years old	19	19.8	13	17.8	13	29.5	29	16.1	18	24.3	19	20.9	111	19.9
41 to 50 years old	31	32.3	18	24.7	9	20.5	44	24.4	15	20.3	29	31.9	146	26.2
51 to 60 years old	18	18.8	23	31.5	9	20.5	51	28.3	17	23.0	21	23.1	139	24.9
Above 61 years old	26	27.1	8	11.0	9	20.5	38	21.1	18	24.3	14	15.4	113	20.3
Mean	**51.4**		**47.0**		**48.1**		**50.2**		**49.7**		**47.4**		**49.3**	
Educational Attainment														
Elementary level	37	38.5	38	52.1	16	36.4	69	38.5	22	30.1	33	37.1	215	38.8
High school level	34	35.4	16	21.9	11	25.0	77	43.0	20	27.4	45	50.6	203	36.6
College level	24	25.0	15	20.6	12	27.3	28	15.6	24	32.9	10	11.2	113	20.4
Occupation														
No answer	0	0.0	0	0.0	1	2.3	4	2.2	2	2.7	3	3.3	10	1.8
Farming	86	89.6	51	69.9	13	29.5	147	81.7	61	82.4	57	62.6	415	74.4
Others	10	10.4	22	30.1	30	68.2	29	16.1	11	14.9	31	34.1	133	23.8
Monthly Income														
No answer	29	302	7	9.6	11	25.0	6	3.3	5	6.7	25	27.5	83	14.9
Php3,000 & below	40	59.7	45	61.6	11	25.0	71	39.4	46	62.2	46	50.5	259	46.4
Over Php 3,000	27	28.1	21	28.8	22	50.0	103	57.2	23	31.1	20	22.0	216	38.7
Mean	**5323.9**		**3083.6**		**5689.4**		**4315.9**		**3835.6**		**3187.9**		**4155.8**	
Total	**96**	**100**	**73**	**100**	**44**	**100**	**180**	**100**	**74**	**100**	**91**	**100**	**558**	**100**
	96	**17.2**	**73**	**13.1**	**44**	**7.9**	**180**	**32.2**	**74**	**13.3**	**91**	**16.3**	**558**	**100**

Table 2. Distribution of Respondents According to Monthly Income (Php) from Native Chicken Production and Native Chicken Production Experience (N=558)

Category	Province												Total	
	Capiz		Negros		Guimaras		Antique		Iloilo		Aklan			
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Native Chicken Production Income (Php)														
No Answer	1	1.0	1	1.4	8	18.2	69	38.3	4	5.4	4	4.4	87	15.6
500 and Below	38	40.0	21	29.2	8	22.2	49	44.1	36	51.4	55	63.2	207	43.9
501-1000	31	32.6	42	58.3	9	25.0	50	45.0	19	27.1	9	10.3	160	34.0
1001- 1500	3	3.2	4	5.6	3	8.3	3	2.7	5	7.1	16	18.4	34	7.2
1501- 2000	14	14.7	5	6.9	6	16.7	5	4.5	4	5.7	5	5.7	39	8.3
2000 & Above	9	9.5	0	0.0	10	27.8	4	3.6	6	8.6	2	2.3	31	6.6
Mean	**1355.3**		**828.5**		**2143.3**		**794.9**		**824.6**		**697.5**		**1002.5**	
Native Chicken Production Experience (years)														
No answer	10	10.4	3	4.2	0	0.0	20	11.1	2	2.7	2	2.2	37	6.6
10 years and below	22	22.9	33	45.2	25	56.8	69	38.3	26	35.1	37	40.7	212	38.0
11 to 20 years	27	28.1	19	26.0	10	22.7	41	22.8	18	24.3	34	37.4	149	26.7
21 to 30 years	21	21.9	9	12.3	4	9.2	30	16.7	15	20.3	11	12.1	90	16.1
31 to 40 years	11	11.5	7	9.6	3	6.8	11	6.1	8	10.8	4	4.3	44	7.9
Above 40 years	5	5.2	2	2.7	2	4.5	9	5.0	5	6.8	3	3.3	26	4.7
Total	**96**	**100**	**73**	**100**	**44**	**100**	**180**	**100**	**74**	**100**	**91**	**100**	**558**	**100**
Mean	**21.1**		**15.6**		**14.3**		**17.1**		**20.1**		**15.5**		**17.5**	

Table 3. Distribution of Respondents According to their Breeders (N=558)

Categories	Province													
	Capiz (96)		Negros (73)		Guimaras(44)		Antique(180)		Iloilo(74)		Aklan(91)		Total	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Number of Hens														
No answer	0	0.0	1	1.4	1	2.3	4	2.2	0	0.0	1	1.1	7	1.2
10 and Below	15	15.6	33	45.8	21	48.8	57	31.7	1	1.4	39	43.3	166	30.1
11-20	40	41.7	28	38.9	14	32.6	97	53.8	59	79.7	42	46.7	280	50.8
More than 20	41	42.7	11	15.3	8	18.6	22	12.2	14	19.0	9	10.0	105	19.0
Mean	**22.3**		**12.8**		**14.9**		**14.9**		**19.8**		**12.6**		**16.2**	
Number of Roosters														
No answer	0	0.0	4	5.5	1	2.3	4	2.2	1	1.3	1	1.1	11	2.0
2 and Below	39	40.6	31	42.5	27	61.4	50	27.8	19	25.7	30	33.0	196	35.1
3-5	42	43.8	34	46.6	11	25.0	46	25.6	31	41.9	44	48.3	208	37.3
More than 5	15	15.6	4	5.5	5	11.4	80	44.4	23	31.1	16	17.6	143	25.6
Mean	**3.9**		**2.9**		**3.5**		**5.7**		**4.5**		**3.7**		**4.4**	
Strain (Hens)														
Upgrade	17	17.7	39	53.4	21	47.7	82	45.5	47	63.5	41	45.1	247	44.3
Darag	33	34.4	22	30.1	3	6.8	56	31.1	42	56.8	35	38.5	191	34.2
Jolo	7	7.3	49	67.1	31	70.4	26	14.4	39	52.7	9	9.9	161	28.9
Mongrels	53	55.2	8	11.0	2	4.5	5	2.8	8	10.8	29	31.9	105	18.8
Native	0	0.0	10	13.7	1	2.3	28	15.6	0	0.0	21	23.1	60	10.8
Others	1	1.0	1	1.4	1	2.3	0	0.0	2	2.7	3	3.3	8	1.5
Strain (Rooster)														
Upgrade	13	13.5	33	45.2	20	45.4	76	42.2	45	60.8	41	45.1	228	40.9
Jolo	14	14.6	46	63.0	27	61.4	36	20.0	43	58.1	3	3.3	169	30.3
Darag	25	26.0	6	8.2	1	2.3	43	23.9	31	41.9	34	37.4	140	25.1
Mongrels	45	46.9	3	4.1	0	0.0	4	2.2	7	9.4	28	30.8	87	15.6
Native	0	0.0	9	12.3	1	2.3	28	15.6	0	0.0	16	17.6	54	9.7
Others	0	0.0	1	1.4	0	0.0	0	0.0	1	1.4	2	2.2	4	0.8

Feeds and feeding. The usual feed stuffs given by the raisers to their native chickens were almost the same for pullets, cockerels, hens and roosters. For pullets, the most common feed stuff was corn/crack corn (40.7%), rice bran (37.1%), home mixed ration (33.3%), filled/unfilled palay grains (20.6%) and rice/milled rice (20.6%). Only 14.7% used commercial formulation.

Except in Antique and Iloilo, corn/crack corn was the major feedstuff for pullets in other provinces. The majority (56.1%) of the Antique raisers used home-mixed ration while those in Iloilo, where the majority (68.9%) used rice bran (Table 5).

For cockerels, the most common feed stuff was also corn/crack corn (41.2%), rice bran (37.5%), home mixed ration (31.2%), rice/milled rice (20.6%), filled/unfilled palay (20.4%) and commercial formulation (15.8). Just like with pullets, all the raisers in other provinces except Antique and Iloilo used corn/crack corn as major feedstuff for cockerels. In Antique, the majority (55.6%) of the growers also used home mixed ration but in Iloilo, the majority (68.9%) used rice bran.

The feed stuffs given to hens were quite similar. The most common was still corn/crack corn (42.3%), rice bran (37.6%), home mixed ration (31.0%), rice/milled rice (21.1%), filled/unfilled palay grains (20.1%) and commercial formulation (16.5%). The majority of the raisers in Capiz (63.5%), Negros Occidental (50.7%), Guimaras (59.1%) and Aklan (51.6%) used corn/crack corn. The majority (70.3%) of the raisers in Iloilo and Antique (53.9%) used rice bran and home mixed ration, respectively.

These were the same observations for the roosters. Corn/crack corn was the prevalent feed stuff (41.4%) followed by rice bran (37.6%), home mixed ration (31.0%), rice/milled rice (20.6%), filled/unfilled palay grains (20.3%) and commercial formulation (16.5%). Across provinces in the region, the same trend was observed (Table 5).

The native chicken raisers generally (66.5%) spread feeds on the ground for the chickens to eat. This practice was most popular (90.4%) among the respondents in Negros Occidental and least common (54.1%) among those in Iloilo (Table 4).

The volume of feeds given to native chickens varied according to their growth stage (Table 6). For pullets, most of the growers (30.8%) provided 50 grams of feeds and below per bird per day with a mean of 71.1 grams per bird/day. The Capiz respondents reported the highest mean amount of 114.8 grams per day, those in Aklan reported the lowest (45.8 grams).

