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OCCURRENCE OF *AEDES* LARVAE IN DOMESTIC WATER STORAGE CONTAINERS IN TWO VILLAGES OF PAKOKKU TOWNSHIP MAGWAY REGION, MYANMAR

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ABSTRACT

Aedes aegypti larvae distribution study was conducted in Sin Lin and Anout Taw villages in Pakokku Township Magway Region using non-intervention descriptive field investigation method. A total of 50 households each were randomly inspected for *Aedes* larvae positivity in Sin Lan and Anout Taw villages. *Aedes* larvae positive containers of different container categories as major, minor and miscellaneous sources and types were recorded and compared with each other. Larva indices as House Index (HI), Container Index (CI), Breteau Index (BI) and percentage of Key containers, Key premises and Pupal indices were also calculated. Result found that a total of 30(60.00%) and 44(88%) of households were found to be *Aedes* larvae positive in water storage containers in Sin Lin and Anout Taw village. Larva positivity were found 21.91% and 71.19% of major, 11.82% and 32.16% of minor and 47.37% and 60.00% of miscellaneous containers in Sin Lan and Anout Taw village respectively. In Sin Lan and Anout Taw villages, 37.50% and 42.86% of bago jar in major, 22.22% earthen pots and 41.82% earthen flower pots in minor, and 22.22% and 53.33% discarded earthen pots in miscellaneous containers were found highest percentage of positive containers. Positivity of key premises was higher 18(36%) in Anout Taw than 5(10%) in Sin Lin villages although key container were not difference in both areas i.e. 6(12%) and 7(11.67%). Larval indices such as House Index (HI) Container Index (CI) and Breteau Index (BI) were found to be 60.00%, 15.46%, 120 and 88.00%, 43.92%, 224 respectively in Sin Lan and Anout Taw villages. Pupal indices in villages were found to be highest in children 6.18 and 7.02 Pupae/child followed by pupae/household i.e. 4.2 and 7.02 in Sin Lan and Anout Tow village. In conclusion bago jars, earthen pots, earthen flower vases were highly positive for *Aedes* larvae. Mostly big bago jars, metal drums, plastic drum, concrete tank, water cleaning tank and manmade tree hold (which were used for cattle feed baths were found over 1500 each larvae) were found key containers. Therefore, there were urgently need to control *Aedes* larvae in both areas using different larval control methods which are biological method as releasing larvivorous fishes, dragon fly nymph, mechanical method as nets sweeper, chemical method as abate which is more suitable and also need community base participation.

KEYWORDS: Container, *Aedes aegypti*, positivity, larvae, Index.

INTRODUCTION

Mosquitoes are the single largest group of insects, which serve as intermediate hosts in the transmission of many important human diseases as malaria, dengue fever, yellow fever and filariasis. There are three genera of mosquitoes. They are *Aedes*, *Culex* and *Anopheles*. *Aedes aegypti* is one of the world's most widely distributed mosquitoes and is of considerable medical importance as a vector of dengue fever, dengue haemorrhagic fever (DHF) and yellow fever (Service, 1992). *Culex quinquefasciatus* transmits: Japanese encephalitis, West Nile fever, Viral arthritis, Polyarthritis and *Anopheles* transmits Malaria (Gordon *et al*., 1962). Mosquito is prevalent world over especially between latitude 45° north and latitude 40° south and the tropic regions (WHO, 1996). Especially in recent years, the distribution space of both mosquitoes and mosquito-borne disease has been changing and expanding for reasons such as increasing rates of environmental corruption, climatic changes, vector and pathogen resistance to insecticides and drugs, progressive urbanization and population movement (WHO, 1984). *Aedes aegypti* is generally thought to be the vector of dengue in more urban areas, so *Ae.aegypti* is the more important to treat. The species *Ae.aegypti* is considered as the major vector of dengue fever, dengue

haemorrhagic fever and dengue shock syndrome (DF, DHF, DSS) in many subtropical and tropical countries throughout the world. Prevention of DHF outbreaks in endemic areas is based on long term anti mosquito control measures particularly household and environmental sanitation with emphasis on larval source reduction. Only vector control promises permanency and a cost effective solution (Halstead, 1988).

