

Volume 2-Number 1-2020-6

PROPAGATION OF UNDERUTILIZED PLANTS TO ADDRESS IRON DEFICIENCY ANEMIA IN SCHOOL CHILDREN

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Abstract

The context of this study focused on the underutilized plants such *Basella alba* Linn. (alugbati), *Momordica charantia* L. (ampalayang ligaw), *Amaranthus viridis* (kulitis), *Corchorus olitorius* L. (saluyot) and *Talinum triangulare* Willd. (talinum) to be an organic agent in addressing iron deficiency anemia caused by malnutrition and poor body mass index status. The research problem determined how schools and community could promote the propagation and consumption of underutilized plants to address iron deficiency anemia among students.

Guided with the mentioned problem, multiple methods such as survey, observations, interviews, picture taking and other field works were applied in order to gather substantial data. As a result, it has found that student informants had moderate awareness on the *alugbati*, *saluyot*, *ampalayang ligaw*, *kulitis*, and *talinum* as underutilized plants with the school community prior to the implementation of the plant propagation campaign. Most of the students were slightly aware on the benefits of the underutilized plants can offer and serve to their health and body as a whole. School and community may implement the advocacy of propagation of underutilized plants as a campaign to address the iron deficiency anemia among school children with the collaboration of the school principal, teachers as well as parents. As the objectives of this

campaign, the cooperation of the school principal and teachers, following ethical considerations for the parents and students, the researcher also assures the participants that the plants to be used in the campaign were all safe to eat, identified and certified by the Bureau of Plant and Industry, through various solutions such as feeding program and *Gulayan sa Bakuran*, the body mass index of the student-informants was improved and normalized after the implementation of the propagation of the underutilized plants. The body mass index from baseline to end-line was decreased into comparable improvement of 2 to almost 5 percent of the number of students with severely wasted status among the three schools.

Introduction

Public schools are expected to promote not only quality education, but a healthy environment and school climate as well. Educational institutions focus on the academic aspect of instructions. Most of the educational researches involving students concentrate on the students' performance in academics and students' achievements in both classroom and extracurricular activities.

Among the numerous areas of research in Biology, perhaps researchers should look first on the significant contribution of the subject, per se, to the daily life of the students and particularly in propagating herbs and its nutritional substance of what our school children are eating each day as they struggle through a day of learning.

The school environment is expected to give awareness on health contribution of different plants, particularly the medicinal ones. In the same manner, schools are encouraged to set botanical gardens of medicinal plants particularly among public schools. This advocacy campaign by the Department of Education (DepEd) through DepEd Memorandum No. 191 series of 2013 in addressing nutrition issues among public schools is strengthened through the augmentation of school-based Feeding Program, *Gulayan sa Paaralan* and *Gulayan sa Bakuran* projects.

These projects focus on the strengthening of agriculture and other related subjects through vegetable planting among schools. In the same manner, DepEd desires to use these projects as agent for other related advocacy like vegetable income-generating project and supplemental resources for School-Based Feeding Program (SBFP).

Gulayan sa paaralan project has been implemented by the Department of Education as a source of ingredients for the SBFP and encourage the families of beneficiaries to have their own home garden for the continuous nutritional improvement at home in order to improve the nutritional status learners from Kinder to Grade 6 by at least 70% at the end of its 120 feeding days.

GPP also aims to boost classroom attendance by 85%, and improve children's health, nutritional values and behavior and to address malnutrition among school children. *Gulayan sa paaralan* suggests a three-pronged approach to address malnutrition through gardening, supplementary feeding, and nutrition education and empower elementary schools to continuously grow and harvest vegetables, through reliable and scientific practices.

School garden also promotes the value of agriculture through vegetable gardening. This advocacy makes the full turn among students to look back the significance of planting and harvesting of vegetables for both health awareness and vegetable consumptions.

Nutrition awareness may also be performed and disseminated through Biology subject, particularly in studying plants and herbs. These programs and projects are initiatives of the government to address health problems among school children. One of the major problems concerning health of school children is anemia.

Studies show the relationship between nutrition and psychomotor development as well as psychosocial behavior of the students. Iron-deficiency anemia in infancy has been consistently shown to negatively influence performance in tests of psychomotor development. In most studies of short-term follow-up, lower scores did not improve with iron therapy, despite complete hematologic replenishment (Walter, 2003). This relationship has been highly under-researched, but there exist many studies that look at the nutritional benefits of many proteins, vitamins, and food substances as they affect learning and brain function. Public schools have the potential to play a very important role in preparing and sustaining our students' potential learning abilities and benefitting their social responsibilities by supplying nutritious breakfasts and lunches during school days. Prior to this, schools have the ability to propagate vegetables and herbal plants with highly nutritive value to establish sense of responsiveness and health consciousness among school children.

One of the primary health problems among school children is anemia. Anemia is a major public health problem in developing countries (Simbauranga, 2013). Iron deficiency anemia (IDA), as defined by the Philippine Statistics Authority (2016), is a condition that occurs when the amount of iron absorbed by the human body is too small to meet the body's demands, which may be due to insufficient iron intake, reduced bioavailability of dietary iron, chronic blood loss, and/or increased iron requirements, as occurring during pregnancy or the period of growth, with the hemoglobin level.

In the year 2010, Nutrition and Consumer Protection of the United Nations revealed on their statistics that iron deficiency anemia is the most alarming of the micronutrient deficiencies affecting a considerable proportion of infants (56.6%), pregnant women (50.7%), lactating women (45.7%) and male older persons (49.1%).