Table 4. Distribution of Respondents According to their Means of Acquisition of their Breeding Stocks and Means of Raising and Means of Feeding Native Chicken (Multiple Response N=558)

Categories	Province													
	Capiz		Negros		Guimaras		Antique		Iloilo		Aklan		Total	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Means of breeding stock acquisition														
Own grown	64	66.7	60	82.2	20	45.5	143	79.4	51	68.9	88	96.7	426	76.3
From friends/neighbors	31	32.3	14	19.2	19	43.2	32	17.8	26	35.1	59	64.8	181	32.4
Buy in the market	17	17.7	7	9.6	10	22.7	6	3.3	17	23.0	11	12.1	68	12.2
Others	2	2.0	2	2.7	0	0.0	0	0.0	4	5.5	1	1.1	9	1.6
Means of Raising														
No answer	0	0.0	0	0.0	1	2.2	2	1.1	0	0.0	0	0.0	2	0.4
Free range	67	69.8	66	90.5	19	43.2	110	61.1	46	62.2	33	36.3	341	61.1
Semi-confinement	3	3.1	5	6.8	11	25.0	44	24.4	6	8.1	0	0.0	69	12.4
Complete confinement	0	0.0	0	0.0	0	0.0	1	0.6	1	1.4	0	0.0	2	0.4
Mixed	26	27.1	2	2.7	13	29.5	23	12.8	21	28.4	58	63.7	144	25.8
Means of Feeding														
No answer	1	1.0	1	1.4	0	0.0	4	2.2	0	0.0	1	1.1	7	1.3
Broadcast	69	71.9	66	90.4	25	56.8	115	63.9	40	54.1	56	61.5	371	66.5
Use of feeding trough	0	0.0	2	2.7	8	18.2	9	5.0	7	9.5	0	0.0	26	4.6
Broadcast & feeding through	26	27.1	4	5.5	11	25.0	52	28.9	27	36.5	34	37.4	154	27.6
Total	96	100	73	100	44	100	180	100	74	100	91	100	558	100

Table 5. Distribution of Respondents According to their Usual Feedstuff for Native Chicken (Multiple Response, N=558)

Usual Feeds	Province													
	Capiz		Negros		Guimaras		Antique		Iloilo		Aklan		Total	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Pullets Feedstuff														
Corn/crack corn	59	61.5	36	49.3	21	47.7	34	18.9	32	43.2	45	49.4	227	40.7
Rice bran	54	56.2	12	16.4	15	34.1	34	18.9	51	68.9	41	45.1	207	37.1
Home mixed ration	16	16.7	26	35.6	1	2.3	101	56.1	3	4.1	39	42.9	186	33.3
Filled/unfilled palay	38	39.6	1	1.4	3	6.8	55	30.6	0	0.0	18	19.8	115	20.6
Rice/milled rice	42	43.7	3	4.1	3	6.8	2	1.1	42	56.8	22	24.2	115	20.6
Commercial formulation	11	11.5	15	20.5	7	15.9	15	8.3	11	14.9	23	25.3	82	14.7
Others	0	0.0	0	0.0	25	56.8	0	0.0	1	1.4	41	45.1	67	12.0
Cockerels Feedstuff														
Corn/crack corn	59	61.5	36	49.3	22	50.0	35	19.4	30	40.5	48	52.7	230	41.2
Rice bran	56	58.3	11	15.1	15	34.1	35	19.4	51	68.9	41	45.1	209	37.5
Home mixed ration	17	17.7	25	34.2	1	2.3	100	55.6	3	4.1	28	30.8	174	31.2
Rice/milled rice	44	45.8	5	6.8	3	6.8	2	1.1	40	54.1	21	23.1	115	20.6
Filled/unfilled palay	38	39.6	2	2.7	3	6.8	56	31.1	0	0.0	15	16.5	114	20.4
Commercial formulation	11	11.5	15	20.5	7	15.9	16	8.9	11	14.9	28	30.8	88	15.8
Others	0	0.0	0	0.0	25	56.8	0	0.0	1	1.4	42	46.2	68	12.2
Hens Feedstuff														
Corn/crack corn	61	63.5	37	50.7	26	59.1	35	19.4	30	40.5	47	51.6	236	42.3
Rice bran	59	61.5	11	15.1	24	54.5	36	20.0	52	70.3	37	40.7	210	37.6
Home mixed ration	19	19.8	26	35.6	1	2.3	97	53.9	3	4.1	27	29.7	173	31.0
Filled/unfilled palay	34	35.4	2	2.7	3	6.8	57	31.7	0	0.0	16	17.6	112	20.1
Rice/milled rice	48	50.0	5	6.8	3	6.8	2	1.1	40	54.1	20	22.0	118	21.1
Commercial formulation	11	11.5	15	20.5	9	20.5	17	9.4	11	14.9	29	31.9	92	16.5
Others	0	0.0	0	0.0	23	52.3	0	0.0	1	1.4	39	42.9	63	11.3
Roosters Feedstuff														
Corn/crack corn	60	62.5	36	49.3	25	56.8	34	18.9	31	41.9	45	49.4	231	41.4
Rice bran	59	61.5	11	15.1	15	34.1	36	20.0	51	68.9	38	41.8	210	37.6
Home mixed ration	19	19.8	25	34.2	1	2.3	97	53.9	3	4.1	28	30.8	173	31.0
Filled/unfilled palay	35	36.5	2	2.7	3	6.8	57	31.7	0	0.0	16	17.6	113	20.3
Rice/milled rice	46	47.9	4	5.5	3	6.8	2	1.1	40	54.1	20	22.0	115	20.6
Commercial formulation	11	11.5	14	19.2	10	22.7	18	10.0	10	13.5	29	31.9	92	16.5
Others	0	0.0	0	0.0	22	50.0	0	0.0	1	1.4	36	39.6	59	10.6

Table 6.Distribution of Respondents According to Amount (Grams) of Feeds Given per Bird/Day

Amount of Feeds	Province													
	Capiz		Negros		Guimaras		Antique		Iloilo		Aklan		Total	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Pullets														
No answer	67	69.8	41	56.2	26	59.1	63	35.0	1	1.4	37	40.6	235	42.1
50 grams and below	0	0.0	5	6.8	9	20.5	62	34.4	46	62.2	50	55.0	172	30.8
More than 50 grams	29	30.2	27	37.0	9	20.5	55	30.6	27	36.4	4	4.4	151	27.1
Mean	**114.8**		**99.4**		**74.7**		**62.3**		**73.1**		**45.8**		**71.1**	
Cockerels														
No answer	67	69.8	41	56.2	26	59.1	63	35.0	1	1.3	38	41.8	236	42.3
60 grams and below	0	0.0	5	6.8	9	20.5	63	35.0	51	69.0	52	57.1	180	32.3
More than 60 grams	29	30.2	27	37.0	9	20.5	54	30.0	22	29.8	1	1.1	142	25.4
Mean	**109.3**		**98.8**		**80.3**		**64.8**		**72.6**		**41.7**		**71.03**	
Hens														
No answer	2	2.1	6	8.2	8	18.2	64	35.6	1	1.4	36	39.6	117	20.9
60 grams and below	4	4.2	27	37.0	18	40.9	60	33.3	53	71.6	53	58.2	215	38.5
More than 60 grams	90	93.7	40	54.8	18	40.9	56	31.1	20	27.0	1	1.1	226	40.5
Mean	**132.3**		**80.3**		**86.8**		**68.6**		**59.4**		**46.2**		**81.1**	
Roosters														
No answer	2	2.1	7	9.6	8	18.2	65	36.1	1	1.3	36	39.6	119	21.3
125 grams and below	43	44.8	63	86.3	28	63.6	113	62.8	68	91.9	54	59.3	369	66.1
More than 125 grams	51	53.1	3	4.2	8	18.2	2	1.2	5	6.8	1	1.1	70	12.5
Mean	**132.3**		**75.1**		**86.1**		**72.9**		**45.1**		**46.4**		**79.1**	
Total	**96**	**100**	**73**	**100**	**44**	**100**	**180**	**100**	**74**	**100**	**91**	**100**	**558**	**100**

For cockerels, most of the raisers (32.3%) provided 60 grams of feeds and below per bird per day with a mean of 71.03 grams/bird/day. The raisers in Capiz supplied the highest mean amount of 109.3 grams while those in Aklan still supplied the lowest (41.7 grams). For the hens, most of the raisers (38.5%) allocated 60 grams of feeds or below per bird per day. Their mean amount given to hens was 81.1 grams per bird per day. As with cockerels, the same trend was observed with hens raisers from Capiz providing the highest amount of feeds (132.3 grams) and those from Aklan, the lowest (46.2 grams).

For roosters, most of the raisers (66.1%) provided 125 grams of feeds and below/bird/day. Their mean amount of feeds given to roosters was 79.1 grams/bird/day with Capiz raisers providing the highest (132.3 grams) and those in Iloilo, the lowest (45.1 grams).

As can be gleaned from Table 7, almost half (46.8%) of the raisers spent Php 300.00 or lower for feeds. The mean estimated expenditure was Php 491.9 per month. Purchases of Php300/month or less for feeds were common among the majority of the respondents except for those in Iloilo, where most (43.2%) spent Php 301.00 to Php 600.00 per month. Based on mean expenses per month, the raisers in Aklan reported the lowest (Php 296.4) while those in Guimaras reported the highest (PhP 830.00).

Mortality, causes and control practices. Higher incidence of mortality among native chickens was observed by the respondents to start in March (24.7%), peaked in June (43.5%) and dwindled towards August (21.0%). This trend was quite similar among all provinces except in Aklan. In Aklan, this started in November (35.2%), peaked in December (44.0%), and declined in March (42.9%) of the next year (Table 8).

The native chicken raisers largely attributed this mortality to change of climate (83.5%), diseases (60.9%) and pests (29.6%). This observation was generally true to all provinces (Table 9).

Pests commonly observed by the raisers included avian pest (34.5%) and rats (38.8%) while the most common diseases included cold/flu (27.4%), respiratory diseases (19.7%), pneumonia (17.6%), and New Castle Disease (15.3%).

Across provinces, the majority (66.0% to 66.7%) of the raisers in Negros Occidental, Guimaras and Aklan did not provide any answer for specific pests of their native chicken. Avian pest was most common in Capiz (50.0%), Guimaras (33.3%) and Antique (82.4%) while rats were predominant in Iloilo (90.0%), Negros Occidental (33.3%), and Aklan (28.3%). For diseases,

respiratory diseases (44.9%) and avian influenza (44.9%) were most common in Capiz, New Castle Disease (16.7%) and Coryza (16.7%) were most common in Negros Occidental and cold/flu was mostly reported in Guimaras (67.9%) and Aklan (41.5%). In Antique, the most common disease was pneumonia (39.0%) while respiratory diseases was most common in Iloilo (55.3%) (Table 9).

