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Continuance Commitment
Normative Commitment

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M. C. Lontoc

Perceived Organizational Culture and Organizational Commitment of Cavite State University's Faculty Members 30

A. B. Diato

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Local Community
Mahogany Trees

Indang

2000 ft





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For correspondence, write to:

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2000 ft



Carbon Storage Potential of Mahogany (*Swietenia* spp.) Forest in Cavite State University, Philippines: A Basis for a Carbon Mitigation Plan

Jose T. Collado¹, Daniel M. Sarmiento¹
and Glenn Bryan A. Creencia¹

*Department of Forestry and Environmental Science
College of Agriculture, Food, Environment and Natural Resources
Cavite State University, Indang, Cavite*

ABSTRACT

A tropical forest has a valuable role in relation to climate change being a source and sink of carbon. The study created a distribution map of mahogany found trees (*Swietenia macrophylla*) in Cavite State University; determined the morphometrics of mahogany trees in the university in terms of diameter at breast height (DBH) and height; determined the total carbon storage of mahogany trees in the university; determined the factors affecting carbon sequestration of the mahogany; and created a proposed carbon mitigation plan for the utilization and management of mahogany trees in the university. The height and diameter at DBH of all mahogany trees were measured. Allometric equation was used to calculate the carbon storage of mahogany trees. The location of mahogany trees was determined using Global Positioning System device. There are 3,402 mahogany trees inside the university. Majority of the mahogany trees have a diameter of 30 cm and there are 712 mahogany trees that have DBH below 30 cm. Mahogany forest covers about 7.32 ha of the total land area (76.19 ha) of Cavite State University and it cumulatively stored carbon amounting to 1,960.79 Mg C ha⁻¹. The height of mahogany greatly affected the carbon sequestration of mahogany trees since the growth of the tree indicates increasing biomass, thus, carbon is being stored in the body of the tree. CvSU contributed in carbon mitigation since there is a high density of forest found inside the campus.

Keywords: *carbon sequestration, carbon storage, morphometrics*

INTRODUCTION

Climate change is one of the concerns of the world today. Global surface temperature has increased by more than 0.8 °C since 1980 and average temperature has exceeded in the last century average every year (Global Change, 2017). Anthropogenic activities like burning of fossil fuels such as coal, oil, and gas, have caused an increase in the level of carbon dioxide (CO₂) in the atmosphere. Potential impacts of climate change include sea-level rise, increased wildfires, floods, droughts, tropical storms; change in amount, timing, and distribution of rain, snow and runoff; and disturbance of coastal marine and other ecosystems (Sunquist *et al.*, 2008). Moreover, carbon dioxide level increased by 46 percent in over 250 years (Hindustantimes, 2019), thus, mitigation and efforts, small or big scale, must be done in order to reduce the impacts of climate change. The Intergovernmental Panel on Climate Change (IPCC) emphasized that the impacts of 2.7

degrees Fahrenheit of global warming are far greater than the expected. This rise in the global temperature could happen within 11 to 20 years with the continuous emission of carbon dioxide (Leahay, 2018).

Carbon sinks on Earth like tropical forest play a significant role in harvesting large amounts of carbon from the atmosphere and has a big contribution in relation to climate change being a source and sink of carbon (Lasco & Pulhin, 2003; Ussiri & Lal, 2017). Carbon sequestration, a process by which atmospheric carbon dioxide is taken by plants through photosynthesis and eventually stored in the biomass and soils. Tree biomass stores carbon through photosynthesis, therefore deforestation lessen the number of carbon storage, that can reduce and slow down the process of global warming (Reicosky, 2008). Tropical forests contain about 25 percent of the world's carbon and the forest region of the world adds another 20 percent of the world's carbon (Yale University, 2019). Thus, managing forest resources and protecting these from

anthropogenic activities were recommended to achieve environmental sustainability (Sheikh & Kumar, 2010).

The Philippine forest ecosystem have always been the source and sink of carbon. The Philippine forest land have a great possibility to sequester and store carbon due to its immense and abundance of vegetation (Lasco *et al.*, 2004). In one of the studies in the Philippines, carbon storage of mahogany has been evaluated, since this species was used in reforestation program in the country. The Mt. Makiling Forest Reserve in Laguna has a mahogany transplantation and its carbon storage after a decade was evaluated to determine its contribution in climate change mitigation (Racelis *et al.*, 2019).

Cavite State University (CvSU) Don Severino de las Alas Campus is situated at Barangay Bancod, Indang, Cavite. CvSU has an area coverage of 76.19 hectares. The most abundant tree found inside the university is mahogany with 1,679 trees as of 2017 (CvSU-Environmental Performance Report & Management Plan, 2017). Mahogany (*Sweitenia macrophylla*) trees produce wood that is dense, and the tree that can hold its own in strong winds and makes it useful as a street tree (Spengler, 2019). Mahogany was first imported to Europe in 1724, and soon became known because of its different characteristics (Britannica, 2019) and can grow rapidly until it dominates an area by inhibiting the growth of other species or allelopathy, usually the native species (Bareja, 2012).

Objectives of the Study

The study primarily aimed to determine the carbon storage potential of mahogany forest found in Cavite State University.

Specifically, this study aimed to:

1. Create a distribution map of mahogany tree in the university;
2. Determine the morphometrics of mahogany trees in the university in terms of diameter at

breast height (DBH) and height;

3. Determine the total carbon storage of mahogany trees in the university;
4. Determine the factors affecting the carbon sequestration of mahogany trees in the university; and
5. Create a proposed carbon mitigation plan for the utilization and management of mahogany trees in the university.

METHODOLOGY

Study Area

Cavite State University (Figure 1) has an area coverage of 76.1891 hectares. The university is located in Indang, Cavite with a geographical location of 14°11'55.60" N and 120°52'51.63' E (CvSU-EPRMP, 2017).

Mapping of mahogany plantations in Cavite State University

A GPS device was used to get the coordinates of the mahogany trees in the university. ArcMap 10.4 was used to map the location of the distribution of mahogany trees in the university.

Tree categorization and classification

This study has covered all the mahogany trees that can be found in the study area. The trees were categorized based on their diameter at breast height (DBH) whether they are sapling (<10cm), poles (10-30cm), and standard (>30cm) (Maclauchlan, 2009).

Diameter at breast height (DBH) measurement

To determine the DBH of the trees, 1.3 m was measured above the soil surface, except when the trunk has irregularities. When there are two trunks, the DBH was measured as the average of

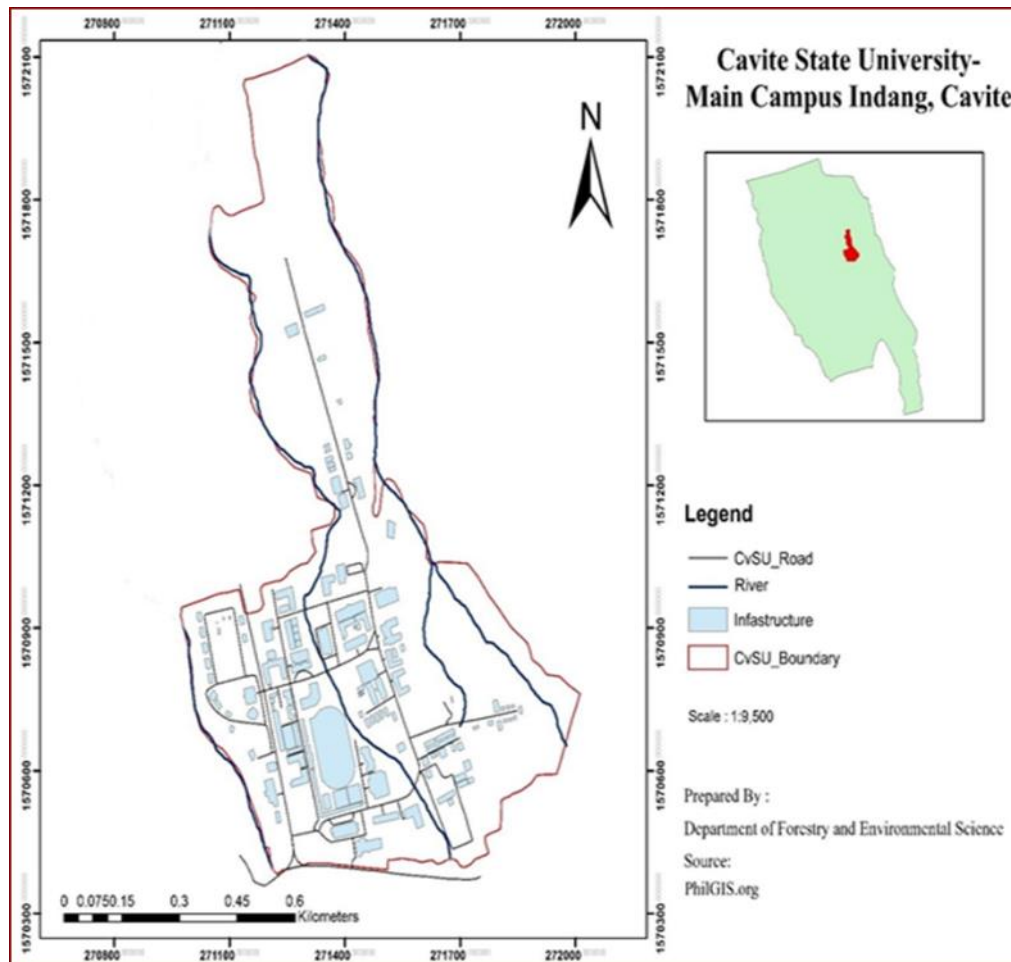


Figure 1. Cavite State University - Don Severino de las Alas Campus Indang, Cavite (CvSU-EPRMP, 2017)

the two trunks. Tape measure was used to obtain the DBH (Hairiah *et al.*, 2001).

Tree height measurement

A rangefinder was used to determine the angle to the tip of the tree based on a fixed distance from the sampled tree. The tree height can be determined according to the scale reading on the clinometer (Hairiah *et al.*, 2001).

Computation of aboveground biomass (AGB) of Tree

The biomass was estimated using allometric equation. Aboveground biomass was calculated by multiplying the bio-volume to the green wood density of the species. Tree bio-volume (T_{BV}) value was calculated by multiplying the diameter and height of the tree species to factor 0.4.

$$\text{Tree Bio-volume } (T_{BV}) = 0.4 \times (D)^2 \times H$$

$$\text{Aboveground Biomass (AGB)} = \text{wood density} \times T_{BV}$$

where:

T_{BV} = Tree bio-volume

AGB = Aboveground Biomass

D = diameter

H = height

whereas:

Diameter in meter (D) = GBH/π

H = height (meter)

Wood density was obtained from the Global Wood Density Database (Dryad, 2009). The standard average density of 0.6 g/cm^3 is applied whenever the density value is not available for the tree species (Zanne *et al.*, 2009).

Computation of belowground biomass (BGB)

The belowground biomass was calculated by multiplying the aboveground biomass by 0.26 factors as the root and shoot ratio. It excludes fine roots having < 2mm diameter (Hangarge et al., 2012).

$$\text{Belowground Biomass (BGB)} = \text{AGB} \times 0.26$$

where:

BGB= belowground biomass

AGB= aboveground biomass

Computation of total biomass

The total biomass was calculated by adding the aboveground biomass and belowground biomass (Sheikh et al., 2011).

$$\text{Total Biomass} = \text{AGB} + \text{BGB}$$

where:

BGB= belowground biomass

AGB= aboveground biomass

Estimation of carbon on trees

According to Pearson, Brown, & Birdsey (2005), generally, 50 percent of the biomass of trees is considered as carbon.

$$\text{Carbon storage} = \text{total biomass} \times 50\%$$

Computation of tree biomass density and carbon stored was calculated using the following equations (Lasco & Pulhin, 2003):

$$\text{Tree Biomass Density} = \text{tree biomass} / \text{sample area in hectare}$$

$$\text{Carbon Stored (MgC}^{\text{ha}^{-1}}) = \text{tree biomass density} \times \text{Carbon content}$$

where:

$$\text{MgC}^{\text{ha}^{-1}} = \text{Tonne}$$

Statistical analysis

The non-linear models were used to determine the carbon sequestration potential of mahogany trees in Cavite State University. The basic biomass model consists of estimating the components of the model.

$$\text{Nonlinear: } Y = X^{\beta} + \varepsilon$$

where:

Y = observed tree biomass

X = predictor variable (diameter, height)

β = model parameter

ε = error term

RESULTS AND DISCUSSION

Mahogany Trees in Cavite State University

Cavite State University - Don Severino de las Alas Campus has a wide distribution of mahogany trees with a total cover of 7.32 hectares (Figure 2). The mahogany trees dominated the riparian area within the vicinity of the university. There are 3,402 mahogany trees based on the conducted total enumeration of mahogany trees (Table 1). The enumerated trees are classified based on their diameter at breast height; 2,690 trees have a diameter of 30cm and 712 trees have DBH below 30cm (Figures 2 and 3).

Diameter at Breast Height and Height of the Mahogany Trees

Table 2 shows the structural parameters of the morphometric profile of mahogany trees. The

morphometrics of trees predict the carbon storage of a tree.

Each tree species plays an important role in carbon sequestration. The mahogany tree is the most abundant tree based on the CvSU Environmental Performance Report and Management Plan (2017). Being dominant, mahogany absorbs high amounts of carbon dioxide compared to other tree species that has low population. The amount of carbon stored in a forest is based on the size and the age of the tree; the older trees have low rate of carbon sequestration (Sheikh & Kumar, 2010).

Biomass of Mahogany Trees

Forest biometrics increase the demand for the accuracy and precision in quantitative approaches for computing the carbon sequestration potential. Biometric is important for forest measurement as tool of forestry science (Oregon State University, 2011). Half (50%) of the biomass of trees is considered as carbon

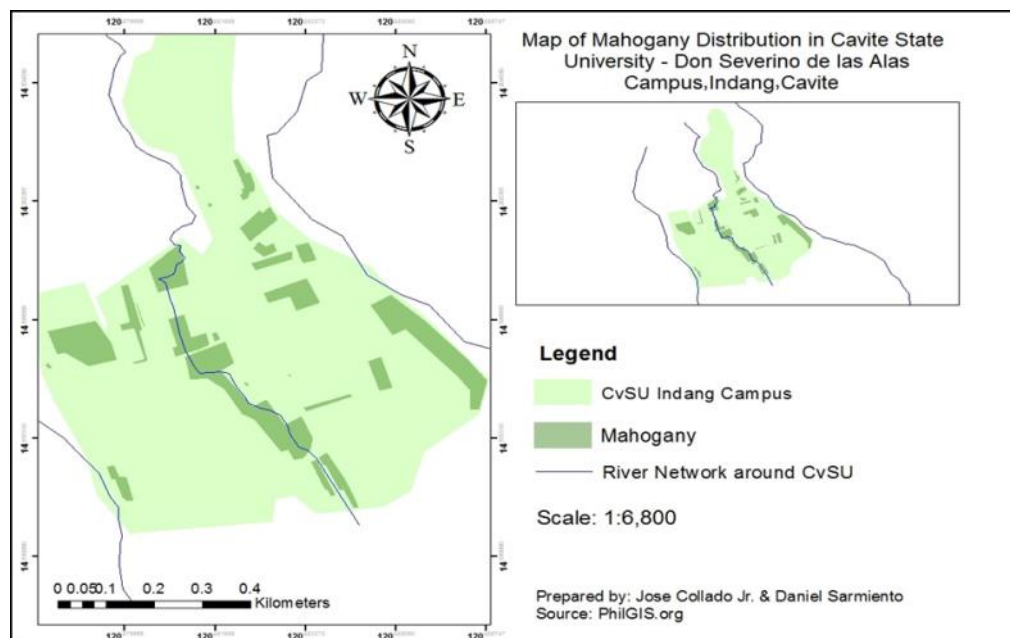


Figure 2. Map of mahogany distribution in Cavite State University-Don Severino delas Alas Campus, Indang, Cavite

according to Pearson, Brown, & Birdsey (2005) as cited by Suryawanshi, Patel, Kale, & Patil (2014). Table 3 shows the forest biometrics of mahogany trees. The aboveground and belowground biomass of trees account for the total carbon stored by the mahogany trees.

