SPAMAST
RESEARCH
JOURNAL

SPAMAST VISION

"A premier competitive institution of higher learning providing professional training in Education, Agri-Fisheries, Science and Technology, Agri-Business, Information Technology and other related disciplines geared towards inclusive growth and development in the ASEAN Region and beyond. "

SPAMAST MISSION

"Creating a rich culture of academic excellence and integrity through innovative instruction, adaptive researches and
sustainable extension and enhanced resource generation
while promoting environmental resilience, equity
and harmony in diversity."

SPAMAST CORE VALUES
(FAITH to SPAMAST)

Functionality, Accountability, Integrity, Transparency, Harmony to Steadfastness and Passion to attain goals guided by Affinity and Motivation to face adversity imbued with the Aptitude to Serve with compassion and Teamwork.

SPAMAST Research and Extension Goal

"To generate researches in support to the sustainable development agenda of the Philippine government."

Research and Extension Outcomes

1. Highly evident research culture and increased research productivity of faculty and students manifested;

2. Researches relevant and responsive to stakeholders' needs and development implemented and conducted; and

3. Research result dissemination to ensure utilization of research outputs for funded researches, as well as, selected undergraduate and graduate research studies intensified.

FOREWORD

The 2019 edition of the SPAMAST Research Journal addressed subjects ranging from environmental, agricultural and biosystem engineering to social concerns. These works show that life is a dynamic process and that it has to be looked at for harmony and peace.

It is just fitting to extend a profound appreciation of the contributions of the authors, as well as of the Editorial Board, to present this journal version. May all find value and joy in working for the betterment of the world around us.

Editor-in-Chief

NILA NANETTE S. REVILLA, Ph.D.

RUTH S. LUCERO, PhD
President

Welcome to the 2019 issue of the SPAMAST Research Journal. I am sending my warmest gratitude and appreciation to all of the people behind this scholarly work.

Research is a very valuable tool for resolving the problems that we face today and to the problems that we will face tomorrow. It's an essential facet for us to enjoy the present while preparing for what the future will bring.

This research journal will therefore allow us to give our professor-researchers an opportunity to showcase their expertise in seeking a solution to the challenges that we face and that we will face. This research journal gives our researchers the opportunity to publish their work and encourage others to read and get inspiration from it.

Although we have faced many obstacles in the making of this scholarly work, the enthusiasm, passion and commitment of our researchers and editorial staff has empowered us to work even harder and to continue working on the following issues in the SPAMAST Research Journal.

To the readers, we are delighted and profoundly honored that you are with us on this journey and hope that you will be inspired by the work of our SPAMAST researchers.

Let us hope that there will be many more issues. More power for the SPAMAST researchers and the team behind the SPAMAST Research Journal.

Again, CONGRATULATIONS and soar high SPAMAST!!!

RUTH S. LUCERO, PhD
President

ALRENCE S. HALIBAS, PhD
RMTI University, Vietnam
alrence.halibas@rmit.edu.vn

LEOVIGILDO LITO D. MALLILLIN, PhD
Gulf College, Muscat, Oman
loviedsunbright_0722@yahoo.com.ph

ANNA C. BOCAR, PhD
Gulf College, Muscat, Oman
anna@gulfcollege.edu.om

ROLOU LYN R. MAATA, PhD
Gulf College, Muscat, Oman
rolou@gulfcollege.edu.om

ARLO R. MORTOS, EdD
Far Eastern University NRMF, Quezon City
arlomortos@gmail.com

OLUTOSIN ADEMOLA OTEKUNRIN
University of Agriculture Abeokuta, Nigeria
otekunrin.olutosina@pg.funaab.edu.ng

REVIEWERS FOR THIS ISSUE

NILA NANETTE S. REVILLA, PhD
SPAMAST, Malita, Davao Occidental
oial@spamast.edu.ph

MARLYN B. LLAMEG, PhD
SPAMAST, Malita, Davao Occidental
ifms@spamast.edu.ph

ARIEL E. SAN JOSE, PhD
SPAMAST, Malita, Davao Occidental
arielsanjose74@gmail.com

RENAN P. LIMJUCO, PhD
University of the Immaculate Conception, Davao City
ren02lim@gmail.com

SPAMAST RESEARCH JOURNAL STAFF

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BIODIVERSITY OF FAUNA AND FAUNA AND ECO-TOURISM DEVELOPMENT ON MADADMA WATERSHED IN BALABAG, KIDAPAWAN, NORTH COTABATO

Liezl S. Mancao
Faculty, SPAMAST, Institute of Teacher Education
and Information Technology
Malita, Davao Occidental
sumilhiganna@gmail.com

ABSTRACT
Balabag is one of the 40 barangays of Kidapawan City. It has a total land area of 2,542 hectares of which 842 hectares were used as agricultural and multiple purposes while 1,700 hectares forest land. It has a population of 1,719 with 361 households, about 60% of the population were Indigenous People (IP) and 40% were non–IPs. This study aimed to assess the current conservation status of the endemic diverse species which surrounded the watersheds; gathered and identify priority needs of the community; promote the existing tourist destination; respect the "obo manuvu" culture and arts heritage; and enforce forestry laws, regulations and other issuances in watershed management. Inventory, collection and assessment with the participation of local assistants, foresters and plant expert and conservation status using the IUCN Redlist were the methods used. Forty-eight different species of vascular plants were high in Balabag secondary forest. In terms of flora, the study revealed that were 14 species as edible, seven as medicinal, 11 could be utilized as firewood, one as raw material for handicraft-making, one as fuel, six as ornamental, four as food plants for animals and four could be used as dyes, spices, and ropes. On the other hand 23 fauna were recorded in the area, two species of birds, six mammals, seven amphibians, and eight reptiles. One species of threatened and endemic birds was noted, one threatened species (*Megaerops wetmorei*) of mammal and *Limnonectes magnus* (Philippine Woodland Frog), a near threatened species of amphibians were also recorded.

KEYWORDS: Biodiversity, watershed, IUCN Redlist, eco-tourism, Philippines

INTRODUCTION

The Philippines is a treasure trove of biodiversity on earth. It harbors more of diversity of life than any other country on a per hectare basis (DENR-PAWB, 2006). It is one of the 17 megadiverse countries which host 70-80% of the world biodiversity. Yet, Philippine biodiversity is alarmingly endangered, making it a biodiversity hotspot as well (Oliver & Heaney, 1996). The abundance, distribution and degree of threat to which the country's resources are exposed calls for a rapid and effective response to accelerate the coverage of conservation efforts.

Ecosystem diversity is a self- sustaining collection of organisms and habitats. Examples are forest, rivers, mangroves, marine, wetlands etc. One of the sources of these biodiversity is the forest and mountains which provides as aquifers, sources of the water that we drink-and the water that we drink coming from the watershed.

Watershed is an area of land that drains all the streams and rainfall to a common outlet such as the outflow of a reservoir, mouth of a bay or any point along a stream channel like the rivers or other body of water. There is a need to include a specific focus on water and sustainability as they apply to protection of human health and the environment and all living organisms and many of the resources on which our life depends.

Humans use river or streams for drinking water, irrigation, transportation, industry and recreation. Therefore, there is a need to protect, preserve, manage and restore our natural resources for the conditions of maximum social, environmental and economic benefit of the people for sustainability.

Eco-tourism was originally driven by the need to sustain biodiversity, reduce poverty and generate income for communities. To increase tourism expenditures, increasingly attract visitors while providing them with satisfying memorable experience and to do in a profitable way, while enhancing well-being of destination in residents it's because of the quality of their environmental resources (Huybers & Bennette, 2003).

Dolnicar and Leisch (2008) said that recognizing the natural environment represents the main resource for many tourism destination and tourists are increasingly interested in spending their vacation in unspoilt natural areas.

Barangay Balabag is within the rainforest in the premises of Paniki Falls, particularly at Sitio Mawig in Kidapawan City. It is situated at the foot of Mt.

Apo National Park and is about 50 kilometers away from the Kidapawan City passing through a highly curved, steep, rough feeder road and crossing the river nine times along the way.

The area has an elevation of about 1600 masl with a cool temperature (about 26°C). It is a mix of two distinct forest formations from lowland tropical rainforest to mid-mountain forests with predominant primary forests. Being a part of Mount Apo National Park, it is rich in diverse species of flora and fauna. Adjacent lands to the forests are inhabited by tribal groups like Bagobos, Manobos and Klata. They are usually farmers and beneficiaries of projects like livestock dispersal. They grow tiger grass and earn from it by making soft brooms.

The entire area of Barangay Balabag is covered under tenurial instrument – Certificate of Ancestral Domain Title (CADT) as proof of ownership by the tribe. From 18th century *Kapitan Umpan* was the 6th generation tribal leader of the barangay.

Objectives of the Study

The general objective of this research paper was to provide information on biodiversity of fauna and flora in protected forest in Barangay Balabag in Cotabato Province and utilize the natural resources for present and future generation to enjoy. Thus, the specific objectives were formulated to:

1. assess and protect the current status of the watersheds;
2. gather priority needs of the community for the development of the area.
3. identify priority projects that will also conserve the endemic species of flora & fauna;
4. promote / showcase the existing tourist destination in the area;
5. respect the "*obo manuvu*" culture and arts heritage;
6. strictly enforce forestry laws, regulations and other issuances in watershed management.

Theoretical Framework

This study focused on biodiversity of flora and fauna, eco-tourism development and strengthening environmental, conservation and protection of the watershed area specifically in MADADMA, Balabag, Kidapawan City, Cotabato.

A number of watersheds in the country are classified under critical condition. They are at risk to denudation while providing irrigation for agricultural crop production, water supply of domestic uses (Posa et al., 2008). Thus, in the pursuit of sustainable development, watersheds need protection and

conservation as well as rehabilitation of degrading areas (Francisco & Rola, 2004). However, in order to sustain, biodiversity studies on flora and fauna are required hence eco-tourism must be developed.

There must be regular biodiversity assessment especially in the protected areas like watershed. The local community people must be involved in this activity so that they may increase in their spirit of conserving the remaining economically important flora and fauna. Threatened species of both flora and fauna must be protected because all of them have vital roles in maintaining the ecosystem and acquiring eco-tourism development.

Definition of Terms
1. Biodiversity refers to the existence of many different kinds of plants and animals in an environment.
2. Critically Endangered refers to those animals or species whose continued existence is critical.
3. Ecotourism denotes the practice of raveling to beautiful natural places for pleasure in a way that does not damage the environment.
4. Endemic means common in a particular area that is existing.
5. Extinct refers to none existing of a certain species.
6. Least Concern   refers to those animals or species which is of less importance.
7. MADADMA stands for *Manobo Apao* Descendants Ancestral Domain of Mt. Apo.
8. Near Threatened refers to those animals or species which are threatened by extinction.
9. Rare means seldom occurring or found in an area.
10. Vulnerable refers to those physically harmed or damaged plants and animals.
11. Watershed are those areas of land that drain all the streams and rainfall to a common outlet such as the outflow of a reservoir, mouth of a bay or any point along a stream channel like the rivers or other body of water

METHOD

Locale of the Study
This study site is within the rainforest in the premises of Paniki Falls, particularly at Sitio Mawig, Barangay Balabag in Kidapawan City. It is situated at the foot of Mt. Apo National Park and is about 50 kilometers away from the Kidapawan City passing through a highly curved, steep, rough feeder road and crossing the river nine times along the way.

The area has an elevation of about 1600 masl with a cool temperature (about 26°C). It is a mix of two distinct forest formations from lowland tropical rainforest to mid-mountain forests with predominant primary forests. Being a part of Mount Apo National Park, it is rich in diverse species of flora and fauna. Adjacent lands to the forests are inhabited by tribal groups like Bagobos, Manobos and Klata. They are usually farmers and beneficiaries of projects like livestock dispersal. They grow tiger grass and earn from it by making soft brooms.

Research Design

This study utilized observation and descriptive survey research method. In gathering of data, descriptive survey was used which utilized questionnaires. It involved collecting data in order to answer questions concerning the status of the subject of the study and to explore the cause of particular phenomena (Hammond, 2015).

Respondents and Sampling Procedure

The study population was the community in the area of Balabag, Kidapawan City. Community participants from this population used total population sampling. Total population sampling is a type of purposive sampling technique where you choose to examine the entire population that have a particular set of characteristics (Arikunto, 2010: 183).

Research Instrumentation

The questionnaires were the main instruments used in gathering data in this study. The researcher adopted the survey – questionnaires.

Data Gathering Procedure

Prior Informed Consent (PIC) and Selection of Local Researchers. The research proposal was presented to the community as part of the requirements of EO 247 (Bioprospecting) and RA 9147 (Wildlife Resources Conservation and Protection Act). This was done to obtain the prior informed consent from the community. Approval of the barangay captain and municipal mayor from the study area was obtained consequently. The research was also presented to the members of Protected Area Management Board (PAMB).

Nominations and selection of local researchers (Bagobo, Klata, and Manobo) were made with the stakeholders in Brgy. Balabag, Kidapawan City. The local researchers were chosen based on their sufficient indigenous knowledge of the floral and faunal resources in the study site. These local researchers were compensated and involved in the entire duration of the research project.