Table 7. Distribution of Respondents According to Estimated Monthly Expenses in Feeds (N=558)

Estimated Monthly Expenses in Feeds	Province												Total	
	Capiz		Negros		Guimaras		Antique		Iloilo		Aklan			
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
No answer	1	1.0	3	4.1	11	25.0	43	23.9	2	2.7	2	2.2	62	11.1
Php300 and below	51	53.1	40	54.8	13	29.5	75	41.7	13	17.6	69	75.8	261	46.8
Php301-600	24	25.0	24	32.9	7	16.0	42	23.3	32	43.2	14	15.4	143	25.6
Php601-900	9	9.4	4	5.5	5	11.4	13	7.2	10	13.5	2	2.2	43	7.7
Php900-1200	3	3.1	2	2.7	4	9.1	2	1.1	7	9.5	3	3.3	21	3.8
Php1201-1500	3	3.1	0	0.0	2	4.5	1	0.6	4	5.4	0	0.0	10	1.8
Above Php1500	5	5.2	0	0.0	2	4.5	4	2.2	6	8.1	1	1.1	18	3.2
Total	**96**	**100**	**73**	**100**	**44**	**100**	**180**	**100**	**74**	**100**	**91**	**100**	**558**	**100**
Mean	**533.5**		**372.7**		**830**		**439.8**		**738.5**		**296.4**		**491.9**	

Table 8. Distribution of Respondents According to Months They Have Observed Higher Mortality Among Native Chickens (Multiple Response, N=558)

Months of Mortality Among Native Chickens	Province													
	Capiz		Negros		Guimaras		Antique		Iloilo		Aklan		Total	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
January	1	1.0	4	5.5	3	6.8	10	5.6	3	4.1	12	13.2	33	5.9
February	0	0.0	10	13.7	3	6.8	16	8.9	2	2.7	14	15.4	45	8.1
March	10	10.4	18	24.7	3	6.8	55	30.6	13	17.6	39	42.9	138	24.7
April	17	17.7	13	17.8	7	15.9	115	63.9	32	43.2	8	8.8	192	34.4
May	28	29.2	20	27.4	10	22.7	117	65.0	47	63.5	7	7.7	229	41.0
June	57	59.4	21	28.8	20	45.5	95	52.8	40	54.1	10	11.0	243	43.5
July	35	36.5	22	30.1	20	45.5	68	37.8	28	37.8	9	9.9	182	32.6
August	11	11.5	16	21.9	9	20.5	53	29.4	20	27.0	8	8.8	117	21.0
September	8	8.3	4	5.5	2	4.5	21	11.7	4	5.4	8	8.8	47	8.4
October	7	7.3	1	1.4	0	0.0	8	4.4	2	2.7	9	9.9	27	4.8
November	6	6.2	0	0.0	0	0.0	2	1.1	2	2.7	32	35.2	42	7.5
December	1	1.0	11	15.1	4	9.1	6	3.3	4	5.4	40	44.0	66	11.8

Table 9. Distribution of Respondents According to their Reasons for High Mortality of Native Chicken and Specific Pests and Diseases of Native Chicken (Multiple Response, N=558)

Reasons for High Mortality of Native Chicken	Province													
	Capiz		Negros		Guimaras		Antique		Iloilo		Aklan		Total	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Change of climate	88	91.7	63	86.3	40	90.9	117	65.0	71	95.9	87	95.6	466	83.5
Disease	49	51.0	18	24.7	28	63.6	154	85.6	38	51.4	53	58.2	340	60.9
Pest	52	54.2	3	4.1	3	6.8	34	18.9	20	27.0	53	58.2	165	29.6
Others	35	36.5	16	21.9	1	2.3	7	3.9	9	12.2	11	12.1	79	14.2
Pest (n)	**(52)**		**(3)**		**(3)**		**(34)**		**(20)**		**(53)**		**(165)**	
Avian pest	26	50.0	0	0.0	1	33.3	28	82.4	0	0.0	2	3.8	57	34.5
Rats	25	48.1	1	33.3	0	0.0	5	14.7	18	90.0	15	28.3	64	38.8
Snakes	0	0.0	0	0.0	0	0.0	0	0.0	2	10.0	1	1.9	3	1.8
No answer	1	1.9	2	66.7	2	66.7	1	2.9	0	0.0	35	66.0	41	24.8
Diseases (n)	**(49)**		**(18)**		**(28)**		**(154)**		**(38)**		**(53)**		**(340)**	
Respiratory diseases	22	44.9	1	5.6	3	10.7	0	0.0	21	55.3	20	37.7	67	19.7
Avian Influenza	22	44.9	0	0.0	0	0.0	6	3.9	4	10.5	1	1.9	33	9.7
New castle diseases (aratay)	21	42.9	3	16.7	10	35.7	4	2.6	0	0.0	14	26.4	52	15.3
Cold/flu	0	0.0	2	11.1	19	67.9	47	30.5	3	7.9	22	41.5	93	27.4
Coryza	0	0.0	3	16.7	4	14.3	18	11.7	2	5.3	0	0.0	27	7.9
Fowl fox	0	0.0	2	11.1	2	7.1	9	5.8	6	15.8	0	0.0	19	5.6
Pneumonia	0	0.0	0	0.0	0	0.0	60	39.0	0	0.0	0	0.0	60	17.6
Kalunggo	0	0.0	0	0.0	0	0.0	0	0.0	5	13.2	2	3.8	7	2.1
No answer	0	0.0	7	38.9	0	0.0	10	6.5	0	0.0	0	0.0	17	5.0

Even with these observed pests and diseases, only 12.7% of the raisers claimed that they vaccinated their native chickens while the majority (86.4%) did not vaccinate (Table 10). The practice of vaccination was highest in Aklan (23.1%), followed by those in Negros Occidental (17.8%), Iloilo (10.8%), Antique (9.4%), Guimaras (9.1%) and Capiz (8.3%).

Most of those who vaccinated (46.5%) used New castle disease vaccine, followed by La Sota (23.9%), avian vaccine (14.1%) and pox vaccine (9.9%). Use of New castle disease vaccine was mostly done in Guimaras (100.0%), Negros Occidental (84.6%) and Aklan (61.9%). Use of La Sota was most common in Iloilo (75.0%) and Antique (64.7%) while Avian vaccine was widespread in Capiz (75.0%) (Table 10).

These vaccines were generally intended by the raisers to prevent avian influenza (43.7%) particularly in Iloilo (62.5%), Antique, (58.8%) and Aklan (57.1%) and new castle disease (31.0%) particularly in Negros Occidental (92.3%) and Capiz (62.5%).

Aside from vaccination, the raisers also provided their native chickens with substances for disease prevention and control. Most of them (30.5%) used Vetracin, anti-biotics, (18.6%) and other veterinary drugs (24.0%). Aside from these synthetic materials, only very few raisers used indigenous materials like warm rice, vinegar, *oregano, artamesa, and manunggal* (Table 11).

Across provinces, the use of Vetracin was most common in Guimaras (56.8%), Iloilo (36.5%), Negros Occidental (32.9%), and Aklan (22.0%) while the use of anti-biotics was mostly done in Antique (38.9%) and Capiz (30.2%).

These materials were given to native chickens by the growers to control mostly cold/flu (50.2%), respiratory diseases (19.6%), pneumonia (13.9%), coryza (8.1%), fowl fox (6.9%) and new castle disease (6.7%).

Except for the province of Capiz where the majority of the raisers used substances to control respiratory diseases (66.1%), these substances were generally used to control cold/flu in other provinces (Table 11).

Product Sold

The raisers were more likely to sell more pullets and cockerels than hens or roosters. Most of the respondents (46.4%) were selling five heads of pullets or lower per month. The mean number of heads of pullets sold per month was 5.6. Guimaras had the highest (13.1) followed by Iloilo while

Table 10. Distribution of Respondents According to Vaccination of Native Chicken against Poultry Disease (N=558)

Vaccinate Native Chicken against Poultry Disease	Province													
	Capiz		Negros		Guimaras		Antique		Iloilo		Aklan		Total	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
No answer	0	0.0	0	0.0	0	0.0	0	0.0	5	6.8	0	0.0	5	0.9
Yes	8	8.3	13	17.8	4	9.1	17	9.4	8	10.8	21	23.1	71	12.7
No	88	91.7	60	82.2	40	90.9	163	90.6	61	82.4	70	76.9	482	86.4
Total	**96**	**100**	**73**	**100**	**44**	**100**	**180**	**100**	**74**	**100**	**91**	**100**	**558**	**100**
Vaccines Commonly Used														
No answer	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	23.8	5	7.0
Avian vaccine	6	75.0	1	7.7	0	0	1	5.9	0	0.0	2	9.5	10	14.1
Pox vaccine	2	25.0	1	7.7	0	0	3	17.6	1	12.5	0	0.0	7	9.9
New Castle vaccine	1	12.5	11	84.6	4	100.0	2	11.8	2	25.0	13	61.9	33	46.5
La Sota	0	0.0	0	0.0	0	0.0	11	64.7	6	75.0	0	0.0	17	23.9
Immunization	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	4.8	1	1.4
Target Diseases of the Vaccines														
No answer	0	0.0	1	7.7	2	50.0	2	11.8	1	12.5	6	28.6	12	16.9
New castle Disease	5	62.5	12	92.3	1	25.0	2	11.8	2	25.0	0	0.0	22	31.0
Avian Influenza	3	37.5	0	0.0	1	25.0	10	58.8	5	62.5	12	57.1	31	43.7
Cold/flu	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	14.3	3	4.2
Coryza	0	0.0	0	0.0	0	0.0	3	17.6	0	0.0	0	0.0	3	4.2