Initiative of the university in conserving trees within the campus is essential and CvSU's efforts in planting trees inside the campus lead to a total carbon storage of 1,960.79 Mg C ha⁻¹. In a study conducted at the Mt. Makiling Forest Reserve in

Laguna, Philippines, the mahogany plantation present in the area has a total carbon storage of 542.58 Mg C ha⁻¹ for the 387 trees inventoried (Racelis et al., 2019). Similarly, in other countries like Taiwan, the man-made forest present in the area was evaluated based on its carbon storage and the study showed that the Taiwan red cypress forest has a total carbon storage of 68.85–96.81 Mg C ha⁻¹ and Japanese cedar has a total carbon storage 101.14–164.80 Mg ha⁻¹ (Yen and Wang, 2013). Carbon storage cannot be materialized or monetized, thus it is

Table 1. Tree categorization

TREE CATEGORIES	NUMBER OF TREES	PERCENTAGE
Sapling > 10cm	601	17.67%
Poles 11 - 29cm	1,977	58.11%
Standard < 30cm	824	24.22%
TOTAL	3,402	100%

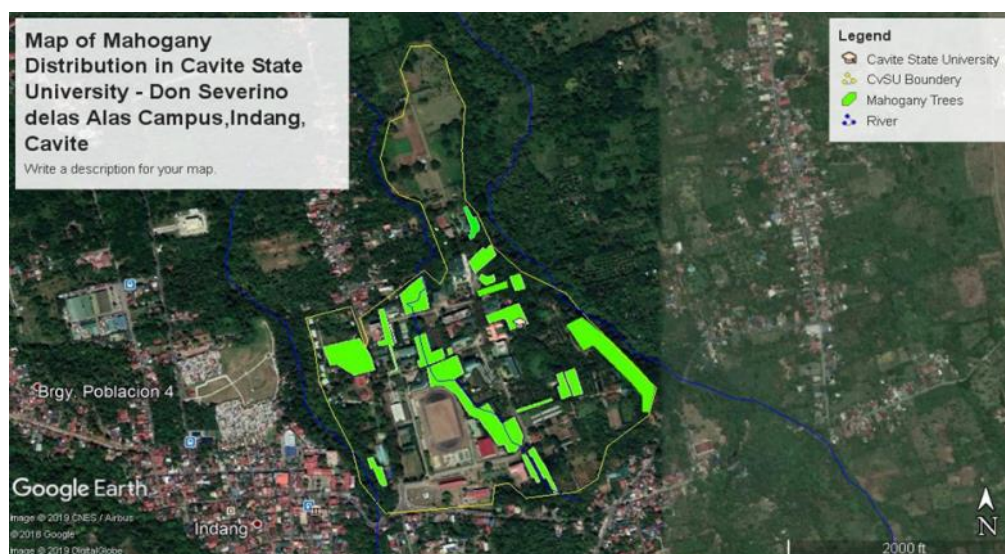


Figure 3. Map of mahogany distribution in Cavite State University-Don Severino delas Alas Campus, Indang, Cavite (Google Earth Pro)

Table 2. Morphometric profile of mahogany trees in Cavite State University

STRUCTURAL PARAMETER	MEAN \pm STANDARD DEVIATION
Diameter at Breast Height (cm)	21.16 \pm 9.99
Height (m)	8.20 \pm 2.95
Tree volume (kg cm ²)	1467.47 \pm 117.93

Table 3. Carbon sequestration of mahogany-dominated vegetation

FOREST BIOMETRICS	TOTAL
Total Biomass	Tonnes
Aboveground Biomass	3,778,568.32
Belowground Biomass	982,427.76
Tree Biomass Density	650.41
Carbon Content	2,380.50
Carbon Storage	1,960.79

undervalued; However, a tree census could form the basis for carbon management program (De Villiers, 2014).

Carbon Sequestration Modelling

Figure 4.0 and 4.1 show the nonlinear model of the diameter at breast height and height of the mahogany to its biomass. The graphs show that the height of the trees predicts its biomass more than the DBH does. Thus, the carbon sequestration of trees is highly affected by the height of the tree rather than the diameter at breast height which is contradicting with the consistent findings of other studies which show that DBH is the predictor of carbon storage of trees. This is evident in the study of Afzal & Akhtar (2013) where DBH is proved to be a highly significant factor affecting carbon sequestration in a tree. In view of advances in

describing productivity of trees, no consensus exists about the nature of productivity at the scale of the individual tree (Stephenson et al., 2014). However, it is still evident that the growth of the trees including height, ring width, and basal increment contribute to carbon storage of trees (Sillett et al., 2010), thus, larger trees fix large amount of carbon than the smaller trees (Stephenson et al., 2014).

Table 4 shows the regression model diagnostics. This model formulates assumptions and investigates whether or not there are observations with a large analysis. Carbon sequestration based on DBH was 15, 015 and the carbon sequestration based on the height was 3, 733. Based on the value of Akaike Information Criterion (AIC), height has a lower value than DBH. Therefore, the higher the height of the tree, the higher its carbon sequestration.

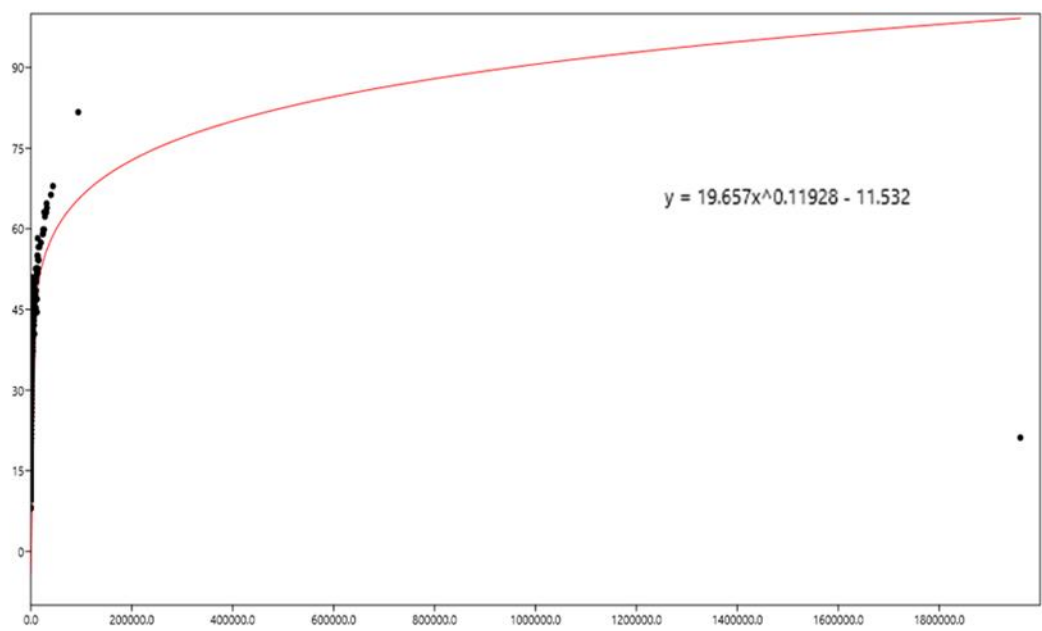


Figure 4.0. Nonlinear Model of the Carbon Sequestration vs. DBH of Mahogany

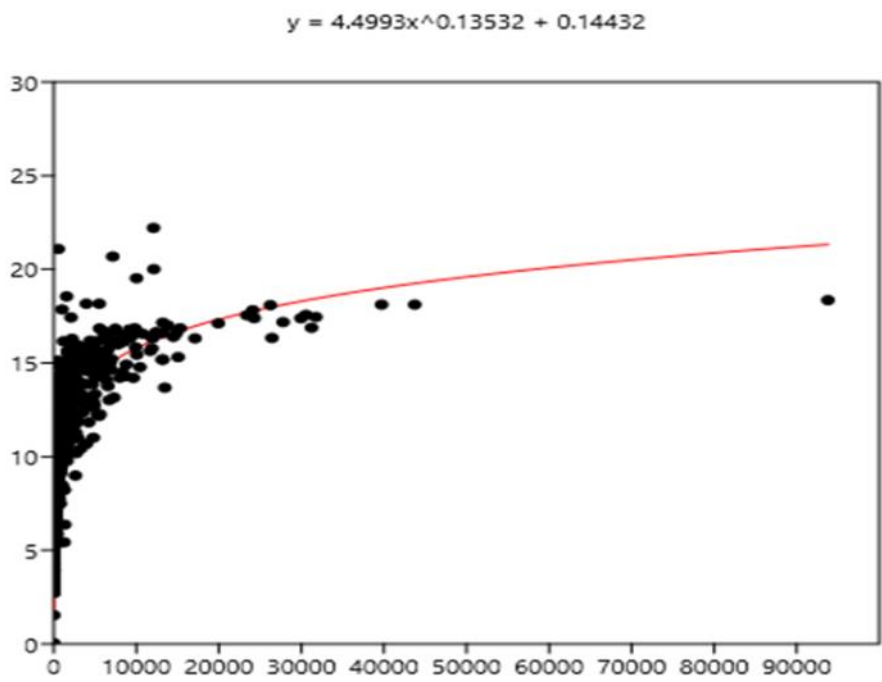


Figure 4.1. Nonlinear Model of the Carbon Sequestration vs. Height of Mahogany

Table 4. Regression model diagnostics

MODEL	AKAIKE INFORMATION CRITERION (AIC) VALUE
1 (Carbon Sequestration-DBH)	15015
2 (Carbon Sequestration-Height)	3733

*Lesser AIC means robust or best model.

Proposed Carbon Mitigation Plan

This plan is proposed to evaluate the different options on how to utilize the mahogany trees found inside the university since it is considered now as an invasive alien species (IAS). Table 5 shows that the best option for carbon mitigation plan is Plan B, to cut all mahogany trees for furniture production. Based on the impact categorization, Plan B will provide a livelihood from furniture. Moreover, there will be minimal emission of carbon and high economic benefit. Furniture making preserves the body of the tree and prevent release of carbon into the atmosphere. Plan A is almost the same as Plan B, but instead of making furniture, it just produced logs for other purposes. Plan C, charcoal production is not recommended as an option for carbon mitigation plan since it releases a high amount of carbon back to the atmosphere.

CONCLUSIONS

Based on the results, the following conclusions were drawn:

1. The university has a wide distribution of mahogany trees with a total cover of 7.32 hectares.
2. There are 3,402 mahogany trees based on the conducted total enumeration of mahogany trees. The enumerated trees are classified based on their diameter at breast height; 2,690 trees have a diameter of 30cm

and 712 trees have diameter below 30cm.

3. Mahogany forest covers about 7.32 ha of Cavite State University and it stored carbon amounting to 1,960.79 tons. These trees served as carbon sinks in the university, thereby contributing to climate change mitigation. Cavite State University houses different species of trees and eventually be a carbon sink.
4. Carbon sequestration modelling through non-linear modelling shows that the height of the mahogany tree affects the tree biomass.
5. Carbon mitigation plan for mahogany forest is essential for decision making. Charcoal production as an option in carbon mitigation is not advisable to do since it releases high amounts of carbon back to the atmosphere since it involves combustion process. Moreover, this option has a low economic benefit. Cutting all mahogany trees for furniture production is the most recommended. It will provide a livelihood from furniture and shall cause minimal emission of carbon and high economic benefit.

RECOMMENDATIONS

It is recommended that the carbon storage assessment of all the trees found inside Cavite State University be conducted to determine their potential as good carbon sinks that can help

OPTION	SET UP REQUIREMENTS	EXECUTION	ESTIMATED BUDGET	EXPECTED ACTION	PRESENCE OF CARBON EMISSION	IMPACT
Plan A- Cut all mahogany trees for log production	Tools -manpower -power saw	1-3 months	Php 100,000	Sell the logs	Yes	Minimal emission of carbon to the atmosphere; high capital cost; less economic benefit
Plan B- Cut all mahogany trees for furniture production	Tools -manpower -power saw	1-3 months	Php 100,000	Make a furniture and sell	Yes	Minimal emission of carbon to the atmosphere; high capital cost; higher economic benefit
Plan C- Charcoal production out of all mahogany trees	Tools -manpower -power saw	3-6 months	Php 50,000	Produce charcoal and sell	Yes	Higher emission of carbon to the atmosphere; low capital costs; less economic value
Plan D- Planting of mahogany	Tools -manpower	1-2 months	Php 20,000	Become more invasive	No	No emission of carbon to the atmosphere; low capital cost; no return of investment
Plan E- let the mahogany tree grow		None	None	Become more invasive	No	No emission of carbon to the atmosphere; no capital cost; no return of investment

Impact categorization: best- green; good- yellow; fair- red

mitigate climate change. It is also suggested that the carbon mitigation action plan be considered for decision making regarding the utilization of mahogany trees inside the university since it is considered as an invasive species. Cavite State University must continue planting trees inside the campus and plan tree planting activities wisely to avoid conflict with the future plans of the university. CvSU must not use invasive alien species in tree planting activities instead plant native and endemic trees. Moreover, planting trees must be practiced by different institutions to contribute in combating climate change as a global challenge.

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Leadership Styles and Management Techniques of Chiefs of Police in Region IV-A

Marissa C. Lontoc
College of Criminal Justice
Cavite State University, Indang, Cavite

ABSTRACT

It is essential that chief of police plays two roles in police organization: a leader and a manager. Careful examination on how police leadership and management shape the structure, practices, and performance is needed in the field of law enforcement. This is an assessment of Philippine National Police (PNP) officers' leadership and management techniques particularly the Chiefs of Police in local cities in Region IV-A or CALABARZON (Cavite, Laguna, Batangas, Rizal, Quezon) Region among the police chiefs themselves, their subordinates, and the community officials. A questionnaire developed by the researcher was used to determine the chief of police leadership style and management techniques. Descriptive statistics such as weighted mean, frequency and percentage were used to obtain the leadership style and management technique of chiefs of police in Region 4-A. While Kruskal Wallis test statistics was used to test the differences among the respondents' assessments on the leadership style and management techniques.

The chiefs of police assessed themselves as transformational leaders who have heart for their subordinates by setting themselves as providers, mentors and supporters. Subordinates and community members see their chiefs of police as transactional leaders who faithfully adhere to standard operating procedure and legitimacy. Among the management techniques, directing is mostly felt by the subordinates in view of the fact that chiefs of police direct their subordinates while setting themselves as an epitome of valor and excellence. A highly significant difference on the leadership styles of police was noted. Likewise, there is a highly significant difference on the management technique of chiefs of police.

A developed framework geared towards improving chief of police leadership style was highlighted in this study.

Keywords: *chief of police leadership style, chief of police management techniques, enhancement program for chief of police leadership styles and management techniques*

INTRODUCTION

Several studies have been conducted to specifically reveal the characteristics that police leaders must possess (Pearson-Goff & Herrington, 2013). Among the characteristics that have been identified, leadership was the most important skill followed by communication and decision making (Dantzker, 1996). Batts, Smoot and Scrivner (2012) define leadership as "the act of moving people, organization, and/or processes to preferred states of being." They add that in policing, leadership means making a change towards an improved and productive police operation. They also define leadership according to policing context which means

"exercising command authority in time of crisis". Leadership entails supervisory style of police leaders which has huge impact on police management (National Institute of Justice, 2003).

In the United States, the National Institute of Justice (2003) presented research findings showing that frontline officers such as sergeants and lieutenants' impact on the behavior of patrol officer; however, impact may vary according to the supervision style of frontline officers. The paper highlighted that "active" supervisory style which means "leading by example" is found to be the most effective style influencing patrol officers. Active style demonstrates the leader could take the risk – if it's safe for Serge then it is safe for me, too. Hence, the police administration could

positively attain its goal with smooth alignment of frontline officers to patrol officers.

In Australia, Sarver and Miller (2014) conducted a study which aimed to determine the relationship between leadership style and demographic profile of police chief. Among the styles, the most preferred and the most effective style noted was transformation style of which leaders had confident, energetic, and open-minded attitude towards police administration.

In the Philippines, Kiunisala, Guiam, and Cabanlit (2004) attempted to describe the crime prevention campaign and leadership styles of police precinct chiefs in General Santos City. As regards leadership style, it was found out that police chiefs were considered consultative type of leaders. Subordinates would prefer to have a leader who consults peers, subordinates, local officials before making a decision.