Flora. In order to qualify all plants, the "Modified Stripline-Transect line Method" was used. The method was adopted from the Forest Inventory Manual of Parks and Wildlife Bureau (PAWB) of the Department of Environment and Natural Resources (DENR) revised by the College of Forestry, Central Mindanao University. Two transect lines were established. The length of the transect lines varied depending on the size of the sampling site and the terrain present. This method was implemented to cover a wide range of situations. In the first sampling site, a 200m X 20m sampling area was established (4000m^2 sampling size). This was done by laying a continuous 200m line/strip on the ground and measuring 10m on both sides of the strip. The transect was divided into 10 sampling plots or stations. Hence, each sampling plot measured 20m X 20m. The second line measured 260m X 20 (5200m^2) with 13 sampling stations.

Species Identification and Nomenclature. A census within the transect line was done in addition to opportunistic identification and collection. Species found in every sampling plot were noted. Quick characterization, description and identification were done on site. For each plant species in the survey area, the official common name and widely accepted scientific name was placed first in the checklist. Several field guides on floras available were used from which to select the most appropriate scientific name for plant species. The guides include those by Asis and Hernandez (1980), Brown (1921), de Guzman et al., (1986), Hutchinson (1967), Pancho (1983), Pancho and Gruezo (2006; 2009), Porter (1959), Remollo (2000), Rojo (1999), Salvoza (1963), Seeber (1979).

Determination of Economic Importance of Plants Identified. The economic importance of each species identified was determined using published literatures/guides. Further, a focused group discussion was conducted with local community people to know how these plants are being utilized and validate the different uses of plants identified in the area. The panel was composed of community people among them being traditional folk healers, farmers, homemakers and elders.

Fauna. Standard sampling techniques by Haribon Foundation were used in the study (Mallari & Tabaranza, 2001). Capture-mark-release technique was employed in most of the captured individuals (samples were marked and were released after processing). Some of the samples that need to be verified were preserved in 70% alcohol and were brought to the laboratory for further identification. Direct observation and informal interviews to key informants were also done to supplement the data gathered.

Birds. Mist nets (10m x 2m with 5 pockets) were used primarily to sample birds. These were set up at least 0.5 to 3 meters above the ground to sample ground and understory dwellers and sky nets as high as 15 meters above the ground were set up along strategic flight paths to catch canopy species. These were checked every two hours. The captured birds were processed immediately to reduce stress. Captured birds were taken from the entanglement and placed in cloth bags. All captured samples were photo-documented and identified. The notable characteristics and standard biometric measurements, namely total length (TL), wing length (WL), bill length, tarsus length, tail length and the weight, were taken and recorded in the data sheets. A Guide to the Birds of the Philippines by Kennedy et al., (2000) was used as reference for identification.

To supplement the identification of birds, transect walk was done in the study area. This was operated by listing all the birds seen and observed using a binocular while walking in a 1-km line within the site. The walk was accompanied by a para-biologist, a local resident who is an expert of birds in the area. The local name was listed and identified in the camp site using photographic guides.

Mammals. Systematic trapping and mist netting were used to sample small non-volant and volant mammals, respectively. Direct observation and interviews with the local residents were also done to record large mammalian species. Mist nets were used to sample volant mammals, which were the same nets used to sample birds. The nets were left open at night to capture bats and other nocturnal species. Checking was done in the early evening since insect-eating bats are active at this time, and in interval hours thereafter so as to prevent the bats from tearing the nets. A total of 102-net nights were operated in each study area.

Captured bats were photo documented and identified. The age of the bat was estimated by observing the degree of ossification of the metacarpal-phalange joints (Anthony 1998). The juvenile bats were excluded from the biometric measurement. Adult bat's biometric measurements namely total (TL), forearm (FAL), tail (TV), ear, hindfoot (HFL) length and the weight were taken and recorded in the data sheets. Other characteristics like the absence or presence of tail, white markings in the ear, tragus and antitragus of the ear, structure of the nose, interfemoral membrane and other notable traits in each samples were also recorded. The condylocanine length (CCL), condylobasal length (CBL) and the maxillary toothrow of the skulls of preserved samples brought to the laboratory for verification were measured and recorded.

Small non-volant mammals were captured using live traps. Trap lines, approximately one km in length, with 15 traps were established around the area. Individual traps were placed in locations of likely capture (near holes, along fallen logs, etc.). The traps were baited with freshly cooked coconut meat with peanut butter and the others with live earthworms. All traps were checked every morning, and baits were changed at least once daily. A total of 250-trap nights were operated in each area.   .

All captured non-volant mammals were measured and recorded. Body measurements such as tail to vent (TV), head-body length (HBL), total length (TL) and the weight were recorded in the data sheets.

Unless voucher specimens were needed for further identification, all samples were tagged and released. Taxonomic guides by Ingle and Heaney (1992), Heaney et al., (1998) and Heaney et al., (1999) were used in the identification of volant and non-volant mammals.

Herpetofauna (Reptiles and Amphibians). Amphibians and reptiles were captured by hand. Opportunistic catching was increased by searching a variety of habitats, i.e., forest floor, leaf litter piles, tree trunks and branches, tree holes, root tangles, water tributaries and small ponds (Oliveros et al., 2004). Photographs of reptiles and amphibians were taken in the wild and/or after capture.

Standard measurements of captured animals were taken using a ruler. For amphibians, measurements were recorded for snout-vent length, hind limb length, eye diameter, head length, snout length, head breadth, and eye diameter. For reptiles, snout-vent length, tail length, total length, axilla-groin distance, eye diameter, head breadth, and snout length were measured. Identification was carried out using the guide by Alcala (1986).

Conservation Status and Distribution. The International Union for the Conservation of Nature (IUCN) Redlist (IUCN 2010) was used as reference for the conservation and distribution status of the recorded fauna. The species were categorized as critically endangered (CR), endangered (EN), vulnerable (VU), near threatened (NT), least concern (LC), endemic, rare, and/or economically important species. Knowing the conservation status of each species in the area is of great importance for bio-monitoring and protection of biodiversity.

Gathering priority needs of community. An interview based approach using semi-structured questionnaire in which questions related to priority

needs of community were recorded using a voice recorder and with the help of an informant while making visits to the area for site viewing and observation.

Identify priority projects. An interactive discussion approached through meetings and discussions with various stakeholders like traditional herbal healers, school teachers, social workers, and local people were conducted to record the different identified priority projects.

Promote/showcase tourist destination. Focus group discussion on Marketing and helping used IEC materials as well as involving social media on online tools was inculcated to promote tourist destination of the community. Respect the "Obo Manuvu" culture and arts heritage. Community immersion with interview and focus group discussion based approached were conducted with the community.

Enforced forestry laws, regulations and other issuances in watershed management. Concerned agencies like the DENR and LGU'S was invited to spoke to the community to implement conservation mechanisms like establishment of nurseries and planting the seedlings in the vacant patches in the area as well as in their own fields.

Statistical Treatment of Data

The community responses to the questionnaires were tallied, tabulated, and prepared in a manner suitable for use. Diversity Indices using Relative Abundance was measured using the formula:

$P1 = ni/N \times 100$

Where:

P1= relative abundance
n= number of individuals of I genera
N= total number of individuals of all genera

Species Richness- this refers to the number of species.

n= species richness

Species Diversity

Species diversity was measured using Shannon-Weiner Index:

$H = ([(n1/N) \text{ inn } (n1/N)]$

Where

H= Shannon-Weiner Index
N= total number of individuals of population sampled
n= total number of individuals belonging to "I" genera

Evenness €
   Evenness was measured using the formula:
   E=H/H maximum
Where:
   E=evenness
   H= Shanno-Weiner Index
   H maximum= maximum diversity of all species

RESULTS AND DISCUSSION

Participatory Inventory of Plants and Species Richness

Vascular Plants
   With the local researchers (B'laan, Bagobo, Klata, and Manobo), inventory of flora in the area survey showed a total of 48 different species of vascular plants belonging to six genera distributed in four families.

   MADADMA watershed in Balabag (part of Mt. Apo Natural Park) shows evidence of higher species richness with 48 species recorded. Table 1 shows summary of plant per habit.

Table 1. Summary of plants per habit

Habit	MADADMA Watershed Balabag
Tress	14
Shrubs	7
Herbs	7
Vines	1
Palms	1
Grasses	6
Sedges	4
Ferns	4
Total	48

   Participatory Assessment of Economically Important Flora. Participatory inventory and assessment of economically important flora revealed that 14 species were edible plants, 7 species medicinal, 11 species are utilized for lumber/firewood, 1 as raw material for handicraft-making, 1 species as fuel, 6 species ornamental, 4 species as food plants for animals and 4 species are used for other purposes as dye, spices, jewelry and accessories and ropes.

Table 2. Lists of plants with their uses

Scientific Name	Common Name	Family	Uses
SPECIES EDIBLE			
1. *Artrocarpus blancoi (Elmer)* Merr.	Antipolo	Moracea	Food (starchy seeds)
2. *Melastoma malabaricum* L.	Malatungao	Melastomataceae	Food (seeds)
3. *Pangium edule* Reinw	Pangi	Flacourtiaceae	Food (spice)
4. *Schismatoglottis ltifolia miq.*	Pihau	Araceae	Food
5. *Hibiscus surattensis* Linn	Labuag (Kolabog)	Malvaceae	Food
6. *Spondias pinnata (L.F.)* Kurz.	Libas	Anacardiaceae	Food
7. *Hibiscus sabdariffa* Linn	Roselle Morado (red leaves)	Malvaceae	Food
8. *Spondia purpurea* Linn	Sineguelas (Sargilyas)	Anacardiaceae	Food
9. *Kolowratia elegans* Linn	Tagbak	Anacardiaceae	Food
10. *Nasturtium officinale* Linn	Watercress	Brassicaceae	Food
11. *Atuna racemosa Rafini.* ssp. Racemosa	Tabon-tabon	Chrysobalanaceae	Food
12. *Rubusf raxinifolius* Linn	Wild strawberry	Berberidaceae	Food
13. *Phyllanthus acidus* (L) Skeels	Karmay	Phyllanthaceae	Food
14. *Artocarpus nitidus Trec ssp.* Nitidus	Kubi	Moraceae	Food
MEDICINAL			
1. *Acanthus montanus*	Mountain thistle	Acanthaceae	Medicinal, perceived protection from bad spirits
2. *Blumea balsaniefera*	Sambong	Asteraceae	Medicinal
3. *Cananga odoratum (Lamk.) Hook.f. & Thoms*	Ilang-ilang	Annonaceae	Medicinal, industrial (perfume)
4. *Cassia alata*	Acapulco	Fabaceae	Medicinal
5. *Celtis luzonica Warb.*	Magabuyo	Ulamceae	Medicine, betel nut for chewing with tobacco and calcium oxide (apug)
6. *Cinnamon mercadoii* Vidal	Kalingag	Lauraceae	Medicinal, condiment
7. *Cyperus kyllingia Endl.*	Busicad	Cyperaceae	Medicinal
FIREWOOD			
1. *Cratoxylum sumatranum (Jack)* Blume	Pag-uringon	Clusiaceae	Firewood
2. *Leucaena leucocephala* (Lam.) de Wit	Ipil-ipil	Fabaceae	Firewood
3. *Duabanga moluccana* Blume	Loktob	Lythraceae	Firewood
4. *Dysoxylum gaudichaudianum* (A. Juss.) Miq.	Igiu	Meliaceae	Firewood
5. *Dysoxylum excelsum* Blume	Kuling-babui	Meliaceae	Firewood
6. *Gymnostoma rumphianum* (Miq.) L.A.S. Johnson	Agoho del Monte	Casuarinaceae	Firewood

7.	*Ficus magnoliifolia* Blume	Kanapai	Moraceae	Firewood
8.	*Ficus minahassae* (Teijsm. & de Vr.) Miq.	Hagimit	Moraceae	Firewood
9.	*Ficus odorata* (Blanco) Merr.	Pakiling	Moraceae	Firewood
10.	*Vitex glabrata* R. Br.	Bongoog	Lamiaceae	Firewood
11.	*Viticipremna philippinensis* (Turcz.) H.J.Lam	Lingo Lingo	Lamiaceae	Firewood
HANDICRAFT				
1.	*Bauhinia integrifolia subsp. cumingiana* (Benth.) K.Larsen & S.S.Larsen	Agpoi	Fabaceae	tying materials, rope & bag making
FUEL				
1.	*Sterculia crassieramea*	Malapapaya	Sterculiaceae	Fuel
ORNAMENTAL				
1.	*Begonia soccinea* Hook	Begonia	Bigoniaceae	Ornamental
2.	*Diplodiscus paniculatus* Turcz.	Balobo	Malvaceae	Ornamental
3.	*Drynaria quercifolia* (L.) J. Sm.	Leaf Oak Fern	Polypodiaceae	Ornamental
4.	*Ficus heteropleura* Blume	Upling buntotan	Moraceae	Ornamental
5.	*Iresine herbstii* Hook	Blood leaf	Amaranthaceae	Ornamental
6.	*Livistonia rotundifolia* (Lam.) Mart.	Anahaw	Dipterocarpaceae	Ornamental
FOOD PLANTS				
1.	*Melastoma malabaricum* L.	Malatungao	Melastomataceae	Spices/food
2.	*Pangium edule* Reinw	Pangi	Flacourtiaceae	Spices/food
3.	*Peperomia ppellucid*	Olasiman ihalas	Portulacaceae	Spices/food
4.	*Shorea assamica* Dyer.ssp.philippinensis (Brandis) Sym.	Manngasinuro	Elaeocarpaceae	Spices/food
OTHER PURPOSES				
1.	*Coix lacryma jobi* L	Katigbi	Poaceae	Jewelry and accessories
2.	*Saccharum spontaneum*	Tiger grass	Poaceae	Soft brooms
3.	*Ficus ulmifolia* Lam.	Is-is	Moraceae	Furniture & heavy construction
4.	*Antidesma bunuis* (L.) Spreng	Bignai	Euphorbiaceae	Wood, dye, rope & cardboard

Fauna

Birds. Rapid survey recorded 2 species of birds from the area. The results revealed that the total number of species recorded was 9% of the total species recorded in the Philippines (Kennedy et al. 2000). There were 17 (33%) species endemic to the Philippines. Only *Alcedo argentata* was considered as vulnerable by IUCN redlist (2010).