Table 11. Distribution of Respondents According to Substances Usually Given to their Native Chicken and their Target Diseases (Multiple Response, N=558)

Substance Usually Given to their Native Chicken	Province													
	Capiz		Negros		Guimaras		Antique		Iloilo		Aklan		Total	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Vetracin	17	17.7	24	32.9	25	56.8	57	31.7	27	36.5	20	22.0	170	30.5
Anti-biotics	29	30.2	1	1.4	1	2.3	70	38.9	3	4.1	0	0.0	104	18.6
Other veterinary drugs	9	9.3	17	23.3	6	13.6	67	37.2	26	35.1	9	9.9	134	24.0
Indigenous materials	4	4.2	6	8.2	0	0.0	1	0.6	9	12.3	6	6.6	26	4.7
No answer	37	38.5	25	34.2	12	27.3	0	0.0	10	13.5	56	61.5	140	25.1
Targeted Diseases														
Cold/Flu	1	1.7	29	60.4	21	65.6	99	55.0	37	57.8	23	65.7	210	50.2
Respiratory disease	39	66.1	17	35.4	8	25.0	0	0.0	16	25.0	2	5.7	82	19.6
Pneumonia	0	0.0	0	0.0	0	0.0	58	32.2	0	0.0	0	0.0	58	13.9
Coryza	0	0.0	5	10.4	3	9.4	23	12.8	3	4.7	0	0.0	34	8.1
New Castle Disease	11	18.6	15	31.3	0	0.0	0	0.0	2	3.1	0	0.0	28	6.7
Fowl fox	0	0.0	16	33.3	1	3.1	4	2.2	4	6.3	4	11.4	29	6.9
Avian Influenza	0	0.0	0	0.0	0	0.0	8	4.4	1	1.6	1	2.9	10	2.4
Cholera	0	0.0	0	0.0	0	0.0	0	0.0	2	3.1	0	0.0	2	0.5
Coccidiosis	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	0	0.0	1	0.2
No answer	8	13.6	0	0.0	0	0.0	0	0.0	0	0.0	5	14.3	13	3.1

Aklan had the lowest (3.1). About the same proportion of the growers (43.4%) sold five heads of cockerels or lower. They sold an average of 6.4 cockerels per month. Guimaras had the highest (19.3) mean number of cockerels sold per month followed by those in Iloilo (8.2) with Aklan having the lowest (4.2).

The respondents also sold hens and roosters but at a relatively lower quantity than pullets and cockerels. The majority (65.4%) of the growers did not sell their hens or provided no answer. This was particularly true in Aklan (90.1%), Antique (89.4%), Guimaras (75.0%) and Iloilo (55.4%). Less than a quarter (22.7%) of the growers had sold 1 to 2 heads of hens. The respondents sold an average of 3.4 heads of hens per month. More or less the same pattern was observed on the sale of roosters.

Only six raisers had sold their chicks while three had sold 5 and the other three had sold 10, or an average of 7.5 chicks per month. Of the six, three were from Capiz and the other three were from Aklan (Table 12).

Factors Affecting Sale of Native Chicken

The results also revealed that more than one-fourth (26.7 %) of the raisers believed that one of the major factors affecting the volume of native chicken they sold was the supply and demand of native chicken. Other factors identified by most respondents were financial needs for production of native chicken (19.5 %), climatic factors (16.7 %), price of native chicken (13.6 %), and occurrence of pests and diseases (9.9 %).

Across provinces, supply and demand of native chicken was the major factor in Iloilo (45.9%) and Aklan (63.7%) while the financial need for native chicken production was mostly identified in Negros Occidental (58.9%) and Capiz (22.9%). Climatic factors were mostly considered in Guimaras (40.9%) and Antique (22.2%) (Table 13).

Problems encountered. As shown in Table 13, the majority (65.0 %) of the raisers identified diseases as the main problem which is true to all of the provinces in the region. Change of climate and pests were also identified by a little over one-fifth (20.6% and 20.4%, respectively) of the growers. Some of them also reported that their problem was lack of fund to buy expensive feeds (17.0%).

Expansion plan. The majority (83.9 %) of the growers have plans for expansion (Table 14). The proportion of growers who planned to expand was highest in Aklan (98.9%), followed by those in Negros Occidental (91.8%) and Capiz (89.6%). The lowest proportion was in Iloilo (68.9%).

Table 12. Distribution of Respondents According to Volume (no. Of heads) of Native Chicken Sold per Month (N=558)

Volume (no. of heads) Sold	Province													
	Capiz		Negros		Guimaras		Antique		Iloilo		Aklan		Total	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Pullets														
No Answer	18	18.8	18	24.7	14	31.8	120	66.7	13	17.6	15	16.5	198	35.5
5 heads and below	56	58.3	42	57.5	4	9.1	54	30.0	32	43.2	71	78.0	259	46.4
6-10 heads	17	17.7	13	17.8	13	29.5	5	2.8	16	21.6	5	5.5	69	12.4
More than 10 heads	5	5.2	0	0.0	13	29.5	1	0.6	13	17.6	0	0.0	32	5.7
Mean	**5.0**		**4.4**		**13.1**		**3.4**		**8.9**		**3.1**		**5.6**	
Cockerels														
No Answer	15	15.6	10	13.7	14	31.8	118	65.6	16	21.6	20	22.0	193	34.6
Below 5 heads	56	58.3	43	58.9	2	4.5	55	30.6	38	51.4	48	52.7	242	43.4
6-10 heads	18	18.8	20	27.4	9	20.5	4	2.2	10	13.5	21	23.1	82	14.7
More than 10 heads	7	7.3	0	0.0	19	43.2	3	1.7	10	13.5	2	2.2	41	7.3
Mean	**5.5**		**4.7**		**19.3**		**3.7**		**8.2**		**4.2**		**6.4**	
Hens														
No Answer	11	11.5	37	50.7	33	75.0	161	89.4	41	55.4	82	90.1	365	65.4
1-2 heads	50	52.0	32	43.8	2	4.5	10	5.6	25	33.8	8	8.8	127	22.7
3-4 heads	16	16.7	3	4.1	1	2.3	1	0.6	3	4.1	0	0.0	24	4.3
More than 4 heads	19	19.9	1	1.4	8	18.1	8	4.5	5	6.8	1	1.1	42	7.5
Mean	**4.1**		**1.8**		**3.3**		**4.9**		**3.3**		**1.8**		**3.4**	
Rooster														
No Answer	18	18.8	36	49.3	34	77.3	145	80.6	42	56.8	80	87.9	355	63.6
1-2 heads	44	45.8	29	39.7	2	4.5	20	11.1	25	33.8	6	6.6	126	22.6
3-4 heads	13	13.5	4	5.5	1	2.3	7	3.9	2	2.7	3	3.3	30	5.4
More than 4 heads	21	21.9	4	5.5	7	15.9	8	4.5	5	6.8	2	2.2	47	8.4
Mean	**3.8**		**2.3**		**4.5**		**3.2**		**2.7**		**2.7**		**3.3**	
Chicks														
No Answer	93	96.9	73	100	44	100	180	100	74	100	88	96.7	552	98.9
5 heads	2	2.1	0	0.0	0	0.0	0	0.0	0	0.0	1	1.1	3	0.5
10 heads	1	1.0	0	0.0	0	0.0	0	0.0	0	0.0	2	2.2	3	0.5
Total	**96**	**100**	**73**	**100**	**44**	**100**	**180**	**100**	**74**	**100**	**91**	**100**	**558**	**100**
Mean	**6.7**		**0**		**0**		**0**		**0**		**8.3**		**7.5**	

Table 13. Distribution of Respondents According to Factors Affecting the Volume of Native Chicken Sold and Problems Encountered in Native Chicken Production (Multiple Response N=558)

Categories	Province													
	Capiz		Negros		Guimaras		Antique		Iloilo		Aklan		Total	
	f	%	f	%	F	%	f	%	f	%	f	%	f	%
Factors Affecting Sales														
No answer	31	32.3	0	0.0	0	0.0	47	26.1	0	0.0	0	0.0	78	14.0
Supply and demand of chicken	17	17.7	6	8.2	10	22.7	24	13.3	34	45.9	58	63.7	149	26.7
Financial needs for production of native chicken	22	22.9	43	58.9	0	0.0	27	15.0	8	10.8	9	9.9	109	19.5
Climatic factors like heat and cold	3	3.1	11	15.1	18	40.9	40	22.2	15	20.3	6	6.6	93	16.7
Low price/unstable price	4	4.2	3	4.1	6	13.6	16	8.9	26	35.1	21	23.1	76	13.6
Occurrence of disease/pest	19	19.8	7	9.6	9	20.5	10	5.6	5	6.8	5	5.5	55	9.9
High mortality rate	0	0.0	14	19.2	0	0.0	1	0.6	22	29.7	12	13.2	49	8.8
Slow growth/lack of hatching eggs	0	0.0	0	0.0	1	2.3	12	6.7	0	0.0	7	7.7	20	3.6
Expensive price per kilo	0	0.0	0	0.0	0	0.0	0	0.0	2	2.7	14	15.4	16	2.9
Number of buyers	0	0.0	4	5.5	0	0.0	3	1.7	2	2.7	0	0.0	9	1.6
Problems Encountered														
Diseases/ Sickness	74	77.1	37	50.7	30	68.2	87	48.3	67	90.5	68	74.7	363	65.0
Change of climate	0	0.0	2	2.7	3	6.8	55	30.6	13	17.6	42	46.2	115	20.6
Pests	36	37.5	8	11.0	5	11.4	38	21.1	10	13.5	17	18.7	114	20.4
Lack of capital to buy feeds	28	29.2	18	24.7	5	11.4	10	5.6	15	20.3	19	20.9	95	17.0
Stolen	0	0.0	0	0.0	0	0.0	0	0.0	13	17.6	25	27.5	38	6.8
High mortality rate	0	0.0	14	19.2	2	4.5	7	3.9	0	0.0	8	8.8	31	5.6
Missing/accident of native chicken	0	0.0	6	8.2	2	4.5	11	6.1	3	4.1	8	8.8	30	5.4
Slow Growth	4	4.2	3	4.1	0	0.0	17	9.4	0	0.0	6	6.6	30	5.4
Confinement during planting & harvesting	0	0.0	0	0.0	0	0.0	26	14.4	1	1.4	0	0.0	27	4.8
Low Price	1	1.0	8	11.0	1	2.3	6	3.33	5	6.8	2	2.2	23	4.1
Limited space of housing facilities	0	0.0	0	0.0	1	2.3	14	7.8	2	2.7	1	1.1	18	3.2
Flash floods	8	8.3	0	0.0	0	0.0	5	2.8	1	1.4	1	1.1	15	2.7
Others	2	2.1	0	0.0	0	0.0	0	0.0	0	0.0	7	7.7	9	1.6