Clinically recognizable DHF was first noticed in 1969 in Yangon Children's Hospital followed by the first epidemic in Yangon in the year 1970 (Tun Tun Aung *et al*., 1996). The incidence of DHF increased over the two decades. The spread of DHF from Yangon to other States and Regions started at the beginning of 1975 (VBDC, 1990). High number of dengue haemorrhagic fever (DHF) transmission occurs during raining season from May to October. Water storage practices in Yangon city provide year round breeding opportunities for the vector. In States and Regions, *Aedes* breeding sites become established only in raining season when the locals store rain water for the domestic usages.

In the last 50 years incidence have increased 30-folds with increasing geographic expansion to new countries and in the present decade, from urban to rural setting. An estimate that 50 million peoples are at risk in dengue endemic countries (WHO 2008). In South East Asia and Western Pacific Regions, which bear nearly 75% of the current global disease burden due to dengue (WHO 2009). Dengue Fever and DHF are increasingly becoming serious public health problems in Myanmar especially among the 5-10 and 11-15 years old age groups and now noted 15 years above, a vast majority of the cases occur in 5-8 years old age group (Chusak *et al*., 1998, Hlaing Myat Thu, 2009). In Myanmar, the highest numbers of DHF cases were reported from Irrawaddy, Kachin, Magway, Mandalay, Mon, Rakkine, Sagaing, Tanintharyi and Yangon regions (Tun Tun Aung *et al*., 1996). A severe outbreak of DHF occurred for the first time in Yangon in 1970 (Ohn Khin, 1985). The urban areas within the Yangon Regions limits were more affected than the suburban townships of Yangon Division. This epidemic had an affected mostly school going are groups. Generally more DHF cases predominate during the raining season especially in July and August. Highest number of cases was recorded in July (Ohn Khin, 1985). However, the intervals between dengue outbreaks become shorter in the last two decades. High dengue cases in the raining season correspond to the seasonal high densities of *Aedes aegypti* mosquitoes. Only symptomatic treatment is available for the patients. Preventive vaccines are not yet available commercially.

Population growth and industrial installation in Pakokku Township, in Magway Region is necessary accompanied by simultaneous urban development. Therefore, a considerable number of inhabitants living in over crowed periurban districts with unhygienic living conditions provide favourable breeding sites for mosquitoes. In drawing up strategies of *Aedes* control, it is essential that detail bionomic of the mosquito should be studied and clearly understood. As the DHF cases are correlated to the density of *Aedes aegypti* of the locality, factors influencing the seasonal abundance of the vector needed to be studied in detail. The present study was conducted with the following objectives; (1) to determine the prevalence of immature *Aedes aegypti* population in water storage containers in two selected villages of Pakokku Township and (2) to investigate the larval and pupal indices, key containers and key premises of *Aedes* larvae in both areas.

MATERIALS AND METHODS

Study area, study sites and study period.

Pakokku Township is situated at Magway Region. The population of Pakokku Township is about (301051 persons) and is divided into (264) villages (Census, 2015). Periurban areas of Sin Lan village 95° 2′ 4.11″ east longitude and 21° 19′ 38.14″ north latitude and Anout Taw village 94° 48′ 25.34″ east longitude and 21° 19′ 4.08″ north latitude of Pakokku Township, Magway Region with high DHF prevalence within the last five years were chosen as study sites. In each village nursery and day care centers, pre and primary schools were recorded. The inspected sites were chosen randomly in each cluster. This study was conducted from July, 2017 to January, 2018 in both areas.

Study design

The study was conducted using non-intervention descriptive field investigation method. All potential breeding sites in suspected high risk areas were examined in order to carry out the systematic study. Larva positive containers of different container categories and types were recorded and compared with each other. The breeding sources were divided into major, minor and miscellaneous sources. Metal drums, concrete tank, concrete jar, glazed or unglazed earthen jars (big bago jar) (size 30 L-100 L), were considered as major sources. Other sources such as small bago jars (glazed jars), water buckets, plastic bowls, flower vases, small glazed earthen bowls and ant-guards were considered as minor sources. Miscellaneous container categories contain discarded utensils (coconut shell, old cans discarded car tires etc.), earthen pots, broken bago jars, tree hole and hollow bamboo pole.