Balabag secondary forest (part of the Mt. Apo National Park) had the highest number of endemic species (13). But only two species were sighted near MADADMA watershed area.

Laiolo (2010) stated that species richness and diversity of birds may have been affected by vegetation structure and floristic composition. The rapid survey showed that most of the recorded birds were secondary forest dwellers.

High endemicity of birds was recorded in Balabag secondary forest which could be affected by the high elevation as well as its complex vegetation. According to Peterson et al., (2008), most of Mindanao's endemic birds are concentrated at higher elevations. But only two species were noted in the vicinity of the watershed.

Alcedo argentata, a threatened bird species was captured in the area (Figure 1). According to the Birdlife International (2008), it appears to be dependent on forested streams below 1000m and tolerates secondary, selectively logged forest, and streamside vegetation within forested areas.

Figure 1. *Alcedo argentata* (Silvery Kingfisher), a vulnerable species

Figure 1-A. *Dicaeum australe* (Red-keeled flower pecker) is an endemic bird.

Mammals

Rapid survey of mammals recorded a total of 5 species, which belongs to two families. The highest number were fruit bats (*Pteropodidae*) with 3 species, one belongs to family *Muridae*, two from *Rhinolophidae* and *Vespertilionidae* and one from *Sorcidae*. There were five endemic species with only one threatened species (*Megaerops wetmorei*) (Figure 2).

Figure 2. *Megaerops wetmorei* (Mindanao Fruit Bat), a threatened species

The low capture of insect bats in the study might be due to the use of mist nets. According to Sedlock (2001), insect bats have the ability to echolocate and

evade nets. Further studies should be done using harp traps to fully document the occurrence and diversity of microchiropterans in the area. On the other hand, the small non-volant mammals recorded were mostly associated to disturbed and agricultural lands. Three species (*Bullimus bagobus*) was the only murid recorded in Balabag. It is considered as a strictly forest dweller.

Ethnobiological survey recorded a medium-sized non-volant mammal, *Paradoxurus hermaphroditus*. It was found to be present in all the survey area. According to Heaney et al., (1998), these were reported to be common in secondary forest to areas near human communities. The locals considered this species as pest, feeding on their domesticated small chicks. Although common and widespread in the Philippines, this species is subject to excessive hunting reducing its population.

Noteworthy was the presence of the threatened *M. wetmorei* in both conservation areas. According to Heaney et al., (1998) this species is known to inhabit primary and lightly disturbed lowland forest from 800 m to 1200 m. It is currently categorized as vulnerable by IUCN Redlist (2010), which is threatened by habitat loss (Rosell-Ambal et al., 2008).

Amphibians. There were seven amphibians which are restricted to Mindanao faunal region. Some species were determined as threatened (*Limnonectes magnus*) and vulnerable (*Ansonia mcgregori, Megophrys stejnegeri, Philautus acutirostris* and *Rhacophorus bimaculatus*). Invasive species were also noted *Hoplobatrachus rugulosus* (East Asian Bullfrog) and *Rhinella marina* (Giant Marine Toad).

Generally, amphibians prefer ground, riparian, and arboreal strata as microhabitats which are relatively prominent in montane forest even at high elevations (Navas, 2006) and humid lower elevated forests. The presence of water bodies and moist locations in Balabag such as small rivers, streams and pools may help explain the abundance of these organisms in the area. The presence of ground cover and litter in the terrestrial habitats serve as microhabitats that allow anurans to complete their life cycle. The presence of a diverse species in the area can be attributed to these different microhabitats (Relox et al., 2010).

In addition, most of the vulnerable species, including *Ansonia mcgregori, Megophrys stejnegeri, Philautus acutirostris* and *Rhacophorus bimaculatus* were found only in Balabag near MADADMA watershed. *A. mcgregori* is a species restricted to Mindanao faunal region where it inhabits cool mountain streams and rivers in lower montane and lowland forests. It is recorded from

several protected areas of Mindanao including Mount Malindang, Mount Apo and Mount Kitanglad Range Natural Parks. Threats to this species include habitat destruction, deforestation and improper use and disposal of pesticides and herbicides (Diesmos et al., 2004).

Megophrys stejnegeri is a species known from many parts of Mindanao like Mount Malindang (Nuńeza et al., 2006) and in the southern and eastern islands of the Philippines. This species is relatively common but the population may be decreasing due to loss of lowland rainforest. This could be accounted to logging and the pollution of mountain streams and rivers due to agricultural effluents and mine tailings (Diesmos et al., 2004). Another species, *Philautus acutirostris* is restricted to Mindanao faunal region. It has also been recorded in Mt. Malindang (Nuńeza et al., 2006) and Mt. Hamiguitan (Relox et al., 2010). This species inhabits arboreal and occasionally terrestrial microhabitats in mossy and montane rainforests and disturbed areas adjacent to forests (Diesmos et al., 2004). *Rhacophorus bimaculatus* is locally common but patchily distributed. This species has been recorded from southern Luzon, Bohol, and Mindanao in the Philippines where it is found in some protected areas including Mt. Malindang and Mt. Apo National Parks (Diesmos et al., 2004).

Amphibian species worldwide appear to be suffering population level declines caused, at least in part, by the degradation and fragmentation of habitat and the intervening areas between habitat patches. Amphibians are frequently characterized as having limited dispersal abilities, and strong site fidelity. Amphibian populations have suffered widespread declines and extinctions in recent decades (Pokhrel et al., 2011). Limited dispersal ability may further increase the vulnerability of amphibians and reptiles to changes in climate. Slight changes in water level in breeding ponds can trigger reproductive failure and, in a single year, can cause a severe drop in the population size of short-lived species, while persistent environmental changes can lead to extinctions of species.

Figure 3. *Limnonectes magnus* (Philippine Woodland Frog), a near threatened species
Vulnerable Species

A. *Ansonia mcgregori* (Mcgregor's Toad)

B. *Megophrys stejnegeri* (Midanao Horned Frog)

C. *Philautus acutirostris* (Pointed snouted tree frog)

D. *Rhacophorus bimaculatus* Asiatic tree frog)

Invasive species recorded

E.*Hoplobatrachus rugulosus* (East Asian Bullfrog)

F. *Rhinella marina* (Giant Marine Toad)

Reptiles. Eight species representing 6 families were recorded. Of this, 4 species were snakes and 4 were lizards. All snakes and lizards were of least concern. The figure below shows some endemic reptile species. *Tropidonophis dendrophiops* (Spotted Water Snake), *Oxyrhabdium modestum* (Non-banded Philippine Burrowing Snake), *Boiga angulate* (Philippine Blunt-headed tree snake), *Rhabdophis auriculata* (White-lined Water Snake) and lizards *Cyrtodactylus annulatus* (Small bent-toed gecko), *Gonocephalus semperi* (White-spotted Anglehead) **,** *Sphenomorphus fasciatus* (Banded sphenomorphus) and *Tropidophorus misaminus* (Misamis waterside skink).

Some endemic reptile species

A. *Tropidonophis dendrophiops* (Spotted Water Snake)

B. Oxyrhabdium modestum (Non-banded Philippine Burrowing Snake)

C. *Boiga angulate* (Philippine Blunt-headed tree snake

D. *Rhabdophis auriculata* (White-lined Water Snake

E. *Cyrtodactylus annulatus* (Small bent-toed gecko)

F. *Gonocephalus semperi* (White-spotted Anglehead)

G. *Sphenomorphus fasciatus* (Banded sphenomorphus)

H. *Tropidophorus misaminus* (Misamis waterside skink)

Priority needs of the community for the development of the area. Priority projects that conserve the endemic species of flora and fauna. There is a need for the community to have a room or function hall as well as cultural museum where they can showcase their indigenous musical instruments, cultural dress and indigenous jewelry. A cafeteria where it served as one of their livelihoods is a must where they can serve their homemade coffee to the tourist/visitors. Cottages, bunk house and viewing deck must also be constructed for the

community to generate income. Table 3 shows the community priority needs/ identified projects.

Table 3. Community Priority Needs/ Identified Projects

Community Priority Needs	Identified Projects

1. Room/building Cultural Facility Area
   a. museum
   b. function room
   c. amenities multi media
	1. capability building and organizing
	   a. Organic farming technology
	   b. Marketing

1. Rest room/ dressing rooms/ mini coffee shop or cafeteria	a. Propagation of *Katigbi* b. Tiger grass and Botanical medicinal plants

2. Cottages and Bunk house for tourist visitors	2. Skills Training
	   a. Jewelry/Dressmaking sewing
	   b. Quality enhancement of soft brooms/Herbal preparation and utilization/ coffee processing

3. View deck areas and facilities
   a. Railings
   b. Viewing deck
	3. Production
	   a. Indigenous Jewelry/accessories selling
	   b. Coffee making/ soft brooms

Promote / Showcase the Existing Tourist Destination in the area. Marketing and giving of leaflets/ brochures or any IEC materials will help showcase the existing tourist destination to visitors and tourists who want to explore the area.

Respect the "*Obo Manuvu*" Culture and Arts Heritage. A visitor or tourist who visited the community should have the courage to listen, encourage, congratulate and be helpful to the indigenous people. Because they are of great help if you are good to them especially if you are conducting study in the community area.

Strictly Enforce Forestry Laws, Regulations and other Issuances in Watershed Management. Invited concerned agencies like DENR and LGU's must advocate the forestry laws, regulations and other issuances in watershed management which enable improved environmental integrity and sustainability.

SUMMARY AND CONCLUSIONS

1. With the local researchers (B'laan, Bagobo, Klata and Manobo), inventory of flora in survey showed a total of 48 different species of vascular plants belonging to 33 genera distributed in 7 families.

2. Species richness was relatively higher in the plots with mossy bryophytes or the upper elevation than in lower elevation and near watershed area.

3. Participatory inventory and assessment of economically important flora revealed that 14 species were edible plants, 7 species medicinal, 11 species are utilized for lumber/firewood, 1 as raw material for handicraft-making, 1 species as fuel, 6 species ornamental, 4 species as food plants for animals and 4 species are used for other purposes as dye, spices, jewelry and accessories and ropes.

4. Twenty-two species of fauna were recorded in the area of Balabag secondary forest, there were 2 species of birds, 6 mammals, 8 reptiles and 7 amphibians.

5. One species of bird is endemic to the area and one species, *Alcedo argentata* was determined as vulnerable. Five species of mammals were Philippine endemic and one species, *Megaerops wetmorei* was determined as threatened. For amphibians, two   were invasive and one species were determined as threatened (*Limnonectes magnus*) and vulnerable (*Ansonia mcgregori, Megophrys stejnegeri, Philautus acutirostris* and *Rhacophorus bimaculatus*). Eight reptile endemics species captured. All lizards and snakes were of least concern.

6. Marketing and distributing leaflets and brochures specifying the area `destination would at least help the community showcase the area for tourism.

7. Respecting the indigenous culture and traditions by listening and being helpful would at least guarantee tourist to be secured and comfortable in the area.

8. Distributed IEC materials for field guides and for conservation promotion among the community people in the area would at least make them aware of the environment.

RECOMMENDATIONS

Based on the findings of this project, the following recommendations are offered:

1. The spirit of conservation of the remaining endangered, endemic and economically important flora and fauna in the survey areas must be promoted to the community people. IEC materials plus seminars must be availed by the community people. The spirit of conservation must be felt by the community

people themselves so that they will be more supportive to the conservation programs to be implemented by concerned agencies or groups.

2. Local ordinances must be formulated to regulate the use of natural resources. Concerned agencies like the DENR and LGU must have strong will power to guard the forest against encroachment. Threatened species of both flora and fauna must be protected because all of them have vital roles in maintaining the ecosystem.

3. There must be regular biodiversity assessment especially in the watershed area. The local community people must be involved in this activity so that they may increase in their spirit of conserving the remaining economically important flora and fauna.

4. Concerned agencies like the DENR and LGU'S may implement conservation mechanisms like establishment of nurseries and planting the seedlings in the vacant patches in the forest as well as in their own fields.

5. Because inventory is not fully complete, a further exploration in the areas is recommended. Continuous monitoring should be done especially for threatened species not only within the vicinity of the watershed area but also outside the premises.

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CONFLICT RESOLUTION SKILLS AND TEAM BUILDING COMPETENCE OF SCHOOL HEADS: A MODEL EFFECTIVE SCHOOL MANAGEMENT

Glenford C. Franca
Faculty, SPAMAST, Institute of Teacher Education
and Information Technology
Malita, Davao Occidental
glenfordfranca@yahoo.com

ABSTRACT

The study was conducted in public elementary schools in Malita District to determine to measure conflict resolution skills and team building competence of school heads as a model for effective school management. Descriptive-correlational design was employed. Descriptive statistics and correlational analysis were used in the study. The level of conflict management, collaboration and compromise achieved the highest mean, while accommodation was the lowest. Among the indicators on the level of team building competence of school heads, accountability got the highest mean, while the lowest mean has been achieved by interdependence. Result showed that as conflict resolution increases team building decreases. Based on the result of the study, training in fair negotiations and conflict resolution should be undertaken by school classroom administrators. Additionally, the results suggest that school administrators should recognize its meaning and open themselves up to a contact structure that allows faculty members to participate. Subsequently, school administrators need to integrate conflict resolution skills as a key component in enhancing the school environment.