Table 14. Distribution of Respondents According to their Plans for Expansion (N=558)

Plans for Expansion	Province													
	Capiz		Negros		Guimaras		Antique		Iloilo		Aklan		Total	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Yes	86	89.6	67	91.8	34	77.3	140	77.8	51	68.9	90	98.9	468	83.9
No	10	10.4	6	8.2	10	22.7	40	22.2	23	31.1	1	1.1	90	16.1
Total	**96**	**100**	**73**	**100**	**44**	**100**	**180**	**100**	**74**	**100**	**91**	**100**	**558**	**100**
Hens														
10 heads and below	19	22.1	18	27.3	11	32.4	41	29.3	24	46.2	65	72.2	178	38.0
11-20 heads	31	36.0	23	34.8	6	17.6	63	45.0	10	19.2	13	14.4	146	31.2
21-30 heads	12	14.0	8	12.1	2	5.9	15	10.7	12	23.1	2	2.2	51	10.9
31-40 heads	7	8.1	2	3.0	0	0	4	2.8	4	7.7	2	2.2	19	4.1
41-50 heads	16	18.6	11	16.7	4	11.8	12	8.6	0	0.0	2	2.2	45	9.6
51 and above heads	1	1.2	4	6.1	11	32.4	5	3.6	2	3.8	6	6.7	29	6.2
Total	**86**	**100**	**66**	**100**	**34**	**100**	**140**	**100**	**52**	**100**	**90**	**100**	**468**	**100**
Mean	**25.6**		**27.4**		**57.2**		**23.9**		**20.8**		**15.4**		**25.1**	
Roosters														
10 heads and below	86	100.0	63	95.4	26	76.5	124	88.6	24	46.2	65	72.2	388	82.9
11-20 heads	0	0	2	3.0	2	5.9	16	11.4	10	19.2	13	14.4	43	9.2
21 and above	0	0	1	1.5	6	17.6	0	0	18	34.6	12	13.3	37	7.9
Total	**86**	**100.0**	**66**	**100.0**	**34**	**100.0**	**140**	**100.0**	**52**	**100.0**	**90**	**100.0**	**468**	**100**
Mean	**4.5**		**5.2**		**13.8**		**6.4**		**5.2**		**4.6**		**5.9**	

Of those who have expansion plans, the majority (69.2% and 82.9%) of the raisers said they will increase their breeders to not more than 20 heads of hens and not more than 10 heads of roosters, respectively. This is more or less true to all the provinces. Based on the mean number of heads of hens and roosters the respondents planned to expand, raisers in Guimaras had the highest mean number of hens (57.2 heads) and roosters (13.8 heads) while Aklan growers had the least mean number of hens (15.4 heads) and Capiz raisers had the least mean number of roosters (4.5 heads).

Conclusions

Based on the above findings, the following conclusions are presented:

1. The native chicken raiser-respondents were mostly from Antique, above 30 years of age and elementary or high school educated. They were generally farmers by occupation receiving an average income of Php 4,155.80 per month.
2. From their native chicken production, the respondents earned an average of Php 1,002.50 per month with raisers from Guimaras earning the highest. On the average, income from native chicken can augment about a quarter of the respondents' income from their major occupation.
3. The respondents had been into native chicken production for an average of 17.5 years with an average of 16.2 heads of hens and 4.4 heads of roosters for breeding or an average of 1 rooster to 4 hens. The breeders were mostly upgraded and home grown native chicken followed by Darag and Jolo.
4. The native chicken growers generally raised their native chicken in free range. The usual feed stuffs given by the native chicken growers to their native chickens are more or less the same for pullets, cockerels, hens and roosters. Their most common feed stuff was corn/crack corn, followed by rice bran, home mixed ration, filled/unfilled palay and rice/milled rice. The native chicken growers feed their chickens by generally broadcasting on the ground.
5. Amount of feeds given to native chickens varied according to the growth stage of chickens. The mean amount of feeds for pullets was 71.1 grams per bird/day, 71.03 grams/bird/day for cockerels, 81.1 grams per bird per day for hens, and 79.1 grams/bird/day for roosters. The mean estimated expenditure for feeds was Php 491.90 per month.
6. Higher incidence of mortality among native chickens was observed by the respondents starting March, peaking in June and dwindling towards August. Mortality was largely attributed to climate change and prevalence of pests and diseases. The common pests included avian pest and rats while the most common diseases included cold/flu, respiratory diseases, pneumonia, and New Castle Disease.

7. Generally, the native chicken growers did not vaccinate their native chickens. Most of those who vaccinate were using New castle disease vaccine, followed by La Sota, avian vaccine and pox vaccine. These vaccines were generally intended by the raisers to prevent avian influenza, particularly in Iloilo.

8. The raisers also provided their native chickens with substances for disease prevention and control such as Vetracin, anti-biotics and other veterinary drugs. Aside from these synthetic materials, some of the growers used indigenous materials like warm rice, vinegar, oregano, artamesa, and manunggal. These materials were given to native chickens to control mostly cold/flu, respiratory diseases, pneumonia, coryza, fowl pox, and new castle disease.

9. The raisers were more likely to sell more pullets and cockerels than hens or roosters. The mean number of heads of pullets sold per month was 5.6, 6.4 heads of cockerels, 3.4 heads of hens and 7.5 chicks per month.

10. The raisers believed that the major factors affecting the volume of their native chicken sold was the supply and demand of native chicken, financial needs for production, climatic factors, price of native chicken, and occurrence of pests and diseases. The growers identified diseases as the main problem followed by climate change, pests, and lack of capital to buy high cost feeds.

11. The native chicken raisers have plans for expansion. The proportion of growers who planned to expand was highest in Aklan and lowest in Iloilo.

Recommendations

Based on the findings and conclusions of the study, the following are recommended:

1. The geographical areas where native chicken production abound may be used as basis for intervention. These areas can be the focal points for development assistance to increase production and improve marketing of native chicken in the region.

2. To improve their relatively low level of income, the respondents should consider raising more native chicken by at least doubling their present number of breeders.

3. Since the respondents are generally raising upgraded native chicken, proper disclosure of the product should be practiced to avoid product misrepresentation.

4. With higher incidence of mortality among native chickens from March to August largely due to climate change, diseases and pests, and a very limited proportion of the growers practice vaccination, it is recommended that preventive and curative measures like vaccination and other related mechanisms should be practiced by the raisers during this period to reduce or minimize mortality.

5. Efficacy of different indigenous materials in the prevention and control of pests and diseases among native chicken should be looked into as a means to reduce production cost and as a means to really produce organic native chicken.

6. There is a need to organize the native chicken raisers preferably on per area basis to pool their resources and create a product volume sufficient to directly sell to processors or consumers at a more competitive price.

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THE EFFECTS OF SOIL APPLICATION OF BIOFERTILIZERS ON THE EARLY GROWTH OF BEAUTY LEAF (*Calophyllum inophyllum* L.)

Ernesto S. Elefan

ABSTRACT

This study was carried-out to determine the early growth response of Beauty Leaf (*Calophyllum inophyllum* L.) to five biofertilizers namely Azotobacter, Bio Green, MyKo Vam, Vam Root Inoculant, and Bio N when compared with the Untreated control. Treatments were laid-out in a Randomized Complete Block Design, each replicated three times. Results showed that plant height and root length did not significantly vary among plants fertilized with Azotobacter, Bio Green, MykoVam, and Vam Root but significantly differ from those applied with Bio N and Untreated-control. Plants in all biofertilizers had comparable shoot dry matter weight but were significantly better from the Untreated control. Significantly highest root dry weight was registered by the Azotobacter-fertilized beauty leaf. Final leaf count, shoot base diameter, fresh shoot and root biomass, however, did not differ significantly among all treatments. Based on the results, Azotobacter, Bio Green, MyKoVam, and Vam Root Inoculant are potential biofertilizers for Beauty leaf under a screen house condition.

Keywords: Biofertilizers, Azotobacter, Bio Green , Bio N, MyKoVam. Vam Root Inoculant, Beauty leaf, *Calophyllum inophyllum* L.

INTRODUCTION

Rationale of the Study

Beauty leaf or Alexandrian laurel (*Calophyllum inophyllum* L.) of Family *Clusiaceae*, is a threatened (Stevens. 2006; Species Survival Commission, 2007) and emerging energy tree in the world. The alarming continuous use of fossil fuels that destroys the ozone layer has now become a major global concern and that search for alternative biofuel sources has been gaining ground of which Beauty leaf is one highly recommended plant species. Its mature, dried seeds yield about 65% oil from its dry weight and has the highest per tree oil yield of the 75 plant species evaluated (Hathurusingha & Ashwath, 2007). The average oil yield is 11.7 kg/tree or 4680 kg/hectare (Wikepedia, 2008) whose retail price in 2005 was already over US$ 450/l. Its seed oil contains up to 30% resinous materials and used as raw material for soap production, carrier oil, skin moisturizer, hair oil in cosmetics and also in aromatherapy (Lemmens, 2005).