Moreover, the U.S. Institute for Health Metrics and Evaluation (2017) released a statistics showing that in the 2005 to 2015, anemia is ranked 6th among health problems in the Philippines which becomes prevalent. In this case, the health problem regarding iron deficiency anemia has become not only a global issue, but also one of the primary problems here in the Philippines. This health problem is common among school children who are commonly prone in malnutrition.

Pouraram (2010) states that despite of too many studies about iron and its contribution to the health, there are limited research conducted focused on undernourished and non-anemic persons.

Among the public secondary schools in Pandi, the numbers of severely wasted students are: Bunsuran High School (32); Masagana High School (4); and Virginia Ramirez-Cruz High School (56).

Based on the aforesaid statements, the researcher has come up with the following research problem and research questions.

Research Problem

The general problem of this research is: How schools could promote the propagation and consumption of underutilized plants in addressing iron deficiency anemia among students?

Guided with this problem are the specific research questions:

1. How may the awareness of the students on IDA and knowledge on the health value of the underutilized plants be enhanced through school-community campaign for the plant propagation of *Basella alba* Linn. (*alugbati*), *Momordica charantia* L. (*ampalayang ligaw*), *Amaranthus viridis* (*kulitis*), *Corchorus olitorious* L. (*saluyot*) and *Talinum triangulare* Willd. (*talinum*)?
2. What school and community activities may be implemented to strengthen the campaign on propagation of underutilized plants?
3. What solutions do the school and community plant propagation campaign offer in addressing Iron Deficiency Anemia (IDA)?
4. How did the teachers, students and parents perceive the underutilized plants after completing the campaign?

[Integrated of Review of Related Literature and Studies](#)

This part of the research includes the different relevant articles and readings that have been carried in the previous research discussion which has a relationship and disparity with the

present study, thus reviews of different studies relevant to the present study are presented below.

Anemia is positively associated with other nutritional deficiencies like malaria, malnutrition, HIV infection, and low socioeconomic status. Because of its low cost and feasibility, World Health Organization has included evaluation of palmar pallor (skin color of the palm) as the initial tool to detect severe anemia in its algorithm for management of sick children (Simbouranga, 2013).

The prevalence of anemia in a population as measured by low hemoglobin concentration, or low hematocrit is by far the several well-established methods using indicator for detecting iron deficiency (Semba et al., 2008). In promoting awareness on the benefits of science subject in our daily life among learners, school alone may not be enough to transpire every learning in terms of iron deficiency anemia.

Anemia is defined as low level of hemoglobin in the blood by a reduced quality or quantity of red blood cells. Anemia is one of the world's most widespread health problems (Pan American Health Organization, 2007). Anemia has been a worldwide health issue and concern. Different health organizations are paying their attention in addressing the problems on iron deficiency anemia.

Guzman, Guzman and Llanos (2016) discussed that during childhood there is a need for more iron as it grows. Iron deficiency anemia is similar to those other types of anemia although there are specific symptoms that can be attributed to iron deficiency. It was also concluded that Iron Deficiency Anemia is the most common type of anemia that is associated with malnutrition in all stages of life. Gomez (as cited in Puntis, 2010) stated that malnutrition among children are usually caused by insufficient food available. Puntis added malnutrition can also be manifested through the inadequate nutrient intake to meet physiological requirements.

Villavert (2016) found out the problem of malnutrition among school children may be addressed by the *Gulayan sa Paaralan* project which serves as the main source of commodities to sustain supplementary feeding. Vegetable gardening may give sustainable supplement on the nutritional needs of school children particular those who have low status in body mass index.

The implementation of *Gulayan sa Paaralan* is one of the solutions made by the government to address malnutrition and hunger issue in the Philippines and the continuation of the program may lead to resolution or larger issues. Students are expected to be part of the promotion of health and nutrition education as well as valuing agriculture as a life support system.

Anemia and malnutrition among children continue to be main public health issues and primary challenges in most of the developing countries. Anemia and malnutrition diffuse all aspects of their health and even physical, cognitive and social development (Ewusie, 2013). The discussion

of Iron Deficiency Anemia shows that the primary cause of such is lack enough food nutrients which lead to malnutrition.

Herbs with properties that may help prevent and fight iron deficiency anemia are ideal to propagate among public schools in order to address the deficiency among school children. One of the underutilized plants is *alugbati*.

Alugbati (Basella alba Linn.), is commonly known as Malabar spinach or the red vine. The stem is purplish (shade of red) and succulent with heart shape leaves (Philippine Medicinal Plants, undated). It bears green to dark red fruits. A popular leafy and stew vegetable, it is and a good substitute for spinach. It is popular for its medicinal properties - excellent source of calcium and iron; good source of Vitamin A, Vitamin C, and Vitamin B. Found in settled areas, in hedges, old cultivated areas etc. throughout the Philippines, also occurs in tropical Asia.

Ampalayang ligaw (Momordica charantia L.), has been recommended by the Department of Health (DOH) as one of the best supplements to prevent liver problems, diabetes and HIV. It is also used to treat skin diseases, and sterility in women, as a parasiticide, antipyretic and purgative. There are also reports that the seed extracts induce abortion. *Ampalayang ligaw* remains important and significant vegetable crop and production is expected to increase because of its medicinal properties. Breeding for less bitterness will increase the crop's popularity as vegetable (Philippine Medicinal Plants, undated). Sage Press Inc. (2002) enumerated the properties and actions of *ampalayang ligaw* such as anthelmintic, antibacterial, antibiotic, antidiabetic, anti-inflammatory, and the anti-leukemic property which addresses iron deficiency anemia.