Larval indices

Larval survey in the selected areas were carried out according to (Shappard *et al*., 1969) and (WHO, 1996). *Aedes* larvae positivity in all kinds of water storage containers (major, minor and miscellaneous) were detected and recorded in both study areas. House Index (HI), Container Index (CI), Breteau Index (BI) and percentage of Key containers (>500 larvae/container) and Key premises (three and above positive containers/house) were calculated. Pupal indices as

pupae/ child, pupae/ person and pupae/ container were also calculated.

Larval indices were calculated as follows:

$$\text{(a) House Index (HI)} = \frac{\text{No. of house positive for } \textit{Aedes aegypti} \text{ larvae} \times 100}{\text{Total number of house examined}}$$

$$\text{(b) Container Index (CI)} = \frac{\text{No. of house positive for } \textit{Aedes aegypti} \text{ larvae} \times 100}{\text{Total number of house examined}}$$

(c) Breteau Index (BI) = No. of positive containers per 100 houses.
(d) Key containers = 500 and above larvae positive per container.
(e) Key premises = three and above positive containers with *Aedes* larvae per house.

Identification of specimens
Aedes species identification was done according to Rampa and Prachong, 1994.

Data collection method
Standard sheet for data collection was developed and noted down for the particulars including total water holding containers with water, type of water containers, larva positivity, larva and pupa count and percentages of positive containers.

Statistical analyses
Field data were recorded in appropriate forms and statistical analyses were conducted using Microsoft Excel. In addition comparison in percentage of positive containers between two studied areas were also used Microsoft Excel.

RESULTS

Larva positivity rate in different water storage containers during survey period in Sin Lan and Anout Taw villages
Household used and unused major, minor and miscellaneous water storage containers from both Sin Lan and Anout Taw villages were inspected for larva and pupa positivity. Larva positive and un-positive containers were recorded in chart sheet. In larval survey period key containers and key premises were also recorded.

Sin Lan village

Table 1: Larva positive rate of major water storage containers during survey period in Sin Lan village, Pakokku Township (pH 6.5 -7, 25 - 27ºC, RH 80-92%) (A) Major containers.

Type of containers	Total containers exam	Larva positive containers	Total larvae	Total pupae	Key containe r	Individually Positivity rate %	Total positivity %
Big Bago jar	21	6	777	3	1	28.57%	37.5%
Metal drum	24	3	900		1	12.5%	18.75%
Plastic drum	1	1	600	2	1	100%	6.25%
Concrete tank	22	4	1710		2	18.18%	25.00%
Concrete jar	5	2	256	5	0	40.00%	12.5%
Total	73	16	4243	10	5	21.92%	100%

A total of 73 major water storage containers were inspected and found that 21.92% (16/73) major containers were positive for *Aedes* larvae. Highest number of Bago jar were positive with *Aedes* larvae (37.50%) followed by Concrete tank (25.00%). Lowest container positivity was found in Plastic drum which drum was found key container with 600 larvae. Lowest number of larvae was found in concrete jar. Five Key containers (500 and above larvae positive container) were found in major containers which were 2 Concrete jars, one bago jar, one metal drum and one plastic drum (Table 1).

Table 2: Larva positive rate of different water storage containers (minor)during survey period in Sin Lan village, Pakokku Township (pH 6.5 -7, 25 - 27ºC, RH 80-92%) Minor containers.

Type of containers	Total containers exam	Larva positive containers	Total larvae	Total pupae	Key container	Individually Positivity rate %	Total positivity %
Small bago jar	7	3	242	8	0	42.86%	8.57%
Aluminum Pot	10	0	0		0	0	0

flower pot	85	4	225	6	0	4.71%	11.43%
Bucket	14	1	24		0	7.14%	2.86%
Plastic/ Tire bucket	21	1	115		0	4.76%	2.86%
earthen pot	159	26	1545	39	0	16.35%	74.29%
Total	296	35	2151	53	0	11.82%	100%

Table (2) shows that a total of 296 minor containers were inspected and found that 35 (11.82%) of minor containers were *Aedes aegypti* larvae positive. Highest larvae positivity rate of minor container was found 74.29% in earthen pots followed by flower pots 11.43%. Lowest positivity rate was found in bucket and plastic / tire buckets 2.86% each respectively.