On the other hand, Hess and Orthmann (2012) introduced management in their book titled *Management and Supervision in Law Enforcement*. They identify management as the process of utilizing resources in order to attain the goal of the organization. In the context of law enforcement management, it is about the process that includes decision making on what goal and objective to do, implementation of a work plan, utilization of resources which are factors that impact on high work efficiency. Management is undertaken by managers.

Based on the definitions, leadership and management are related but two different concepts. The two giants in police leadership and management studies have actually made a distinction between the two. This distinction was first discussed in the now seminal and foundational article by Abraham Zaleznik in 1977. He mentioned that leaders promote change, new approaches, and work to understand people's beliefs to gain their commitment while managers promote stability, exercise authority, and work to get things accomplished. Bennis (1989) elaborated that leaders aim to innovate new practices in an organization, discover new solutions to problems, are people – oriented, give

emphasis on long –term problems, and try to bring down status quo. However, managers according to him, implement current practices in an organization, implement existing solutions to problems, are focused on orders and systems in an organization, give emphasis on short – term problems, and maintain the status quo.

In Mastrofski's (2006) paper entitled "Police Organization and Management Issues for the Next Decade", managers and leaders are used interchangeably. In his discussion about issues in police leadership and management, police chief should perform leader and manager. He adds that police chief selection is a crucial decision in police administration. Unlike any type of leaders in a private company or organization that look after profit, police chief has substantial influence towards the performance of the organization. Police chief's role encompasses his ability to change the practices from the predecessors. Mastrofski (2006) insists that it is deemed necessary to conduct studies about police leadership in order to identify their best practices and their contribution specifically during a reform which could happen over time.

It is essential that chief of police plays two roles in police organization; a leader and a manager. Although it is found to be difficult to acquire; these characteristics are both needed to ensure that the organization operates effectively and efficiently.

In the development of different qualities of leadership style, Lewins (1939) categorized and described three types of leadership: transformational, laissez faire and transactional leadership.

In contrast, to achieve the vision and mission of the organization, identification of management techniques is highly important to distinguish. These are: planning, organizing, directing and controlling.

Careful examination on how police leadership and management shape the structure, practices and performance is needed in the field of law enforcement. As Mastrofski (2006) mentions,

“there is not much rigorous research on police leadership”. This observation seems to hold true even in the Philippine context. Apparently, only few studies have been conducted about the police leadership and even fewer studies, if none at all, were conducted about the police leadership and management techniques in the country.

Hence, this study aimed to fill that gap by doing a rigorous analysis of Philippine National Police (PNP) officers’ leadership and management techniques particularly the Chiefs of Police in Region IV-A or CALABARZON (Cavite, Laguna, Batangas, Rizal, Quezon) Region.

METHODOLOGY

Research Design

The quantitative method using the descriptive correlation research design was used in this study. Numerical data were obtained through a survey.

Research Population and Sampling

There were three groups of respondents in this study. The first group of respondents was composed of 19 chiefs of police (commissioned officers) in Region IV-A. The second group of respondents was composed of 160 (non-commissioned officers) selected police officers in Region IV-A. While, the third group of respondents was composed of 135 community members represented by city and barangay officials of Region IV-A.

The first set of respondents was determined through complete enumeration technique. All the 19 chiefs of police in the cities of Region IV-A were included in the study since the researcher wanted to make the data more generalizable among the police officers in the region. The second set of respondents was selected through stratified random sampling to ensure that each province in the region was well represented. The

convenience sampling was utilized in selecting the third set of respondents since the researcher did not have enough resources and time to cover those who live far from the center of the cities in the region. Therefore, only those accessible to the researcher at the time the study was conducted and were considered.

Research Instrument and Validation

The survey questionnaire developed by the researcher was used as the main data gathering tool of this study. This was divided into three parts. The first part inquired on the demographic profile of the respondents. The second part assessed the leadership style of PNP chief of police while the third part determined the management techniques used by the PNP in terms of: planning; organizing; directing and controlling.

The content and construct validity of the said questionnaire were ensured by a psychometrician, three (3) selected police chiefs and two (2) community members. Those who validated the instrument were excluded as respondents of this study. Likewise, the survey questionnaire was found to be highly reliable (125 items; $\alpha = .86$).

Data Gathering Procedure

A formal letter asking permission for the conduct of the study was sent to the Regional Director PRO-CALABARZON. Upon approval, the survey was initiated.

For PNP, the survey was conducted in every city police station in Region IV-A. There were approximately 19 city police stations in the entire CALABARZON broken down as follows: 7 in Cavite; 6 in Laguna; 3 in Batangas; 1 in Rizal; and 2 in Quezon.

For the community, as the third set of respondents, the survey was also conducted in each city of CALABARZON: 7 in Cavite; 6 in Laguna; 3 in Batangas; 1 in Rizal; and 2 in

Quezon.

After the distribution of questionnaire, these were then retrieved and subjected to statistical treatment and evaluation. This was analyzed and interpreted to develop framework for PNP leadership.

Statistical Treatment of Data

The following statistical tools were used in this study:

1. Descriptive statistics such as Weighted Mean, Frequency Distribution, and Percentage were used to obtain data on the chiefs of police leadership style and management technique.
2. The inferential statistics, Kruskal Wallis test, on the other hand, was used to test the differences among the respondents' assessments on the leadership style and management techniques of chief of police in Region IV-A.

RESULTS AND DISCUSSION

Leadership Styles of Chief of Police in the Philippines

Chiefs of police believe that of the three styles of leadership, they identified themselves most as transformative leaders. They have the characteristics of attending the need of subordinate (individualized consideration); giving empathy and support (charismatic leadership); respecting and recognizing individual intellectual contribution (intellectual stimulation); and acting as mentor and coach (inspirational leadership). For Dobby (2004) police chiefs could actually be considered transformational leaders only if they have the characteristics of achieving a high-quality service to community and subordinates; display high personal and professional standards; genuine concern for subordinates well

-being, development and acknowledgment of their work and accomplishment.

Interestingly, their subordinates and the community members could attest much to this perceived leadership style of the chiefs of police. Both felt that the chiefs of police may be supportive in moral aspect and are respectful of individual contribution for the team but would like to get followed according to their own ideas.

This seems to reflect what Grint (2005) argues for the need to have a social interaction between the police chiefs and their subordinates in its truest sense. Grint suggests that it is not enough for the leaders to have emotional intelligence and charisma, but more so, they must be able to be truly welcoming of the subordinates' ideas.

Also, the perception of both the subordinates and the community members verifies what Tourish (1998) argues about the danger of a transformational leader. He claims that this type of leadership puts too much power on the leaders and makes the subordinates passive readily to commit themselves without demur.

All of these points are focused on the drawbacks of transformational leadership style. In fact, Bass (1990) as cited by Cockroft (2014), claimed that transformational leadership is flawed. He added that while it aims to improve the overall police culture, it is not an appropriate solution for every organization. Cockroft (2014), likewise, said that "there is a need to acknowledge that policing covers a wide range of roles within increasingly complex organizational environments" (p.16). Therefore, that one form of leadership will be universal across different organizations is improbable.

The chiefs of police, apparently, have a recognition of this. In fact, though they claim that they are transformational leaders, they still think, that at the same time they are also laissez faire and transactional leaders.

Chiefs of police also perceived themselves as laissez faire leaders. They believe in freedom of

choice for the employees, leaving them alone so they can do as they want (Goodnight, 2011). But, subordinates and community officials suggest that the chiefs did not totally allow subordinates to work without their guidance. There may be cases that chiefs designated duties which would allow the subordinates to work independently, but in most cases the chief would still be in around barking orders to them as they do their jobs.

Chiefs of police likewise, assessed themselves as transactional leaders who rewards or disciplines the subordinates depending on the adequacy of the follower's performance (Franco & Matos, 2015).

Chiefs of police described themselves as leaders that focused more on reward than punishment (contingent reward). Similarly, both subordinates and community official were in the same vein of their chiefs' leadership style. They also confirmed that the chiefs were characterized by legitimacy which means performances must be based on standard operating procedures (active management by exception).

It is important to note that all groups revealed that chiefs of police may not be characterized as a transactional leaders dubbed "fault-finder" (passive management). Both subordinates and the community members claim that the subordinates do not get punished when their performance quality or quantity falls below production standards. Thereby making their mistakes and shortcomings unchecked.

Management Techniques of Chiefs of Police in Philippines

Chiefs of police perceived that they highly observe planning in their management technique. This refers to the "what", "how", and "when" of performance. It is making a decision in the present about the future objectives (Pal, 2011). It also covers evaluation and feedback from the stakeholders.

Both their subordinates and the community members do seem to agree this chief of police claim. However, both think that chiefs of police do not recognize the significance of the feedback of subordinates and other stakeholders who are involved in the implementation of plans that much.

Murphy and Drodge (2004) argue that when the leaders make their subordinates feel that they matter, the quality of their performance and service to the community improve drastically. Therefore, leaders must make a conscious effort to ensure that their subordinates perceive them positively.

On the other hand, neglecting the public's engagement in the achievement of the organizational goals is detrimental (Currie & Lockett, 2007). They argue that only when the public are fully involved that they get to fully commit themselves to the attainment of these goals. This implies the need for the leaders to also make the community members feel that they have a bearing on the organization.

Another management technique apparently used by the chiefs of police is organizing. It is the function of management that involves developing an organizational structure and allocating human resources to ensure the accomplishment of objectives (Pal, 2011). They claim that they would rely on a subordinate who they knew could do well their assigned task. The findings of the present study confirm Gottschalk and Glomseth's (2012) conclusions that police leaders identified themselves as more personnel leaders and their actual practices revealed that they are more of a resource allocator. Such management entails making decisions about who should do what and when.

However, both the subordinates and the community members, likewise, could not attest much to this. The subordinates think that the chiefs of police do not place the right individual at the right job most of the time. While the community members think that chiefs of police rarely delegate authority to subordinates.

Moreover, directing as a management technique is mostly claimed to be used by the chiefs of police themselves. Directing is the function of leading the subordinates to perform efficiently and contribute their optimum to the achievement of organizational objectives (Pal, 2011).

Both their subordinates and community members have a reservation regarding the chiefs of police claim that they practice directing by setting as a good example. The subordinates claim that chiefs of police do absolutely oversee the work performance of subordinates. Meanwhile, the community members have an observation that chiefs of police tend to give direction based on what has been planned and organized. Johnson (2017) study "leading by example" described that supervisor may have an impact on work of their subordinates by having direct participation to their subordinates' activities. With this, chief may not only lead them to accomplish task and attain organizational objectives but also supervises individual subordinate's performance.

Finally, controlling as a management technique seems to be popular among police chiefs as well. "Controlling is done by "ensuring that the divisional, departmental, sectional and individual performances are consistent with the predetermined objectives and goals" (Pal, 2011).

However, both the subordinates and the community members were not fully resolved with the idea that the chiefs of police absolutely employ controlling as a management technique. The subordinates claim that the chiefs of police tend to be lenient as they do not bother to discover reasons/causes of deviation from their organization's goal most of the time. Community members, on the other hand, claim that chiefs of police do not absolutely control any deviation from the plan.

Proposed Framework

It is important that PNP would have series of enhancement trainings to chiefs of police for them to acquire positive characteristics of different leadership and management styles that

would be relevant in their subordinates and community. In order to acquire good leadership and management style, this study conceptualizes a paradigm that PNP may use during their leadership training and team building.

As seen in Figure 1, the primary style that the chiefs of police should employ among their subordinates and community is the transactional leadership style. These types of leaders faithfully follow vision, mission, principles and doctrines of the organization. As a result, subordinates and community would do the same as they wholeheartedly accept all the decisions which adhere to the doctrines of the organization. Furthermore, a transactional leader would have a system called contingent reward wherein rewards are given for carrying out well a task. Contingent reward may be in the form of promotion, bonus and increment. With this practice, it opens a type of leadership which motivates the subordinates to achieve higher level of performance. Transactional type follows transformational type. Transformational type of leaders that motivate subordinates and community members through praise. It has four components such as 1) charismatic leadership; 2) inspirational motivation; 3) intellectual stimulation; and 4) individualized consideration. Chiefs of police may possess any of the four components. They can be charismatic leaders who are emulated by subordinates and community because of their good deeds. They can also be leaders who serve as inspiration to subordinates and community through arousing them to attain the shared goals of PNP. Another side of transformational leaders are those who can stimulate creativity and resourcefulness of the subordinates and community. In addition, another good point of transformational leaders are those who act as coach and mentor which focused on discovering the best abilities of the subordinates. The last type of leadership which is not much recommended in any organization is called laissez-faire leadership. However, this paper still takes on the positive effect of this type of leadership. It must be executed wisely through mutual discussion among the police chiefs, their subordinates, and the community members.

Chiefs of police may gradually release their subordinates and the community members by offering them additional task whereby beginning to function as pseudo-managers in a participatory manner or with police chief intervention. As laissez-faire leaders, chiefs of police must guide, counsel, direct, instruct and share job information to train their subordinates and the community members to reveal their best abilities. In addition, gradual release should be followed by documented decision-making capabilities of the pseudo-managers to prove their true ability. Once they are fully trained and are proven to give sound decision, subordinates and community

members may be empowered to make decision but within the agreed boundaries cited in the standard operating procedure of the organization. This means that the cycle goes back to transactional type of leaders; thus, subordinates and community members will be acquiring the same structure of leadership style as portrayed by the chiefs of police.

This proposed paradigm is reflective of what Hersey, Blanchard, and Johnson (2000) said, "leaders do not have just one style of leadership, but rather have many varying styles".

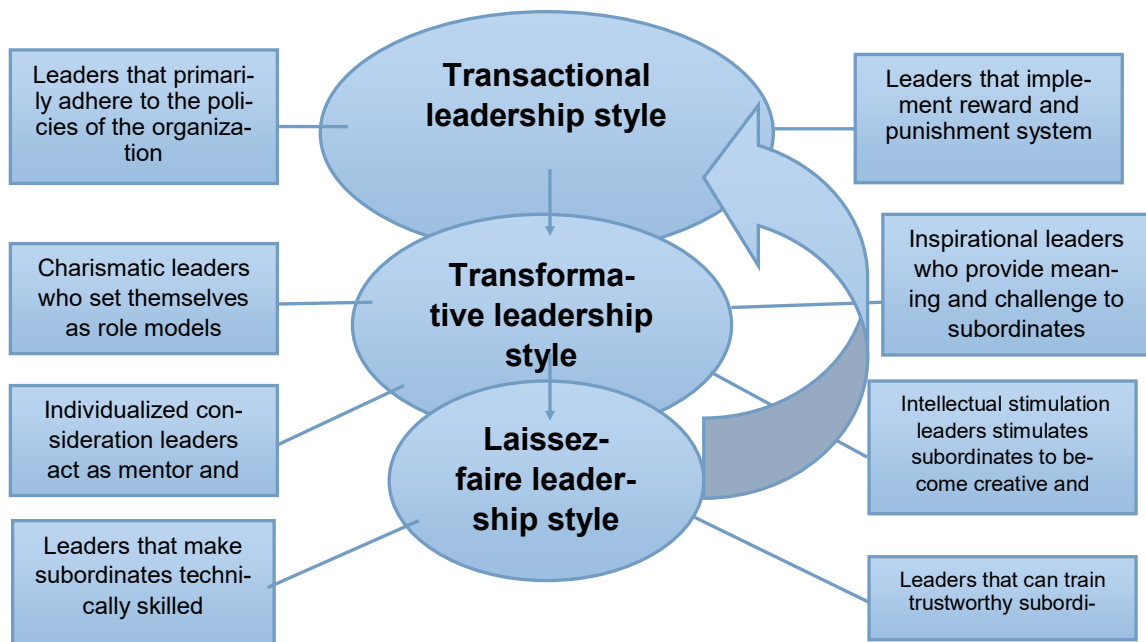


Figure 1. Proposed Framework for Leadership Styles

CONCLUSION

Chiefs of police are aware of the positive influence of being transformational leaders. As much as they would prefer to be judged as leaders who “inspire and intellectually stimulate their followers” (p48.), as this is one characteristic of transformational leader according to Masal (2014), both subordinates and community view police chiefs as leaders that are not open-minded to accept others’ ideas. It is noteworthy that among the three leadership styles, chiefs of police view themselves with the characteristics of transformational leaders, but this kind of leadership is not applicable in every situation. With this, leadership style varies according to what is needed: for transactional, chiefs of police value more of rewards than punishment and they claim that they follow religiously the standard operating procedure; and for laissez faire, there are times that subordinates impose a decision, but this is rarely practiced.