Keywords: Conflict resolution skills, team building competence, effective school management

INTRODUCTION

Conflict is common in all aspects of life (Donovan, 1993) and exists at all levels (Green, 1984; Marion, 1995). Conflict resolution is therefore a crucial challenge for members of all types of higher education institutions at all levels (Brown et al., 2002; Green, 1984; Haas, 1999; Harmon, 2003; Marion, 1995; Pepin, 2005). Conflict resolution in an educational institution was also illustrated in Green's (1984) study, which looked at conflict management between managers, teachers, students and outsiders. In one study, researchers found that school community administrators and faculty agreed that conflict management was the most often identified skill in leadership needed by administrators and faculty members (Cooper & Pagotto, 2003).

In Davao del Sur division, recent experience of misunderstandings and grudges among teachers and some school leaders has challenged conflict resolution and team building skills among school leaders. This motivated the researcher to address the need as soon as possible. This study was therefore undertaken.

Objectives of the Study

Generally, the study aimed to assess the relationship of conflict resolution skills and team building competence of public elementary school heads in Malita District in improving school management. Specifically, it addressed following:

1. Determine the demographic profile of the respondents.
2. Determine the levels of conflict management skills of school heads for effective school management according to the following:
   - 2.1. competition;
   - 2.2. collaboration;
   - 2.3. compromise;
   - 2.4. avoidance; and
   - 2.5. accommodation.
3. Determine the levels of team building competence of school heads for effective school management according to the following:
   - 3.1. shared goals;
   - 3.2. interdependence;
   - 3.3. commitment; and
   - 3.4. accountability
4. Determine the relationship on conflict resolution skills and team building competence of school heads for effective school management.

Research Framework

Independent Variables   Dependent Variable

CONFLICT MANAGEMENT SKILLS
Competition
Collaboration
Compromise
Avoidance
Accommodation
TEAM BUILDING COMPETENCE
Shared Goals
Interdependence
Commitment
Accountability

Effective School Management
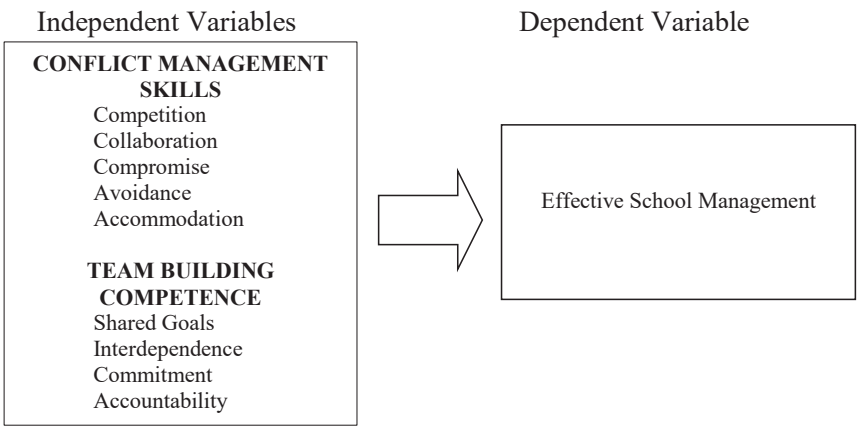
Fig. 1. Schematic diagram showing the relationship of the dependent and independent variables of the study

The conceptual framework for the analysis comprised independent and dependent variables relevant to the three research questions. Data collection included personal and work-related demographic information, ROCI-II products for conflict management evaluation. Figure 1 displays independent variables and dependent variables of the study. The independent variables were the five conflict management types and team building skills. The dependent variable was the effective school management. The study suggested that the conflict resolution skills and team building competence could serve as paradigm for school administrators.

METHOD

Locale of the Study

The study was conducted in Malita District, Division of Davao del Sur, specifically in the barangays of Feliz, Kidalapong, Bolila,Sanghay,Talogoy, Bagsak, Lacaron, Pangian, Buhangin, Tubalan, New Argao, Tingolo, Bisang, Jack Harvey, Kibalatong, Tical, Bito, Malaway, Santagose, and Kablulan.

Research Design

This study used descriptive-correlation to find out the relationship of conflict resolution skills and team building competence of school heads in Malita District, Division of Davao del Sur. It was undertaken to describe the characteristics of the variable in a situation.

Respondents and Sampling Procedure

The respondents of the study were chosen using draw lot technique. Fifty percent (50%) of the public elementary schools in Malita North and South Districts were considered. Likewise, 195 of teachers were tapped as respondents. Since there were only two (2) district supervisors, both of them were also included in the study.

Research Instrument

A questionnaire was developed and validated through pilot testing. Ten (10) teachers were selected for the pilot testing as suggested by Fraser et al., (2018). The pilot-testing respondents were requested to encircle the numbers of the items they did not understand, and to underline phrases and words that were either unclear or unintelligible. After receiving all the completed pilot research questionnaires, the researcher reviewed the responses for clarity and distribution without running an item analysis. Minor linguistic mistakes were discovered, such as sentence construction and spelling errors. Such errors were corrected and returned for another round of response.

After the pilot test, the questionnaire was submitted to the Thesis Advisory Committee for final checking. The comments and corrections of the Thesis Advisory Committee were considered. The committee found the questionnaire valid and reliable. The questionnaire was divided into parts. The first part was the profile of the respondents. The second part was used to measure the conflict resolution skills and team building competence of the school managers/school heads. The questions were scaled using the following:

Range	Description	Interpretation
4.5 – 5.0	Very High	The school administrators always manifest these criteria
3.5 – 4.4	High	The school administrators often manifest these criteria
2.5 – 3.4	Moderately High	The school administrators sometimes manifest these criteria
1.5 – 2.4	Low	The school administrators rarely manifest these criteria
1.0 – 1.4	Very Low	The school administrators never manifest these criteria

Data Gathering Procedures

Necessary permission and clearances from the key offices of the Department of Education (DepEd) were sought by the researcher. The questionnaire for the school managers and teachers was then administered to their respective schools or during district meeting. The teachers were gathered at the school manager's office. They were oriented on the study and how to

accomplish the research instrument by the researcher. Moreover, for district supervisors, the questionnaire was administered at the district supervisor's office. The respondents were given enough time to answer and fill the questionnaire. After answering, the questionnaires were checked and subjected to statistical analysis.

Statistical Treatment of Data

Data were tabulated and analyzed according to the objectives of the study using mean, percentage, Pearson-r and r values.

RESULTS AND DISCUSSION

Profile of the Respondents

There were 195 surveyed respondents. As indicated in the table, 180 or 92.3% were teachers. The other 5 or 2.56% were Head Teachers, 5 or 2.56% were Principals, 3 or 1.54% were Teachers-in-Charge and 2 or 1.02 were Supervisors. All the 195 respondents were on a permanent status. As to years of working, 101 of 195 or 51.79% were in service for 5 to less than 10 years, followed by 10 years or more with 50 respondents or 25.64% then 2 to less than 5 years with 25 respondents or 12.82% then 1 to less than 2 years with 17 respondents at 8.72%. Finally, there were three respondents had less than one year of working experience.

As to educational attainment, 146 or 74.87% were baccalaureate degree holders followed by master's graduate with 43 respondents or 22.05%, then by post-graduates with 8 respondents or 4.1%. Majority of the respondents were married which comprise 183 or 93.84% followed by single with 12 at 6.15%.

As to Sex, majority of the respondents were female with 183 or 93.84% while the male were only 12 or 6.15%. Most of the respondents belong to age bracket 41 – 50 years old with 82 respondents comprising 42.05%, followed by 31-40 years old or 36.92% then 51-60 years old at 33 or 16.92%.

Successful teamwork relies upon synergism existing between all team members creating an environment where they are all willing to contribute and participate in order to promote and nurture a positive, effective team environment. Team members must be flexible enough to adapt to cooperative working environments where goals are achieved through collaboration and social interdependence rather than individualized, competitive goals (Luca & Tarricone, 2001). Thus, the socio-demographic profile has less to do with the effectiveness of school management.

Conflict Management Skills of School Heads Competition

All in all, the indicator got a grand mean of 2.98 described as Moderately High interpreted as the school administrators sometimes manifest these criteria. The researcher believed that incentives for good performance should also be added as the school administrators pose healthy competition. This is an innovative change as Green (1984) opines that constructive conflict is managed and not resolved in situations where conflict can be beneficial, such as producing innovative changes.

Collaboration

The grand mean was 3.07 described as High. The school administrators often manifested these criteria. And so, the researcher anchored on Stanley and Algert (2007) as he proposes for an imperative need for organizations to provide leaders the training in conflict management in order to benefit the organization holistically. This would simply mean if one would be equipped such skills it would lead to harmony and peace among its workplace.

Compromise

Managers require communication skills to motivate others, as well as form teams and build relationships like responding to conflicts by implementing conflict-handling behavior, which included discussing issues in private and keeping all the relevant parties calm and utilized a flexible or open minded approach. Rahim (1985), Rahim and Bonoma (1979) emphasize on the five management styles which were later modified into five conflict handling styles: avoiding, compromising, dominating, integrating, and obliging. Thus, in particular, school heads or managers must manage conflict among peers, subordinates, external constituents, and students.

These interactions create situations for conflict to arise, and thus require specific behaviors on the part of leaders. It is indeed basic to know the importance and meaning of compromise before the school administrators in Malita can perform this skill.

Avoidance

Consequently, the school administrators manifested the lowest criterion in accepting corrections when confronted, with the lowest mean at 2.3. Everybody commits mistakes. It just depends on the approach of the parties involved on how they correct each other. Unfortunately, many become victims of bullying in the workplace because they don't address the issue clearly to the right person.

Three studies moreover specified which particular reactions from the employee confronted with a conflict associated with bullying. Their findings linked conflict to being a target of bullying through productive (i.e. problem-solving) and destructive (i.e. yielding, avoiding or fighting) conflict management styles (Aquino, 2000).

Accommodation

This implied the school manager's personality wherein he/she could step up or step down from his dealing with the various personalities he/she would encounter in the workplace or school he was assigned.

It would necessitate one to look in his skills in dealing with situations where accommodation played a significant role in dealing with his peers and subordinates. In relation with, Marion (1995) discussed bureaucratic nature of the public elementary school and the need for conflict management as a result of executive leaders' interactions with many groups such as the community, board members, faculty, students and many other groups. These interactions create situations for conflict to arise, and thus require specific behaviors on the part of leaders. In the same manner, it is imperative that accommodation would become a potent factor in the success of the school's workplace. All in all the grand mean is 2.56 described as Moderately High interpreted as the school administrators sometimes manifest this criterion in managing conflict as to accommodation.

Conflict can be categorized as both constructive and destructive. Constructive conflict, otherwise known as constructive controversy, is defined as situations when one person's ideas, information, conclusions, theories, and opinions are incompatible with those of another, and the two seek to reach an agreement (Johnson & Johnson, 1999). If the school administrators be given enough time to learn more about conflict management, then they will improve and understand its categories logically.

Levels of Conflict Management Skills of School Heads

These indicators can help in managing conflict of school heads as Cherniss and Goleman (2001) say, conflict management emphasizes the need to listen, empathize and negotiate. Add to that is Silberman's remark, the ability of managers to manage and resolve conflict is seen to encompass negotiation skills and creativity." Finally, accommodation got the lowest rate at 2.56 described as low interpreted as the school administrators rarely manifest these criteria in trying to satisfy the other's needs, accommodating and giving in to other's wishes, is often going with the other's suggestions, trying to satisfy other's expectations, tends to show favor to one party, experiences struggle

between choosing from one party, listens to both parties before deciding, listens to both parties before deciding, tries logically to use conflict management styles in various situations and has the capacity to accommodate fairly.

Individuals promote and encourage their fellow team members to achieve, contribute, and learn Interpersonal Skills includes the ability to discuss issues openly with team members, be honest, trustworthy, and supportive and show respect and commitment to the team and to its individuals. Fostering a caring work environment is important including the ability to work effectively with other team members; Open Communication and positive feedback – actively listening to the concerns and needs of team members and valuing their contribution and expressing this helps to create an effective work environment (Johnson & Johnson, 1995).

Team Building Competence of School Heads

The school administrators need to improve on joining in activities that will inspire them to work on common goals as conflict management is an integral process in creating program that can disseminate ideas and skills for averting, overseeing and amicably resolving conflicts (Water, 2000). This cannot be done only by one person or from his idea alone.

Interdependence

The school administrators had the capacity to share to others the meaning of interdependence as it reached the highest mean of 2.62 described as moderately high interpreted as this criterion was practiced in the workplace sometimes. Thus, it was highly recommended to give this area an attention for the school administrators in Malita to contribute more to their school's development.