Table 3: Larva positive rate of different water storage containers (miscellaneous) during survey period in Sin Lan village, Pakokku Township (pH 6.5 -7, 25 - 27ºC, RH 80-92%) Miscellaneous containers.

Type of containers	Total containers exam	Larva positive containers	Total larvae	Total pupae	Key container	Individually Positivity rate %	Total positivity %
Coconut shell	0	0	0	0	0	0	0
Tin,Plastic can	2	1	5	0	0	50%	11.11%
car tire	5	1	63	1	0	20%	11.11%
bottle glass	0	0	0	0	0	0	0
Caldron (big pan)	1	1	16	1	0	100%	11.11%
Plastic bucket	1	1	75	6	0	100%	11.11%
discarded earthen pot	5	2	84	10	0	40%	22.22%
Glassed bowl	3	1	245	6	0	33.33%	11.11%
Bamboo stem	0	0	0	0	0	0	0
Manmade tree hole	2	2	3200	123	2	100%	22.22%
Total	19	9	3688	147	2	47.37%	100%

Key container= >500 larvae positive container,

Table (3) shows that a total of 19 miscellaneous containers were inspected and 9 (47.37%) containers were found to be positive for *Aedes* larvae. Highest positivity was found in discarded earthen pot and hole of tree stem 22.22% followed by plastic/tin can , car tire, glassed bowl, plastic bucket and caldron (big pan)(11.11%). Highest amount of larvae (3200) were found in hole of tree stem which were used as cattle food pan.

Anout Taw village

Table 4: Larva positive rate of different water storage containers (Major) during survey period in Anout Taw village, Pakokku Township (pH 6.5 -7, 25 - 27ºC, RH 80-92%) (A) Major containers.

Type of containers	Total containers examined	Larva positive containers	Total larvae	Total pupae	Key container	Individually Positivity rate %	Total positivity %
Big Bago jar	27	18	1869	61		66.67%	42.86%
Metal drum	15	11	5809	79	5	73.33%	26.19%
Plastic drum	0	0	0	0		0%	0%
Concrete tank	12	9	641	10		75.00%	21.43%
Water cleaning tank	5	4	1317	29	1	80.00%	9.52%
Concrete jar	0	0	0	0		0%	
Total	59	42	9636	179	6	71.19%	100%

Table (4) shows that a total of 59 major water storage containers were inspected and found that 42 (71.19%) of water storage containers were found to *Aedes* larvae positive. Out of positive containers bago jar was found highest positivity (42.86%) followed by metal drum (26.19%) and concrete tank (21.43%). Lowest positivity rate was found in water cleaning tank. Six key containers were found in major containers, of this five metal drums and one water cleaning tank were found to be over 500 *Aedes* larvae.

Table 5: Larva positive rate of different water storage containers (minor) during survey period in Anout Taw village, Pakokku Township (pH 6.5 -7, 25 - 27ºC, RH 80-92%) Minor containers.

Type of containers	Total containers exam	Larva positive containers	Total larvae	Total pupae	Key container	Individually Positivity rate %	Total positivity %
Small bago jar	27	12	498	13	0	44.44%	21.82%
Aluminum Pot	3	2	35	0	0	66.670	3.63%
flower pot	69	23	840	34	0	33.33%	41.82%
Bucket	6	0	0	0	0	0%	0%
Plastic/Tire bucket	8	3	170	0	0	37.50%	5.46%
earthen pot	58	15	455	12	0	25.86%	27.27%
Total	171	55	1998	59	0	32.16%	100%

Table (5) shows that a total number of 171 minor containers were inspected and found 55 (32.16%) minor containers were *Aedes* larvae positive. Out of these positive containers flower pots were found (41.82%) highest positivity followed by earthen pot (27.27%). Aluminum pot was found lowest positive (3.36%).

Table 6: Larva positive rate of different water storage containers (miscellaneous) during survey period in Anout Taw village, Pakokku Township (pH 6.5 -7, 25 - 27ºC, RH 80-92%) Miscellaneous containers.