Chiefs of police follow a directing management style which may make the subordinates to function at their best; however, subordinates see chiefs of police as unaware of their deviance resulting in low capability of the chiefs to control the subordinates’ shortcomings.

The sophisticated roles of chiefs of police implicate the need of a solid ground on leadership and management. In every single role, there is one specific and appropriate action that they should execute. With this, there is no single style that should be possessed by police chiefs but various styles which is practiced that is reflective of their trainings and experiences.

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Table 1. Mean Analysis of Transformational Leadership Style of Police Chief in Region IV-A

Statement	Police Chief	Verbal Response	Verbal Interpretation	Subordinate	Verbal Response	Verbal Interpretation	Community	Verbal Response	Verbal Interpretation
The Chief of Police...	Mean Score			Mean Score			Mean Score		
1. Attends to the needs of subordinates.	4.83	Strongly Agree	Very High	4.10	Agree	High	4.29	Strongly Agree	Very High
2. Acts as mentor to subordinates.	4.67	Strongly Agree	Very High	4.10	Agree	High	4.25	Strongly Agree	Very High
3. Coaches subordinates on how to do their job efficiently and effectively.	4.67	Strongly Agree	Very High	4.16	Agree	High	4.23	Strongly Agree	Very High
4. Considers unexpected situations as opportunities to learn.	4.58	Strongly Agree	Very High	4.12	Agree	High	4.17	Agree	High
5. Gives empathy and support to the subordinates.	4.83	Strongly Agree	Very High	4.17	Agree	High	4.25	Strongly Agree	Very High
6. Keeps the communication open.	4.75	Strongly Agree	Very High	4.15	Agree	High	4.25	Strongly Agree	Very High
7. Respects and recognizes individual contribution for the team.	4.75	Strongly Agree	Very High	4.18	Agree	High	4.21	Strongly Agree	Very High
8. Contributes in the creation of culture of aspirations for self-development and intrinsic motivation to the task among his/her subordinates.	4.50	Strongly Agree	Very High	4.12	Agree	High	4.10	Agree	High
9. Solicits subordinates' ideas.	4.58	Strongly Agree	Very High	4.08	Agree	High	4.05	Agree	High
10. Encourages creativity of the subordinates.	4.67	Strongly Agree	Very High	4.11	Agree	High	4.07	Agree	High
TOTAL	4.68	Strongly Agree	Very High	4.13	Agree	High	4.19	Agree	High

Legend

1.00 – 1.79	Strongly Disagree	Very Low
1.80 – 2.59	Disagree	Low
2.60 – 3.39	Undecided	Uncertain
3.40 – 4.19	Agree	High
4.20 – 5.00	Strongly Agree	Very High

Table 2. Mean Analysis of Laissez Faire Leadership Style of Police Chief in Region IV-A

Statement The Chief of Police...	Police Chief Mean Score	Verbal Response	Verbal Interpretation	Subordinate Mean Score	Verbal Response	Verbal Interpretation	Community Mean Score	Verbal Response	Verbal Interpretation
11. Consensus of the group is sought for a major decision.	4.58	Strongly Agree	Very High	4.09	Agree	High	4.13	Agree	High
12. Allows his/her employees to set priorities without his/her guidance.	4.33	Strongly Agree	Very High	3.84	Agree	High	3.97	Agree	High
13. Likes to share his/her leadership power with the subordinate.	4.45	Strongly Agree	Very High	4.10	Agree	High	4.13	Agree	High
14. Just like him/her, the employees can lead by themselves.	4.25	Strongly Agree	Very High	4.06	Agree	High	4.03	Agree	High
15. Allows subordinates to carry out decisions to do their job.	4.33	Strongly Agree	Very High	3.79	Agree	High	3.93	Agree	High
16. Delegates tasks in order to implement a new procedure or process.	4.33	Strongly Agree	Very High	4.11	Agree	High	4.10	Agree	High
17. Allows independence to subordinates as they do their work.	4.25	Strongly Agree	Very High	3.97	Agree	High	3.98	Agree	High
18. Allows subordinates to appraise their own work.	4.33	Strongly Agree	Very High	3.92	Agree	High	3.97	Agree	High
19. Puts little input to subordinates in doing their function.	4.33	Strongly Agree	Very High	3.78	Agree	High	4.14	Agree	High
20. Leaves subordinates alone.	4.08	Agree	High	3.23	Undecided	Uncertain	3.21	Undecided	Uncertain
TOTAL	4.33	Strongly Agree	Very High	3.89	Agree	High	3.96	Agree	High

Table 3. Mean Analysis of Transactional Leadership Style of Police Chief in Region IV-A

Statement	Police Chief	Verbal Response	Verbal Interpretation	Subordinate	Verbal Response	Verbal Interpretation	Community	Verbal Response	Verbal Interpretation
The Chief of Police...	Mean Score			Mean Score			Mean Score		
21. Rewards subordinates for an accomplishment of assigned task and punish them if otherwise.	4.75	Strongly Agree	Very High	4.07	Agree	High	3.66	Agree	High
22. Finds routine work comfortable.	4.50	Strongly Agree	Very High	3.97	Agree	High	3.84	Agree	High
23. Pays attention to subordinates' work to find faults and deviations.	4.17	Agree	High	3.51	Agree	High	3.71	Agree	High
24. Focuses on his/her supervisory role.	4.33	Strongly Agree	Very High	3.95	Agree	High	4.08	Agree	High
25. Gives more emphasis with processes rather than forward-thinking ideas.	4.42	Strongly Agree	Very High	3.80	Agree	High	3.81	Agree	High
26. Gives reward when the set goals are accomplished on-time or ahead of time.	4.58	Strongly Agree	Very High	3.95	Agree	High	3.67	Agree	High
27. Works based on standard operating procedure.	4.25	Strongly Agree	Very High	4.16	Agree	High	4.17	Agree	High
28. Punishes subordinates when performance quality or quantity falls below production standards.	4.17	Agree	High	3.53	Agree	High	3.48	Agree	High
29. Ensures that subordinates work based on written standard policies and procedures.	4.42	Strongly Agree	Very High	4.13	Agree	High	4.11	Agree	High
30. Focuses on the successful achievement of goal one at a time.	4.50	Strongly Agree	Very High	4.07	Agree	High	4.05	Agree	High
TOTAL	4.41	Strongly Agree	Very High	3.91	Agree	High	3.86	Agree	High

Table 4. Mean Analysis of Management in Terms of Planning

Statement The Chief of Police...	Police Chief Mean Score	Verbal Response	Verbal Interpre- tation	Subor- dinate Mean Score	Verbal Response	Verbal Interpre- tation	Comm- unity Mean Score	Verbal Response	Verbal Interpre- tation
1. Uses organizational vision as his/her guide in the planning stage.	4.75	Strongly Agree	Very High	4.22	Strongly Agree	Very High	4.17	Agree	High
2. During planning, he/she is able to formulate courses of action in the attainment of organizational vision and mission.	4.50	Strongly Agree	Very High	4.11	Agree	High	4.09	Agree	High
3. Employs systematic approach in setting goals and objectives.	4.42	Strongly Agree	Very High	4.16	Agree	High	4.10	Agree	High
4. Makes sure that the organizational objectives are stated in a clear, precise and unambiguous language.	4.67	Strongly Agree	Very High	4.17	Agree	High	4.08	Agree	High
5. Ensures that the objectives he/she set are specific, measureable, attainable, realistic and time bounded.	4.58	Strongly Agree	Very High	4.18	Agree	High	4.11	Agree	High
6. Makes sure that subordinates who will be involved in the implementation of program / project fully understands the plan and their functions so that they will become motivated and interested in its execution.	4.67	Strongly Agree	Very High	4.14	Agree	High	4.13	Agree	High
7. Ensures that there is a plan of evaluation in the implementation of programs.	4.75	Strongly Agree	Very High	4.15	Agree	High	4.04	Agree	High
8. Recognizes the significance of the feedback of subordinates and other stakeholders who are involved in the implementation of plans.	4.50	Strongly Agree	Very High	4.05	Agree	High	4.07	Agree	High
9. Utilizes planning to help him/her predict the hindrances in the attainment of vision, mission, goals and objectives.	4.75	Strongly Agree	Very High	4.10	Agree	High	4.11	Agree	High
10. See to it that the best alternative course of action is formulated.	4.50	Strongly Agree	Very High	4.12	Agree	High	4.07	Agree	High
TOTAL	4.61	Strongly Agree	Very High	4.14	Agree	High	4.10	Agree	High

Table 5. Mean Analysis of Management in terms of Organizing

Statement	Police Chief	Verbal Response	Verbal Interpretation	Subordinate	Verbal Response	Verbal Interpretation	Community	Verbal Response	Verbal Interpretation
The Chief of Police...	Mean Score			Mean Score			Mean Score		
1. Identifies / specifies all necessary activities that should be performed by subordinate.	4.50	Strongly Agree	Very High	4.12	Agree	High	4.19	Agree	High
2. Places the right individual at the right job.	4.67	Strongly Agree	Very High	4.03	Agree	High	4.16	Agree	High
3. Delegates authority to middle level managers.	4.42	Strongly Agree	Very High	4.07	Agree	High	3.80	Agree	High
4. Middle level managers give emphasis on human resource management to give competitive advantage to the organization.	4.42	Strongly Agree	Very High	4.07	Agree	High	4.02	Agree	High
5. Makes each individual aware of their position, from whom they have to take orders and to whom they are accountable for.	4.50	Strongly Agree	Very High	4.14	Agree	High	4.07	Agree	High
6. Provides clear job description for each kind of work or assignment.	4.67	Strongly Agree	Very High	4.11	Agree	High	4.17	Agree	High
7. Makes sure that there is a system or procedure for recruitment, selection, placement, training and development of all the staff.	4.50	Strongly Agree	Very High	4.16	Agree	High	4.14	Agree	High
8. Ensures that employees who are assigned to work on specific task and those employees who entail variety of works are proportioned.	4.50	Strongly Agree	Very High	4.09	Agree	High	4.08	Agree	High
9. Combines and groups similar and related activities into units or departments for immediate response of action.	4.42	Strongly Agree	Very High	4.06	Agree	High	4.14	Agree	High
10. Assures the establishment of smooth interaction among various groups toward the achievement of organizational goals.	4.58	Strongly Agree	Very High	4.10	Agree	High	4.12	Agree	High
TOTAL	4.52	Strongly Agree	Very High	4.10	Agree	High	4.09	Agree	High

Table 6. Mean Analysis of Management in Terms of Directing

Statement The Chief of Police...	Police Chief Mean Score	Verbal Response	Verbal Interpretation	Subordinate Mean Score	Verbal Response	Verbal Interpretation	Community Mean Score	Verbal Response	Verbal Interpretation
1. Demonstrates sense of integrity and honesty in the workplace.	4.67	Strongly Agree	Very High	4.16	Agree	High	4.23	Strongly Agree	Very High
2. Set as a good example to all subordinates.	4.92	Strongly Agree	Very High	4.17	Agree	High	4.16	Agree	High
3. Provides guidance and inspiration to subordinates.	4.75	Strongly Agree	Very High	4.16	Agree	High	4.14	Agree	High
4. Gives direction based on what has been planned and organized.	4.58	Strongly Agree	Very High	4.16	Agree	High	4.05	Agree	High
5. Initiates action.	4.75	Strongly Agree	Very High	4.16	Agree	High	4.13	Agree	High
6. Gives clear instruction to subordinates.	4.83	Strongly Agree	Very High	4.16	Agree	High	4.15	Agree	High
7. Setting of direction brings plan into action.	4.42	Strongly Agree	Very High	4.13	Agree	High	4.16	Agree	High
8. Effective and persuasive communication styles encourage subordinates' high performance.	4.58	Strongly Agree	Very High	4.15	Agree	High	4.09	Agree	High
9. Oversees the work performance of subordinates.	4.58	Strongly Agree	Very High	4.09	Agree	High	4.13	Agree	High
10. Consistent and positive attitude towards work influences subordinates to do the same.	4.58	Strongly Agree	Very High	4.13	Agree	High	4.07	Agree	High
TOTAL	4.67	Strongly Agree	Very High	4.15	Agree	High	4.13	Agree	High

Table 7. Mean Analysis of Management in Terms of Controlling

Statement	Police Chief	Verbal Response	Verbal Interpretation	Subordinate	Verbal Response	Verbal Interpretation	Community	Verbal Response	Verbal Interpretation
The Chief of Police...	Mean Score			Mean Score			Mean Score		
1. Periodically assesses the performance of subordinates.	4.67	Strongly Agree	Very High	4.11	Agree	High	4.08	Agree	High
2. Ensures that everything went out as planned.	4.67	Strongly Agree	Very High	4.07	Agree	High	4.05	Agree	High
3. Makes sure that organizational resources are utilized efficiently and effectively.	4.67	Strongly Agree	Very High	4.04	Agree	High	4.02	Agree	High
4. Ensure that every individual under his/her control is performing his/her job according to the standards set for a given task.	4.58	Strongly Agree	Very High	4.12	Agree	High	4.05	Agree	High
5. Controls any deviation from the plan.	4.58	Strongly Agree	Very High	4.04	Agree	High	3.92	Agree	High
6. Discovers the reasons / causes if there is any deviation.	4.58	Strongly Agree	Very High	4.03	Agree	High	4.01	Agree	High
7. Formulates corrective actions for such deviation.	4.58	Strongly Agree	Very High	4.10	Agree	High	3.95	Agree	High
8. Makes follow-up of an aspect or activity if necessary.	4.75	Strongly Agree	Very High	4.09	Agree	High	4.04	Agree	High
9. Open to changes and opinion of other.	4.83	Strongly Agree	Very High	4.05	Agree	High	4.01	Agree	High
10. Commends the effectiveness of subordinates work.	4.67	Strongly Agree	Very High	4.06	Agree	High	4.05	Agree	High
TOTAL	4.66	Strongly Agree	Very High	4.07	Agree	High	4.02	Agree	High

Table 8. Differences on the Assessment of Chiefs of Police, Subordinates and Community on Leadership Style of Chiefs of Police

Leadership Styles	Groups	Mean	Mean Rank	Kruskal Wallis Test Statistics	P-value	Interpretation	Decision
Transformational	Police	4.13	141.83 b	12.258	.002	Highly Significant	Rejected
	Chief of Police	4.68	230.46 a				
	Community	4.19	155.68 b				
Laissez-Faire	Police	3.89	142.88 b	10.283	.006	Highly Significant	Rejected
	Chief of Police	4.33	225.08 a				
	Community	3.96	152.57 b				
Transactional	Police	3.91	150.12 b	12.316	.002	Highly Significant	Rejected
	Chief of Police	4.41	230.58 a				
	Community	3.86	140.36 b				

Means followed by a common letters are not significant at 5% level

Table 9. Differences on the Assessment of Chiefs of Police, Subordinates and Community on Management Techniques of Chiefs of Police

Management Techniques	Groups	Mean	Mean Rank	Kruskal Wallis Test Statistics	P-value	Interpretation	Decision
Planning	Police Chief	4.61	221.00 a	10.559	.005	Highly Significant	Rejected
	Subordinates	4.14	145.92 b				
	Community	4.10	140.46 b				
Organizing	Police Chief	4.52	226.13 a	10.111	.006	Highly Significant	Rejected
	Subordinates	4.10	146.06 b				
	Community	4.09	147.68 b				
Directing	Police Chief	4.67	230.96 a	11.771	.003	Highly Significant	Rejected
	Subordinates	4.15	146.08 b				
	Community	4.13	146.08 b				
Controlling	Police Chief	4.66	241.71 a	15.464	.000	Highly Significant	Rejected
	Subordinates	4.07	148.86 b				
	Community	4.02	141.92 b				
Total	Police Chief	4.62	239.42 a	13.611	.001	Highly Significant	Rejected
	Subordinates	4.12	147.36 b				
	Community	4.09	145.01 b				

Means followed by a common letters are not significant at 5% level

Perceived Organizational Culture and Organizational Commitment of Cavite State University's Faculty Members

Aleli B. Diato
Cavite State University - General Trias Campus
General Trias, Cavite

ABSTRACT

This study was conducted to assess the organizational culture of the Cavite State University (CvSU), the organizational commitment as perceived by its faculty members and the relationship of these two variables. A total of 299 respondents were randomly selected from among 1183 total population of faculty members in the university. A two-part standardized questionnaire was utilized and distributed to the respondents to gather the necessary data. The study revealed that the organizational culture existing in CvSU is a mixed culture, but predominantly clan and market culture as perceived by the faculty- respondents characterized by members that are competitive, goal-oriented and results-driven, yet an environment which is nurturing and cooperative. Moreover, there is a high level of affective commitment and moderately high level of continuance and normative commitment among faculty members which indicated that majority of the faculty members express their desire to stay in the institution. Generally, this study proved that the organizational culture has a positive relationship with the organizational commitment of its faculty members. Furthermore, regression analysis revealed that organizational culture served as a predictor of organizational commitment. Overall, almost 25.60 percent of the affective commitment, 15.60 percent of continuance commitment and 20.30 percent of the normative commitment could be attributed to the perceived organizational culture of the university.

