

Walsh, F. (2007). Traumatic loss and major disasters: Strengthening family and community resilience. *Family process*, 46(2), 207-227.

Zhou, H., Wan, J., & Jia, H. (2010). Resilience to natural hazards: a geographic perspective. *Natural Hazards*, 53(1), 21-41.

## SUSTAINABLE PLANTS FOR DENGUE AFFECTED AREAS

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### ABSTRACT

The world's temperature is continuously increasing which has enormous impact in humans most especially in the increase of dengue cases. Dengue is a re-emerging disease and is one **important** viral disease transmitted by mosquitoes. Temperature is considered one factor in the increase of dengue rates in Cagayan particularly in Tuguegarao City. Thus, there is an indirect relationship between temperature and dengue. As temperature increases, there is also an increase of dengue case. This study aimed to determine the suitable plants to the dengue affected Barangays in Tuguegarao City to decrease the temperature as a factor of the increasing dengue rates. The researchers gathered the data of the dengue rates in Tuguegarao City from the City Health Office for the past six years (2010-2015). It was recorded that Ugac Sur has the highest rate of dengue followed by Caggay, Ugac Norte, San Gabriel Village, Annafunan East and Tanza. Also the researchers conducted soil analysis with the help of the Department of Agriculture to determine the soil characteristics of the dengue affected Barangays. The result shows that the ten carbon dioxide efficient plants can grow depending on the soil type and soil characteristics of the dengue affected Barangays. The study found out that the ten Carbon absorbing plants are suited in the soil type of the identified barangay depending on its soil characteristics in Tuguegarao City (1) Tanza: Bamboo Palm, English Ivy, Spider Plant, Red-edged Draceana, Rubber tree; (2) San Gabriel Village: Rubber Tree, Snake Plant, Aloe Plant, Bamboo Palm, English Ivy, Spider Plant, Red-edged Draceana; (3) Caggay: Rubber Tree, Snake Plant, Aloe Plant; (4) Annafunan East: English Ivy, Rubber Tree, Snake Plant, Philodendron, Peace Lilly; (5) Ugac Norte: Rubber Tree, Snake Plant, Aloe Plant, Golden pothos; (6) Ugac Sur: Rubber tree, Snake Plant, Aloe Plant, Bamboo Palm, English Ivy, Spider Plant, Red-edged Draceana, Golden Pothos.

**Keywords:** *Temperature, Dengue cases, Soil Characteristics, Carbon Dioxide Absorbing Plants, Soil Type*

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## INTRODUCTION

Dengue is an acute febrile disease caused by arboviruses (arthropod-borne viruses) of the Flaviviridae family, with female *Aedes aegypti* mosquitoes as the vector. Climate is an important factor in the temporal and spatial distribution of vector-transmitted diseases like dengue fever. According to various studies, temperature has an impact on the population size, maturation period, blood-sucking activity, and survival rate of *Aedes aegypti*. The relationship to precipitation depends on local characteristics and whether breeding sites are maintained predominantly by rain (Barcellos & Lowe, 2014).

All over the Philippines, temperature is continuously increasing up to 40-42 degree Celsius especially in Cagayan, and particularly in Tuguegarao City. The temperature reached a scorching 37 degrees Celsius – 3.4 degrees away from the country's highest recorded temperature in 2014 at 40.4 degrees Celsius. The same temperature was recorded in the same date in 2013 (Idso & Singer, 2009).

This increasing temperature contributes to an increase in dengue incidence. Dengue incidence fluctuates with climatic conditions and is associated with increased temperature and rainfall. Such conditions favor an increase in the number of available breeding sites, as well as the vector's development, and thereby increase the probability of vector-human (and consequently human-virus) interaction (Dunlap & Jacques, 2013).

In terms of the cities and towns that were seriously infected, Tuguegarao City had the highest number of dengue patients with 195, (DOH, 2013) within the Region 02. One of the most important reasons for the tremendous increase in dengue cases was due to the presence of the four strains of dengue virus circulating in the country (Turingan, 2015). Also, he added that climate change may also aggravate dengue incidence.