Commitment

This entail commitment; successful teamwork relies upon synergism existing between all team members creating an environment where they are all willing to contribute and participate in order to promote and nurture a positive, effective team environment. Team members must be flexible enough to adapt to cooperative working environments where goals are achieved through collaboration and social interdependence rather than individualized, competitive goals (Luca & Tarricone, 2001). Maeroff (1993) provides arguments that team building is an effective method for attacking real problems facing a school as this need commitment. In addition, team building may not be accepted by all in the school. However, when those teachers who are more inclined towards change take part in team building, it often encourages new practices that could permeate the rest of the school. Team spirit according to Pritchett and Pound

(1992) is generated through common goals. Process skills allow teachers to work productively. Teachers begin to realize that they have useful knowledge to contribute. Networks and partnerships can grow out of team efforts in solving problems. Staff development can become more linked towards the needs of the students. He warns that team building should be directed towards solving serious problems and not be adopted as another sideshow as education has had enough of these. Team-building training will influence goals such as communication, trust, and support which are examples of skills and attitudes

Accountability

The school administrators did things in accordance with the principles of Civil Service often as the highest mean at 3.80 described as high. While they needed the team building competence to align all activities to school's value on accountability as the lowest mean at 2.19 which could be interpreted as school administrators practice this criterion rarely.

Team building is the process of helping a work group become more effective in accomplishing its task and satisfying the needs of group members (De Meuse et al., 2009). Moreover, an intervention conducted in a work unit as an action to deal with a condition (or conditions) seen as needing improvement (Dyer, 1977). This strength of the school administrator can greatly help in accomplishing their task as they follow the school's plans, principles and activities.

Level of Team Building Competence of School Heads

Special training can also be given to practice as another method of team building focuses on three basic areas; the quality concept, training in the use of quality tools, and training in special topics. Quality concept training is based on the theories of experts such as Dr. W. Edwards Deming. Such training can last from eight to twelve hours and is intended to generate enthusiasm for the quality concept. Training for the use of quality tools involves giving employees the skills and knowledge to work together in their environment. Tools such as Pareto charts, cause effect diagrams, and control charts are demonstrated as methods for problem solving. The final stage is training for the specific needs of the organization (Brown & Starkey, 1994).

Correlation between Conflict Resolution Skills and Team Building Competence of School Heads

The correlation coefficient result in this study was at $r = -0.125$ which implies that there is a weak/slight negative correlation between conflict resolution and team building. As the conflict resolution increases the team building decreases. As teams must also understand the social processes of

leading a meeting, of generating creativity, of self-management and of leadership as provided by Sims (1995), the author also emphasizes that they need to manage the conflict, as well.

SUMMARY AND CONCLUSIONS

Summary

Based on the presented, analyzed and interpreted data, this chapter presents the key findings and recommendations for this study assessing the level of conflict resolution skills and team building competence of school heads of the school management in Malita District, Davao Occidental. The study sought to answer the following problem statement such as: 1) Demographic profile of the respondents; 2) Levels of conflict management skills of school heads according to Competition, Collaboration, Compromise, Avoidance, and Accommodation; 3) Levels of team building competence of school heads as to Shared goals, Interdependence, Commitment, and Accountability; and 4) Correlation between conflict resolution skills and team building competence of school heads. Most of the interviewees were the 180 teachers on a permanent status belonging mostly to 2-5 years in service. Moreover, most of the respondents are college graduates and majority are married at most 41-50 years old.

Among all the indicators in the level of conflict management, Collaboration got the highest mean while Compromise achieved the lowest. Further, among all the indicators in the level of team building competence of school heads, Accountability got the highest Mean while the lowest Mean was achieved by Interdependence. Notably, there is a weak/slight negative correlation between conflict resolution and team building. As the conflict resolution increases the team building decreases.

Conclusion

There is a significant relationship between the conflict resolution skills and team building competence for effective school management in public elementary schools in Malita District, Davao Occidental.

RECOMMENDATIONS

The result of the study would serve as a reference material for school heads and principals, researchers and other stakeholders in the education sector in matters related to conflict resolution and team-building. Also, the result of the study would serve these organizations in formulating efficient and effective conflict resolution skills for public school heads, managers and teachers that

would result to better school management. Moreover, policy makers can use the study to come up with informed policies/decisions on how conflict resolution skill and team building competence be implemented to the workplace. The result of the study would increase the level of understanding with regard to handling their subordinates and co-workers in their respective workplaces or institutions. This would also tell what particular attitude or behavior needs to be enhanced and improved. And, students, when work attitudes of teachers are disclosed through the result of this study, corrective measures, if necessary would be applied. In the end, beneficial for the students since compromise achieved the lowest rate, training in negotiations and resolving conflicts should be undergone by the school administrators. As interdependence achieved the lowest mean, the school administrators need to know its meaning and open themselves into communication structure that allows faculty member to participate. Since there is a weak/slight negative correlation between conflict resolution and team building, the school administrators need to incorporate team building as a major component in improving school climate in a school, then identify areas needing the most improvement and then introduced team-building techniques.

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DEVELOPMENT AND EVALUATION OF PUMMELO (*Citrus grandis* L.) FRUIT SORTER

Leo C. Radores
Faculty, SPAMAST, Institute of Agricultural
Technology and Entrepreneurial Studies[1]
Buhangin, Malita, Davao Occidental
radores222@gmail.com

ABSTRACT

Pummelo is popular in the market around the world; however, sorting is necessary to meet markets' demands. This study was conducted to design, fabricate, and evaluate the performance of a Pummelo sorting machine. Three conveyor belt speeds in three replications or nine experiments were used in the actual field test. Complete Randomized Design (CRD) in one-way ANOVA was used to differentiate significant differences among treatment means. Belt speeds treatments test were 7-8, 11-12, and 27-28 meter per minute were considered. Further test of significant differences among means treatment were done using Duncan's Multiple Range Test at 5% level of significance. Results showed that the highest sorting capacity of the sorter was at 507 pc /hour using the conveyor belt speed of 27-28 m/min. The highest mean sorting efficiency was recorded at 96.97% at conveyor belt speed of 11-12 m/min. Lowest mechanical damage mean of 0.48% was at conveyor belt speed 7-8 m/min. The manual sorting had an average mean capacity of 477 pcs/hour and mean efficiency of 72.78 %. Pummelo sorter at conveyor belt speed of 27-28 meter/min with sorting capacity of 507 fruits/hour had total estimated sorting output of 973,440 fruits/year. It had an operating cost at Php0.088/pc with a custom rate of Php0.118/fruit. The sorter had to sort 384,536 pcs of Pummelo to attain breakeven cost of operation. It had an estimated net income/ year of Php29, 467.45 and a payback period of 1.4 years.

Keywords: sorter, pummelo, SPAMAST

INTRODUCTION

The Philippines produced an average of 36,686MT of Pummelo spreading over five major producing areas namely; Davao City, Isabela, Cagayan, Nueva Viscaya, and Davao Oriental. The Philippines exported Pummelo in 1999-2001, but due to increasing domestic consumer demand, the country imported Pummelo from other countries (Lustria et al., 2009).

Davao City, as the number one producer of Pummelo was able to produce 12,672 metric tons of Pummelo in 2009 which was 34% of the total production. It is followed by Isabela which produced only 6,917 metric tons which was only 18%. The volume showed and proved that Pummelo is a signature fruit and landmark of Davao City.

Pummelo plays an important role in the market; however sorting is necessary to meet costumers' quality standard and enhance its market value. Sorting is one of the important operations that dictate acceptance of the fruit to consumers in national and even international market (Mangraj et al., 2009). Fruits undergo postharvest preparation especially sorting before transporting from field to market.

Manual sorting and grading of fruit are globally adapted practice for fruits including the Pummelo, but these operations need qualified staff for the consideration of some factors through their physical parameters by visual inspection (Omre & Saxena, 2003). Size and weight are the very common features to classify a certain fruit. Manual weighing is time consuming, inconsistent and less efficient. Moreover, prizes become expensive due to shortage of labor during peak seasons which totally affects the operations (Londhe et al., 2013). Hiring of inexperience sorter affects quality of work in terms of efficient classification which needs extra checking of their sorted fruits, mentoring of newly hired workers and additional cost of supervision.

Research found out that farmers are already educating their children to elevate their mode of living and to move away from farm works. Nowadays, the unavailability of workers has become a problem in the farming industry. The situation is supported by the decreased in the labor force in 2004 (Briones, 2009). As of today, majority of small Pummelo traders and farmers in Davao rely on manual sorting actually experienced the above-mentioned problems. Based on the situation, it reveals the need for the development of an automated grading and sorting machine to address the shortage of farm laborers. In order to alleviate and sustain quality agricultural produce, an affordable and portable fruit sorting machine must be designed and developed.

Objectives of the Study

The general objective of the study was to design, fabricate and evaluate the performance of Pummelo a fruit sorter. The specific objectives of study were the following:

1. to design an automated Pummelo sorter;
2. to fabricate Pummelo sorter;
3. to evaluate the performance of the Pummelo sorter in terms sorting capacity, sorting efficiency, mechanical damage and power requirement;
4. to compare the performance of the fabricated sorter machine to the manual sorting; and,
5. to calculate the cost of operation.

METHOD

The study follows the input-output design. The following criteria were considered on the design of Pummelo fruit sorter.

Properties of crops which are relevant to the design, development, and performance evaluation include variety, size of the fruits, bulk density, and weight class standard for sorting purposes.

1. Input capacity of 500 to 700 fruits per hour and which can accommodate 450 to 650kg of fruits per hour.
2. Standard dimensions from PAES 2008 such as pulleys and belts, including chain sprockets
3. Simplicity of the design for the ease of operation and maintenance.
4. Use of locally available material so that it can easily be constructed in the shop.
5. Use of some standard parts readily available at the local market.
6. Safety of operating the machine.

The Pummelo sorter composed of six main parts: (1) feeding hopper; (2) conveyor belt system, (3) load cell, (4) selector arm, (5) fruit container, and (6) main frame. Figure 1 was operated using an algorithm for sorting mechanism in four weight classifications. The procedures were as follows:

1. Start the machine;
2. Initialize it through the universal asynchronous receiver-transmitter (UART) and analog-to-digital converter (ADC);
3. Clear output open collector (OC) and the Voltage controls the system on a chip (SOC);
4. Check the Pummelo fruits at the load cell;
5. Initialize the over lapped execution circuits (OEC);
6. Determine the weight calculation (ADC conversion) storing as variable 'w' for weight;

7. Wait the end of conversion (EOC) Selection to be disabled;
8. Rotate motor at the conveyor for corresponding weight of Pummelo;
9. Following weight range is decided:
    a. 801g up
    b. 800-601
    c. 401-600
    d. <400

Decide weight ranged based on:
If the calculated weight is w>b, then Arm one sorts the Pummelo fruit;
If the calculated weight is c<w<a, then Arm two sorts the Pummelo fruit;
If the calculated weight is d<w<b, then Arm three sorts the Pummelo fruit;
   1. If the calculated weight is w<c, then sort to fourth basket;
     a. This process is repeatedly performed in all the above steps until all pummelo fruits are sorted; and,
     b. This is the end of the sorting process.

   Testing of the machine was conducted after its completion in order to see whether the different parts were functioning properly. Checking of chain, sprocket, belt tension, calibration of rpm of the rotated parts and the electronic system was done. The rpm, power requirement and consumption, belt slippage and other necessary data were gathered while the machine was at no load. The belt speed with the corresponding pulley was 7-8,11-12, 27-28 m/min, served as treatment.
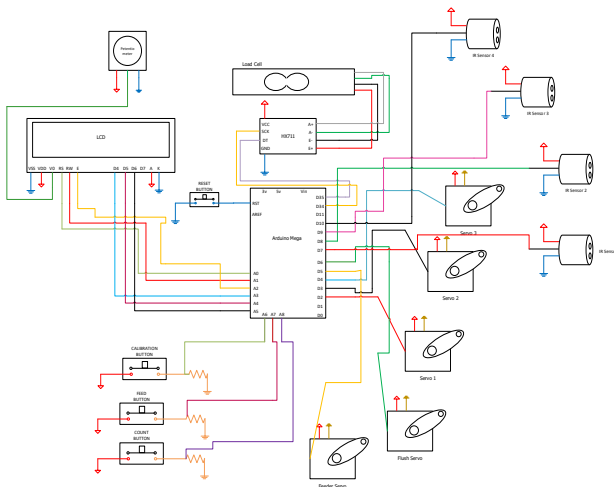

Figure 1. Electronic and Arduino system

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For final testing, the study arranged and analyzed statically using the single factor experiments in Completely Randomized Design (CRD) to determine the effect of the different levels of belt speed at (8-9, 11-12, 27-28m/min) on the efficiency, capacity, and mechanical damage on the fruit being tested.

There were three treatments in three replications with a total of nine experimental units. Each experimental unit was tested using 121 fruits or 97kg of Pummelo fruits using the Magallanes variety. A total of 873 kg average of Pummelo was used. Significant differences among treatment means were determine through the use of One Way ANOVA. Duncan's Multiple Range Test was used to determine which among the means significantly differ from each other. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS).

Manual sorting activities were observed in a Pummelo packing house located in Davao. Data were gathered using survey the questionnaire. The sorting capacity of the Pummelo worker was based on the fruits sorted in one-day operation under normal condition. The result was analyzed using t–test of independent samples.

Cost of operation was analyzed using the Pummelo sorter. The fixed cost, variable cost, interest on investment and breakeven point analysis were also determined

RESULTS AND DISCUSSION

The designed Pummelo fruit sorter in Figure 2 had the following major components; hopper, conveyor belt system or the power transmission assembly, electronic assembly (which includes load cell, microcontroller and servo motors, and sensors), mainframe, and the fruit container. The Pummelo sorter dimensions were presented in Table 1.