Keywords: *CvSU culture, CvSU faculty, Culture principles*

INTRODUCTION

Higher Education Institutions (HEIs) have greater responsibility for producing individuals that are highly competitive. As per Republic Act 7722, the Commission on Higher Education is mandated to promote relevant and quality education through higher education institutions and programs that are at par with international standards and graduates and professionals who are highly competent and recognized in the international arena .

In this regard, the assessment of organizational culture and organizational commitment of faculty members in HEI's is deemed relevant and timely. Organizational culture which gives an overview of the characters of an organization determines the type of faculty members in an organization, while organizational commitment refers to a person's dedication to a person, job or organization.

Culture, as an important factor that affects the changing process of educational innovations were highlighted in literature. Ghorbanhosseini (2013) stated that organizational culture has a direct and significant effect on organizational commitment. This was reaffirmed by Lauture et al. (2012) as they concluded that the positive perception of organizational culture increases the employees' commitment. These studies provided bases for analyzing the relationship between the existing culture in the Cavite State University and the commitment of its faculty members.

The Cavite State University (CvSU), considered as one of the renowned universities in the province, envisions as an institution recognized for excellence in the development of globally competitive and morally upright individuals. To assess if this vision is being lived by, the CvSU's organizational culture and the organizational commitment of its faculty members were described and the relationship between the two

variables was analyzed. The study endeavored to analyze the relationship between perceived organizational culture and organizational commitment of faculty members using the conceptual paradigms of Cameron and Quinn (2006) and Allen and Meyer (1990) as presented in Figure 1.

school department and senior high school were not included in the study. The sample size was computed from population corresponding to the total number of faculty members provided by the CvSU HRDO. Using the Slovin's formula with a confidence level of 95 percent, a total of 299 samples were randomly selected from the 1183

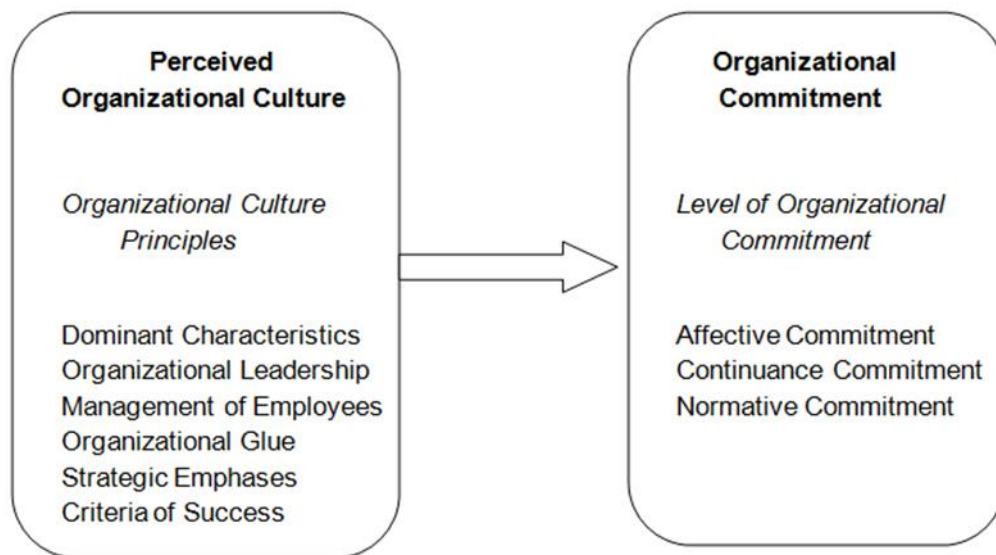


Figure 1. The Conceptual Paradigm of the Study

The relationship of the variables which were analyzed in the study included the six organizational culture principles and three levels of organizational commitment.

METHODOLOGY

The researcher utilized a descriptive-correlational research design to provide a relatively complete picture of the perceived culture of CvSU and the level of commitment of the faculty members while describing the relationship between the two variables. The respondents of the study were the faculty members of CvSU during the second semester of AY 2016-2017. Teachers in the high

population of CvSU- Main Campus and its satellite campuses. Specifically, through stratified random sampling the number of respondents from each campus were computed.

This study utilized a two-part standardized questionnaire consisting of the Organizational Culture Assessment Instrument (OCAI) developed by Cameron and Quinn (1999) and the Three-Component Model Employee Commitment Survey (TCMECS) developed by Allen and Meyer (1990). The OCAI determined the blend of the four culture types that dominate CvSU as an organization. By answering the questionnaire, respondents assessed the six key characteristics of their perceived school culture: dominant characteristics, organizational

leadership, management of employees, organization glue; strategic emphases, and criteria of success. Each key characteristic had four items. The four items were arranged based on the four culture types - clan culture, adhocracy culture, market culture and hierarchy culture. The TCMECS measured three forms of employee commitment to the organization. Affective commitment items assessed faculty members' affection for their job which is manifested in their genuine desire to stay in CvSU. On the other hand, normative commitment items assessed faculty members' sense of obligation to serve CvSU. Lastly, Continuance commitment items assessed faculty members' reason to stay in CvSU which can be due to monetary, professional, or social reasons.

The data were summarized and subjected to statistical treatment using percentage, weighted mean, Pearson R, and simple linear regression. Percentage and weighted mean were used to describe the variables. Pearson R was used to determine the correlation between organizational culture and organizational commitment through the p-values and correlation coefficient values. The regression analysis further explored the relationship between the two variables wherein the correlation value may range from -1 to +1. The negative values indicate a negative relationship between variables of interest while positive values indicate positive relationships.

RESULTS AND DISCUSSION

The Perceived Organizational Culture of CvSU

The study revealed that the following culture types are existing in the Cavite State University as assessed based on the six organizational principles.

As shown, the perceived culture that dominates in Cavite State University is a mixture of Clan Culture and Market culture (Table 1). The assessment on the level of perceived organizational culture based on the six principles revealed that market culture was dominant on three aspects - dominant characteristics, management of employees, and organizational glue. This principle is characterized by an organization with people who are results - oriented, achievement oriented, and people who are very competitive. However, in terms of organizational leadership, strategic emphases, and criteria of success, clan culture prevailed. In such culture, leadership is generally considered to mentor, facilitate, and nurture, while it emphasizes human development, high trust, openness, participation, and teamwork.

The results support the literature (Meyerson & Martin, 1987; & Cameron & Quinn, 2006) stating that an organization consists of mixture of cultures. In addition, among the culture types,

Table 1. Organizational culture as perceived by the respondents

CHARACTERISTICS	TYPE OF CULTURE	MEAN
Dominant Characteristics	Market Culture	3.78
Organizational Leadership	Clan Culture	3.65
Management of Employees	Market Culture	3.63
Organizational Glue	Hierarchical and Market Culture	3.61
Strategic Emphases	Clan Culture	3.66
Criteria of Success	Clan Culture	3.66

clan culture is most favored by the employees in public and private universities, mainly because of the family orientation of the organization (Aktor et al., 2013). It is also important that with the prevalent competitive environment inside and outside organizations, it is imperative for the organizations to have policies that are most suitable for their employees to create and ensure strong commitment among them.

The perceptions of the respondents were evident in some undertakings of the school. In 2016, CvSU became the most outstanding state university in CALABARZON in gender and development implementation. In the same year, students from the College of Engineering and Information Technology (CEIT) were adjudged as winners in a national contest sponsored by Philippine Long Distance Telephone Company (PLDT). The BS Agriculture program under the College of Agriculture, Forestry, Environment, and Natural Resources (CAFENR) was awarded the Center of Excellence by the Commission on Higher Education (CHED) by virtue of Memorandum Order No. 38 Series of 2015. These and more prove that CvSU's organization is results - oriented and that people are very competitive and achievement-oriented. Moreover, clan culture is practiced in the university through encouraging faculty and staff to participate in activities that could enhance their expertise such as seminars, workshops, research and pursuing higher education. Teamwork is enhanced in activities that would showcase expertise in different fields. Employee commitment is strengthened by programs that

could increase the desire of the faculty and staff to stay in the university. Recognition is given to deserving faculty and staff. Concern for people is exhibited among faculty members and this extends to the students and community as the university upholds service through extension programs.

The Perceived Organizational Commitment of Faculty Members

Table 2 presents the level of organizational commitment of the faculty members of CvSU measured in terms of Affective, Normative and Continuance.

Based on the table, faculty members show a high level of affective commitment, while moderately high normative and continuance commitment. This coincides with the study of Masouleh and Allahyari (2017) which revealed that affective commitment is dominant in higher education institutions. The more affective commitment exists in the organization, it consequently leads to increase in level and growth of organizational culture principles of the individuals in the organization (Azadi et al., 2013). Additionally, having a "high level" of affective commitment implies that the faculty members have a high desire to stay in the university, which signifies less probability of employee turnover. This result is noteworthy particularly in addressing issue on faculty turnover as this is one of the pressing problems existing in the university, as well as in some

Table 2. The Perceived Organizational Commitment

ORGANIZATIONAL COMMITMENT	WEIGHTED MEAN	INTERPRETATION
Affective	3.56	High
Normative	3.44	Moderately High
Continuance	3.17	Moderately High

Legend: Very High 4.51 – 5.00; High 3.51 – 4.50; Moderately High; 2.51 – 3.50; Low 1.51 – 2.50; Very Low 1.00 – 1.50.

organizations (Tolentino, 2013). In terms of normative commitment, the “moderately high level” which is observed in the present study has its relevance. In a study by Azizollah, et al. (2016), normative commitment has shown to provide the most optimal working environment, that is through using and propagating an atmosphere full of behaviors, norms, beliefs and positive approaches in an organization. This could possibly explain how this normative commitment is developed and demonstrated by faculty members of CvSU. Conversely, a poor level of normative commitment may lead to overall weak levels of organizational commitment of employees (Sabri, Puzada Sami Ullah, et al., 2013). On the other hand, a low level of continuance commitment was observed in this study which is consistent with the findings of Hamidi, et al. (2017) among employees in health care centers.

Relationship between perceived organizational culture of CvSU and level of organizational commitment of faculty members

The correlation among variables – CvSU’s organizational culture and organizational commitment of its faculty members are presented in this section. Each of the six domains of organizational culture is correlated with each considering the three types of commitment (Table 3).

The results revealed a positive relationship between the perceived CvSU’s organizational culture which are measured in terms of culture principles, and the organizational commitment of faculty members based on the aspect of affective, continuance and normative scales. Organizational leadership which has the highest correlation with affective commitment, the

Table 3. Correlation between perceived organizational culture and level of organizational commitment of CvSU faculty members

ORGANIZATIONAL CULTURE PRINCIPLE	AFFECTIVE COMMITMENT		CONTINUANCE COMMITMENT		NORMATIVE COMMITMENT	
	Correlation coefficient	P value	Correlation coefficient	P value	Correlation coefficient	P value
Dominant characteristics	0.169.	0.003	0.379	<0.000	0.399	<0.000
Organizational leadership	0.230.	<0.000	0.378	<0.000	0.364	<0.000
Management of employees	0.200	0.001	0.309	<0.000	0.401	<0.000
Organizational glue	0.178.	0.002	0.417	<0.000	0.413	<0.000
Strategic emphasis	0.190.	0.001	0.330	<0.000	0.368	<0.000
Criteria of success	0.204.	<0.000	0.329	<0.000	0.429	<0.000

Note: If p value is less than or equal to the level of significance which is 0.05 reject the null hypothesis otherwise accept. Correlation coefficient values: Very Strong $\pm 0.76 - \pm 0.99$; Strong $\pm 0.51 - \pm 0.75$; Moderate $\pm 0.26 - \pm 0.50$; Weak $\pm 0.11 - \pm 0.25$; Very Weak $\pm 0.01 - \pm 0.10$.

correlation value of 0.230 is interpreted as "moderate correlation". Meanwhile, dominant characteristics had the lowest correlation with affective commitment. Their correlation value of 0.169 is interpreted as "weak correlation". On the other hand, organizational glue has the highest correlation with continuance commitment, with correlation value of 0.417 which is interpreted as "moderate correlation". While management of employees with the least correlation with continuance commitment has a correlation value of 0.309 which is interpreted as "moderate correlation". Lastly, the criteria of success had the highest correlation with normative commitment, with correlation value of 0.429 which is interpreted as "moderate correlation", while organizational leadership had the least correlation with normative commitment, with correlation value of 0.364 which is interpreted as "moderate correlation". Altogether, it can be deduced that there is weak to moderate correlation among the variables in the study.

These findings are consistent with studies wherein positive relationship between organizational culture and organizational commitment were observed (Ghorbanhosseini, 2013); Lauture et al., 2012; & Khan & Rashid, 2012). Moreover, an increase in the level of organizational culture principles, leads to stronger or higher level of organizational commitment by the tenured staff of the university (Azizollah, et al., 2016). In another study, it has been pointed out that characteristics of school culture affect how schoolworks towards positive change giving an influence to everyone within a school – administration, faculty, staff, and students (Ebrahimpour et al., 2011). In addition, the presence of committed personnel in each organization not only reduces their absenteeism, delays, and displacements but also leads to a dramatic increase in performance and efficiency of an organization, mental freshness of employees, better manifestation of noble objectives, and organizational mission as well as fulfillment of personal goals (Hamidi, 2017). Locally, the studies of Ashipaoloye (2014), Tolentino (2013), Aquino (2013) and Delima

(2015) indicated that school culture is considered as an important factor that influences teachers' behavior and teacher's attitudes which influence their commitment at work. Moreover, the study of Abarca (2013) is worth examining since it has implied negative commitment on the part of the teachers which are caused by factors such as inadequacy of materials and facilities in school and some behavioral aspects. The study has shown how these factors affect the teacher's performance at work and may affect the success of the organization.

In Cavite State University, this can be observed in several ways. For instance, faculty turnovers are common among job order faculty members. Job order faculty members do not enjoy benefits as that regular faculty members do. This may explain why performances of some job order faculty is affected. Hence, they get low score in student evaluation which is an issue related to faculty commitment. Based on the culture principles discussed previously, employee turn-over results in financial and time costs associated with filling positions, disruption of curricular continuity and difficulty in maintaining a cohesive school environment (Simon & Johnson, 2013) which may lead to some changes on the programs of the school for the faculty members. Hence, faculty turnover is an issue that is also related to culture.

On the positive side, faculty performances are enhanced by the privileges and benefits which the institution offers them. In consonance with the university's vision and mission, the university makes sure that the faculty members are competent and qualified which is done through careful selection during the hiring process. They are being encouraged to pursue higher education in various reputable institutions here and abroad. Some faculty members enjoy various scholarship programs through its Faculty and Staff Development Program (FSDP), as well as scholarship grants from the Commission on Higher Education (CHED), the Department of Science and Technology (DOST), and others. Moreover, some faculty members are sent to local and international seminars, training, and

conferences which make them more equipped with knowledge and skills which they can impart to their students.

In addition, faculty members are exposed and encouraged to conduct research and extension activities as proven by voluminous completed and on-going research which are mostly presented in conferences if not published.