It is established that climate change is happening and it is likely to expand the geographical distribution of several mosquito-borne diseases. The mounting evidence around climate-disease relationships raises many important issues about the potential effects of global climate changes on the transmission of infectious diseases, particularly dengue. There is evidence indicating that dengue epidemics have been associated with temperature, rainfall and relative humidity. Mosquitoes capable of carrying and transmitting diseases like Dengue Fever, for example, now live in at least 28 states. As temperatures increase and rainfall patterns change - and summers become longer - these insects can remain active for longer seasons and in wider areas, greatly increasing the risk for people who live there. The same is true on a global scale: increases in heat, precipitation, and humidity can allow

tropical and subtropical insects to move from regions where infectious diseases grow into new places (Wei, Hansen, Zhang, Li, Liu, Sun, & Bi, 2014)

This simply means that as the temperature continues to increase dengue cases will also increase. This increasing temperature can be mitigated through plants. Plants certainly play an important part in reducing fossil fuel consumption and carbon dioxide emission. Wolverton (1997) from NASA study and assigned plants rating from one to 10 that could remove chemical vapor and air toxins such as carbon dioxide. These are Aloe Plant, Snake Plant, English Ivy, Rubber Tree, Peace Lily, Philodendron, Bamboo Palm, Golden Pothos, Red-Edged Draceana and Spider Plant.

A recent study from the University of Melbourne shows that plants can directly reduce heat by up to 9°. Plants are consistently cooler than materials and manage to bring the temperature down. Therefore, plants can indirectly reduce the increasing dengue rates by altering the temperature since it is one of the factors of the continuous increase of dengue cases. Thus, in this study, the researchers examined whether the soil in Tuguegarao City is suitable for the Carbon Dioxide absorbing plants identified that could help decrease the temperature as one of the factors of the continuous increase of dengue cases in the identified barangays.





### Research Objective




The study aimed to find out the kind of plant which could help reduce the cases of dengue in Tuguegarao City.

### Top 10 Carbon Dioxide Absorbing Plants

Wolverton (1997), author of *“How to Grow Fresh Air – 50 Houseplants that Purify Your Home or Office”*, conducted plant studies for NASA (National Aeronautics and Space Administration) which determined that plants can clean pollutants in homes, offices, factories and retail outlets. Later, Wolverton expanded the study and assigned plants a rating from one to 10 based on a plant's ability to remove chemical vapors or indoor air toxins, ease of growth and maintenance, resistance to insect infestation and the rate at which water evaporates from the leaves.

NAME OF PLANT	DESCRIPTION
 <p>COMMON NAME: Aloe Vera, Medicinal Aloe</p> <p>SCIENTIFIC NAME: <i>Aloe barbadensis miller</i></p>	<p>Aloe Vera is a great plant to improve indoor air quality. It helps to keep home free from benzene which is commonly found in paint and certain chemical cleaners.</p> <p>Aloe Vera is dubbed as an air cleaning expert. One pot of Aloe Vera equals to nine biological air cleaners. It can absorb formaldehyde, carbon dioxide, Carbon monoxide. When harmful elements in the air have exceeded due amount, there will be spots that appear on the leaves, these are signals for help. If you add more pots of aloe, the problem will be resolved. Aloe Vera grows widely in a variety of warm weather. Average temperature stays above 30 to 35 degrees Fahrenheit. In summer, it tolerates low temperature from 50 to 60 degrees Fahrenheit.</p>
 <p>COMMON NAME: Snake Plant, Mother-In-Law's Tongue</p> <p>SCIENTIFIC NAME: <i>Sansevieria trifasciata</i></p>	<p>A wonderful corner plant. It is also efficient in absorbing carbon dioxide and in releasing oxygen during the night (while most plants do during the day); therefore, having one plant in the bedroom may help you experience better sleep.</p>
 <p>COMMON NAME: English ivy</p> <p>SCIENTIFIC NAME: <i>Hedera helix</i></p>	<p>This plant can absorb formaldehyde which is commonly found in some household cleaning products and furniture or carpeting treatments. It can also absorb trace amounts of benzene which is a chemical commonly found in office equipment. Ivy is the most effective indoor plant in absorbing formaldehyde. Ivy per square meter can absorb 1.49 grams of formaldehyde. In the meantime, it can absorb harmful substances like Benzene. In 24 hours, it can absorb 90% of indoor benzene. In 10 square meters, if you put 2-3 pots of ivy, it should be enough to perform the function of cleaning the air and dust.</p>