Type of containers	Total containers exam	Larva positive containers	Total larvae	Total pupae	Key container	Individually Positivity rate %	Total positivity %
Coconut shell	0	0	0	0	0	0%	0%
Tin, Plastic can	0	0	0	0	0	0%	0%
Car tire	0	0	0	0	0	0%	0%
Bottle glass	0	0	0	0	0	0%	0%
Discarded flower pot	1	1	250	12	0	100%	6.67%
Caldron (big pan)	0	0	0	0	0	0%	0%
Plastic bowl	3	1	100	9	0	33.33%	6.67%
Plastic bucket	0	0	0	0	0	0%	0%
discarded earthen pot	8	8	374	20	0	100%	53.33%
Glassed bowl	13	5	188	9	0	38.46%	33.33%
Bamboo stem	0	0	0	0	0	0%	0%
Hole of tree stem	0	0	0	0	0	0%	0%
Total	25	15	912	50	0	60.00%	100%

Table (6) shows that a total of 25 miscellaneous containers were inspected, 15 (60.00%) containers were found to be positive for *Aedes* larvae. Highest positive rate was found 53.33% in discarded earthen pots followed by glassed bowl (33.33%). Lowest container positivity was found in discarded flower pot and plastic bowl (6.67%).

Table 7: Number of different containers categories harboring *Aedes aegypti* larvae during survey period in Sin Lan and Anout Taw villages, Pakokku Township.

Survey	Total houses	Positive houses %	Key container %	Key premises %	Containers					
					Major		Minor		Miscellaneous	
					Inspected	Positive %	Inspected	Positive%	Inspected	Positive%
Sin Lan village	50	30 60.00	7 11.67	5 10.00	73	16 21.91	296	35 11.82	19	9 47.37
Anout Taw village	50	44 88.00	6 12.00	18 36.00	59	42 71.19	171	55 2.16	25	15 60.00

Key container= >500 larvae positive container, Key premises = three and above larvae positive containers per house

Table (7) shows that a total of 50 households each were randomly inspected for *Aedes* larvae positivity in Sin Lan and Anout Taw villages. A total of 30(60.00%) and 44(88%) of households were found to be *Aedes* larvae positive in water storage containers. Out of this 5 (10.00%) Key premises (3& above containers positive for larvae /house) and 7 (11.67%) Key containers were found in Sin Lan village. And a total of 18 (36.00%) households were found Key premises and 6 (12%) of key containers were observed in Anout Taw village. Larva positivity against container categories were found 21.91% of major containers, 11.82% of minor containers

and 47.37% of miscellaneous containers were found larvae positive in Sin Lan village and 42/59 (71.19%) of major, 55/171 (32.16%) minor and 15/25 (60.00%) miscellaneous containers were found *Aedes* larvae positive Anout Taw village respectively.

Table 8: Larval indices in Sin Lan and Anout Taw villages.

Villages	House Index (HI)	Container Index (CI)	Breteau Index (BI)
Sin Lan	60.00%	15.46%	120
Anout Taw	88.00%	43.92%	224

Larval indices such as House Index (HI) Container Index (CI) and Breteau Index(BI) were found to be 60.00%, 15.46% and 120 respectively in Sin Lan village and 88.00%, 43.92% and 224 respectively in Anout Taw village (Table 8).

Table 9: Pupal indices of Sin Lan and Anout Taw villages, Pakokku Township.

Inspected materials	Sin Lan village			Anout Taw village		
	Total samples	Pupa positivity	Pupa indices	Total samples	Pupa positivity	Pupa indices
Total household	50	210	4.2 P/h	50	288	5.76 P/h
Total population	201	210	1.05 P/p	229	288	1.26 P/p
>12yr = adult	167	210	1.26 P/a	188	288	1.53P/a
<12 yr = children	34	210	6.18 P/c	41	288	7.02 P/c
Total inspected containers	388	210	0.54 P/ic	255	288	1.13 P/ic
Total larvae positive containers	60	210	3.5 P/pc	112	288	2.57 P/pc

P/h =Pupae/ household, P/p=Pupae/ person, P/a=Pupae/ adult, P/c=Pupae/child, P/ic=Pupae/ inspected container, P/pc=Pupae/positive container

Pupal indices of Sin Lan village were found to be highest in children 6.18 Pupae/child followed by 4.2 pupae/ household and lowest index was found in 1.05 pupae/persons. The pupal indices of Anout Taw village were found to be highest in children 7.02pupae/child followed by 5.76 pupae/ household, lowest was found in 1.13 pupae/inspected container (Table 9).