Since the variables are positively correlated, subjecting the variables to simple regression is necessary to further analyze and describe how much can the organizational culture predict organizational commitment of faculty members based on affective, continuance and normative scales. To address this part, the overall mean of all organizational culture principles was taken and means of each of the three types of commitment were subjected to analysis.

Results of regression analysis shows a moderately high relationship between organizational culture and affective commitment, while a moderately low relationship exists between organizational culture and continuance commitment, as well as organizational culture and normative commitment of faculty members (Table 4). This further indicates that 25.60 percent of the perceived affective commitment, 15.60 percent of continuance commitment and 20.30 percent of the normative commitment can be attributed to the perceived organizational culture of CvSU.

CONCLUSION

It is concluded that CvSU's culture as perceived by the faculty-respondents is characterized by competitive, goal-oriented, and results-driven faculty members. However, a nurturing environment is present which emphasizes on cooperation and human development. In terms of the level of commitment, faculty members have a strong emotional attachment to the organization and the work they do. While a moderately high normative commitment means that some faculty members feel a sense of obligation to the organization even if they want to pursue better opportunities. While it is true that there are turnovers happening in CvSU, still some of the faculty members express their desire to stay in the institution because of the privileges and benefits the institution has provided them which also explains a moderately high level of continuance commitment. Lastly, the characteristics of CvSU's culture has a positive impact on the faculty members' dedication at work, especially in terms of affective commitment.

The CvSU's mission and vision is a reflection of its culture and how the faculty is working towards achieving the university's goals speak of their commitment. It is therefore imperative to live up to the desirable culture that could promote faculty enhancement and empowerment.

Table 4. Regression analysis of perceived organizational culture and level of organizational commitment

ORGANIZATIONAL CULTURE PRINCIPLE	AFFECTIVE COMMITMENT	CONTINUANCE COMMITMENT	NORMATIVE COMMITMENT
Multiple R	.506	.395	.451
R Square	.256	.156	.203

Note: Correlation value may range from -1 to +1, the negative values indicate a negative relationship between variables of interest while positive values indicate positive relationship.

Nevertheless, this study has its limitations. In terms of the assessed organizational culture and level of commitment, there may be components that were not covered since the instruments used in the study were developed in a non-Asian context. Therefore, it is suggested to explore the two variables using other scales employing different models to assess the organizational culture the Cavite State University and the organizational commitment of its faculty members. The relationship between the variables may also be tested.

Another area that is worth doing is to analyze the relationship of the two variables in a more detailed manner, such that instead of considering organizational culture as one, it may be worthy to consider each organizational culture principles. Explore further how each principle predicts each type of organizational commitment.

Further study may also be done considering the nature of both culture and commitment as enduring. Thus, a longitudinal study on organizational culture and organizational commitment is suggested which will measure how perceptions of culture and commitment may either change or persevere with time and experience. Through this, administrators may have a more holistic perspective of the factors that could affect their employees' workplace experience.

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Semen Quality and Testicular Ultrasound Features of Heat Stressed Bulgarian Murrah Buffalo Bulls Subjected to Fan and Sprinkler Cooling

Rezin C. Bahia^{1*}, Renato SA. Vega², Jose Arceo N. Bautista², Jezie A. Acorda³,
Ronaldo B. Saludes⁴, Abraham G. Tandang⁵ and Thelma A. Saludes⁵

¹*College of Veterinary Medicine and Biomedical Sciences,
Cavite State University, Indang, Cavite*

²*Institute of Animal Science, University of the Philippines Los Baños
College 4031, Laguna, Philippines*

³*College of Veterinary Medicine, University of the Philippines Los Baños
College 4031, Laguna, Philippines*

⁴*Institute of of Agricultural Engineering, University of the Philippines Los Baños
College 4031, Laguna, Philippines*

⁵*Philippine Carabao Center - University of the Philippines Los Baños
College 4031, Laguna, Philippines*

ABSTRACT

The study aimed to determine the monthly changes, and the effect of fan and sprinkle cooling on semen quality of Murrah buffalo bulls during the second and third quarter months of the year and to determine monthly changes and effect of fan and sprinkler cooling in testicular tissue using ultrasonography.

The effect of month of collection and treatment was tested between a group of 6 Murrah buffalo bulls subjected to fan and sprinkler cooling and a group of 6 Murrah buffalo bulls without fan and sprinkler cooling in a 6-month trial period. Semen quality parameters which included Semen Volume (SV), Live Sperm Count (LSC), Semen Mass Activity (SMA), Semen Consistency (SCo), Semen Initial Motility (SIM), and Sperm Concentration (SC) were measured monthly. The difference between rectal and scrotal surface temperatures was determined and related to semen quality after the 13.5-day sperm production cycle. The study also determined the cost effectiveness of the fan and sprinkler cooling intervention. Furthermore, testicular ultrasonographic Echomean (Em) and Testicular Covering Thickness (TCT) were measured and compared at the start, middle and end of the six-month period of fan and sprinkle cooling. Findings were related to sperm quality of Murrah buffalo bulls.

There were no effects of months and its interaction to treatment for all parameters. There were effects of treatment for SV, LSC, SMA, SCo, and SIM. There was higher LSC (95.18 ± 0.58 vs 81.67 ± 1.90 %), SMA (2.77 ± 0.07 vs 2.28 ± 0.10), SCo (2.72 ± 0.06 vs 2.36 ± 0.10), and SIM (53.78 ± 1.54 vs 43.19 ± 2.44) in the experimental group than in the control group. There was higher SV (5.62 ± 0.37 vs 4.63 ± 0.08 ml) in the control group than in the experimental group. There was no effect of treatment for SC. Rectal Temperature and Scrotal Surface Temperature Difference (RTSSTD) were 5.74°C for the experimental group and 5.14°C for the control group. There was a tendency ($P=0.1166$) for Em to be lower in the experimental group (101.81 ± 6.58) compared to the Em of the control group (116.74 ± 4.50). TCT was comparable among the collection months. TCT was greater in the experimental group than the control group (13.44 ± 0.24 vs 11.44 ± 0.47 mm).

Fan and sprinkler cooling was a cost-effective way to improve semen quality of Murrah buffalo bulls.

Keywords: *cooling, heat stress, semen quality, testicular echomean*

INTRODUCTION

In the tropical Philippines, semen production by Murrah buffalo bulls can be affected by heat stress which may depress semen quality. Heat stress has detrimental effect on the semen quality of bulls [1]. Testicular tissue damage caused by heat stress alters semen quality. Visualization of testicular damage of various causes can be done using several ways. One of them is ultrasonography. Ultrasonography is usually used in assessing reproductive capacities of female animals. Ultrasonography in male animals is not commonly done to assess reproductive functions. However, there are studies that looked into the usefulness of ultrasonography to evaluate the breeding soundness of male animals. [2] looked on the use of testicular ultrasound as a non-invasive tool to identify specific testicular and epididymal lesions. [3] found that testicular ultrasound may help evaluate reproductive soundness of status of sheep rams. Seminiferous tubule calcification affects the homogeneity of testicular parenchyma during the warmest season. Homogeneity changed but not reaching the levels compatible with testicular degeneration as confirmed by semen quality maintenance throughout the year.

Various studies on the provision of cooling using fan and sprinklers during hot and dry season significantly improve semen quality. However, these findings were validated on locations with different environmental conditions. The study determined the monthly changes, and the effect of fan and sprinkle cooling on semen quality of Murrah buffalo bulls during the second and third quarter months of the year. The difference between rectal and scrotal surface temperatures was also determined and related to semen quality after the 13.5-day sperm production cycle. The study also determined the cost effectiveness of the fan and sprinkler cooling intervention. Moreover, the study determined the monthly changes and effect of fan and sprinkler cooling on testicular tissue using ultrasonography.

MATERIALS AND METHODS

Study area

The Philippine Carabao Center (PCC) - University of the Philippines Los Baños (UPLB) Station Farm is

located inside the UPLB campus, near the Dairy Training and Research Institute (DTRI). It is located on the foot of Mt. Makiling, Los Baños, Laguna, Philippines with a climate described as tropical monsoon. The bull barn is situated at 14°09'08.1" N 121°14'33.5" E. Near the barn is the PCC Artificial Insemination Laboratory.

Animal care and management

Animals were kept in enclosures with an area of 16.75 square meters [dimension of 5.03 m in length (shaded part is 3.48 m; unshaded part is 1.55 m) and 3.33 m in width]. Enclosures were installed with cemented water trough which were always filled with water for drinking. Feeding was done twice a day with cut and carry forage which comprised of mixture of paragrass, stargrass and napier. The farm had an on-site veterinarian to maintain the general well-being and health of the animals and to attend to medical and surgical cases.

Ethical consideration

In accordance with the ethical use of animals in research, all procedures done in the study were reviewed and approved by the Institutional Animal Care Committee (IACUC) under the University of the Philippines College of Veterinary Medicine (UPCVM) with Assigned Protocol No. 2018-0008.

Experimental design

Twelve (12) apparently healthy Murrah buffalo bulls were used in the study. All were in their mature breeding ages of three years and above. Pair sampling was done by randomly assigning bulls with relatively close ages (in months) into the experimental (EXPT) and control (CTRL) groups. The bulls weighed from 440.5 kg to 680.5 and had body condition scores (BCS) from 3.0 to 4.0 at the start of the study.

The animals were divided into two groups of six, housed into a barn with individual enclosures. One group was assigned as the experimental group, with a mounted 26 inches industrial fan (190 m³/minute air volume) and ½ inch water sprinkle head at approximately 2.5 m over the enclosures and the other was the control group with existing housing

ventilation and shade. Water sprinkler with a 0.19 cubic meter/minute water discharge had a 1.5-meter diameter in the enclosure floor. Water temperature was recorded at 31 to 33°C. The treatment groups were housed in the opposite ends of the barn. Animals were marked accordingly. They were acclimatized in their respective enclosures for two weeks before the start of the experiment. The animals were maintained similarly based on existing farm husbandry practices.

The trial was performed from April to September 2018. This coincided with the second and third quarter periods of the year. The barn's Relative Humidity (RH) and Ambient Temperature (AT) were measured with EasyLog EL-USB-2-LCD® data logger at 15 minutes interval. The logger was retrieved to save data and re set up monthly. Monthly Average RH and AT was derived from the statistical tool of the data logger. The monthly Average Thermal Humidity Index (THI) was computed using the formula [2]: $THI = db^{\circ}C - \{0.31 - 0.31RH\}(db^{\circ}C - 14.4)$ [where $db^{\circ}C$ = monthly average dry bulb temperature in °C and RH = monthly average relative humidity percentage (RH%) / 100].

The fan and sprinkle were switched on automatically during the day with the following schedule: [1] 8:30 to 10:00 am (continuous fan), [2] 10:00 to 11:00 am (10 minutes sprinkler and 45 minutes fan), [3] 11:00 am to 12:00 noon (60 minutes continuous fan), [4] 12:00 noon – 1:00 pm (10 minutes sprinkler and 45 minutes fan), [5] 1:00 pm to 2:00 pm (60 minutes continuous fan), [6] 2:00 pm to 3:00 pm (10 minutes sprinkler and 45 minutes fan), and [7] 3:00 pm to 4:30 pm (continuous fan).

Semen Evaluation

Semen collection of the experimental animals was done twice a week (Tuesdays and Fridays starting 5:00am) using an artificial vagina for the 6-month trial period. Each bull had two collections per collection day. Semen Volume (SV) was measured using collection tube graduation. Semen Volume (SV) is the total volume derived from the two collections. After collection, ejaculates were brought to the PCC UPLB Station AI Laboratory for routine evaluation and processing. Experienced laboratory technicians evaluated the semen using one drop of semen into a glass slide. The parameters evaluated were: (1) semen mass activity (SMA), (2) semen consistency (SCo) and (3) semen initial motility (SIM).

The following criteria were used for mass activity: + - no movement, ++ - slow swirl, +++ - fast swirl, ++++ - faster swirl, and +++++ - fastest swirl. The following criteria were used for consistency: + - thin, ++ - moderate thickness, +++ - thick. Initial motility was the combination of the evaluation using mass activity and consistency. Each plus (+) sign was equivalent to a score of 10 and each asterisk (*) sign was equivalent to a score of 5. Evaluated semen with initial motility score of <55 was declared discarded semen and semen with initial motility of ≥ 60 was declared good for processing.

Sperm Concentration (SC) was measured using IMV Technologies Bovine Photometer n°1248® after 40 ul semen dilution with 3960 ul NaCl solution.

Live Sperm Count (LSC) was done once in a month (last Friday of the month) using a Nikon Eclipse E200®. At 40 x, 200 sperm cells from slides with eosin-nigrosin stained semen smear were counted and the percentage of live sperms were computed.

All parameters were expressed as monthly averages and treatment averages. Baseline values for SV, SC, SMA, SCo and SIM were computed using semen evaluation data of March and was used as reference value for derived semen quality parameters. In addition, the average Rectal Temperature and Scrotal Surface Temperature Difference (RTSSTD) was computed from measured rectal and scrotal surface temperatures for both experimental and control groups (Chapter 3 Study 1). Considering the 13.5 day sperm production cycle, SV, SC, SMA, SCo and SIM were noted from two collections after a two week period of the RT and SST measurement. The averages for SV, SC, SMA, SCo and SIM were computed for the 6-month trial and related to the RTSSTD.

Cost and benefit analysis for maintaining the experimental and control groups was done. Using technical assumptions, costs were determined in maintaining the bulls. Profit was determined by the number of straws produced by the treatment groups multiplied by the prevailing costs of semen straw. Net profit difference between the treatments was expressed as profit per bull per month.

Ultrasonography

Six bulls were purposively selected from the total of 12 bulls based on their temperament and willingness to

be scanned. Three bulls from the experimental group and three bulls from the control group were subjected to testicular ultrasonography. Animals were scanned at a specified date at the start (April 4), middle (June 25) and last (September 27) weeks of the 6-month trial period. The left testicle was scanned using Honda Electronics HS 101V® ultrasound with a HLV 155 5.0MHz 50mm rectal probe. The left testicle was the only one scanned because the willingness of the bull to be scanned was considered. The probe was placed on the middle of the posterior side of the scrotum along the transverse plane of the left testicle.

Image analysis and biometric measurements were done using Adobe Photoshop CS3Extended version 10.0. Testicular echomean was measured in three areas of the ultrasonogram. Each area consists of 25 sq mm placed in a homogenous area of the image. Using the Adobe Photoshop ruler tab as reference, the areas were located uniformly for all the ultrasonograms. Area 1 was placed 6 cm from the side and 3 cm from the top. Area 2 was placed 5 cm from the side and 4 cm from the top. Area 3 was placed 5.5 cm from the side and 5 cm from the top. Adobe Photoshop automatically measured the echomean of the three areas using the luminosity analysis feature of the histogram. Testicular covering thickness (TCT) was measured using the ruler tool of Adobe Photoshop. Testicular diameter was not measured because some of the image did not capture the through and through image of the testicular tissue. The average Echomeans (Em) and Testicular Covering Thickness (TCT) of the treatment groups were computed and compared. Findings were related to sperm quality.

Statistical Analysis

Two Factorial in Randomized Complete Block Design (SAS version 9) where month is Factor A and treatment is Factor B was used to analyze hematologic response data. Three Factorial in Randomized Complete Block Design (SAS version 9) where month is Factor A, period is Factor B and treatment is Factor C was used to analyze physiologic response data. Mean differences were tested using Least Significant Difference (LSD). All means were expressed as mean±standard error of the mean (Mean±SEM).

RESULTS AND DISCUSSION

Thermal Humidity Index (THI)

The average Thermal Humidity Index recorded monthly. The highest THI was recorded in the Month of May at 28.32 and the lowest THI was recorded in the month of July at 26.80 (Table 1).

During the duration of the study, the animals were experiencing extreme severe heat stress conditions at THI>25.6 [4]. THI increase in the month of May was remarkable making the animals experience the highest consequence of the heat stress condition. Moderate degree of the heat stress condition was in the months of April, June, August and September. The least degree of the heat stress condition was in July.