 <p>COMMON NAME: Rubber Tree</p> <p>SCIENTIFIC NAME: <i>Hevea brasiliensis</i></p>	<p>The low-maintenance plant is a powerful toxin eliminator and air purifier. Its large leaves can absorb airborne chemicals and break down, rendering them harmless. It absorbs exhaled carbon dioxide and convert it to breathable oxygen. It easily grows in dim lighting and cooler climates.</p>
 <p>COMMON NAME: Peace Lily</p> <p>SCIENTIFIC NAME: <i>Spathiphyllum</i></p>	<p>Peace Lily helps reduce the levels of mold spores that grow in the home by absorbing those spores through its leaves circulating them to the plant's roots where they are used as food. In addition, the plant can absorb harmful vapors from alcohol and acetone.</p>
 <p>COMMON NAME: Philodendron, Sweetheart Vine, Heart-leaf Philodendron</p> <p>SCIENTIFIC NAME: <i>Philodendron scandens oxycardium</i></p>	<p>The heart-shaped philodendron is a popular plant choice for indoor areas, as it is easy to care for and can grow decorative vines. Similar to the English Ivy, such plant is particularly good at absorbing formaldehyde.</p>
 <p>COMMON NAME: Bamboo Palm, Reed Palm</p> <p>SCIENTIFIC NAME: <i>Chamaedorea</i></p>	<p>The palm is quite effective at clearing out benzene and trichloroethylene. It does well between 65-80 degrees Celsius.</p>

 <p>COMMON NAME: Golden Pothos, Money Plant, Devil's Ivy</p> <p>SCIENTIFIC NAME: <i>Epipremnum aureum</i></p>	<p>The pothos is a simple yet beautiful plant. Able to clear formaldehyde from the air, it's a beneficial plant to have in living room or as a hanging plant as the leaves will grow down in cascading vines. It grows best in cool temperatures and in low levels of sunlight.</p>
 <p>COMMON NAME: Red-edged Dracaena, Madagascar Dragon Tree</p> <p>SCIENTIFIC NAME: <i>Dracaena reflexa</i></p>	<p>This vibrant plant can grow to the ceiling height (15 foot dracaenas are common), making it a great plant for decorating and filling up space. It is beneficial for removing toxins, such as xylene, trichloroethylene, and formaldehyde from the air. It flourishes in sunlight and will be a welcome addition in your home. It grows between 65 to 80 degrees Fahrenheit, it will usually suffer if it gets too cold and cannot tolerate freezing.</p>
 <p>COMMON NAME: Spider Plant, Spider Ivy, Ribbon Plant</p> <p>SCIENTIFIC NAME: <i>Chlorophytum comosum</i></p>	<p>The spider plant is a commonly found houseplant and is one that is really easy to grow. Within just two days, this plant can remove up to 90 percent of the toxins in your indoor air. The leaves grow quickly and help to absorb harmful substances like mold and other allergens so it is the perfect plant for those who have common dust allergies. It also helps to absorb small traces of formaldehyde and carbon monoxide. The spider plant can perform photosynthesis under weak light and absorb harmful air. One pot of spider plant in 8-10 square meters of room is enough to perform as an air filter, which releases oxygen and absorbs Carcinogens like formaldehyde and Styrene. Spider plant is very strong in absorbing carbon monoxide and formaldehyde normally up to 95% and 85% respectively. It decomposes benzene and Nicotine in tobaccos. So it is called green filters. If the soil is dry, it will survive without issue down 5 degrees Celsius to 41 degrees Fahrenheit. If the soil is wet or gets colder than this, damage on the plant will likely result.</p>

## METHODS

The study utilized an experimental research design to test the soil quality and characteristics and to identify plants that can grow to this type of soil that will help decrease the temperature as one of the factors of the continuous increase of dengue cases.

The study was conducted in Tuguegarao City since it is considered with the highest temperature in the Philippines and of the Western Pacific Region and second with the most number of dengue cases in Region 2. Quitlong (2015) further said that such high temperature will continuously increase in the coming years because of climate change. The researchers tested the soil quality and soil characteristic in terms of nutritional contents of the soil through the Department of Agriculture in order to know which plants can grow in the identified barangays: Tanza, Caggay, San Gabriel Village, Anafunan East, Ugac Norte, Ugac Sur through soil analysis.