Table 1. Specification of Pummelo (*Citrus grandis* L.) sorter

| Item	Specification
Capacity, pcs. /hr.	507
Sorting Efficiency,	95.87
Mechanical Damage,	0.79
Main Structure	
Weight, kg	250
Overall Dimensions	
Length, mm	3400
Width, mm	1500
Height, mm	1200
Discharge Chute	
Length, mm	280
Width, mm	410
Height, mm	150
Fruit Container	
Length, mm	1430
Width, mm	700
Height, mm	450
Hopper	
Length, mm	600
Width, mm	380
Height, mm	200
Feeding Mechanism	Manual Feeding, Batch Type
Prime Mover	220 V, 746 W single phase, capacitor type electric motor coupled with 1:40 Motor Reducer
Transmission System	Sprocket Chain Drive and Pulley Belt Combination
Gear Sprocket 1	11teeth
Gear Sprocket 2	28 teeth
Sprocket chain number	60mm
Pulley 1	127mm Single sheave pulley
Pulley 2	152.4mm,101.6mm,50.8mm
Belt type	V-belt, A-36, A-85, A-80
Conveyor Type	Flat Belt 120mmx4000mm
Arduino &Electronic System	Arduino Mega, Load Cell, amplifier, Servo Motors, Light Sensors &LCD
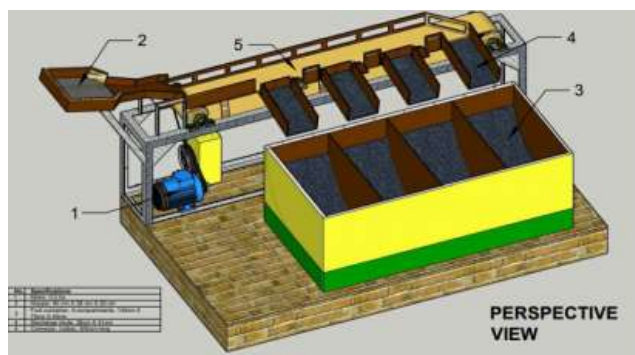
Figure 2. Design of Pummelo sorter in 3D isometric view

Performance Evaluation of the Device

The Pummelo sorter was evaluated by the overall performance in terms of sorting capacity, efficiency and mechanical damage as affected by different conveyor belt speed. Three conveyor belt speed were tested at 7-8, 11-12, 27-28 meter per minute.

Sorting Capacity

Table 2 shows the sorting capacity, efficiency and mechanical damage at 8-9, 11-12, and 27-28 conveyor belt speed in meter per minute. It has a highest mean of 507 pieces of pummel fruits per hour at speed of 27-28 meter per minute, followed by 396 pieces at 11-12 meter per minute, while the lowest mean was 371 pieces at the speed of 8-9 meter per minute. The sorter at speed of 7-8, 11-12 and 27-28 meter per minute revealed that as belt speed gets faster, performance capacity is higher.

Sorting Efficiency

Sorting efficiency was 96.97% at belt conveyor speed of 11-12meter per minute, followed by 96.69% at 7-8 meter per minute and 95.87% at conveyor belt speed of 27-28 meter per minute. Data showed that sorting efficiency range of 1.65%. Results revealed that, increasing belt speed has positive effect on the performance of the machine.

Table 2 Performance of Pummelo Sorter as affected by different belt sped

Conveyor Belt Speed, m/min	Sorting capacity, Pummelo/hr.	Sorting Efficiency, %	Mechanical damage,%
7-8	370.85[a]	96.69[a]	0.48[a]
11-12	396.08[a]	96.97[a]	0.65[a]
27-28	506.87[b]	95.87[a]	0.79[a]

Means not sharing the same letter, in row or column, differ significantly by DMRT at 5 level of significant

Mechanical Damage

Table 2 showed the result on mechanical damage of fruits in three conveyor belt speeds at 7-8, 11-12, and 27-28 meter per minute. The highest mean was 0.79% at conveyor belt speed of 27-28 meter per minute, followed by 0.65% at conveyor belt speed 11-12 meter per minute while the lowest mean of 0.48% was obtained at conveyor belt speed of 7-8 meter per minute. Data revealed that 0.92 %. Pummelo sorter showed less mechanical damage of fruits during testing operation

Comparison of Manual Sorting Versus Machine Sorting

Table 3 revealed that manual sorting has a mean capacity of 477 pieces of fruits per hour. Result showed that the Pummelo Sorter has a lead difference in terms of capacity, efficiency and cost per day: 30 pcs. /hr. 23.09% efficient and Php 150 /day respectively.

Table 3. Comparison of Pummelo sorter manual sorting

Types of Sorting	Efficiency,%	Labor cost/day	Capacity, pcs/hr.
Pummelo sorter	507	95.87	300
Manual sorting	477	72.78	450

Operating Cost of Pummelo Sorter

The machine has a total fixed cost of Php11,536.07/yr. These costs entailed a depreciation of Php7,449.30 and Php2,845.22 for an interest of investment. The taxes, insurance, and shelter cost is Php1, 241.55. Variable costs accumulated during operation were repair of maintenance (R & M), energy cost, engine, and labor cost, with a total cost of Php38.47 per hour in which in one-year operation, it would cost Php73, 862.4. The total operating cost of utilizing the machine is, Php 85,398.47/yr. It has an operating cost of Php0.088/pc with a custom rate of Php0.118/pc. Thus, the machine has an estimated gross income of Php114,865.92/yr. and net income of Php29,467.45/yr. with a payback period of 1.4years.

CONCLUSION

The designed Pummelo sorter is timely to address the need of the Pummelo growers and traders. Also, the fabricated Pummelo sorter is functional which has a performance capacity and efficiency. It can sort at a maximum of 4056 fruits per day and 95.87 % efficient. Moreover, there is a significant difference on the performance on the machine in terms of sorting capacity at three conveyor belt speeds. However, there is no significant difference on sorting efficiency and mechanical damage at three conveyor speeds are noted. It

is also find that there was no significant difference in terms of capacity between Pummelo sorter and manual sorting. However, there is a significant difference in terms of sorting efficiency. It has a lead difference capacity and efficiency of 30 pieces per hour and 23.09 %, respectively. Thus, the Pummelo sorter is better than manual sorting. The cost of fabricating the machine is Php41,385.00.00. The projected annual net income of the machine is Php 29,467.45   per year. The designed Pummelo sorter has a payback period of 1.4 years.

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EFFECTS OF CAGE AQUACULTURE TO THE PHYSICO-CHEMICAL STATUS OF MARICULTURE PARK IN TUBALAN COVE

Dario R. Morastil
Faculty, SPAMAST, Institute of Fisheries and
Marine Sciences
morastildario@yahoo.com

ABSTRACT

This study was conducted in Tubalan Cove to determine the amount of DO, BOD, phosphates, nitrates, pH, salinity, temperature, and transparency; to determine the volume of fish and shell caught; and to determine the awareness level of coastal folks in the preservation effort of Tubalan Cove. Turbidity was significantly higher in Alibungog than in Tubalan and Udalo. Temperature, salinity, pH, and DO vary insignificantly among three sampling stations. Water parameters with high levels were COD, phosphates, and Amm-cal N while parameters with normal levels were pH, DO, nitrate, nitrite, salinity, and hydrogen sulfide. Mean age of respondents was 39 years old, and majority was high school level. Frequently caught fish was Nokos (squid), 4 hours in a day spent in fishing, 4 days a week spent in fishing; gill net was common type of fishing gears. Tuway shells were frequently caught in gleaning, 3 hours in a day spent in gleaning, 2 days spent in a week gleaning, Tagad was common the type of gleaning gears. Moreover, the participants revealed that they caught more fish and shells before the establishment of cage aqua-culture in the area. Respondent were moderately aware on dynamite and poison fishing, and fine mesh net used while aware on water quality monitoring. Tubalan Cove is still at safe level but close monitoring particularly of those parameters with high levels to be led by the Malita LGU, BFAR, SPAMAST Research Center to prevent possible occurrence of fish kill.

KEYWORDS: Cage aquaculture, physico-chemical status, mari-culture, Tubalan cove

INTRODUCTION

Marine fish pens and fish cages are flourishing in the coves of Davao Occidental particularly in Malalag and Tubalan bays. The trend is increasing perhaps due to the profitability of this aquaculture but uncertain as to when this may continue to flourish or may stop due to pollution in marine waters. Unlike in the aquaculture of Laguna de Bay, no fish kill yet occurring in the bays of Davao del Sur and Occidental since it is open water. Unlike to Taal Lake which is an isolated body of water with limited carrying capacity thus more prone to fish kills. Though coves are interconnected to open oceans, it has to be well regulated through scientific research so that significant findings can be a good tool for policy makers in the barangay or municipal level.

Furthermore, through policy legislations it can prevent further deterioration of the marine ecosystem in the area. Significant indicators like dissolved oxygen (D.O.), biological oxygen demand (B.O.D.), Chemical Oxygen Demand (COD), hydrogen sulfide, nitrate-N, nitrite-N, nitrogen-ammonia cal, phosphates, salinity, temperature, and transparency are essential parameters to determine the balance of aquatic ecosystem.

This study also determined the effect of fish cages aquaculture practices on the current fish catch in the area. Thus, this study was proposed in order to find out what is the extent of the organic matter build up in the seafloor and water column of the Tubalan Cove.

Objectives of the Study

This research was conducted to assess the effect of widespread commercial feeding to cage aquaculture in Tubalan Cove Mari-culture Park. In particular the study aimed:

1. To determine the amount of DO (Dissolved Oxygen), BOD (Biological Oxygen Demand), phosphates, nitrates, pH, salinity, temperature, and transparency in the study site and compare them to the standard.

2. To determine volume of fish catch and shell gleaning activity as affected by commercial feed inputs in the mari-culture park.

3. To determine awareness level of coastal folks in the preservation effort of Tubalan Cove.

Conceptual Framework

Dependent Variable

Independent Variable

- Physico-Chemical Status of Seawater in Mariculture Park of Tubalan Cove
- Fishing and Gleaning Activity of fisher folks

Levels of different physico-chemical of seawater samples
- Amount of Dissolved Oxygen
- Biological Oxygen Demand
- Chemical Oxygen Demand (COD)
- Phosphates
- Nitrate-N
- Nitrite-N
- Ammonia-N
- pH
- Salinity
- Temperature; and
- Transparency

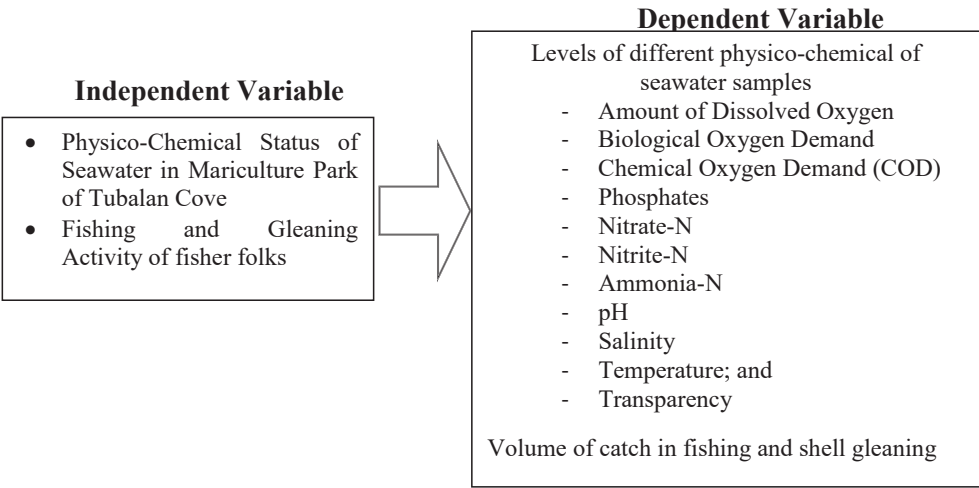Volume of catch in fishing and shell gleaning

Figure 1. Conceptual framework showing the input and output variables.

METHOD

Research Locale

This study was conducted in Tubalan Cove. Tubalan Cove is situated in Davao Occidental, Southern Philippines. It is geographical located at 6° 29' 49" North, 125° 33' 53" East.

Fig. 2 Locale of the Study

Research Design

This study was a descriptive research and utilized both the results of laboratory analysis of identified parameters and the utilization of survey/interview questionnaire that includes volume of catch in both fishing and gleaning of coastal folks in the study area.

Formulation of Questionnaire and Focus Group Discussion

Cage operators and care takers were the focus group to fill-up or answer the formulated questionnaire. The questionnaire was discussed first to the focus group for their comments to further improve its content particularly on volume of catch in both fishing and gleaning of the coastal folks. It comprises demographic profile of respondents, fishing activities, gleaning activities, and awareness level in the preservation of the mari-culture park.

Collection of Water Samples

Sites of water sampling were sourced from surrounding vicinity (about 5 m distance) of actual locations of fish cages. About 200 ml per site was collected and a total of 60 sites were sampled. Water sample preservation for laboratory analysis at UIC Science Resource Center, Davao City was done by placing the composite samples inside a plastic cooler with ice water inside. It was tightly sealed prior to transport.

Highly unstable parameters such as pH, temperature, transparency, salinity and dissolved oxygen were measured on site and simultaneous with the three sampling stations for three consecutive weeks. Three sampling stations were determined namely Udalo, Tubalan, and Alibungog. At Udalo where most of the fish cages were installed was the focus of water analysis for pH, salinity, DO, BOD, COD, phosphate, nitrate, Amm-cal N, Nitrite, and hydrogen sulfide for four quarters to have a good data collection.