Table 1. Average Ambient Temperature, Relative Humidity and Thermal Humidity Index (THI) during the experimental period

Collection Month	Average Ambient Temperature (°C)	Average Relative Humidity (%)	Average THI
April	28.10	78.20	27.17
May	29.30	78.80	28.32
June	28.00	84.60	27.35
July	27.30	87.40	26.80
August	27.80	85.00	27.18
September	27.50	89.00	27.05

Semen Volume and Sperm Concentration

Semen Volume (SV) differed between experimental and control groups (Table 2). Control group had higher SV than experimental group (Figure 1). This is inconsistent with [5] findings that there is increased semen volume with shaded and water sprinkled Murrah buffalo. However, [6] reported a non-significant difference in semen volume in Jersey cattle with and without shed and water sprinkle. [7] noted inconsistencies in the semen volume as affected by heat stress. [8] reported that during the hot dry

summer season, semen volume marked the highest among Murrah buffalo bulls.

The average SV of the experimental group of 4.63 ± 0.08 ml was within its baseline value of 4.60 ± 0.21 ml while the average SV of the control group of 5.62 ± 0.37 ml was within and slightly above its baseline value of 5.27 ± 0.29 ml.

There was no month interaction for SV. Monthly SV were comparable (Table 2).

Table 2. Semen volume (ml) of Murrah buffalo bulls with or without fan and sprinkler cooling and month of collection.

Collection Month	Treatments		Mean \pm SEM
	Experimental	Control	
April	4.37	5.89	5.13 \pm 0.44
May	5.20	6.78	5.99 \pm 0.68
June	4.55	5.48	5.01 \pm 0.51
July	4.48	5.57	5.03 \pm 0.44
August	4.53	5.04	4.78 \pm 0.35
September	4.66	4.98	4.82 \pm 0.45
Mean \pm SEM ^s	4.63 \pm 0.08	5.62 \pm 0.37	

s – significant at $p < 0.01$

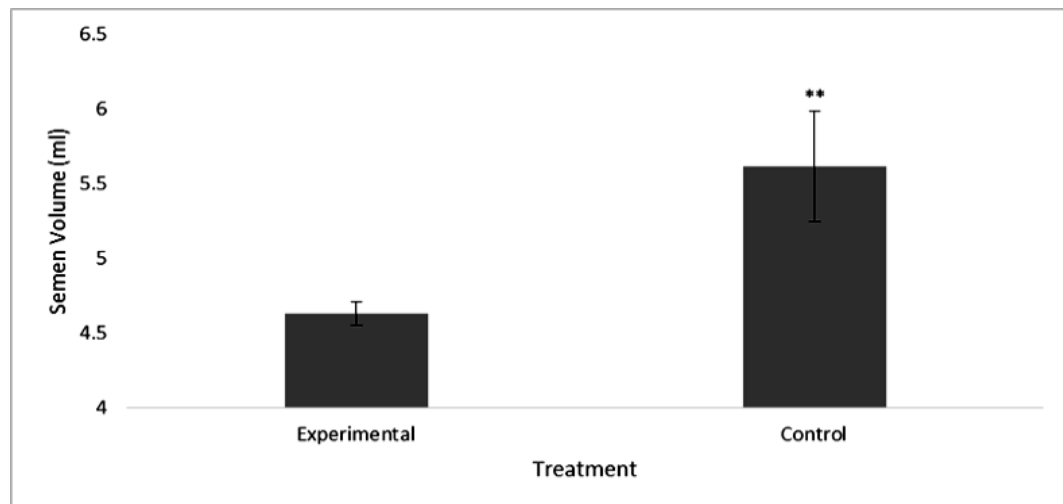


Figure 1. Semen volume (ml) of Murrah buffalo bulls with fan and sprinkler (Experimental) and without fan and sprinkler (Control). Mean values are different at $p < 0.01$.

There was no month interaction for Sperm Concentration (SC). SC was comparable between experimental and control groups and among the months of collection (Table 3). Although not statistically significant, SC was higher in the experimental group than the control group.

Both the average SC of the experimental group of 176.39 ± 5.98 ($\times 10^7/\text{ml}$) and the average SC of the control group of 172.01 ± 5.19 ($\times 10^7/\text{ml}$) were within and above their baselines of 165.02 ± 10.84 ($\times 10^7/\text{ml}$) and 163.06 ± 10.51 ($\times 10^7/\text{ml}$), respectively.

Considering that semen volume was significantly higher in control and an apparent higher sperm concentration in the experimental group, semen concentration was affected by the cooling intervention. The role of the epididymis is to concentrate semen by absorbing fluid coming from the testis. In the control group, the increased semen volume was due to the detrimental effect of heat stress to the epididymal function to concentrate semen. The experimental group was able to ensure semen quality by storing a concentrated semen than an ejaculate full of fluids. Moreover, SV was lesser in the experimental group as a result of the mitigation of the increased watery secretion of the accessory sex glands as mediated by heat stress. It is possible that the accessory sex glands of the control group increased water composition of their secretions as a heat stress response. This response was mitigated by the cooling intervention in the experimental group.

Semen Quality

Live Sperm Count (LSC) differed between experimental and control groups (Table 4). Experimental group had higher LSC than the control group (Figure 24). There was no month interaction for LSC. Monthly LSC were comparable (Table 4).

Semen Mass Activity (SMA) differed between experimental and control groups (Table 5). Experimental group had higher SMA than control group (Figure 3). The average SMA of the experimental group of 2.77 ± 0.07 was within and slightly above its baseline value of 2.73 ± 0.09 while the average SMA of the control group of 2.28 ± 0.10 was below its baseline value of 2.72 ± 0.09 .

There was no month interaction for SMA. Monthly SMA were comparable (Table 5).

Semen Consistency (SCo) differed between experimental and control groups (Table 6). Experimental group had higher SCo than the control group (Figure 4). The average SCo of the experimental group of 2.72 ± 0.06 was within its baseline value of 2.74 ± 0.09 while the average SCo of the control group of 2.36 ± 0.10 was below its baseline value of 2.73 ± 0.09 .

There was no month interaction for SCo. Monthly SCo were comparable (Table 6).

Table 3. Sperm Concentration ($\times 10^7/\text{ml}$) of Murrah buffalo bulls with or without fan and sprinkler cooling and month of collection

Collection Month	Treatments		
	Experimental	Control	Mean \pm SEM
April	187.49	170.44	178.96 \pm 7.98
May	173.81	169.99	171.90 \pm 8.99
June	172.87	180.93	176.90 \pm 9.09
July	179.52	177.87	178.69 \pm 10.25
August	165.49	169.50	167.49 \pm 12.63
September	179.15	163.34	171.25 \pm 9.98
Mean \pm SEM	176.39 \pm 5.98	172.01 \pm 5.19	

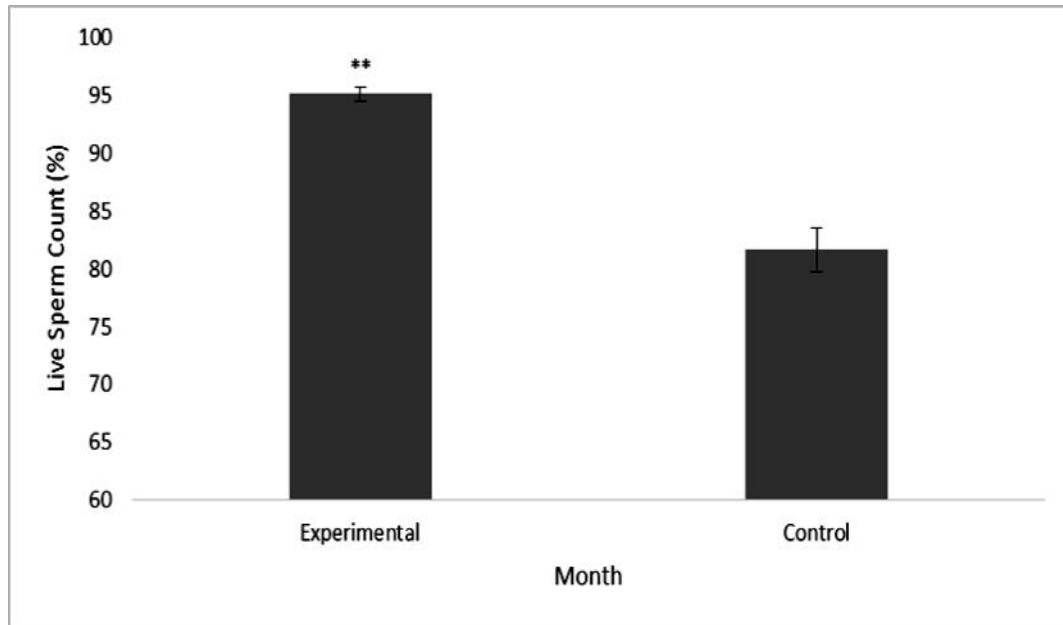


Figure 2. Live sperm count (%) of Murrah buffalo bulls with fan and sprinkler (Experimental) and without fan and sprinkler (Control). Mean values are different at $p < 0.01$.

Table 4. Live Sperm Counts (%) of Murrah buffalo bulls with or without fan and sprinkler cooling and month of collection

Collection Month	Treatments		Mean \pm SEM
	Experimental	Control	
April	97.71	81.42	89.56 \pm 3.97
May	91.58	79.13	85.35 \pm 3.42
June	95.63	87.25	91.44 \pm 1.63
July	79.46	79.46	88.40 \pm 4.52
August	94.17	79.54	86.85 \pm 2.48
September	94.67	83.25	88.96 \pm 1.91
Mean \pm SEM ^s	95.18 \pm 0.58	81.67 \pm 1.90	

s – significant at $p < 0.01$

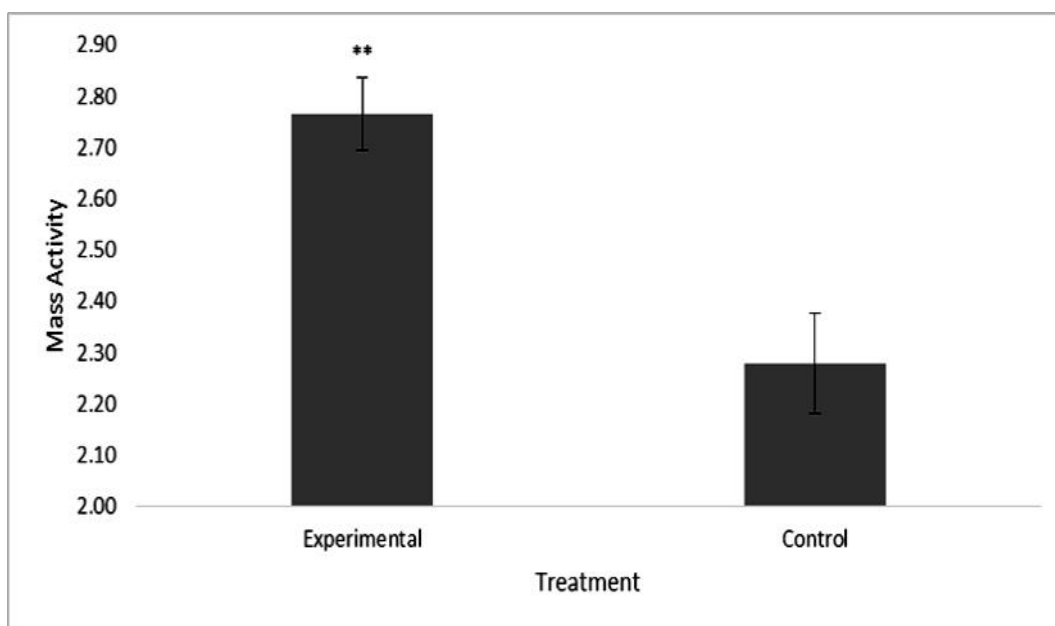


Figure 3. Semen Mass Activity of Murrah buffalo bulls with fan and sprinkler (Experimental) and without fan and sprinkler (Control). Mean values are different at $p < 0.01$.

Table 5. Semen Mass Activity of Murrah buffalo bulls with or without fan and sprinkler cooling and month of collection

Collection Month	Treatments		Mean \pm SEM
	Experimental	Control	
April	2.62	2.54	2.58 \pm 0.09
May	2.88	2.34	2.61 \pm 0.17
June	2.80	2.34	2.57 \pm 0.18
July	2.71	2.15	2.43 \pm 0.16
August	2.76	2.05	2.41 \pm 0.21
September	2.82	2.24	2.53 \pm 0.17
Mean \pm SEM ^s	2.77 \pm 0.07	2.28 \pm 0.10	

s – significant at $p < 0.01$

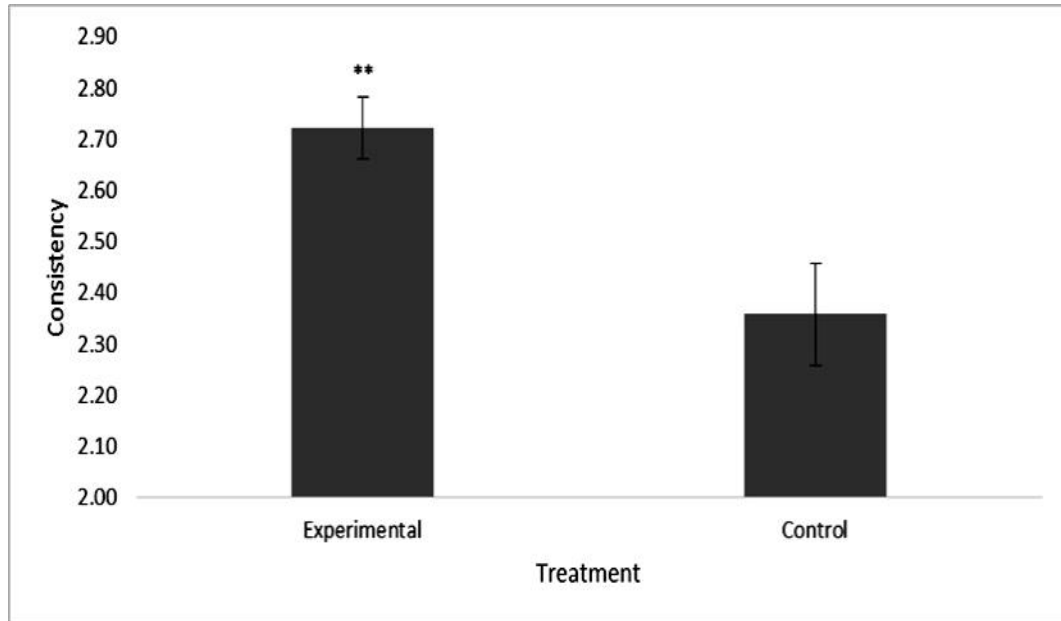


Figure 4. Semen Consistency of Murrah buffalo bulls with fan and sprinkler (Experimental) and without fan and sprinkler (Control). Mean values are different at $p < 0.01$.

Table 6. Semen Consistency of Murrah buffalo bulls with or without fan and sprinkler cooling and month of collection

Collection Month	Treatments		Mean \pm SEM
	Experimental	Control	
April	2.60	2.59	2.60 \pm 0.09
May	2.83	2.45	2.64 \pm 0.16
June	2.73	2.39	2.56 \pm 0.15
July	2.69	2.20	2.44 \pm 0.15
August	2.67	2.17	2.42 \pm 0.19
September	2.81	2.34	2.57 \pm 0.17
Mean \pm SEM ^s	2.72 \pm 0.06	2.36 \pm 0.10	

s— significant at $p < 0.01$

Semen Initial Motility (SIM) differed between experimental and control groups (Table 7). Experimental group had higher SIM than the control group (Figure 5). The average SIM of the experimental group of 53.78 ± 1.54 was within its

baseline value of 53.67 ± 2.22 while the average SIM of the control group of 43.19 ± 2.44 was below its baseline value of 53.42 ± 2.19 .

There was no month interaction for SIM. Monthly SIM were comparable (Table 7).