## RESULTS

Table 1. Type of Plant which Can Grow in the Dengue Infected Areas Based on Type of Soil of the Barangay.

AREAS AFFECTED IN TUGUEGARAO CITY	TYPE OF SOIL	TYPE OF PLANT
1. Tanza	Drained soil	Bamboo Palm, English Ivy, Spider Plant, Red- edged Dracaena, Rubber Tree
2. San Gabriel Village	Loam soil, Drained soil	Rubber Tree, Snake Plant, Aloe Vera, Bamboo Palm, English Ivy, Spider Plant, Red-edged Dracaena
3. Caggay	Sandy soil, Loam soil,	Rubber Tree, Snake Plant, Aloe Vera
4. Anafunan East	Moist soil, Loam soil	English Ivy, Rubber Tree, Snake Plant, Philodendron, Peace Lily
5. Ugac Norte	Loam soil, Clay	Rubber Tree, Snake Plant, Aloe Vera, Golden Pothos
6. Ugac Sur	Loam soil,, Drained soil	Rubber Tree, Snake Plant, Aloe Vera, Bamboo Palm, English Ivy, Spider Plant, Red- edged Dracaena, Golden Pothos

Table 1 shows the types of soil as described by the researchers and the type of plant which could grow in the barangays according to NASA. As

seen from the table, rubber tree is common to all barangays. Snake plant grows in the 5 barangays; English ivy and Aloe Vera grow in the 4 barangays; Red- edged dracaena and Bamboo palm grow in the 3 barangays.

Table 2. Plants that can grow in Brgy. Tanza according to the Characteristic of Soil

		CHARACTERISTICS OF THE SOIL			
TANZA	Plants	pH	O.M.% (N)	P,ppm Olsen's Mtd	K,ppm H <sub>2</sub> SO
		7.3	2.3	19	710
<b>SOIL TYPE: DRAINED SOIL</b>	Bamboo Palm	5.6-7.8	3	1	3
	English ivy	6.5	3	1	2
	Red-edged dracaena	7	9	6	12
	Spider plant	6-7.2	3	1	2
	Rubber tree	4-6.5	20	10	12

The table shows the soil type and the soil characteristic of barangay Tanza and the plants that could grow according to its soil type and characteristic based on the amount of pH level with 7.3, nitrogen with 2.3 %, phosphorous with 19 and potassium with 710. It shows that the pH level, potassium, and phosphorous of the soil of Tanza is sufficient since it provides more than what the plant needs, the amount of nitrogen in the soil is not enough in the needed nitrogen of the plants, Bamboo Palm, English Ivy and Spider Plant needs 3%, Red-Edged Dracaena needs 9 % and Rubber tree need 20 % but the soil can only provide 2.3 % . This means that the identified plants will grow in the soil of barangay Tanza but have limitations in terms of nitrogen which can cause the plants to grow unhealthy.

Table 3. Plants that can grow in Brgy. San Gabriel Village according to the Characteristic of Soil

		CHARACTERISTICS OF THE SOIL			
SAN GABRIEL VILLAGE	Plants	pH	O.M.% (N)	P,ppm Olsen's Mtd	K,ppm H <sub>2</sub> SO
<b>SOIL TYPE: LOAM SOIL, DRAINED SOIL</b>		7.5	0.9	95	510
	Bamboo Palm	5.6-7.8	3	1	3
	English ivy	6.5	3	1	2
	Red-edged dracaena	7	9	6	12
	Spider plant	6-7.2	3	1	2
	Rubber tree	4-6.5	20	10	12
	Aloe vera	7-8.5	10	40	10
Snake plant	6.1-7.8	9	3	6	

The table shows the soil type and the soil characteristic of barangay San Gabriel Village and the plants that could grow according to its soil type and characteristic based on the amount of pH level with 7.5, nitrogen with 0.9 %, phosphorous with 95 and potassium with 510. It shows that the pH level, potassium, and phosphorous of the soil of San Gabriel Village is sufficient to the plant needs, the amount of nitrogen in the soil is not enough in the needed nitrogen of the plants since it only provides 0.9% while plants like Bamboo Palm, English Ivy and Spider Plant require a nitrogen content of 3%, Red-edged Dracaena and snake Plant require 9 %, Aloe Vera requires 10 % and Rubber tree requires 20 %. This means that the identified plants would grow in the soil of barangay San Gabriel Village but have limitations in terms of nitrogen and that such limitation may make the plants grow unhealthy.