Moreover, other properties of *ampalayang ligaw* are antimicrobial, antimutagenic, antimycobacterial, antioxidant, antitumor, antiulcer, antiviral, aperitive, aphrodisiac, astringent, carminative, cytostatic, cytotoxic, depurative, hormonal, hypocholesterolemic, hypotensive, hypotriglyceridemic, hypoglycemic, immunostimulant, insecticidal, lactagogue, laxative, purgative, refrigerant, stomachic, styptic, tonic, and vermifuge which address other health problems.

School gardens have been representations of nature and education throughout America's history. They have stood as examples of educational and social philosophies and theories for the betterment of America's youth; they have been symbols of freedom and the American spirit; they have also been representations of healthy living and healthy learning (Hayden-Smith, 2010). Many organizations and professionals supported the establishment of school gardens because of the positive effects they had on civic improvement, education, safety, and social and moral development (Lawson, 2005).

Lautenschlager and Smith (2008) found a moderate increase in knowledge gained from a garden program using experiential learning methods. Students participated in the garden curriculum and had the opportunity to reflect upon the knowledge and experiences in a daily journal. This simply states the implication of school plant propagation through school garden may give positive output on the prevention and awareness on health and nutrition.

As a discipline that supports the study of teaching and learning of a diverse and skill-oriented field, it is beneficial for educators to provide learning experiences to students. Experiential learning is often associated with agriculture education in practice and in theory (Roberts, 2006).

Kulitis (Amaranthus viridis), also known as *Kulitis* are herbaceous annuals with simple leaves, and flowers in heads or spikes. The spikes are sometimes several centimeters long. Love-lies-bleeding has dry red bracts that surround the flower which allows them to retain their freshness for some time. For this reason, the plant is a symbol of immortality (Philippine Medicinal Plants, undated).

Kulitis (Amaranthus viridis) is the common name used for plants with blossoms that do not readily fade when picked found in the tropical countries and temperate regions where many are widely naturalized. They are herbaceous annuals with simple leaves, and flowers in heads or spikes. The spikes are sometimes several centimeters long. Love-lies-bleeding has dry red bracts that surround the flower which allows them to retain their freshness for some time. For this reason, the plant is a symbol of immortality. This plant may contribute to address the problems on iron deficiency anemia among schools. *Kulitis* will be easy to propagate in school gardens through Biology subject.

Kulitis is a food that blossoms anywhere with the scientific name *Amaranthus viridis*. *Kulitis* leaves are filled of antioxidants, protein, vitamins, calcium, carbohydrate, iron and minerals that has numerous health benefits which can contribute to stimulate growth and repair, reduce inflammation, prevent certain chronic diseases, boost bone strength, lower blood pressure, improve the immune system, reduce the appearance of varicose veins, maintain healthy hair and ease weight loss effort (Jean, 2016). The root of *kulitis* is also useful in treatment of menorrhagia, an abnormally heavy or prolonged menstruation; can be a symptom of uterine tumors and can lead to anemia if prolonged and not treated (Vicedo, 2010). *Kulitis* has enormous use particularly in treating iron deficiency. Aside from *kulitis*, *talinum* is also found beneficial in addressing iron deficiency problems.

Saluyot (Corchorus olitorious L.), is a green leafy vegetable that is rich in calcium, phosphorus, potassium and iron. It has also been determined that 100 grams of *saluyot* contains an ample amount of riboflavin, and other nutrients good for blood (Philippine Medicinal Plants, undated). With these facts alone, we can appreciate the benefits that can be derived from eating and

incorporating *saluyot* in one's diet. This vegetable also assures safety of intake even for pregnant mothers. Unlike other plants with medicinal benefits like *makabuhay* (*Tinospora rumphii boerl*), it is safe to be eaten even by those which are medically considered to be in a weak state. *Saluyot* can be found basically everywhere. From warm, tropical countries like the Philippines to tropical deserts and wet forest zones, *saluyot* is abundant. It does not require much attention and care, and thus, thrives without cultivation the whole year round.

Talinum (*Talinum triangulare* Willd.), leaves contain an appreciable amount of bioactive compounds. Medically the presence of these phytochemicals explains the use of this vegetable in ethnomedicine for the management of various ailments (Aja, Okaka, Onu, Ibiam & Urako, 2010). *Talinum* plant has elements which include Calcium, Potassium, Magnesium, Sodium and Iron which address anemia and other problems related to iron deficiency (Ajiboye et al., 2014). Several studies were conducted showing the significant contribution and use of the different plants to address iron related health problems.

The aforesaid underutilized plants are some of the example of herbs which may help the students to increase their Body Mass Index from being severely wasted due to iron deficiency anemia. Food fortification refers to the supplement of micronutrients to processed foods. It is a strategy to improve the health and micronutrients status of population (Hertrampf, 2002). As stated by Allen, de Denoist, Dary, and Hurrel (2006), food fortification has an enormous and positive impact on public health, particularly in improving and controlling micronutrient deficiency.

Some of the advantages of food fortification includes the sustainable storing and restoration of nutrients more effectively and efficiently than irregular food supplement. Allen et al, (2006) also added the fortified foods help to lower the risk of multiple health deficiencies that can result to poor quality diet. Adolphe (2007) also found that the development of acceptable fortified foods and vitamin-fortified pureed foods is feasible and are an effective way to increase and improve the nutritional status. On the other hand, Pouraram (2010) found that there is not guarantee the flour fortification will able to control iron deficiency in non-anemic healthy individuals. Ullah and Khan (2008) found that the vegetarian food habit is associated with reduced risk of cancer, cardiovascular and neurodegenerative disorders and improve, in a large scale, the health and nutrients of the body.