DISCUSSION

The present study was conducted in two villages as Sin Lan village and Anout Taw village of Pakokku Township, Magway Region to determine the distribution of *Aedes aegypti* larvae in different water storage containers. The study found that in Sin Lan village, a total of 388 water storage containers (73 major, 296 minor and 19 miscellaneous) were inspected and found that 60 containers {16/73 (21.92%) major, 35/296 (11.82%) minor and 9/19(47.37%) miscellaneous containers} were positive for *Aedes* larvae. When compare the containers positivity, the highest number of big bago jars were positive with *Aedes* larvae in major containers followed by concrete tank, in minor containers, earthen pots were found highest larval positivity followed by flower pots. And in miscellaneous containers, discarded earthen pots and hold of tree stems (manmade tree hold) were found highest positivity (22.22%). Lowest number of larvae was found in tin can (only five larvae).

Although in Anout Taw village, an all total of 255 water storage containers were inspected and found that 112 containers 42/59 {(71.19%) major, 55/171 (32.16%) minor and 15/25 (60.00%) miscellaneous} containers were positive for *Aedes* larvae. Big bago jars were also highly positive with *Aedes* larvae followed by metal drum in major containers. In minor containers flower pots were highly positive with larvae followed by earthen pots and in miscellaneous containers discarded earthen pot were found highly positive with *Aedes* larvae followed by glassed bowls. In the study villages mostly they have used earthen water storage containers as bago jars, earthen pot, earthen flower pot and glassed earthen bowls. Therefore it may be larval positivity is high in earthen water storage containers in both areas. In both Sin Lan and Anout Taw villages earthen flower pots were used for religious purposes in household and larva positivity in flower pots was high in Anout Taw village. Same results has been observed in Hpa-an Township, high numbers of minor containers were inspected in Taung Nar village because the villagers used high number of flower pots in household for worshipping of religious purposes (Than Than Kyi, 2015). Although other researchers observed that in Yangon areas, mostly larvae were positive in spirit bowls, metal drums and concrete jars (Pe Than Htun et al., 2010, Maung Maung Mya et al., 2011).

Because these water storage containers were placed forward and back ward of the house's under the gutters, without covers to keep water for household used. Same result has been found in a recent study in Hpa-an Township it was found that big bago jars was highly

positivity with *Aedes* larvae (Than Than Kyi, 2015). Although other researchers found that metal drums, bago jars, concrete jars and discarded car tires were highly larvae positive in Yangon areas. Because metal drums, bago jars and concrete jars which containers were placed under the gutters to keep rain water in raining season. Most householders used big bago jars, metal drums plastic drums and concrete jars to store water for multiple used (Tun Lin, *et al*., 1995, Maung Maung Mya, *et al*., 2005, Myint Myint Chit, 2009). Seven Key containers (over 500 larvae positive container) five in major containers (one big bago jar, one metal drum, one plastic drum and two concrete tanks) and two in miscellaneous containers (two hole of tree stems which were used as food pat of cattle) were recorded in Sin Lan village and six Key containers in major containers (five metal drum and one water cleaning tank) were recorded in Anout Taw village. Than Than Kyi (2015) also revealed that big bago jars are highly key containers of *Aedes* larvae in Hpa-an Township and one of the bago jar which was used for preservation of Thittothi in Taung Nar village was found with plenty of *Armijaris* and *Culex* larvae but in the study areas of Pakokku there were not found any preservative containers. Although in some containers *Aedes* larvae were found co-breeder with *Culex* larvae in earthen pots which pots were used in latrine. Other researchers mention that metal drums, concrete jars, spirit bowls and bamboo stems were found key containers in Yangon Region (Tun Lin, *et al*., 1995, Pe Than Htun, *et al*., 2010 Maung Maung Mya, *et al*., 2005). Metal drum and bago jars are highly positive for *Aedes* larvae and metal drums are regarded as key containers in Tha Key Ta, Shan Chaung and Dagon North Township, Yangon Region (Maung Maung Mya, *et al*., 2011, Tun Lin, *et al*., 1995, Maung Maung Mya, *et al*., 2013). A study of Than Than Kyi (2015) in both Mingalar Ywar Thit and Taung Nar villages, in Hpa-an Township, some major containers such as concrete tanks, metal drum and concrete jars were found positive with Aquarian fishes and dragonfly nymphs. Those containers were found absent of *Aedes* larvae. In present study in both villages of Sin Lan and Anout Taw, some larvae absent concrete tanks were found to be dragon fly nymphs and small fish. Other researchers also revealed that dragonfly nymphs were mostly found in concrete tank, concrete jars and some metal drums (inner surface covered with cement) and ponds in Yangon Region which nymphs are highly predator of mosquito larvae (Sebastian, *et al*., 1990, Maung Maung Mya, *et al*., 2013).