Table 4. Plants that can grow in Brgy. Caggay according to the Characteristic of Soil

		CHARACTERISTICS OF THE SOIL			
CAGGAY	Plants	pH	O.M.% (N)	P,ppm Olsen's Mtd	K,ppm H <sub>2</sub> SO
				7.1	1.9
<b>SOIL TYPE: SANDY, LOAM SOIL</b>	Rubber tree	4-6.5	20	10	12
	Aloe vera	7-8.5	10	40	10
	Snake plant	6.1-7.8	9	3	6

The table shows the soil type and the soil characteristic of barangay Caggay and the plants that could grow according to its soil type and characteristic based on the amount of pH level with 7.1, nitrogen with 1.9, phosphorous with 56 and potassium with 490. It shows that the pH level, potassium, and phosphorous of the soil of Caggay is sufficient to the plant needs since it can provide more than what the plants need but the amount of nitrogen in the soil is not enough to the needed nitrogen of the plants. It can only provide 1.9 % of nitrogen but plants like Rubber tree needs 20 %, Aloe Vera needs 10 % and Snake Plant needs 9 %. This means that the identified plants will grow in the soil of barangay Caggay but have limitations in terms of nitrogen and such conditions may eventually make the plants grow unhealthy.

Table 5. Plants that can grow in Brgy. Annafunan East according to the Characteristic of Soil

		CHARACTERISTICS OF THE SOIL			
ANNAFUNAN EAST	Plants	pH	O.M.% (N)	P,ppm Olsen's Mtd	K,ppm H <sub>2</sub> SO
				7.7	1.0
<b>SOIL TYPE: MOIST SOIL, LOAM SOIL.</b>	English ivy	6.5	3	1	2
	Rubber tree	4-6.5	20	10	12
	Snake plant	6.1-7.8	9	3	6
	Philodendron	6-6.5	20	20	20
	Peace Lilly	5.6-6	20	20	20

The table shows the soil type and the soil characteristic of barangay Annafunan East and the plants that could grow according to its soil type and characteristic based on the amount of pH level with 7.7, nitrogen with 1.0 %, phosphorous with 66 and potassium with 1000. It shows that the pH level,

potassium, and phosphorous of the soil of Annafunan East is sufficient to the plant needs since it can provide more than what the plant needs, the amount of nitrogen in the soil is not enough for the needed nitrogen of the plants. English ivy needs 3%, Rubber tree needs 20%, Snake plant needs 9%, Philodendron needs 20% and Peace Lily needs 20% but the soil can only provide 1.0 % of it. This means that the identified plants could grow in the soil of barangay Annafunan East but have limitations in terms of nitrogen and that will cause the plants to grow unhealthy.

Table 6. Plants that can grow in Brgy. Ugac Norte according to the Characteristic of Soil

		CHARACTERISTICS OF THE SOIL			
UGAC NORTE	Plants	pH	O.M.% (N)	P,ppm Olsen's Mtd	K,ppm H <sub>2</sub> SO
				7.1	1.9
<b>SOIL TYPE: LOAM SOIL, CLAY</b>	Rubber tree	4-6.5	20	10	12
	Aloe Vera	7-8.5	10	40	10
	Snake plant	6.1-7.8	9	3	6
	Golden Pothos	5.1-6.5	20	20	20
	Pothos				

The table shows the soil type and the soil characteristic of barangay Ugac Norte and the plants that could grow according to its soil type and characteristic based on the amount of pH level of 6.8, nitrogen with 2.5 %, phosphorous with 136 and potassium with 1000. It shows that the pH level is sufficient to Aloe Vera with 7-8.5 and Snake Plant with 6.1-7.8 but not in Rubber tree with 4-6.5 and Golden Pothos with 5.1-6.5. Potassium, and phosphorous of the soil of Ugac Norte is sufficient to the plant needs as shown, the amount of nitrogen in the soil is not enough for the needed nitrogen of the plants since it cannot provide what the plants need, Rubber Tree requires an amount of 20%, Aloe Vera requires 10%, Snake Plant requires 9% and Golden Pothos requires 20% but the soil can only provide 2.5 % of it. This means that the identified plants will grow in the soil of barangay Ugac Norte but have limitations in terms of nitrogen and Ph level on Rubber tree and Golden Pothos and that such phenomenon may cause the plants to grow unhealthy.