To sum up, studies show the multiple issues on anemia, underutilized plants and food fortification. The argumentative part of the issues substantiates this study in order to see if the implementation of school-community campaign on propagating underutilized plants may fight against iron deficiency anemia through school initiative project as part of Biology subject is a challenge that addressed around globally.

The researcher reviewed related studies which are significant in order to enrich the context of this study. Related studies also serve as basis on the argument building in every part of the research discussion.

Simbauranga (2013) discussed the anemia as a major public health problem in developing countries worldwide and is contributing significantly to morbidity and mortality among children under five years for about 43%. Two-third are residing in Sub Saharan Africa. The study determined the prevalence of anemia and its associated factors as well as morphological types of anemia among children under five years admitted in medical center. The study of Simbauraga discussed the implication of anemia was 77.2%. Mild, moderate and severe anemia was 16.5%, 33% and 27.7% respectively. Anemia among under five-year-old children admitted medical center is high. Iron deficiency anemia is the leading type. Factors strongly associated with severe anemia were malaria parasitaemia, presence of hemoglobin and unemployment among caretakers.

Considering a high prevalence of anemia, the study has been recommended that the approach to anemia control should be revised. Preventive strategies such as iron supplementation, antimalarial prophylaxis, follow up clinics, regular screening of hemoglobin level must target all children under five years irrespective of their hemoglobin level or clinical status.

The reviewed study discussed the implication of anemia and its possible recommendation on how to minimize the iron problems among children. Similarly, this current study concerns with the iron deficiency among school children and assess the school and community actions and contingency plans to address iron deficiency anemia through the science subject.

Guzman et al. (2016) published a documentary study on the pathogenesis of iron deficiency anemia (IDA). It has been noted the IDA is the cause of half of all cases of anemia. This reviewed study implied the significance of data of the IDA on the primary care and pediatrics in order for them to identify it and act accordingly. The current study also concerns on the immediate actions the school and community can provide to address the anemia issues and problems, particularly among school children.

Another study conducted by Tashreeg (2016) on autoimmune hemolytic anemia caused by ceftriaxone, leading to the destruction of red blood cells causing secondary anemia. These studies investigated the possibility of ceftriaxone drug as an etiology of immune hemolytic anemia among patients and explore the correlation to the duration of drug taken. The study found that the ceftriaxone has no effect on patients. It does not induce the immune hemolytic anemia. Ross (2010) used to review existing literature about past research that highlighted studies concerning nutrition and its relationship to brain function, cognition, learning, and social behaviors. There is indication that school breakfast and lunch programs are not up to par with

current United States Department of Agriculture standards and that standards may not be utilizing the latest research about nutrition. Studies have shown that proper nutrition has a direct effect on student performance and behavior in school. Much of the literature reviewed confirmed that nutrition has a direct effect on neurotransmitters which are important in sending messages from the body to the brain. This study indicates that health and nutrition may contribute to the achievement of the learners and school children. Proper nutrition, in general may help the school children to perform well at school. Proper nutrition includes the prevention to the iron deficiency anemia. School children are expected to have a balance nutrition prevent the lack of iron and red blood cells.

Odeh (2006) also discussed that improper daily healthy practices and poor knowledge regarding iron rich nutrients and its absorption found. Previous history of other diseases seems to contribute to the highly observed prevalence rate of iron deficiency anemia.

The reviewed related studies were used to enrich the context and constructs of this research. The studies gathered serve as support to justify the arguments and issues on the implementation of school-community campaign on propagation underutilized plants such as *alugbati*, *ampalayang ligaw*, *kulitis*, *saluyot* and *talinum*, in addressing iron deficiency anemia among school children. The implementation of school-community campaign may help the instructional delivery of Biology more interesting and effective as it may be localized and personalized according to the needs of the school, community, and learners.

Methodology

This research employed mixed-methodology with participatory action research design in order to achieve the purpose of this study which is to determine and describe the thoughts and perception of Biology students among public secondary schools in Pandi, Bulacan.

It is phenomenological in the sense of it investigated various reaction to, or perceptions of in the lived-experiences of the Biology students as they propagate *alugbati ampalayang ligaw*, *kulitis*, *saluyot*, and *talinum*, through school-community campaign. In addition, this study compared the baseline and end line data of the severely wasted students to see the effects of the propagation and consumption of underutilized plants within the school community and at home through school feeding program and *gulayan sa bakuran* project.

Thus, the study wanted to understand how the world appears to the students as of the implementation and advocacy campaign of propagation of underutilized plants as an intervention program to address the iron deficiency anemia among school children.

Guided with the research design discussed above, the researcher conducted the study through the following sampling procedure. The primary subjects of this research were the public secondary school in the Municipality of Pandi such as Masagana High School, Bunsuran High School, and Virginia Ramirez-Cruz High School which purposively selected with total enumeration sampling procedure. In support to the data, the researcher conducted random interview among 9 students, 11 teachers and 12 parents in order to triangulate the gathered results. This study used interview guide, recorder, camera, memoranda and notes as research instruments to guarantee the validity, authenticity and reliability of all data, figures, papers and other information to collect the data. Considering the documentation and phenomenological approach, the following instruments were also being utilized by the researcher to gather information that will be analysed in this research:

To gather the data on how does participants respond and react to their environment as they perform the activity campaign of *alugbati ampalayang ligaw*, *kulitis*, *saluyot* and *talinum*, propagation, the researcher herself took notes the informants' answers to the interview and questionnaire. As the respondent gave reactions with the questions and interview, the researcher made some minutes on the data through field notes. Photographs of the activities and events of the plant propagation, specifically their outputs and reactions were included in this study to substantiate the result and findings of this research.