Analysis of Physico-Chemical Parameters

All the collected samples were analyzed in the accredited laboratory at UIC-Science Resource Center, Davao City, following standard methods.

Three types of sampling adopted for collecting water samples. Grab or Catch sampling, the sample is collected at a particular time and place that represents the composition of the source at that particular point and time; Composite sampling, a mixture of grab samples is collected at the same sampling point at different time intervals (applicable for quarterly sampling since this study is good for one year); and Integrated sampling, a mixture of grab samples collected at different points simultaneously.

Parameters such as pH, DO, temperature, and transparency were measured on site for three consecutive weeks. The preservation procedure includes keeping the samples in the dark (inside plastic cooler with cover), lowering the temperature to retard reactions. Care was given emphasis in the travel time and preservation of samples.

Launching of Survey Questionnaire

Coastal folk that reside along shorelines of the three sampling stations were personally interviewed by enumerators. Only matured ones ranging from 20 to 58 years old were interviewed as active fish catchers and shell gleaners. Personal interview were done simultaneously among the three sampling stations.

Volume of Catch Determination before and After Establishments of Cage Aquaculture

It is important to note that the "after" values would mean the present fish and gleaning catch during the conduct of the study. While "before" values represents the volume of catch in both fishing and gleaning prior to the proliferation of cage aquaculture in the cove.

Statistical Treatment

Descriptive statistics was employed by determining the recent pysico-chemical parameters of seawater in Tubalan Cove Mari-culture Part and compare it with the international standard in aquaculture water quality. This is to evaluate whether it is still on safe or already in critical level the surrounding seawaters of cage aquaculture. ANOVA was used in comparing different levels of water parameters among the three sampling stations.

RESULTS AND DISCUSSION

Physico-chemical parameters

Turbidity

Unstable parameters like turbidity, temperature, salinity, pH, and DO were sampled on sites for the three sampling stations, namely: Udalo, Tubalan, and Alibungog. Table 1a below shows the data of turbidity sampled for three consecutive weeks. All the readings were within tolerable limits for aquaculture.

Ability of water to transmit the light that restricts light penetration and limit photosynthesis is termed as turbidity and is the resultant effect of several factors such as suspended clay particles, dispersion of plankton organisms,

particulate organic matters and also the pigments caused by the decomposition of organic matter.

Boyd and Lichtkoppler (1979) suggested that the clay turbidity in water to 30 cm or less may prevent development of plankton blooms, 30 to 60 cm and as below 30 cm - generally adequate for good fish production and there is an increase in the frequency of dissolved oxygen problems when values above 60 cm, as light penetrates to greater depths encourage underwater macrophyte growth, and so there is less plankton to serve as food for fish. According to Bhatnagar *et al*. (2004) turbidity range from 30-80 cm is good for fish health; 15-40 cm is good for intensive culture system and < 12 cm causes stress. According to Santhosh and Singh (2007) the transparency between 30 and 40 cm indicates optimum productivity of a pond for good fish culture.

Table 1a. Turbidity (in cm) data in weekly interval

Sampling Station	Turbidity (cm) ns		
	Week 1	Week 2	Week 3
Udalo	304.80	274.32	335.28
Tubalan	365.76	335.28	365.76
Alibungog	396.24	426.72	457.20

Although there were variations in turbidity readings from week 1 to week 3 among three sampling stations but statistically it revealed no significant difference.

By comparing means of turbidity among the three sampling stations, it showed a significant difference that favors for Alibungog. Alibungog was under LGU management headed by the mayor of the municipality of Malita that it was intended for tourism purposes and no fish cage nor fish pen was allowed to be established in the area.

Temperature

It is defined as the degree of hotness or coldness in the body of a living organism either in water or on land (Lucinda & Martin, 1999). As fish is a cold blooded animal, its body temperature changes according to that of environment affecting its metabolism and physiology and ultimately affecting the production. Higher temperature increases the rate of bio-chemical activity of the micro biota, plant respiratory rate, and so increase in oxygen demand. It further cause decreased solubility of oxygen and also increased level of ammonia in water. However, during under extended ice cover, the gases like hydrogen sulfide, carbon dioxide, methane, and some others can build up to dangerously high levels affecting fish health. Table 2a below shows the data of temperature

sampled for three consecutive weeks. All the readings were within tolerable limits for aquaculture.

Table 2a. Summary of temperature data in weekly interval

Sampling Station	Temperature (^{0}Celcius)		
	Week 1	Week 2	Week 3
Udalo	28	28	28
Tubalan	29	28	28
Alibungog	28	27	27

Salinity

It is defined as the total concentration of electrically charged ions (cations – Ca++, Mg++, K+, Na+ ; anions – CO3-, HCO3-, SO4-, Cl- and other components such as NO3-, NH4+ and PO4-). Salinity is a major driving factor that affects the density and growth of aquatic organism's population (Jamabo, 2008).

Fish are sensitive to the salt concentration of their waters and have evolved a system that maintains a constant salt ionic balance in its bloodstream through the movement of salts and water across their gill membranes. According to Meck (1996) fresh and saltwater fish species generally show poor tolerance to large changes in water salinity. Often salinity limits vary species to species level. Garg and Bhatnagar (1996) have given desirable range 2 ppt for common carp; however, Bhatnagar et al. (2004) gave different ideal levels of salinity as 10-20 ppt for P. monodon; 10-25 ppt for euryhaline species and 25-28 ppt for P. indicus. Barman et al. (2005) gave a level of 10 ppt suitable for Mugil cephalus and Garg et al. (2003) suggested 25 ppt for Chanos chanos (Forsskal).

Table 3a shows the raw data for salinity in a weekly sampling for the three sampling stations. All the values were within tolerable limits for Chanos chanos cultured in an open sea or in a mari-culture park.

Table 3a. Salinity raw data in weekly interval

Sampling Station	Salinity (ppt)		
	Week 1	Week 2	Week 3
Udalo	35	37	38
Tubalan	34	40	35
Alibungog	41	41	35

Although there were variations in salinity readings from week 1 to week 3 among three sampling stations but statistically it revealed no significant difference. The P-value of 0.341 is beyond 0.05 level of significance.

pH

The pH of natural waters is greatly influenced by the concentration of carbon dioxide which is an acidic gas (Boyd, 1979). Fish have an average blood pH of 7.4, a little deviation from this value, generally between 7.0 to 8.5 is more optimum and conducive to fish life. pH between 7 to 8.5 is ideal for biological productivity , fishes can become stressed in water with a pH ranging from 4.0 to 6.5 and 9.0 to 11.0 and death is almost certain at a pH of less than 4.0 or greater than 11.0 (Ekubo & Abowei, 2011). According to Santhosh and Singh (2007) the suitable pH range for fish culture is between 6.7 and 9.5 and ldeal pH level is between 7.5 and 8.5 and above and below this is stressful to the fishes. Ideally, an aquaculture pond should have a pH between 6.5 and 9 (Wurts & Durborow, 1992: Bhatnagar et al., 2004). Bhatnagar et al. (2004) also recommended that <4 or >10.5 is lethal to fish/shellfish culture; 7.5-8.5 is highly congenial for P.monodon; 7.0-9.0 is acceptable limits; 9.0 -10.5 is sublethal for fish culture.

Table 4a shows the raw data for pH in a weekly sampling for the three sampling stations. All the values were within tolerable limits for Chanos chanos cultured in an open sea or in a mari-culture park.

Table 4a. The prevailing pH level in three sampling sites

Sampling Station	pH		
	Week 1	Week 2	Week 3
Udalo	8.0	8.4	8.7
Tubalan	8.5	8.6	8.6
Alibungog	8.4	8.6	6.9

DO (Dissolved Oxygen)

Dissolved oxygen affects the growth, survival, distribution, behavior and physiology of shrimps and other aquatic organisms (Solis, 1988). The principal source of oxygen in water is atmospheric air and photosynthetic planktons. Obtaining sufficient oxygen is a greater problem for aquatic organisms than terrestrial ones, due to low solubility of oxygen in water and solubility decreases with factors like- increase in temperature; increase in salinity; low atmospheric pressure, high humidity, high concentration of submerged plants, plankton blooms. Oxygen depletion in water leads to poor feeding of fish, starvation, reduced growth and more fish mortality, either directly or indirectly (Bhatnagar & Garg, 2000).

According to Banerjea (1967) DO between 3.0-5.0 ppm in ponds is unproductive and for average or good production it should be above 5.0 ppm. It may be incidentally mentioned that very high concentration of DO leading to a state of super saturation sometimes becomes lethal to fish fry during the rearing of spawn in nursery ponds (Alikunhi et al., 1952) so for oxygen, the approximate saturation level at 50° F is 11.5 mg L-1, at 70° F., 9 mg L-1, and at 90° F., 7.5 mg L-1. Tropical fishes have more tolerance to low DO than temperate fishes. According to Bhatnagar and Singh (2010) and Bhatnagar et al. (2004) DO level >5ppm is essential to support good fish production. Bhatnagar et al. (2004) also suggested that 1-3 ppm has sublethal effect on growth and feed utilization; 0.3-0.8 ppm is lethal to fishes and >14 ppm is lethal to fish fry, and gas bubble disease may occur. DO less than 1- Death of Fish, Less than 5 - Fish survive but grow slowly and will be sluggish, 5 and above- Desirable. According to Santhosh and Singh (2007) Catfishes and other air breathing fishes can survive in low oxygen concentration of 4 mg L-1. Ekubo and Abowei (2011) recommended that fish can die if exposed to less than 0.3 mg L-1 of DO for a long period of time, minimum concentration of 1.0 mg L-1 DO is essential to sustain fish for long period and 5.0 mg L-1 are adequate in fishponds.

Table 5a shows the raw data for DO in a weekly sampling for the three sampling stations. All the values were within tolerable limits for Chanos chanos cultured in an open sea or in a mari-culture park.

Table 5a. Dissolved oxygen reading in different sampling stations

Sampling Station	DO (ppm)		
	Week 1	Week 2	Week 3
Udalo	6.4	4.4	6.6
Tubalan	7.0	5.3	8.1
Alibungog	8.0	8.0	8.0

Results of Laboratory Analysis of Composite Water Samples

Table 6a shows the quarterly lab analysis of composite water samples of Tubalan Cove. There were ten parameters analyzed and seven out ten samples are still within the safe level. This will be shown in the succeeding table. pH reading ranges from 7.5 to 8.2 with a mean of 7.73. DO reading ranges from 6.9 to 8.6 with a mean of 7.4. BOD ranges from 0.99 t0 1.0 with a mean of 0.99. COD reading ranges from 119 to 713 with a mean of 423. Phosphate has uniform reading of 0.22 all throughout the four quarters.

Nitrate reading ranges from 0.2 to 0.89 with a mean of 0.3975. Ammonium-cal N reading ranges from 0.22 to 3.55 with a mean of 1.5825. Nitrite reading ranges from 0.002 to 0.007 with a mean of 0.00325. Salinity

reading ranges from 39.8 ppt to 41.9 ppt with a mean of 40.7 ppt. Hydrogen sulfide reading has uniform of 0.02 for the four quarters.

Table 6a. The prevailing physico-chemical parameters in three sampling sites of Mari-culture Park, Tubalan, Davao Occidental

Parameters	1st Quarter 9/27/2017	2nd Quarter 1/4/2017	3rd Quarter 6/30/2017	4th Quarter 3/21/2018	Mean
pH	7.5	7.5	8.2	7.7	7.73
Dissolved Oxygen (D.O) mg/l	7.1	6.9	8.6	7.0	7.40
Biological Oxygen Demand (BOD) mg/l	0.99	0.99	0.99	1	0.9925
Chemical Oxygen Demand (COD) mg/l	713	610	250	119	423
Phosphate mg/l	0.22	0.22	0.22	0.22	0.22
Nitrate mg/l	0.3	0.2	0.2	0.89	0.3975
Amm-cal Nitrogen mg/l	0.22	0.24	3.55	2.32	1.5825
Nitrite mg/l	0.002	0.002	0.002	0.007	0.00325
Salinity mg/l	40,256	41,984	40,768	39,808	40704
Hydrogen Sulfide mg/l	0.02	0.02	0.02	0.02	0.02

Table 6b shows the mean reading of different water parameters from Tubalan Cove and its equivalent reading for International Standard. There seven parameters that are within the International Standard and three parameters that are beyond the standard.

Seven parameters that are still on its safe levels are: pH, DO, BOD, Nitrate, Nitrite, salinity, and hydrogen sulfide. The three parameters that are beyond the standard are: COD, phosphate, and Ammonium-cal Nitrogen.

COD (Chemical Oxygen Demand) is the standard method for indirect measurement of the amount of pollution (that cannot be oxidized biologically) in a sample of water. BOD is the measurement of total dissolved oxygen consumed by microorganisms for biodegradation of organic matter such as food particles or sewage etc. The excess entry of cattle and domestic sewage from the non-point sources and similarly increase in phosphate in the village ponds may be attributed to high organic load in these ponds thus causing higher level of BOD.