Table 7 Plants that can grow in Brgy. Ugac Sur according to the Characteristic of Soil

		CHARACTERISTICS OF THE SOIL			
		pH	O.M.% (N)	P,ppm Olsen's Mtd	K,ppm H <sub>2</sub> SO
<b>UGAC SUR</b>	Plants	6.5	0.7	208	710
	Bamboo Palm	5.6-7.8	3	1	3
	English ivy	6.5	3	1	2
	Red-edged dracaena	7	9	6	12
	Spider plant	6-7.2	3	1	2
	Rubber tree	4-6.5	20	10	12
	Aloe vera	7-8.5	10	40	10
	Snake plant	6.1-7.8	9	3	6
	Golden pothos	5.1-6.5	20	20	20
	<b>SOIL TYPE: LOAM SOIL, DRAINED SOIL</b>				

The table shows the soil type and the soil characteristic of barangay Ugac Sur and the plants that could grow according to its soil type and characteristic based on the amount of pH level of 6.5, nitrogen with 0.7, phosphorous with 208 and potassium with 710. It shows that the pH level, potassium and phosphorous of the soil of Ugac Sur is sufficient to the plant needs, the amount of nitrogen in the soil is 0.7 % which is not enough for the needed nitrogen of the plants since Bamboo Palm, English Ivy, Red-edged Dracaena, Spider Plant, need 3 % of nitrogen, Rubber Tree and Golden Pothos need 20 % of it, Aloe Vera needs 10 % and Snake Plant needs 9 %. This shows that the soil of Ugac Sur cannot provide more than what the plant needs according to the Nitrogen content. This means that the identified plants could grow in the soil of barangay Ugac Sur but have limitations and that such limitation may cause unhealthy growth of the said plant.

In general, Rubber tree is common to all barangays, English ivy and aloe plant grow in the four barangays, Red-edged Dracaena and Bamboo palm grows in the 3 other barangays.

## DISCUSSION

This study determined the suitable plants to the soil type of identified barangays in Tuguegarao City with the highest rate of dengue cases brought about by the increase of temperature. All over the Philippines, in Cagayan, particularly in Tuguegarao City temperature is continuously increasing up to 40-42 degree Celsius (DOH, 2009). This increasing temperature may contribute to an increase in dengue incidence. Dengue incidence fluctuates with climatic conditions and is associated with increased temperature and rainfall.

In terms of the cities and towns that were seriously infected, Tuguegarao City had the highest number of dengue patients with 195 cases within the region (Turingan, 2015). This study revealed that from 2010 to 2015, Tanza, San Gabriel, Caggay, Annafunan East, Ugac Norte, Ugac Sur were the identified barangays with the highest rate of dengue cases, (CHO). The identified barangays are actually neighboring barangays of the City. It is possible that the dengue virus is easily carried by the dengue carrying mosquitoes to these places.

According to Philippine Atmospheric Geophysical and Astronomical Services Administration report, the temperatures of Tuguegarao City from 2010-2015 are 38 degrees, 37.9, 36.5, 37.5, 40.4, 39.2, respectively. This condition may have been brought about by climate change and which may have eventually contributed to the increase of dengue incidence. Further, dengue incidence fluctuates with climatic conditions and is associated with increased temperature and rainfall.