The conditional relationship guide will be completed by selecting a category and placing the category name at the far-left column. Ultimately this process will be completed for all categories identified in the study. The format is designed to ask and answer each relational question about the category named at the left column. Various analyses of the data gathered from the different informants and observations from the immersion will be used to assure the accuracy, reliability, validity, and credibility of this research.

To establish the validity and to reveal deeper sense of implication of the data from interview, triangulation among the data and among the informants were done. The three methods of data gathering will be used in this study are interview, immersion, and observation.

The research was triangulate through the collection of the data. The researcher gathered data through multiple techniques. The first into consideration was the gathering of visual data through the use of camera. In addition, direct observation was done to substantiate the visual data which were taken from the camera. Furthermore, casual interviews were done to gather verbal data directly from the informants.

Results and Discussion

Part I. Knowledge and Awareness among Students

Baseline of Body Mass Index. The fundamental data used in this research came from the baseline results of the students' body mass index gathered from the documents and record of the school. The body mass index assessment was conducted on June 16, 2017 through weighing and measuring the height of the students guided by the nutrition teachers in each school. Students were identified through searching who among the grade 8 students have severely wasted status.

Preparation on Propagation of Underutilized plants. The initial campaign for this study was rolled out last June 16, 2017 through planting of *saluyot* and *alugbati*. The rest of the plants such as *ampalayang ligaw*, *kulitis*, and *talinum* have been propagated in the following month.

In order to verify the classification and variety of plants, the researcher sought certifications from the Bureau of Plant Industry for the plants *aluigbati*, *saluyot*, *ampalayang ligaw*, *kulitis* and *talinum*. Part of the preparation was the gathering of materials needed in the propagation activities such as plastic containers, soil, and other necessities for the project.

Administering the Questionnaire Knowledge and Awareness. The description of awareness on plant propagation of underutilized plants among Grade 8 students before the implementation of the program are showcased in table 1.

Table 1

Frequency Distribution and Descriptive Measures of Students Awareness on Propagation of Underutilized Plants

Awareness on Propagation of Underutilized Plants	5	4	3	2	1	Mean	Verbal Interpretation
1. I understand the goal of Propagating of Underutilized Plants in School and at Home	0	45	33	14	0	3.34	Moderately Aware
2. I know the following plants under this research study:							
a. <i>Alugbati</i>	0	16	47	29	0	2.86	Moderately Aware
b. <i>Ampalayang ligaw</i>	0	13	40	39	0	2.72	Moderately Aware
c. <i>Kulitis</i>	0	17	36	39	0	2.76	Moderately Aware
d. <i>Saluyot</i>	35	38	19	0	0	4.17	Aware
e. <i>Talinum</i>	0	0	14	36	42	1.70	Slightly Aware
3. I know the different recipes of the above underutilized plants	14	16	39	23	0	3.23	Moderately Aware
4. I know other uses of these underutilized plants	12	31	24	25	0	3.33	Moderately Aware
5. I know the health benefits that these underutilized plants can offer	0	11	15	31	35	2.02	Slightly Aware
6. I know that through school "Feeding Program", these underutilized plants can help improve the health awareness/condition of some school children	23	40	16	13	0	3.79	Aware
7. I know the significance of partnership between the school and community	18	22	32	20	0	3.41	Moderately Aware
8. I know the significance of planting these underutilized plants at home through "Gulayan sa Bakuran"	7	19	27	39	0	2.93	Moderately Aware
9. I know that through the active participation of teachers, school children and parents Iron Deficiency Anemia (IDA) will be given a solution.	48	35	9	0	0	4.42	Aware
10. I know that "Feeding Program" and "Gulayan sa Bakuran" must continue for a better result.	42	35	9	6	0	4.23	Aware
						Weighted Mean	Moderately Aware
						3.21	

The data showed in table 1 explains the frequency distribution and descriptive measures of students aware on propagation of underutilized plants prior to the implementation of the *Gulayan sa Bakuran* and school feeding program.

Majority of the items and the numerical value, as well as the verbal interpretation, fall in moderate awareness. This means that student informants had no idea on what the underutilized plants used in this study and the benefits of these plants to their health particularly in addressing the iron deficiency anemia.

To enumerate, the items under number 2 such as *alugbati* (2.86), *ampalayang ligaw* (2.72), and *kulitis* (2.76), which was asking if the students know the plants under this research were on the moderate awareness level only and *talinum* (1.70) fell on the slightly aware level.

Furthermore, *saluyot* (4.17) is on the aware level which explained by the student informants that they are familiar with this plant as it was always mentioned by their teachers at school and sometimes their parents at home.

Prior to the implementation of plant propagation, students' awareness on the different recipes of the above underutilized plants (3.23) was on moderate level. Most of the students do not even know the health benefits that these underutilized plants can offer as it was described with slightly aware (2.02). Table 3 shows the weighted mean as 3.21 in moderately aware.

To qualify the result in numerical data, this study took interview and observation among the students, teachers, and parents who participated in this activity. Based on the casual interview to the student participants of this study, they don't have any idea about the underutilized plants that were being propagated through this research. This context was manifested on the numerical result showed in the table above. Students who undergone feeding program, prior to the implementation of the plant propagation were on the interest on what will they do as they go along. Students, during the interview stated that they are not familiar with the plants which were identified in this study as underutilized. *Alugbati*, among the other plant, was the only plant most of the students are familiar with.