The fatty-acid methyl ester component of seed oil meets all of the major bio-diesel requirements in the USA (ASTM D 6751), and contains benzoi*c* acid responsible for its cicatrizing properties which has a wide range of skin problems therapy. It is reportedly a good antiseptic, disinfectant, and astringent and has anti-inflammatory, antifungal, antibacterial and insecticidal activity (Quisumbing, 1978). It was discovered to have anti HIV and anti cancer agent called Calocoumarin A whose efficacy in treating the dreaded diseases is under investigation (Hathurusingha & Ashwath, 2007). Locally known as Dankalan or Bitaog, it is a durable multi-purpose timber but is rarely available in large quantities. The wood is resistant to termites while its heartwood is resistant to preservative treatment and is a prized timber for carving, cabinet making, boat building, and is traditionally used for food vessels (Hathurusingha & Ashwath, 2007). Despite its enormous uses, Beauty leaf current status is under threat and any conservation effort should be put in place to protect it.

One major step of protecting this threatened tree species is by *ex situ* conservation and mass propagation either by seeds or cuttings. It takes 5 to 8 months before seedlings can be planted in the field to ensure their vigorous and healthy condition to attain the desired survival rate. Beauty leaf can be moderately difficult to propagate because its initial growth is slow. Seeds germinate gradually but shelled seeds germinate faster than seeds in their shells. Germination rates for fresh seeds are greater than 90% (Elevitch, 2006). However, to ensure fast and vigorous growth of seedlings in the

nursery before establishing them in the field, one biotechnology that can be adopted with reportedly high efficacy is the application of biofertilizers (Elefan, 2008; Padilla, 2006),

Biofertilizers are natural fertilizers of symbiotic and asymbiotic beneficial microbial inoculants of bacteria, algae, and fungi alone or in combination. Their preference over chemical fertilizers offers economic and ecological benefits by way of soil health and fertility to farmers and reduced application of chemical inorganic fertilizers that pollute the environment (Gandanegara, 2007; Ozturk & Caglar, 2003). These can accelerate the decomposition of organic residues that release soil nutrients through mineralization and facilitate the uptake of plant nutrients like nitrogen and phosphorus (Tawfik, et al, 2006; Topolianits, et al, 2002; Galal, *et a*l. 2000; Rao, S. & Reddy, S., 2002); improve plant growth vigor by providing growth regulating substances (Bashan, et al, 2004; Chiu-Chung Young, 1994; Parr, Hornick, and Kaufmann, 2006; Mrkovacki & Milic, 2001; Verkade, et al, 2008) that help the host plant suppress pathogens and tolerate environmental stress (Li, 2007), and improve morpho-physiological characters that increased biomass and crop yield (Tawfik, *et al*, 2006; Cano, *et al*, 2007; Casta, 2001; Gandanegara, 2007; Nuntagij, 2007; Wu , et al, 2005; Nuruzzaman, *et al*., 2003; Ozturk, et al., 2003; Galal, *et al*, 2000; and Gupta & Baig, 2001).

Several biofertilizer researches on agro-forestry tree species and annual agricultural crops were conducted worldwide but no similar study had been done with beauty leaf. In the Philippines, few biofertilizer studies had been done and these were limited only to rice, corn, sugarcane, certain legumes, vegetables, fruit trees, and *Jatropha* (Dalmacio, 2008; Padilla 2006, Elefan, 2008; Sugar Regulatory Administration, 2007). So far, no published scientific report on the application of the biotechnology to Beauty leaf is available. Hence, the researcher finds it imperative to undertake this pioneering study to determine the early growth response of this threatened indigenous tree to the soil application of locally-available biofertilizers and arrive at recommended material for use.

Objectives of the Study

Generally, the study aimed to evaluate the early growth response of Beauty leaf (*Calophylllum inophyllum* L.) to biofertilizer application under a screen house condition based on seedling height, stem base diameter, leaf count, root length, shoot weight (fresh and dry), and root weight (fresh and dry).

Scope and Limitation of the Study

This pot experiment was conducted for five months to evaluate the early growth response of Beauty leaf (*Calophyllum inophyllum* L.) to the five biofertilizers namely *Azotobacter*, Bio Green, Bio N, Mykovam, and Vam Root inoculant which were applied only once at planting and then compared to the Untreated control. Although published work pointed out the effectiveness of Bio N in annual crops like corn and rice and less effectiveness in some tree species like *Jatropha curcas* (Padilla,2006), its inclusion in the study was based on the premise that different plant species would always differ in their physiologic response to the various kinds of biofertiflizers and this study was a pioneering one in Beauty leaf. Normally, in 5 to 8 months, the tree seedlings already acquire the desired shoot and root development while in pots that will allow them to be able to adapt in the field after they are transplanted (Elevitch, 2006). Early growth response herein was limited only to seedling height, leaf count, shoot base diameter, root length, shoot weight (fresh and dry), and root weight (dry) of plants. The planting media used was a mixture of clay-loam soil and river sand in a 1:2 ratio.

METHODOLOGY

This pot experiment was conducted in a screen house of the Life Sciences Department, Central Philippine University, Iloilo City Philippines in order to evaluate the effects of soil application of five locally produced biofertilizers namely Azotobacter, Bio Geen, Bio N, MykoVam, and Vam Root Inoculant on the early growth of Beauty leaf (*Calophyllum inophyllum* L.) which were compared to the Untreated Control. It was carried out in a randomized complete block design (RCBD) with three replications. The planting medium used was a mixture of 1 part clay-loam soil and 2 parts clean river sand.

The planting media were first oven-heated at 80°C before potting them. Five pots were allocated per replicated treatment or a total of 90 pots for the entire experiment. Biofertilizers were applied directly into the soil before sowing the seeds based on the manufacturers' recommended rates. Brown fruits of wrinkled skin collected from Dancalan, Negros Occidental, Philippines in December 2008 were soaked overnight to remove the skin. Just prior to planting, seeds were shelled entirely by cracking the shell using a

pair of pliers. Three seeds were sown per pot. One seedling per pot was maintained after thinning which was done a week after seedling emergence.

Initial plant height measurement and leaf count were done a week after seedling emergence and at 2-week intervals thereafter for 19 weeks. Shoot base diameter, root length, shoot biomass (fresh and dry), and root biomass (fresh and dry) were measured at the termination of the study. Data collected were statistically-analyzed using the analysis of variance ANOVA for RCBD. Significant differences among treatment means were analyzed using the Duncan's multiple range test at the 5% level of probability.

RESULTS AND DISCUSSION

Plant height. Average periodic plant height measurements significantly differed at 5, 7, 9, and 15 but not at 3, 11, 13, 17, and 19 weeks after seedling emergence. Final height in Azotobacter, Vam Root Inoculant, MyKoVam, and Bio Green- applied plants were about the same but were significantly taller than the Untreated control and Bio N treated plants. Generally, of the five biofertilizers used, Bio N appeared to be less effective for Beauty leaf. The fast growth rate of plants applied with biofertilizers, except Bio N, can be attributed to the ability of these beneficial microorganisms to effectively associate with higher plants. Similar published works (Chiu-Chung Young, 1994; Mrkovacki & Milic, 2001; Parr, Hornick, & Kaufmann, 2006) have shown that biofertilizers induced the production of phytohormone-like substances like auxins that alter plant growth and morphology which consequently improved the total vegetative growth of the experimental plants. The less efficacy of Bio N to induce significant growth in Beauty leaf can be also be due to the physiologic inability of the microbial inoculum to infect the root system that could have stimulated the synthesis of growth hormone and enhanced the absorption of vital nutrients from the environment.

Leaf count. Data in Table 2 shows that leaf count differed significantly among treatment means 5, 7, 9, and 15 weeks but not significant at 1, 3, 11, 13, 17, and 19 weeks after seedling emergence. On the first three weeks of growth, biofertilizer application did not significantly affect leaf count in which period, sustained growth of seedlings could have been dependent on the food stored in the large seed itself. Significant differences, however, were observed on the 5^{th}, 7^{th}, and 9^{th} week after seedling emergence. The five

Table.1. Average Periodic Plant Height (cm) of Beauty leaf Measured at Two-Week Intervals

Biofertilizers	Weeks After Seedling Emergence									
	1	3	5	7	9	11	13	15	17	19
Azotobacter	10.95^{ab}	17.33^{ab}	21.95^{a}	23.10^{a}	25.10^{a}	27.67^{a}	29.33^{a}	30.01^{a}	31.63^{a}	31.99^{a}
Bio Green	9.10^{cde}	15.66^{bc}	18.30^{c}	20.93^{cd}	22.90^{bc}	24.87^{bc}	25.50^{bcd}	26.47^{bcd}	27.7^{bc}	29.27^{a}
Bio N	9.77^{bc}	16.10^{b}	19.58^{cd}	20.76^{cd}	22.17c	24.57^{cd}	24.93^{cd}	26.17^{cd}	26.89^{bc}	28.37^{b}
MykoVam	7.79^{e}	15.90^{c}	20.07^{bc}	21.53^{bc}	24.29^{ab}	25.43^{abc}	26.43^{bc}	27.57^{bc}	28.63^{b}	29.73^{a}
Vam Root Inoculant	11.89^{a}	17.56^{a}	21.11^{ab}	22.28^{ab}	24.29^{ab}	26.18^{ab}	27.00^{b}	28.08^{b}	28.74^{b}	30.75^{a}
Control	9.70^{c}	15.23^{c}	18.58^{dc}	19.87^{d}	21.30^{c}	23.37^{d}	24.43^{d}	25.10^{d}	25.90^{c}	26.69^{b}

^{abcde} Treatment means followed by the same letter superscript are not significantly different at the 5 % level of probability

biofertilizers had no significant effects in terms of leaf count having registered a leaf count range of 9.06 to 10.00 per plant on the 9th week but had significantly more leaves than the Untreated Control plants. Bio Green and MyKo Vam were consistently most promising. The significantly higher leaf counts during this period can be attributed to enhanced plant uptake of available soil nutrients such as nitrogen and phosphorus as a result of their effective plant root colonization and consequently improved rooting ability especially during the early stage of plant growth (Sahay & Varma, 2000).

Table 2. Average Periodic Leaf Count in Beauty Leaf Measured at Two-week Intervals.