A total of 19 miscellaneous containers from Sin Lan village and a total of 25 miscellaneous containers from Anout Taw village were inspected for *Aedes* larvae and found that discarded earthen pots provided highest positivity rate in both areas (22.22%) in Sin Lan village and 53.33% in Anout Taw village). Earthen pots and earthen flower pots were abundantly present in both areas and full with water which provided good breeding places for *Aedes* mosquitoes. In both villages, manmade tree holes which were used as cattle food baths in cow shed in the villages and some discarded tree holes in Sin Lan village were full with water and two were found high number of larvae more than 1500 larvae were present in these containers. Present study found that two tree holes of miscellaneous were key containers in Sin Lan village although there were not found key container in miscellaneous containers in Anout Taw village. And also no bamboo stem were found in both areas. *Aedes albopictus* was found together with *Aedes aegypti* in tree holes in Sin Lan village. Other researchers mentioned that *Aedes albopictus* was mostly found in bamboo stem and *Aedes aegypti* was found in all kind of containers as bago jars, metal drums, car tires (Maung Maung Mya, *et al*., 2011, Tun Lin, *et al*., 1995). Several researchers mentioned that spirit bowls are key containers of *Aedes* larvae in semi urban and rural areas of Yangon Region (Maung Maung Mya, *et al*., 2011, Tun Lin, *et al*., 1995, Pe Than Htun, *et al*., 2010, Maung Maung Mya, 2013).

Aedes aegypti and *Aedes albopictus* larvae were observed co-breders in the Key container of manmade tree holes. Same result was found in Hpa-an Township Kayin State (Than Than Kyi, 2015) Same observation of *Aedes aegypti* and *Aedes albopictus* larvae were observed in a spirit bowl in Hmawbi Township, Yangon Region (Maung Maung Mya, *et al*., 2005). A similar study done by other researcher in Insein Township revealed that *Aedes* larvae were bred together with *Toxorhynchites* larvae in car tires. *Toxorhynchites* larvae were easily found in unused bago jars, earthen pots and discarded old car tires (Myint Myint Chit, 2009) and mostly they were found together with *Aedes* larvae due to the fact that they are predators of mosquito larvae (Chuah &Yap 1984). Present study has not observed any *Toxorhynchites* larvae in water storage containers. Most of the major containers were found as Key containers in both areas such as bago jars, metal drum. The results of the present studies agreed with the results of other researchers they had found high number of Key premises and Key containers in Tha key Ta Township, North Dagon Township and Shwe Pyi Thar Township in raining season (Htin Zaw Soe, *et al*., 2004, Maung Maung Mya, 2005, Myint Myint Chit, 2009). Tin Mar Yi Tun, (2007) mentioned that in pre-monsoon survey, 62.19% of major containers were positive for *Aedes aegypti* larvae in North Dagon Township followed by 50% of Pazundaung area. Percentage of positive miscellaneous containers of Latha Township was higher than that of other Townships and the highest percentage of positive premises (70.59%) was found in North Dagon in post monsoon period in Yangon Region (Tin Mar Yi Tun, 2007).