1 - Figure 1. Interview with the students who underwent treatment of underutilized plants through feeding program

For student informants from BNHS, they mix *alugbati* with sardines in order to enhance its taste ("*alugbati lng po ang alam ko... sinasama sa sardinas*"). While the other underutilized plants, prior to the conduct of this research, were not well-known for the student informants.

For student informants from MHS ("*hindi ko kilala yung ibang halaman, yung alugbati lang po kasi nababanggit ng teacher ko sa klase... di pa ako nakita ng talinum*").

For student informants from VRCHS ("*ang nanay ko po mahilig sa saluyot, un po nilalaga nya pag prito ang ulam.*")

("Minsan nga po sinasama sa iba ibang gulay muka po wala lasa pero nasasarapan po sila ni tatay.")

Interview with the Teachers. Teachers who participated in the research activities, from plant propagation to feeding program, expressed appreciation and better understanding on the significance of the activities.

A teacher from Bunsuran states that (*I can't imagine na pwede pala tayo magkaroon ng mas magandang school activities na makakatulong for our students most especially yung mga students natin ma nasa severely wasted status ng BMI*) I can't imagine that we can still have productive school activities for our students, most especially those with severely wasted status in their BMI.

A teacher from Masagana even said that (*"Pamilyar sa akin ang alugbati at saluyot pero di ko masyado pinapansin, siguro dahil di ako mahilig magluto."*)

While the teacher in Virginia states (*"noong bata kmi nakakakain ako nyan kasi wala masyado pagpipilian, kaya alam ko lasa nyang alugbati, saka mabilis tumubo yan eh*).

In addition, canteen teachers from Bunsuran, Masagana and Virginia Ramirez-Cruz high school expressed that they will include the suggested menu in their school canteen recipes.



2 - Figure 2. Interview with the Teachers

Interview with the Parents. Parents were also considered as they were interviewed by the research to gather, supplemental data from their experiences in having *Gulayan sa Bakuran* and consumption of the underutilize plants and used as part of their weekly or daily meal at most.



3 - Figure 3. Interview with the parents of students who underwent treatment and implemented “Gulayan sa Bakuran” and implemented Gulayan sa Bakuran

Parents from Bunsuran claimed (*“naku paborito ko yan ng bata pa kmi, mahilig magluto ang nanay ko nyan, kaso nalipat kmi sa malayo sa bukid kaya di na nakagisnan ng mga anak ko.”*). Parent from Masagana also shared her story, (*“dati di ko din masyado pinapansin yan pero nung mapasama ko sa mga nagbebenta ng herbal supplement, don ako simula nagka interes dyan sa kulitis, gamot nga din yan sa sakit sa balat eh”*)

Parents from Virginia mentioned (*“naku ang mahilig ditto sa mga halaman nay an ay ang biyenan ko, pero susubukan din namin kung makakatulong, kaya pala malakas lagi si amang.”*). Parents testified that, in the beginning of plant propagation, it was hard and unusual to include the garden activities as part of their daily routine. (*“nung una ma’am, nakakalimutan ko pa diligan *laugh*, pero nasanay na rin ako ung lumaon... yung anak ko, nung simula ayaw kumain siguro kasi hindi nya kilala yung halaman”*).

Interview to parents indicates that shift of experiences from the start of the implementation of plant propagation through *Gulayan sa Bakuran* and underutilized plants consumption. It also revealed the willingness of the parents to participate in the programs of the school for the benefits of their children.

Part II. School and Community Activities

Gulayan sa Paaralan. Primarily, secondary schools in the municipality of Pandi, Bulacan implement *Gulayan sa Paaralan* project as part of the annual programs and activities in Technology and Livelihood Education-Agriculture subject which has been started on May 23, 2017 during the launching of *Brigada Eskwela*. This project has been also maximized for the implementation of propagation of underutilized plants in addressing iron deficiency anemia among school children.

Gulayan sa Paaralan was utilized in this research as an outlet to easily realize the implementation of propagation of underutilized plants as initial activity of the campaign to address iron deficiency anemia among students.

Moreover, *Gulayan sa Paaralan* is part of the year round activities of every public school so as the participating schools in this research. Figure 8 shows the setup of *Gulayan sa Paaralan* project of the participating schools.



4 - Figure 4. Gulayan sa Paaralan

Gulayan sa Bakuran. In addition, the *gulayan* projects amplify from the school to every house of the student-informants of the study through *Gulayan sa Bakuran*.

Both parents and students were collaboratively participated in the implementation of the *Gulayan sa Bakuran* as part of the campaign on propagation of underutilized plants to address iron deficiency anemia caused by malnutrition. Parents of students with severely wasted BMI status accepted the proposal and give their consent for their children to undergo this program of improving the body mass index status by including the underutilized plants in the daily meal of the school feeding program.



5 - Figure 5. Distribution of Plants for Propagation at Home

Most of the parents are familiar with the plants as they explained that these plants were always part of their medicinal garden when they were in the elementary school. On their story their children don't want to include underutilized plants in their meal because they are not familiar with these herbs. Parents added that their children began to appreciate and eat these underutilized plants. Students have also positive attitude towards their eating habit in spite of adding medicinal plants to their daily meal. According to the student-informants, they will now ask their parents to add nutritious medicinal plants in most of their dishes to sustain the improvement of their health. In addition to their concern, they will no longer set aside these plant, instead they will start to propagate in their yard.