Biofertilizers	Weeks After Seedling Emergence									
	1	3	5	7	9	11	13	15	17	19
Azotobacter	5.60^{ns}	6.13^{ns}	8.00^{a}	8.53^{a}	9.40^{ab}	10.53^{ns}	11.07^{ns}	12.06^{ab}	12.40^{ns}	12.47^{ns}
Bio Green	5.40	6.00	7.47^{ab}	8.73^{a}	10.00^{a}	10.93	11.47	12. 30^{a}	12.53	12.60
Bio N	5.06	6.13	8.00^{a}	8.47^{a}	9.40^{ab}	10. 53	10.80	11.40^{bc}	11.40	11.40
MykoVam	5.06	6.53	8.00^{a}	9.00^{a}	9.80^{a}	10. 47	11.07	11.73^{abc}	12.07	12.13
VamRoot Inoculant	4.87	5.87	7.33^{bc}	8.33^{ab}	9.06^{bc}	10. 26	10.86	11.80^{ab}	12.20	12.26
Control (Untreated)	5.13	5.87	6.90^{c}	7.60^{b}	8.60^{c}	9.73	10.27	10.87^{c}	11.47	11.47

^{abc} Treatment means followed by the same letter superscripts are not significantly different from each other by DMRT.

^{ns} Not significantly different at the 5% level of probability

Shoot base diameter and root length. No significant differences on shoot base diameter were observed among treatment means indicative of the lack of influence of the materials on shoot base growth within the 19-week growth period (Table 3). Root growth, however, was influenced by biofertilizers as

shown by the significant differences in root length when compared with the Untreated control. Vam Root Inoculant induced a significantly greatest root elongation, however, MyKo Vam, Bio Green, and Azotobacter can be suitable alternative biofertilizers to use for Beauty leaf. These biofertilizers have shown to be compatible with Beauty leaf having influenced root development by possibly enhancing root meristematic activity, N-fixation, and P-solubilization (Young, et al., 1988). Ecologically, having longer roots becomes an advantage to beauty leaf for it will enhance uptake of water and nutrients (Wu, et al 2006) that may be available in the soil to sustain its growth and development.

Shoot and root biomass weight. Significant differences in the shoot and root dry biomass weights among treatment means were observed in 19 weeks of seedling growth but not the shoot and root fresh biomass weights (Table 3). .Azotobacter, MykoVam, and Vam Root were comparable in their shoot dry biomass and proved to be significantly better biofertilizers than Bio Green and Bio N which were comparable with the Untreated control. Azotobacter registered a significantly highest dry root biomass weight that can be attributed to its ability to effectively colonize Beauty leaf and enhance its production of organic material. Generally, Azotobacter showed to be the most compatible biofertilizer considering its consistently significant influence on shoot and root biomass dry weights.

Table 3. Average Shoot Base Diameter, Root Length, Shoot and Root Biomass Weight of Beauty 19 Weeks After Soil Application of Biofertilizers.

Biofertilizers	Shoot Base Diameter	Root Length	Shoot Biomass Weight		Root Biomass Weight	
			Fresh	Dry	Fresh	Dry
	(cm)	(cm)	(g)	(g)	(g)	(g)
Azotobacter	0.78^{ns}	23.92^{ab}	11.31^{ns}	4.63^{a}	4.06^{ns}	1.26^{a}
Bio Green	0.73	24.00^{ab}	10.87	4.28^{ab}	3.36	0.96^{bc}
Bio N	0.74	23.11^{bc}	10.51	4.27^{ab}	3.07	0.95^{bc}
MykoVam	0.74	24.74^{ab}	11.27	4.57^{a}	3.84	1.06^{b}
Vam Root Inoculant	0.76	26.12^{a}	11.00	4.63^{a}	3.29	0.91^{bc}
Control (Untreated)	0.70	20.83^{c}	10.00	3.71^{b}	3.11	0.89^{c}

^{abc} Treatment means followed by the same letter superscripts are not significantly different from each other.

^{ns} Not significant at the 5% level of probability.

CONCLUSION AND RECOMMENDATION

Basing on the various growth response parameters to evaluate the performance of Beauty leaf when applied with biofertilizers at planting, generally, Azotobacter, Bio Green, MyKoVam, and Vam Root Inoculant, but not Bio N proved to be potential recommended alternative biofertilizers for growing this biofuel tree under a screen house condition. A field study, however, is suggested for further performance evaluation of these materials.

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The Almighty God, for His greatest love and protection, this little secondary piece is humbly offered.

The Researcher

DESIGN AND DEVELOPMENT OF AUTOMATIC BATTERY CHARGER WITH CONTROLLER FOR BATTERY CHARGING STATION

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ABSTRACT

The study aimed to design and construct a locally-made battery charge controller for the Battery Charging Station (BCS) project implemented by Central Philippine University-Affiliated Non-conventional Energy Center (CPU-ANEC). The battery charge controller was designed only to protect the battery from over-charging. The functionality of the charge-controller was tested using a solar panel and a battery. The charging current was controlled by the PWM circuit. During charging, the output of the PWM circuit was both set approximately to ten percent (10%) duty cycle for charging ninety percent (90%) duty cycle for trickle charging. The output waveform and the duty cycle of the PWM circuit were checked using the oscilloscope. Testing of the charge-controller was done for four days of continuous operation to ensure the reliability of the system. Based on the test results, when the duty cycle was ten percent (10%), the green LED lighted-up and the ammeter indicated maximum charging current, while for the ninety percent (90%) duty cycle, a yellow LED light-up indicating minimum current. The red LED light-up when the polarity of the battery was reversed, while the orange LED lighted-up only when the battery state of charge was empty. These test results show that the battery charge-controller worked as expected by meeting the required design parameters. The unit is now ready for use.

INTRODUCTION

Solar energy is one of the renewable energy sources being promoted by the Department of Energy (DOE) to replace fossil fuels in generating electricity. The CPU-Affiliated Non-conventional Energy Center (CPU-ANEC), established in 1989 under the College of Engineering, is one of the ANEC agencies in the country tasked by DOE to tap this renewable power source to be utilized for areas which could not be reached by grid electricity. In its 16 years of existence, the CPU-ANEC has undertaken more than 70 projects utilizing micro-hydro and photovoltaic (PV) cell technology. Of these projects, 46 solar charging stations were constructed to allow charging batteries in the community.

All of the 46 solar charging station projects of CPU-ANEC, have no equipment to protect the battery from being subjected to overcharging. Due to this, the people in the community utilizing the battery charging station (BCS) complained about the short life span of their battery.

Solar charging stations must be provided with a charge controller to prevent the overcharging of batteries. Overcharging is the condition where a fully charged battery is continuously charged by a normal charging current and if this is frequently done, it will shorten the battery life. It must also protect the solar charging station from reversal of connections of the battery polarities, thus, resulting in the damage of the blocking diode on the solar panels. Blocking diode is an electronic component that is used to protect each panel when it is connected in parallel. This controller must be made from local components and materials so that maintenance and after sales services can easily be provided to the customers. It will also be designed by considering the current, voltage, and power rating of the solar charging station.

The charge-controller is an essential component in protecting both the battery and the charging station from problems caused by incorrect usage of the facility. In solar charging stations, it is important to make use of the full potential of the power being delivered by the sun during peak hours without compromising the battery life. Another thing that needs to be considered is the ability of the charging station to fully charge the battery within one day so that its utilization during nighttime can be guaranteed.

This low-cost automatic battery charger with controller is primarily designed for a solar battery charging station. This system is designed based

on its specifications and limitations. The maximum charging current is set to 8 A. The controller can be connected to either two (2) solar panels with a rating of 75 Watt-peak (75 W-p) or three (3) 50 W-p panels connected in parallel. Most BCS installed were composed of sixteen (16) 75 Watt-peak panel. Charging nine (9) plates of N50 battery requires two (2) of these panels for normal operation and therefore needs eight (8) charge controllers are sets for each BCS.

This controller was made from readily and locally available components and materials so that the maintenance and other after-installation services can easily be provided. It was also designed with considerations on the current, voltage, and power rating requirements of the solar charging station. Thus, these consumptions study will benefit the CPU-ANEC and the communities with solar charging station. This will help CPU-ANEC to continuously operate their projects and to save cost from the operation and maintenance of these devices. Moreover, through this project, the communities can be provided with a controller for their battery charging, thus, guaranteeing smoother and continuous operation of the system through prevention of sudden damage of their batteries caused by overcharging.

METHODOLOGY

The Design of the Charger

The design of the battery charge-controller was based on the block diagram of the given system shown in Figure 1. The simplified diagram is composed of 15 blocks, properly labeled to correspond to each block's specific function and operation. These blocks include solar panel, blocking diode, shunt control-element, trickle charge indicator, pulse width modulator (PWM), high voltage reconnect (HVR), high voltage disconnect (HVD), charge indicator, battery, low voltage disconnect (LVD), low voltage reconnect (LVR), load controller, full charge indicator, reverse polarity protection, and the load.

The solar panel or photovoltaic cell (PV) is used to supply power to the circuit in order to charge the battery during daytime. The shunt control element controls the charging of the battery. The HVR senses the voltage level of the battery; if the battery voltage is less than 13 V, the HVR triggers the control element to reconnect the PV to charge the battery. The HVD triggers the control element to disconnect the PV from the battery terminals to stop the PV from charging the battery if the battery voltage reaches 14.4 V.