Clerk (1986) reported that BOD range of 2 to 4 mg L-1 does not show pollution while levels beyond 5 mg L-1 are indicative of serious pollution. According to Bhatnagar et al. (2004) the BOD level between 3.0-6.0 ppm is optimum for normal activities of fishes; 6.0-12.0 ppm is sublethal to fishes and

>12.0 ppm can usually cause fish kill due to suffocation. Santhosh and Singh (2007) recommended optimum BOD level for aquaculture should be less than 10 mg L-1 but the water with BOD less than 10-15 mg L-1 can be considered for fish culture. Bhatnagar and Singh (2010) suggested the BOD <1.6mg L-1 level is suitable for pond fish culture and according to Ekubo and Abowei (2011) aquatic system with BOD levels between 1.0 and 2.0 mg L-1 -considered clean; 3.0 mg L-1 fairly clean; 5.0 mg L-1 doubtful and 10.0 mg L-1 definitely bad and polluted.

Table 6b. Comparison of water sample analysis

Parameters	Mean	International Standard
pH	7.725	optimum is 7.5 to 8.5
Dissolved Oxygen (D.O) mg/l	7.4	optimum is above 3.5 ppm
Biological Oxygen Demand (BOD) mg/l	0.9925	optimum less than 10 ppm
Chemical Oxygen Demand (COD) mg/l	423	optimum less than 70 ppm
Phosphate mg/l	0.22	optimum is 0.05 to 0.07 ppm; 1 ppm is good for plankton production
Nitrate mg/l	0.3975	optimum less than 5 ppm
Amm-cal Nitrogen mg/l	1.5825	optimum less than 1 ppm
Nitrite mg/l	0.00325	optimum less than 0.01 ppm
Salinity mg/l	40704	optimum 35 to 45 parts per thousand
Hydrogen Sulphide mg/l	0.02	optimum less than 0.03 ppm

Ammonia is the by-product from protein metabolism excreted by fish and bacterial decomposition of organic matter (fig- 4) such as wasted food, faeces, dead planktons, sewage etc. The unionized form of ammonia (NH_3) is extremely toxic while the ionized form (NH_4^+) is not and both the forms are grouped together as "total ammonia".

Ammonia in the range >0.1 mg L-11tends to cause gill damage, destroy mucous producing membranes, "sub- lethal" effects like reduced growth, poor feed conversion, and reduced disease resistance at concentrations that are lower than lethal concentrations, osmoregulatory imbalance, kidney failure. Fish suffering from ammonia poisoning generally appear sluggish or often at the surface gasping for air.

The toxic levels for un-ionized ammonia for short-term exposure usually lie between 0.6 and 2.0 mg L-1 for pond fish, and sublethal effects may occur at 0.1 to 0.3 mg L-1 (EIFAC, 1973; Robinette, 1976). Maximum limit of ammonia concentration for aquatic organisms is 0.1 mg L-1 (Meade, 1985: Santhosh and

Singh, 2007). According to Swann (1997) and OATA (2008) the levels below 0.02 ppm were considered safe. Stone and Thomforde (2004) stated the desirable range as Total NH3-N: 0-2 mg L-1 and Un-ionized NH3-N: 0 mg L-1 and acceptable range as Total NH3-N: Less than 4 mg L-1 and Un-ionized NH3-N: Less than 0.4 mg L-1. Bhatnagar et al. (2004) suggested 0.01-0.5 ppm is desirable for shrimp; >0.4 ppm is lethal to many fishes & prawn species; 0.05-0.4 ppm has sublethal effect and <0.05 ppm is safe for many tropical fish species and prawns. Bhatnagar and Singh (2010) recommended the level of ammonia (<0.2 mg L-1) suitable for pond fishery.

Nitrite is an intermediate product of the aerobic nitrification bacterial process, produced by the autotrophic Nitrosomonas bacteria combining oxygen and ammonia. Nitrite can be termed as an invisible killer of fish because it oxidizes haemoglobin to methemoglobin in the blood, turning the blood and gills brown and hindering respiration also damage for nervous system, liver, spleen and kidneys of the fish.

The ideal and normal measurement of nitrite is zero in any aquatic system. Stone and Thomforde (2004) suggested that the desirable range 0-1 mg L-1 NO2 and acceptable range less than 4 mg L-1 NO2. According to Bhatnagar et al. (2004) 0.02-1.0 ppm is lethal to many fish species, >1.0 ppm is lethal for many warm water fishes and <0.02 ppm is acceptable. Santhosh and Singh (2007) recommended nitrite concentration in water should not exceed 0.5 mg L-1. OATA (2008) recommended that it should not exceed 0.2 mg L-1 in freshwater and 0.125 mg L-1 in seawater.

Nitrate is harmless and is produced by the autotrophic Nitrobacter bacteria combining oxygen and nitrite (fig.4). Nitrate levels are normally stabilized in the 50-100 ppm range. Meck (1996) recommended that its concentrations from 0 to 200 ppm are acceptable in a fish pond and is generally low toxic for some species whereas especially the marine species are sensitive to its presence. According to Stone and Thomforde (2004) nitrate is relatively nontoxic to fish and not cause any health hazard except at exceedingly high levels (above 90 mg L-1). Santhosh and Singh (2007) described the favorable range of 0.1 mg L-1 to 4.0 mg L-1 in fish culture water. However, OATA (2008) recommends that nitrate levels in marine systems never exceed 100 mg L-1.

Almost all of the phosphorus (P) present in water is in the form of phosphate (PO4) and in surface water mainly present as bound to living or dead particulate matter and in the soil is found as insoluble Ca3(P04)2 and adsorbed phosphates on colloids except under highly acid conditions. It is an essential

plant nutrient as it is often in limited supply and stimulates plant (algae) growth and its role for increasing the aquatic productivity is well recognized.

Soil phosphorus (unit- mg of P2O5 per 100gm of soil) level below 3 might be considered indicative of poor production, between 3 and 6 of average production and ponds having available phosphorus above 6 are productive (Banerjea, 1967). According to Stone and Thomforde (2004) the phosphate level of 0.06 mg L-1 is desirable for fish culture. Bhatnagar et al., (2004) suggested 0.05-0.07 ppm is optimum and productive; 1.0 ppm is good for plankton / shrimp production.

Demographic Profile of Respondents
A total of 41 respondents being interviewed in the study sites. Table 7a shows the mean age of respondents during the interview activity. Most were married with 85.36 % or with mean score of 1.15 that is nearing to 1 that is categorized into married marital status. Educational attainment of respondents was mostly high schools with a mean score of 1.51 which is rounded to 2 that is categorized as high school educational attainment.

Table 7a. Demographic profile of respondents

Age	Marital Status (1=married, 2=single)	Educ. Attainment (1=Elem, 2= High School, 3=Col. Level,
39.39	1.15	1.51
20-58 y.o.	85.36% Mrd	majority HS

Fishing Activity of Respondents
Table 7b shows the mean scores of respondents in their fishing activity. The five choices on types of fish frequently caught were Matambaka, Barilis, Carabalias, Nokos, and others. Out of five choices Nokos was frequently caught.

In terms of hours spent in fishing in a day, the respondents spent 4 hours with a mean score of 4.35 or rounded to 4. When asked on days spent per week in fishing, the mean score is 3.84 or rounded to 4 that categorized to 4 days in a week going to fishing. On types of fishing gears they commonly used, the mean score is 1.73 and rounded to 2 that categorizes for gill net. In comparison of fish catch "before" establishment of cage aquaculture, their mean score is 2.41 and rounded to 2 that categorizes to more. When asked on fish catch after the establishment of cage aquaculture, their mean score is 1.89 and rounded to 2 that still categorizes as more but lesser extent as compared to before cage aquaculture establishments. This implies that Tubalan Cove has still more fish catch according to responses of respondents. The proliferation of cage

aquaculture in the cove is still on its sustainable state as to the conduct of this study. However, there were minimal mortality of cultured Bangus per cage but this seems to be in isolated cases that are occurring inside the culture cage only.

Table 7b. Fishing activity of respondents

Frequently Caught Fish	Hours Spent Fishing in a day	Days spent fishing per week	Type of Fishing Gears Used	Comparison of Catch "before" Establishment of Cage Aquaculture	Comparison of Catch "after" Establishment of Cage Aquaculture
1=Matambaka, 2=Barilis, 3=Carabalias, 4=Nokos, 5=others	1=2hours, 2=3hours, 3=4hours, 4=5hours, 5=5hours & above)	1=1day, 2=2days, 3=3days, 4=4days, 5=days & above)	1=hook & line, 2=gill net, 3= scope net)	1=less catch, 2=more catch, 3=the same catch	1=less catch, 2=more catch, 3=the same catch)
3.72	4.35	3.84	1.73	2.41	1.89
Nokos	4 hours per day	4 days in a week	Gill nets	more	More

Gleaning Activity of Respondents

Table 7c shows the mean scores of respondents in their gleaning activity. The five choices on types of shells frequently caught were Sina, Litub, Tuway, Wasaywasay, and others. Out of five choices Tuway was frequently caught.

In terms of hours spent in gleaning in a day, the respondents spent 3 hours with a mean score of 2.67 or rounded to 3. When asked on days spent per week in gleaning, the mean score is 2.11 or rounded to 2 that categorizes to 2 days in a week going to gleaning. On types of gleaning gears they commonly used, the mean score is 1.61 and rounded to 2 that categorizes for tagad. In comparison of shell catch "before" establishment of cage aquaculture, their mean score is 2.40 and rounded to 2 that categorizes to more catch. When asked on shell catch after the establishments of cage aquaculture, their mean score is 1.61 and rounded to 2 that still categorizes as more catch but with lesser extent as compared to before cage aquaculture establishments. This implies that Tubalan Cove has still more shell catch according to responses of respondents.

Table 7c. Gleaning Activity of Respondents

Frequently Caught Shell	Hours Spent gleaning in a day	Days spent gleaning in a week	Type of gleaning Gears Used	Comparison of Gleaning Catch "before" Establishment of Cage Aquaculture	Comparison of Gleaning Catch "after" Establishment of Cage Aquaculture
1=Sina, 2=Litub, 3=Tuway, 4=Wasaywasay, 5=others	1=1hr, 2=2hours, 3=3hours, 4=4hours, 5=5hours & above	1=1day, 2=2days, 3=3days, 4=4days, 5=days & above	1=guna, 2=tagad, 3=barehands	1=less catch, 2=more catch, 3=the same catch	1=less catch, 2=more catch, 3=the same catch
2.83	2.67	2.11	1.61	2.40	1.61
Tuway	3hrs in a day	2 days in a week	tagad	more	More

Respondent's Awareness Level to Preserve Tubalan Cove

Table 7d shows the mean scores of respondents in their awareness level. The rating scale is from 1 stands for low awareness and 5 for high awareness. In dynamite fishing, the mean score of respondents is 3.5 and rounded to 4 that categorizes as moderately aware. In poison fishing, the mean score is 3.97 and rounded to 4 that categorizes moderately aware. In fine mesh net fishing, the mean score is 3.82 and rounded to 4 that categorizes moderately aware. In water quality monitoring, the mean score is only 3.32 and rounded to 3 that categorizes aware only.

So far, the awareness level of respondents in the preservation of Tubalan Cove is higher which is equivalent to 80% ($^4/_5$) for dynamite, poison, and fine mesh net fishing. But for water quality monitoring, it has only 60% ($^3/_5$).

This is a challenge for BFAR, Malita LGU and SPAMAST Research Center to find ways in monitoring regularly the water quality of Tubalan Cove in order to prevent reaching the critical limit for life support system capacity of the cove. Regular info-disseminations can be conducted on the bad effects of so much establishments of cage aquaculture in the area through science based findings.

Table 7d. Respondents' awareness level to preserve Tubalan Cove

Dynamite Fishing 1=unaware, 2=poorly aware, 3=aware, 4=moderately aware, 5= much aware	Poison Fishing 1=unaware, 2=poorly aware, 3=aware, 4=moderately aware, 5= much aware	Fine Mesh Net Fishing 1=unaware, 2=poorly aware, 3=aware, 4=moderately aware, 5= much aware	Water Quality Monitoring 1=unaware, 2=poorly aware, 3=aware, 4=moderately aware, 5= much aware
3.50	3.97	3.82	3.32
Moderately aware	Moderately aware	Moderately aware	Aware

CONCLUSIONS

The following conclusions were derived as study findings:

1. Temperature, salinity, pH, and DO vary insignificantly in the three sampling stations.

2. Nokos (squid) are frequently caught fish, 4 hours in a day spent in fishing, 4 days a week spent in fishing, gill nets type of fishing gears mostly used, more catch before the establishment of cage culture, and slightly more catch after the establishment of cage aquaculture while Tuway was frequently caught in gleaning, 3 hours in a day spent in gleaning, 2 days spent in a week gleaning, tagad common type of gleaning gears, more catch on gleaning before the establishment of cage aqua-culture, slight more catch in gleaning after the establishment of cage aquaculture.

3. Respondent's awareness level on dynamite fishing is moderately aware, poison fishing is also moderately aware, fine mesh net fishing also moderately aware, and water quality monitoring is aware only.

RECOMMENDATIONS

The following recommendations were suggested as implications of the findings:

1. Close monitoring of water quality particularly those parameters that are beyond international standards be budgeted in close coordination with Malita LGU, BFAR, SPAMAST Research Center to have an advance prevention of possible occurrence of fish kill in Tubalan Mari-culture Park.

2. Formulation of policies for responsible governance for sustainable cage aquaculture production particularly on planning stage that includes zoning, carrying capacity, and siting.

3. Monitoring on the management aspects that includes licensing of fish cage operators, environment monitoring, production regulation, and ensuring

sustainability as to social and economic impacts of cage culture in a mari-culture park.

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East, H., & Jackson, B. (2001). *The social and cultural impact of short-term study-abroad strategies.* Chicago, IL, USA

Journal article
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Online document
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