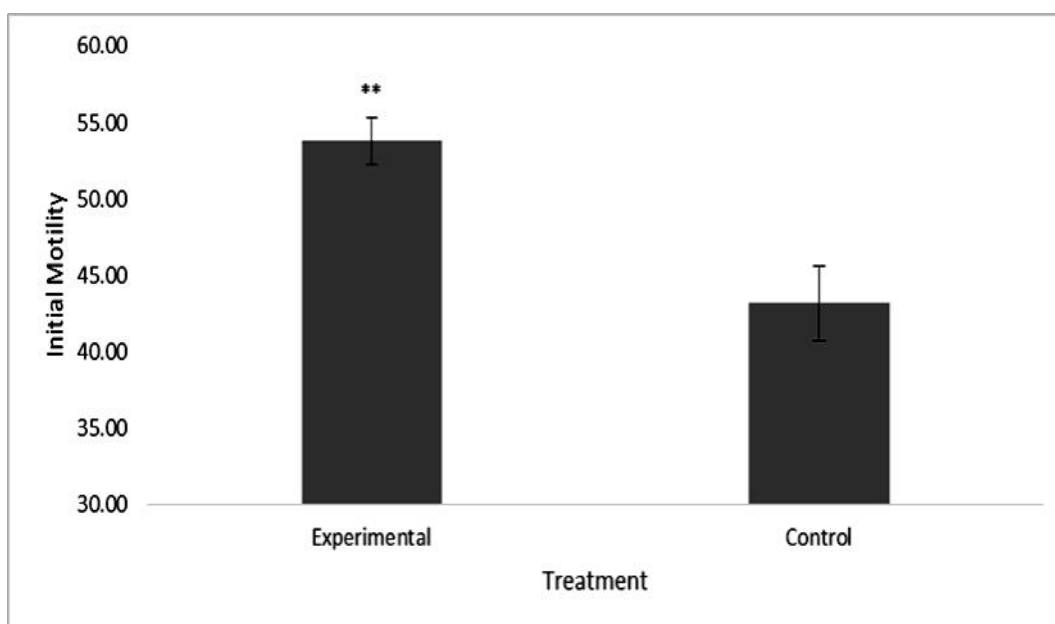


Figure 5. Semen Initial Motility of Murrah buffalo bulls with fan and sprinkler (Experimental) and without fan and sprinkler (Control). Mean values are different at $p < 0.01$.

Table 7. Semen Initial Motility (%) of Murrah buffalo bulls with or without fan and sprinkler cooling and month of collection

Collection Month	Treatments		Mean \pm SEM
	Experimental	Control	
April	51.15	50.69	50.92 \pm 2.04
May	57.29	45.65	51.47 \pm 4.07
June	54.46	45.10	49.78 \pm 3.89
July	52.84	39.59	46.21 \pm 3.80
August	51.88	36.17	44.02 \pm 4.79
September	55.07	41.92	48.49 \pm 4.21
Mean \pm SEM ^s	53.78 \pm 1.54	43.19 \pm 2.44	

s= significant at $p < 0.01$

The present intervention brought a general increase in sperm quality (live sperm count, mass activity, consistency, initial motility). Moreover, the intervention was effective in maintaining the sperm quality parameters within the baseline value for the experimental group. It was also evident that control group's sperm quality was below their baseline values. This is consistent with [5] in buffalo bulls and [6] in Jersey bulls. The present intervention improved semen qualities by reducing the effect of heat stress due to testicular degeneration [9]. Based on the result of Study 2, fan and sprinkler cooling improved red blood cell profile of the experimental group. A good supply of oxygen and nutrients is needed for spermatogenesis to proceed and animals with a better red blood cell profile are more able to sustain this process since red blood cells contain hemoglobin which carries oxygen to various body tissues including testicular tissues.

Rectal temperature and scrotal surface temperature difference and sperm quality

Rectal Temperature and Scrotal Surface Temperature Difference (RTSSTD) was 5.74°C for the experimental group and 5.14°C for the control group. There was apparently greater RTSSTD in the experimental group compared to the control group which may be more conducive for spermatogenesis to proceed.

Table 8 summarizes sperm quality of bulls which was taken after a two-week sperm production cycle following RTSSTD measurements.

The effect of a larger RTSSTD difference was significantly higher SV in control group compared to the experimental group. There was comparable SC between the treatments. As discussed previously, the cooling intervention affected the role of the epididymis to concentrate semen by absorbing fluid coming from the testis. In the control group, there was an increase in semen volume probably because heat stress was detrimental to the epididymal function to concentrate semen.

SMA, SCo and SIM were significantly higher in the experimental group compared to the control group as a consequence of a larger RTSSTD of the experimental group. Similar to the results in the previous section, the cooling intervention brought a general increase in sperm quality in terms of mass activity, consistency and initial motility. In most mammals, testicular temperature 2°C to 6°C lower

than the body temperature is needed for the production of normal sperms [1]. Although the RTSSTD of the experimental and control group were within the aforementioned temperature range, the greater RTSSTD in the experimental group perhaps provided a more conducive environment for spermatogenesis to proceed.

Economic Analysis

The total number of semen straw produced by the experimental group was 26, 666 for the 6-month duration of the study while the straw produced by the control was 21 487. There were an additional 5 179 straws produced by the fan and sprinkler intervention. There was a profit difference of P 12,939.95 per bull per month added to the experimental group by the cooling intervention.

Testicular Ultrasound Features

Samples of the testicular ultrasonic appearance of Murrah bulls are shown in Figure 6. The testicular covering consists of the skin, the cremaster muscle, and the tunics. Topmost was the hyperechoic skin. The next layer which was presented as an hypoechoic area with interspersed hyperechoic areas were the cremaster muscles combined with some fats and the last hyperechoic line was the tunics. The testicular covering ranged from 9 mm to 15 mm. The testicular parenchyma was granular homogenous and moderately echogenic all throughout with no signs of fibrosis and calcifications in all samples. The parenchyma echomean ranged from 83.23 to 146.02 and its thickness ranged from 38 mm to 63 mm. The hyperechoic linear structure distinctively located at the bottom of the ultrasonogram is the testicular covering layer on the other side of the testis starting with the tunica albuginea.

All ultrasonograms (Image A1 to C6 in Figure 6) show homogenous hypoechogenic testicular parenchyma with dispersed hyperechoic areas giving the parenchyma a granular appearance. Image B3, C1 and C3 had almost round distinguishable hyperechoic area in the middle of the ultrasonograms which represent the mediastinum. Image C2 shows a mirror image, an artifact produced by air, in the bottom part of the image.

The present findings are consistent with [10] in Egyptian buffalo bulls where the testis was found with

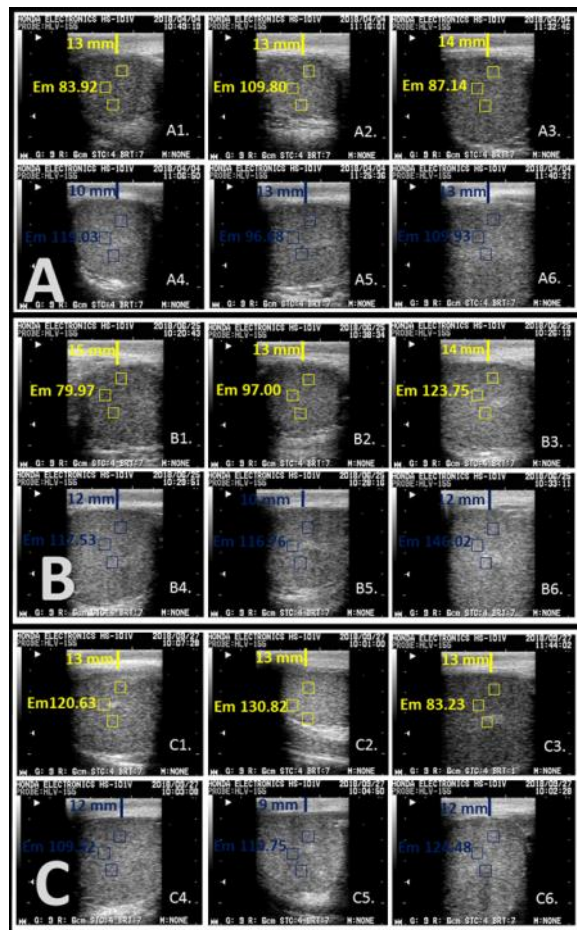


Figure 6. Samples of the testicular ultrasonic appearance of murrh bulls

Table 8. Semen Quality after a Two-week Sperm Production Cycle from Rectal Temperature and Scrotal Surface Temperature Difference Measurement of Murrh buffalo bulls with or without fan and sprinkler cooling

PARAMETER	EXPERIMENTAL (Mean ± SEM)	Control
Semen Volume (ml)	4.62±0.18 ^b	5.66±0.98 ^a
Sperm Concentration (10 ⁷ /ml)	162.91±5.86 ^a	163.97±14.28 ^a
Mass Activity	2.75±0.09 ^a	2.35±0.28 ^b
Consistency	2.71±0.08 ^a	2.39±0.28 ^b
Initial Motility (%)	53.56±1.90 ^a	44.72±6.74 ^b

Means followed by a different letter are different at p<0.05.

a homogeneous hypoechoic parenchyma with a centrally located hyperechoic mediastinum bounded by a distinct hyperechoic tunic. The shape of the mediastinum described in the present study is consistent with the findings of [11] in buffalo bulls where the mediastinum was described as an almost round hyperechoic structure which is centrally located in transverse images.

Ultrasound Echomean

Testicular parenchyma echomeans (Em) were

comparable among the months of collection and between experimental and control groups (Table 9).

The present findings revealed no significant differences among the months of collection.

There was a tendency ($P=0.1166$) for Em to be lower in the experimental group compared to the Em of the control group (Figure 7). This finding shows a more vigorous spermatogenesis activity in the experimental group as evident with the increased fluid content within the testicular parenchyma. The active emptying of the Sertoli cells within the seminiferous tubules would mean that more sperm cells are being

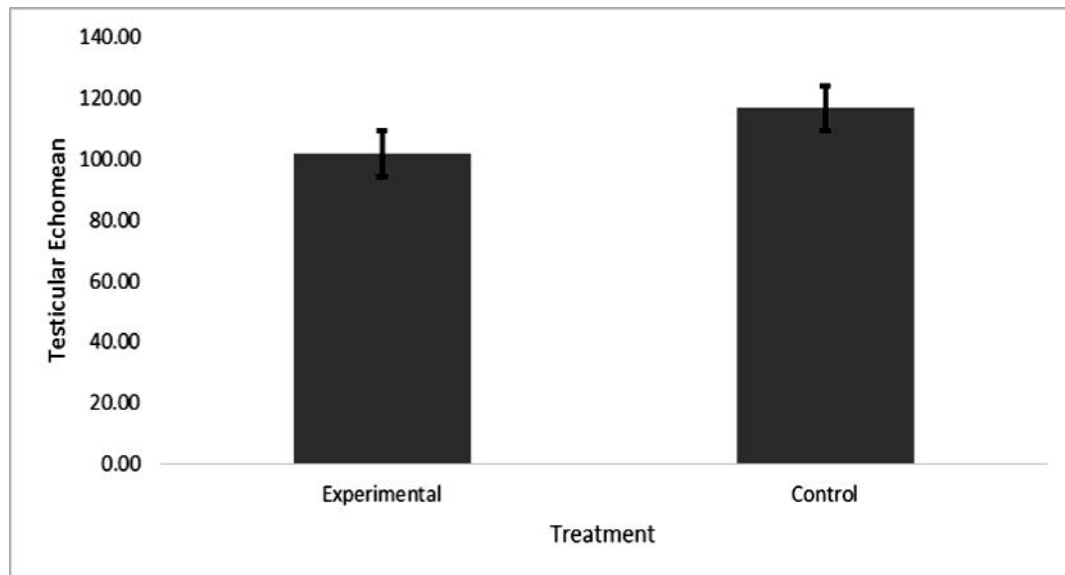


Figure 7. Testicular Parenchyma Echomean (Em) of Murrah buffalo bulls with fan and sprinkler (Experimental) and without fan and sprinkler (Control). Em of experimental group has a tendency to be lower compared to the Em of the control group ($p=0.0116$).

Table 9. Testicular Ultrasonogram Echomean of Murrah buffalo bull with or without fan and sprinkle cooling and month of blood collection

Collection Month	Treatments		Mean \pm SEM
	Experimental	Control	
April	93.62	101.08 \pm 5.73	101.08 \pm 5.73
June	100.24	113.51 \pm 9.28	113.51 \pm 9.28
September	111	113.24 \pm 6.86	113.24 \pm 6.86
Mean \pm SEM ^s	101.81 \pm 6.58	116.74 \pm 4.50	

transported in the seminiferous tubules and this process is facilitated by more fluids. If there were less spermatogenesis activity within the testicular parenchyma there would be less fluid produced and needed. The increased fluid content of the testicular parenchyma of the experimental group, producing less dense echoes in ultrasonograms, means that the testicular tissue is filled with more fluids signaling a more active sperm development. This finding proves the results of improved semen quality that the fan and sprinkler cooling is an effective way to improve semen quality. In the best of the author's knowledge, this is the first time that such findings are reported.

Testicular Covering Thickness

Testicular Covering Thickness (TCT) was comparable among the collection months (Table 10). TCT was greater in the experimental group than the control group (Figure 8).

Increase in the testicular covering in the experimental group was a consequence of the increased spermatogenesis activity within the testicular tissue. Obviously, if there is an increased activity there will be more blood supply to the testicular tissue and to the surrounding scrotal tissues increasing their sizes.

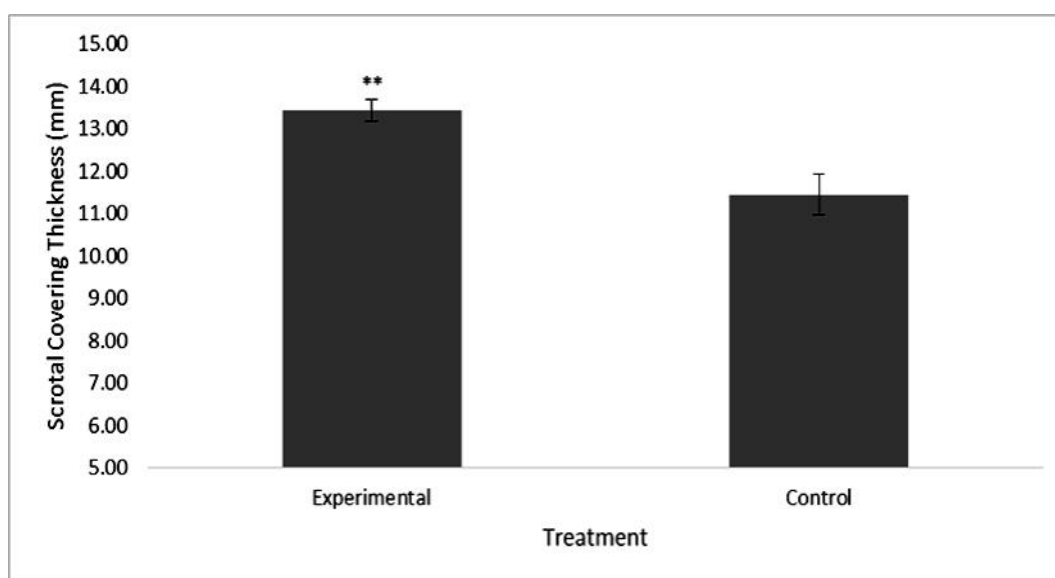


Figure 8. Testicular Covering Thickness (TCT) [mm] of Murrah buffalo bulls with fan and sprinkler (Experimental) and without fan and sprinkler (Control). Mean values are different at $p < 0.01$.

Table 10. Testicular Covering Thickness (mm) of Murrah buffalo bull with or without fan and sprinkle cooling and month of blood collection

Collection Month	Treatments		Mean \pm SEM
	Experimental	Control	
April	13.33	12.00	12.67 \pm 0.56
June	14.00	11.33	12.67 \pm 0.71
September	13.00	11.00	12.00 \pm 0.63
Mean \pm SEM ^s	13.44 \pm 0.24	11.44 \pm 0.47	

s – significant at $p < 0.01$

IMPLICATIONS

Fan and sprinkler cooling mitigates the increase in semen volume as a sign of the detrimental effect of heat stress to the functions of the epididymis and the accessory sex glands. Moreover, Increased Rectal Temperature and Scrotal Surface Temperature Difference provides a better condition to spermatogenesis to proceed improving semen quality. Fan and sprinkler cooling is a cost-effective way to improve semen quality of Murrah buffalo bulls. Ultrasonography may be used to assess the effect of heat stress in testicular tissue and to assess the effectiveness of cooling methods to mitigate the effect of heat stress in testicular tissue.

CONFLICT OF INTEREST

We certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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