In the present study Key premises were found higher 18 in Anout Taw village than five in Sin Lan village. Because Sin Lan village mostly larva were positive in earthen pot, earthen flower pot, bago jars and some discarded earthen pot and car tires. A recent study by Than Than Kyi (2015) revealed that 22(44%) Key

premises of Taung Nar village was higher than 7(19.61%) Key premises of Mingalar Ywar Thit village in monsoon period. Same result of key premises has been found in Tha Key Ta and North Dagon Townships in Yangon Region (Htin Zaw Soe, *et al*., 2004, Tin Mar Yi Tun, 2007, Maung Maung Mya, *et al*., 2013). In the present study larval positivity in water storage containers, Key premises and Key containers were higher in both villages, Because most of the water storage containers were without covered and full with water. The environment of both areas had highest humidity (75-80%) and moderate temperature (27-30ºC). These conditions are favorable for the breeding of *Aedes* larvae. Plenty of oviposition sites are available for *Aedes* mosquitoes and life span of the larval was shortened during raining season (Molly, 1924, Southwood, *et al*., 1972). This also supports the increase of *Aedes aegypti* density in monsoon period. However, Pe Than Htun, *et al*. (2010) revealed that sometime mosquito density increased and DHF outbreak occurred in hot season because water shortages caused lack of cleaning in Dala Township in Yangon Region.

The larval detection surveys were carried out in the villages of Sin Lan and Anout Taw in Pakokku Townships, Magway Region. Larval indices of Sin Lan village found that House Index (HI), Container Index (CI) and Breteau Index (BI) were lesser positivity than Anout Taw village (HI), (CI) and Breteau Index (BI). Although, CI and BI of the Anout Taw village were 2.8 fold higher in CI and 1.87 fold higher in BI than Sin Lan village. Than Than Kyi revealed that when compared with the Breteau Index (172.5) of Mingalar Ywar Thit village it was less than the Breteau Index (BI) (206) of Taung Nar village. Other researchers also revealed that BI was high in North Dagon Township and Tha Key Ta Township in Yangon Region (Maung Maung Mya, 2005, Tin Mar Yi Tun, 2007, Htin Zaw Soe, 2004, Maung Maung Mya, 2013). The positive water storage containers, Key premises and key containers were found higher in both Sin Lan and Anout Taw villages, it may be due to their water storage habit and also breeding habitat of the females *Aedes* mosquitoes. Therefore adult female *Aedes* can easily be searched their oviposition sites in the villages.

In the comparison of Pupal indices in Sin Lan and Anout Taw villages, The children were found to be high risk for transmission in both areas. Pupae/child and pupae/ household were higher in Anout Taw village than the Pupae/ child and pupae/household in Sin Lan village. When compare with Pupae/ person in both areas, Sin Lan village was found 1.26 pupae/ person was not significantly difference with 1.05 pupae/ person in Anout Taw village. The pupae/child of Anout Taw village was higher than the Sin Lan village. Therefore, children are high risk for DHF in Anout Taw village than Sin Lan village. High risk of children has been also found in Tha key ta in Yangon Region and Hpa-an in Kayin State (Maung Maung Mya, *et al*., 2013, Nan Than Than Kyi, 2015). A researcher from Department of Medical Research reported that now DHF transmission is occurred in adult age in Myanmar (Hlaing Myat Thu, 2011).

In the present study found the water storage containers of key premises houses and key containers were placed usually under the roof gutter and full with water which is favourable for gravid female *Aedes aegypti* to lay their eggs in these containers. The major containers, major breeding sources, which are usually placed under the roof gutters just outside the houses are usually replenished by rainfall (Tin Mar Yi Tun, 2007, Maung Maung Mya, 2013). Large water containers as bago jars, earthen pots, concrete tank and metal drums are found to be the main sources for breeding of *Aedes aegypti* as these containers are never completely emptied and also manmade tree hole which are used for cattle feeding bath are also breeding source of *Aedes aegypti* in Pakokku Township. Other researcher revealed that bamboo stems, Candle making machines and refrigerators were also key containers in Hmawbi Township, Yangon Region (Maung Maung Mya 2005).

In control measure, some larvivorus fish species can be used as biological control agents (Htay Aung, *et al*., 1991). The dragon fly nymphs *Bradinopyga germinate rambur*, were also found to be highly larvivorous (Sebastian, *et al*., 1980, Maung Maung Mya, *et al*., 2013). The sweeping method in larval control is a very effective control method; it can remove 95% of larvae within 10 minutes by alternate top and bottom sweeping procedures using cotton net sweeper (Tun Lin, *et al*., 1995).

In the view of the above, the spread of Dengue to both areas should be a matter of great concern to public health authorities and there is urgent need to create awareness among the both Sin Lan and Anout Taw village populations by community participations. The larval control should be done in and around the villages especially around the school compound and all day care centers to be aware of vector borne diseases.

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