Feeding Program. As a sequel of the underutilized plant propagation through *gulayan* projects, school feeding program was one of the activities that served as agent to transpire the objective of this research to address the iron deficiency anemia through appreciation and propagation of underutilized plants.

The school canteen of the participating schools included the harvests from the underutilized plants in their daily menu and served to the students with severely wasted status in their body mass index.

To sum up, based on the presentation and discussion of both numerical and verbal data, students have improvement on the body mass index and justified the significant value of underutilized plants propagation and consumption. Moreover, teachers and parents have also developed awareness on the significant effect of underutilized plants nutrient content in addressing iron deficiency anemia through *gulayan sa bakuran* and school feeding program. The school and community, as they work hand-in-hand, may continue the advocacy of the propagation campaign of the underutilized plants within the community.

Part III. Solutions of School and Community

In addressing the iron deficiency anemia among school children, the campaign should not end only in plant propagation. It should have a sustainability through the initiative, collaborative and continuous support from the school administrators, teachers and parents.

Consultation with the principal and head teachers. The research sought the consent of the school principal and share the positive objectives of the research. The school principals, together with the teachers, also ensured the strict confidentiality of the data, and requested not to include the names of the students involved and participated in this research to protect their credibility as student.

As evidence, the research sought permission to have picture documentation with the school principals of the three participating schools

Meeting with the Parents. Parents of the students were being oriented on the propagation of underutilized plants through *Gulayan sa Paaralan* and *Gulayan sa Bakuran* as well as the feeding program as part of the research school-community campaign in addressing iron deficiency anemia among school children.

Integration of Propagation of Underutilized Plants in Science subject. As part of the long term program of this research, the plant propagation of underutilized plants was integrated in science subject in order to strengthen and rapidly amplify the impact of the activities to the students, teachers and parents of the participating schools. Students, teachers, and parents shared responsibility on the campaign addressing the iron deficiency anemia through plant propagation of underutilized plants and have a productive harvest of vegetables within the school community.

The harvest was a result of the successful integration of plant propagation in teaching science subject. The harvest plants have nutrients which may help the school children in boosting the immunity and improve the body mass index status as fundamental barrier against iron deficiency anemia and malnutrition. Table 2 describe the nutritional matrix of underutilized plants used in this study. The matrix was extracted from MyFitnessPal, Inc, 2018.

The comparison of nutrient contents is shown to describe the essential of underutilized plants as it was consumed by student with severely wasted body mass index status. With this data, it may identify the nutritional intake per serving of the vegetables every time it will be included in the daily meal of the students during feeding program or at home.

Table 2

Underutilized Plants Nutritional Matrix

	Saluyot	Ampalaya Ligaw	Talinum	Kulitis	Alugbati
Calories	344	70	213	47	19
Total Fat	14 g	0 g	2 g	-	0.30 g
Saturated	2 g	0 g	0 g	-	-
Polyunsaturated	4 g	0 g	1 g	-	-
Monounsaturated	9 g	0 g	1 g	-	-
Trans	0 g	0 g	0 g	-	-
Cholesterol	220 mg	0 mg	0 mg	0 mg	0 mg
Vitamin A	218%	30%	0%	12,860	267%
Vitamin C	101%	6%	0%	120 mg	170%
Sodium	917 mg	680 mg	50 mg	51 mg	24 mg
Potassium	82 mg	750 mg	43 mg	443 mg	510 mg
Total Carbs	27 g	15 g	23 g	7.4 g	30.4 g
Dietary Fiber	13 g	3 g	2 g	1.1 g	-
Sugars	6 g	12 g	0 g	-	-
Protein	34 g	3 g	30 g	4.6 g	1.8 g
Calcium	29%	6%	1%	341 mg	11%
Iron	43%	10%	48%	18 mg	15%

Part IV. Understanding and Appreciation of Students, Teachers and Parents

End line of Body Mass Index. Based on the data gathered from the participating schools, the body mass index of the student-informants was improved and normalized after the implementation of the propagation of the underutilized plants. Table 4 shows the progress of body mass index from baseline to end-line.

Severely wasted students in Bunsuran High School has decreased from 32 to 5 students or from 4.47% to 0.74%. Masagana High School, on the other hand, eradicate the severely wasted students from 4 to 0 students. Moreover, Virginia Ramirez-Cruz School reported that there was a decrease of 53 students from 56 to only 3 severely wasted.

In addition, the comparison of students with normal body mass index was illustrated in Table 3. The data supplements the decreased in severely wasted as the students with normal body mass index were increased. In Bunsuran High School, the students with normal BMI were increased from 558 to 593. Masagana High School has an increase of 4 students from 147 to 151. Furthermore, the students with normal BMI were increased from 917 to 1002.

Through the significant change in the BMI of the students with severely wasted status, the students, themselves, as well as the teacher and parents, as stated in the interview deeply appreciated and understood the contribution of these underutilized plant to their health, particularly their children

Table 3

Frequency Distribution and Descriptive Measures of Comparative Data on Body Mass Index

School	Pupils Weighed	Body Mass Index (BMI) Baseline				Body Mass Index (BMI) End-Line			
		Severely Wasted		Normal		Severely Wasted		Normal	
		No.	%	No.	%	No.	%	No.	%
Bunsuran High School	673	32	4.47	558	86.06	5	0.74	593	88.11
Masagana High School	175	4	2.29	147	84.00	0	0.00	151	86.29
Virginia Ramirez-Cruz High School	1122	56	4.99	917	81.73	3	0.27	1,002	89.30

The data in table 3 clearly shows the contribution of the propagation of underutilized plants in addressing health problems and malnutrition to prevent health deficiency particularly iron deficiency anemia as the BMI improved from its baseline to its end line. Osazuwa and Ayo (2010) stated that anemia may cause by malnutrition such as lack of folate, vitamin B12 and protein. Yip and Ramakrishnan (2002) found that the highest prevalence of anemia exists in the developing world where its causes are multifactorial, ranging from micronutrient deficiencies.