This study also found out that according to soil type and soil characteristics, the following plants can grow in Tanza: Bamboo Palm, English Ivy, Spider Plant, Red-edged Dracaena, Rubber tree; San Gabriel Village: Rubber Tree, Snake Plant, Aloe Plant, Bamboo Palm, English Ivy, Spider Plant, Red-edged Dracaena; Caggay: Rubber Tree, Snake Plant, Aloe Plant; Annafunan East: English Ivy, Rubber Tree, Snake Plant, Philodendron, Peace Lilly; Ugac Norte: Rubber Tree, Snake Plant, Aloe Plant, Golden pothos; Ugac Sur: Rubber tree, Snake Plant, Aloe Plant, Bamboo Palm, English Ivy, Spider Plant, Red-edged Dracaena, Golden Pothos. Thus, these identified plants can grow in the affected areas but have limitations; they will grow but is unhealthy because of lack of nitrogen according to the specified amount of nitrogen in the soil. In connection to this, the Department of Agriculture proposed the planting of Rubber tree in the six (6) identified barangays, which could help lessen the continuous increase of the temperature brought about by climate change, which eventually causes the increase of dengue rates within the City. The proposal was based on the test that they conducted with the soil submitted to them. According to Brahma et.al. (2015) rubber tree primarily managed for latex production, is explored in this contribution for its role in vegetation carbon stock management and climate change mitigation. Vegetation carbon sequestration rate revealed that 2.56 mg C ha<sup>-1</sup> year<sup>-1</sup> organic carbon is being accumulated in rubber plantation. Its capability to stock high biomass carbon, restoring degraded and secondary forests through this species will improve advance climate change mitigation strategies.



## CONCLUSION

The study found that the ten Carbon Dioxide absorbing plants could grow in the soil type of the identified barangays with the most cases of Dengue for the past five years depending on its soil characteristics in Tuguegarao City. In Tanza, the plants that could grow are Bamboo Palm, English Ivy, Spider Plant, Red-edged Draceana and Rubber tree; in San Gabriel Village are seven plants which are Rubber Tree, Snake Plant, Aloe Plant, Bamboo Palm, English Ivy, Spider Plant and Red-edged Draceana; in Caggay are also three plants - these are Rubber Tree, Snake Plant and Aloe Plant; in Annafunan East there are five plants which are English Ivy, Rubber Tree, Snake Plant, Philodendron and Peace Lilly; in Ugac Norte are Rubber Tree, Snake Plant, Aloe Plant and Golden pothos and in Ugac Sur are eight plants and these are Rubber tree, Snake Plant, Aloe Plant, Bamboo Palm, English Ivy, Spider Plant, Red-edged Draceana, Golden Pothos.

## RECOMMENDATIONS

Based on the findings of the study, the following recommendations are formulated:

The Natural Science Club of the University of Saint Louis Tuguegarao can offer an outreach program on the Dengue affected areas by planting the 10 Carbon Dioxide absorbing plants depending on its soil type and characteristics in coordination with DENR and the Barangay Officials.

The Department of Agriculture should help in growing the identified plants in order to lessen the increasing amount of temperature and the continuous increase of dengue cases in the City.

Since the plants need more than what the soil can give in terms of nitrogen, it is recommended that those who will plant will pay attention to the fertilizer need of the plants.

The Local Government should help in disseminating information to the community regarding the Top 10 Carbon Dioxide absorbing plants as a tool in mitigating the temperature and the Dengue rates in Tuguegarao City.

Similar study should be conducted in order to know the result and the effectiveness of the Top 10 Carbon Dioxide absorbing plants in altering the temperature and the increasing burden brought about by dengue.

## REFERENCES

- Barcellos, C., & Lowe, R. (2014). Expansion of the dengue transmission area in Brazil: the role of climate and cities. *Tropical Medicine & International Health*, 19(2), 159-168.
- Department of Health (2009). *Dengue cases in Tuguegarao city*. Retrieved from <http://reliefweb.int/report/philippines/doh-dengue-cases-rise-four-times-year>
- Dunlap, R. E., & Jacques, P. J. (2013). Climate change denial books and conservative think tanks exploring the connection. *American Behavioral Scientist*, 57(6), 699-731.
- Idso, C. D., & Singer, S. F. (2009). *Climate change reconsidered: 2009 report of the Nongovernmental International Panel on Climate Change (NIPCC)*. Nongovernmental International Panel on Climate Change.
- Wei, J., Hansen, A., Zhang, Y., Li, H., Liu, Q., Sun, Y., and Bi, P. (2014). The impact of climate change on infectious disease transmission: Perceptions of CDC health professionals in Shanxi Province, China. *PloS one*, 9(10), e109476.
- Wolverton, B. C. (1997). *How to grow fresh air*. Penguin books.