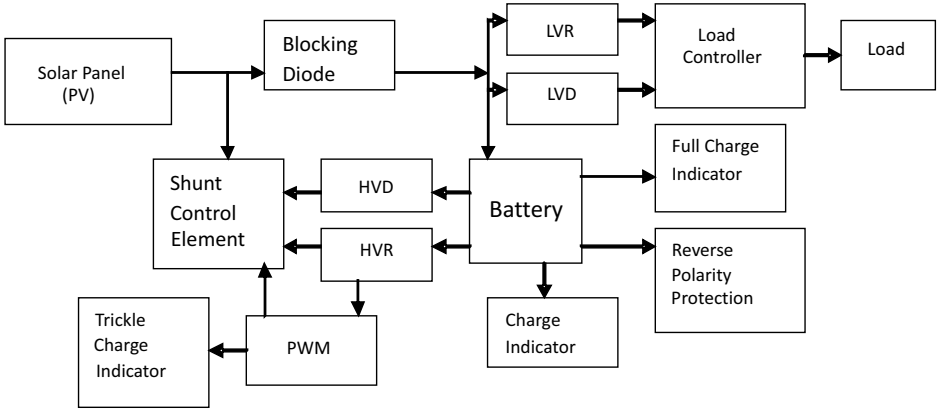

Figure 1. Block diagram of a battery charge-controller

The LVD triggers the load controller to disconnect the load if the battery voltage is less than 11.7 V. The LVR triggers the load controller to reconnect the load if the voltage of the battery reaches 12.7 V. The blocking diode is used to block battery voltage when the PV output voltage is less than the battery voltage to protect the PV panel. The charge indicator shows that the charger is in the process of charging the battery and the full charge indicator suggests that the battery is full, while the trickle charge indicator indicates that it is in the process of trickle charging. The PWM is used for trickle charging to compensate for the loss in the battery when the battery is already full. The reverse polarity protection is used to protect the system from reverse polarity.

Construction of the Battery Charger

The construction of the battery charger was done at Electronics Laboratory Room located at room 204 of the College of Engineering (EN204), by the designers and the technician assigned in the laboratory. The construction had two phases: construction using breadboard for pre evaluation and the construction of the system for final testing and evaluation.

Testing the Circuit Design and Pre-evaluation

The testing of the charger was conducted at the En 204, College of Engineering, Central Philippine University. The parameters tested were the maximum charging current, short circuit current, LVD, LVR, HVD, HVR and the pulse width of the PWM. The final testing and evaluation was done also in the College using two 75 watt-peak solar panels to simulate the actual BCS.

Final Evaluation and Testing of the Finished Design

The final evaluation of the battery charger was performed at the College of Engineering. It was tested by the personnel from the CPU-ANEC and the designers for four days of continuous operation. During the evaluation and testing of the battery charger, the following instruments were used:

1. DMM (Digital Multimeter). METEX model M380 is a multimeter instrument used to measure the Voltage, Current, and Resistance of a given circuit and component.

2. Solar Panel. This was used to supply the battery charger to charge the battery.

3. 9-plate Battery. This was used to test the functionality of the battery charger.

Data Gathered

During the performance evaluation of the battery charger, the following data were gathered:

1. Maximum charging current
2. Short circuit current
3. LVD
4. LVR
5. HVR
6. HVD
7. Pulse and frequency of the PWM

Parameters Analyzed

The parameters analyzed included:

1. the duty cycle of pulse width of the PWM.
2. the charging current at specific duty cycle.

RESULTS AND DISCUSSION

System Overview

The function of the battery charge controller is to protect the battery from overcharging, over discharging and reverse polarity for the protection of the bypass diode. The problem with the existing BCS (Battery Charging Station) of CPU-ANEC is that it has no charge controller to regulate the charging of the battery and to protect the battery and the bypass diode from reverse polarity. This designed controller will solve the problem of a given system and prolong the life span of the battery and the bypass diode. The block diagram in Figure 2 shows how the system is interconnected. The BCS which is made of two panels is connected to the charge controller and the charge controller in turn, is connected to the battery.

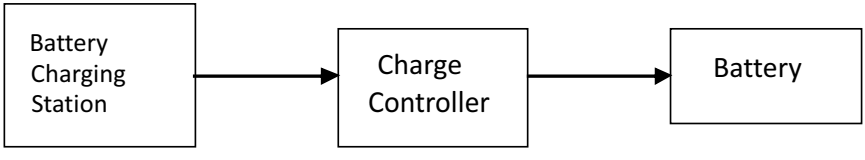

Figure 2. System operation block diagram

The battery charge controller for battery charging station has a maximum charging current of 8 A, HVD of 14.4V, HVR of 13V, LVR of 12.7V, and LVD of 11.7V. The charge controller uses the principle of pulse width modulation techniques to control the battery charging. Also included are indicators to show the status of the charging, and a battery voltage with reverse polarity protection.

Testing and Evaluation Procedure

To test the functionality and operation of the charge controller, the battery was connected first to the charge controller followed by the solar panel as shown in Figure 3. After the system is connected, the charge controller, which is provided with a reset button, started at the initial condition. While charging, the charge controller, through the LEDs, indicated the status of charging and that of the battery voltage. When the battery polarity was reversed, the charge controller automatically disconnected the circuit and the red LED lit up to indicate that the battery polarity was reversed. For the normal operation of the system, the charge controller indicated the status of charging depending on the initial condition and the status of the battery whether it is charging or only trickle charging. The green LED was used to indicate charging while the yellow LED was used for trickle charging.

To test the functionality of the charge controller, the nine-plate, 12 V battery was allowed to discharge below 11.7 V before connecting it to the charge controller. In response, the charge controller disconnected the load (the load is turned off) and the solar panel charged the battery because the voltage was less than the HVR. On the other hand, the ammeter indicated a maximum charging current. The charging current is dependent on the solar insulation; the higher the solar insulation, the higher is the charging current.

To test the functionality of the overcharging protection, the battery was allowed to be fully charged by letting its voltage reached approximately 14.4 V. When the voltage of the battery was approximately equal to 14.4 V, the ammeter indicated a very small charging current, indicating trickle charging. The charge controller indicated that the battery was fully charged. This process was repeated four times to ensure that the system would operate consistently.

Results and Discussion of Testing and Evaluation

The set-point voltages are shown in Table 1. The circuit system was provided with four trimmer resistors to set the HVR, HVD, LVR, and LVD. To set the HVD, the battery voltage was adjusted to 14.4 V and the trimmer resistor was attuned to have a reference voltage of 6.18 V. This voltage is required to trigger the trickle charge function of the charge controller. For HVR setting, the battery voltage was set to 13 V and adjusted another trimmer to have a reference voltage of 3.01 V. This voltage is required to trigger charge

function of a charge controller. For the LVD, the battery voltage was adjusted to 11.7 V while setting another reference voltage to approximately 3.03 V. This voltage is required to trigger the disconnect function of the charge controller which is to disconnect it from the load terminal. In order to activate the LVR function, the battery voltage was set to 12.7 V and the reference voltage was set to approximately 6.19 V. This voltage is required to trigger the reconnect function of the charge controller, connecting it back to the load terminal.

Table 1. Set point reference voltages

Setting Voltages	SPRV (Set Point Reference Voltages)
HVR (High Voltage Reconnect)	SPRV for HVR
HVR=13.05 V	SPRV=3.011V
HVD (High Voltage Disconnect)	SPRV for HVD
HVD = 14.32 V	SPRV=6.18
LVR (Low Voltage Reconnect)	SPRV for LVR
LVR = 12.76 V	SPRV=6.19
LVD (High Voltage Disconnect)	SPRV for LVD
LVD=11.76 V	SPRV=6.19

The PWM parameters were set to approximately 100 Hz output frequency with ten percent (10%) duty cycle for charging, and ninety percent (90%) duty cycle for trickle charging. The results of the tests are shown in Figures 3 and 4. The waveform in the oscilloscope (Figure 3) shows approximately ninety percent (90%) duty cycle with both yellow and green LEDs lit up. This indicates that the charge controller is trickle charging. The ammeter reads small amount of current. Figure 4 shows ten percent (10%) duty cycle with the green LED lit up. This indicates that the charge controller is charging the battery. The ammeter, in this case, reads maximum charging current.

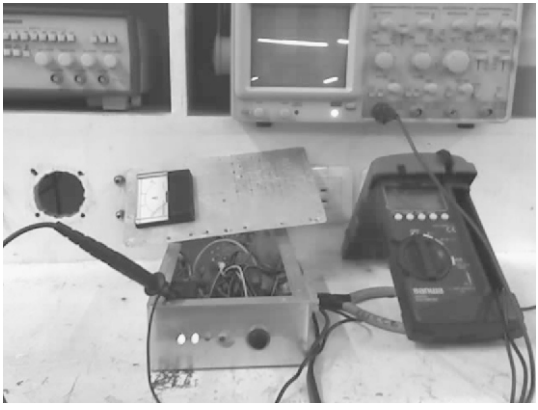

Figure 3. The oscilloscope showing 90% duty cycle with the green and the yellow LEDs lit up indicating trickle charging.

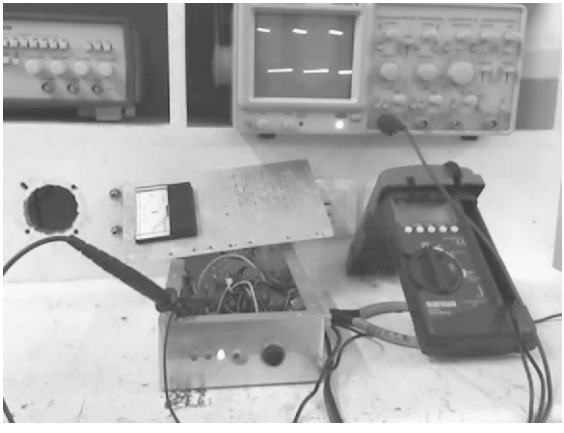

Figure 4. The oscilloscope showing 10% duty cycle with the green LED lit up indicating it is charging.

CONCLUSIONS

Based on the findings of the study, it is apparent that the design and construction of the automatic charger with controller were successful. Using locally available components, the best circuit option for the functionality and reliability of the charge controller was developed. The PWM (Pulse Width Modulator) circuit successfully produced approximately 100 Hz output frequency with 10% duty cycle for charging and 90% duty cycle for trickle charging. The functionality of the charge controller was tested, and was found to be operating normally and is ready for use.

RECOMMENDATIONS

For continuous operation like using this charge controller in the solar house system, it is recommended that a temperature sensor be incorporated to sense the battery temperature to prolong battery life.

A much lower device cost, however, may be also realized by employing only the HVR and HVD functions and eliminating the PWM function.

For high current application, Insulated Gate Bipolar Junction Transistor (IGBJT) could be used for the shunt control element.

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The Researchers