It is interesting to note that utilization of plants such as *alugbati*, *talinum*, *ampalayang ligaw*, and others used in this research, students with severely wasted were minimized as a result of including these plants in the daily meal of feeding program. Moreover, the propagation and consumption of the underutilized plants were maximized through the adaptation of *gulayan sa bakuran* in cooperation with the teachers and most particularly the parents.

Evaluation of Propagation Campaign. The latter of the propagation campaign was the evaluation of the activity. This part supports and gives supplemental inputs to the totality of the propagation campaign. The researcher gathered narrative-essay from the students to cross-validate the experiences and awareness of the students during the process of the propagation campaign. The students from the participating schools state that (*may mga gulay na maaaring matagpuan sa bakuran at hindi na kailangan na bilin sa paengke pero masustansya at nakakatuong sa katawan.*). Another statement from the students shows positive impact on the aware aspect of the propagation campaign (*pwede ako magtanim ng mga gulay tulad ng ampalaya talinum at iba pang natutunan ko sa plant propagation*).

These ideas from the students implies positive contribution of the propagation campaign of underutilized plants to address iron deficiency anemia among school children.

Part V. Significant Difference between the Baseline Data and End line Data of the Body Mass Index

Table 4 describes the significant difference between the baseline and end line data of the body mass index of the students with severely wasted BMI status.

Table 4

Significant Difference between the Baseline Data and End line Data of the Body Mass Index

BMI Data	Std. Deviation	t	df	Sig. (2-tailed)	Verbal Interpretation
BSW – ESW	20.719	5.234	14	.000	Highly Significant
BN – EN	34.541	-4.635	14	.000	Highly Significant

Table 4 shows the comparison of baseline data of severely wasted (BSW) and the end line data of severely wasted (ESW). It shows that level of significance is at .000 which an indication that there is a highly significant difference on the number of students with severely wasted status before and after the plant propagation of underutilized plants through feeding program and *Gulayan sa Bakuran* program.

More so, table 4 also exposes the significant difference between the baseline and end line data of the number of students with normal body mass index status. The data on the table illustrates that there is highly significant difference at .000 level of significance between the baseline and

end line data of the number of students with normal body mass index status before and after the implementation of the propagation of underutilized plants, through *Gulayan sa Bakuran* and feeding program.

Students' awareness was low prior to the implementation of the plant propagation of underutilized plants and other series of activities. In the same manner, inclusion of these plants in the daily consumption may be a solution in addressing iron deficiency anemia among school children. Parents, teachers, and students gained understanding as they appreciate the significance of these underutilized plant in having a good health far from iron deficiency anemia.

It therefore concludes that the plant propagation of underutilized plants, amplified with the school feeding program and *Gulayan sa Bakuran* project, may be implemented as effective, helpful and relevant supplementary program in addressing the iron deficiency anemia caused by malnutrition.

Plant propagation should be extended up to the food consumption from the underutilized plant harvests as a sustainable solution to address iron deficiency anemia among school children.

Awareness of students as well as teachers and parents has manifested from the understanding and appreciation to the health benefits of the underutilized plants.

Students' health status in body mass index have improved through the school-community campaign of plant propagation of underutilized plants. *Gulayan sa Bakuran* may be implemented to strengthen the campaign on propagation of underutilized plants.

Conclusions

On the basis of the significant findings of the study, the researcher set forth the following conclusions:

- a. Students' awareness was low prior to the implementation of the plant propagation of underutilized plants and other series of activities. In the same manner, inclusion of these plants in the daily consumption has been found as an effective solution in addressing iron deficiency anemia among school children. Parents, teachers, and students gained understanding as they appreciated the significance of these underutilized plants in having a good health which greatly helped in combatting iron deficiency anemia.
- b. The plant propagation of underutilized plants, amplified with the school feeding program and *Gulayan sa Bakuran* project, may be implemented as effective,

helpful and relevant supplementary program in addressing the iron deficiency anemia caused by malnutrition.

- c. Plant propagation should be extended up to the food consumption from the underutilized plant harvests as a sustainable solution to address iron deficiency anemia among school children.
- d. Awareness of students as well as teachers and parents has manifested from the understanding and appreciation to the health benefits of the underutilized plants.
- e. Students' health status in body mass index has significantly improved through the school-community campaign of plant propagation of underutilized plants. *Gulayan sa Bakuran* may be implemented to strengthen the campaign on propagation of underutilized plants.

Recommendations

On the bases of the foregoing findings and conclusions, the following were set forth:

1. The advocacy of propagation of underutilized plants may start in the classroom in order for the students and learners to familiarize on different medicinal plants which can be found or propagate within the vicinity of the school.
2. Science teachers may include the underutilized plants and the like in their discussions, including its characteristics and nutrient content for the learners to have better and deeper understanding on its significance.
3. DepEd administrators may consider the inclusion of underutilize plants in the daily meal served in ever school canteen, particularly the meal allocation for those students with severely wasted body mass index status. Supported with high caliber inspectorate team, should also be created, to ensure the high level of implementation of the utilization of underutilized plants among school feeding program in every school canteen in the schools division.
4. Another study related to this may be conducted scrutinizing the integration of underutilized plants awareness across the curriculum, particularly in the primary level.

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