Research article

Richness of Horticultural Crops with Emphasis on Mango Species in Selected Home Gardens in Myanmar

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Abstract This study aims to explore the relationship between home gardens' sizes and species richness of horticultural crops and to study the distribution of mango varieties in the selected area. Sixty home gardens were studied from September, 2018 to October, 2019 in Nay Pyi Taw Union Territory, Myanmar. Drone was used to generate geographical information. Coordinate points of each mango variety was collected. Information on compound dimensions and crop plants namely local names, growth stages, numbers of individual, leaf attitudes and characters were collected. Shannon-Wiener' index was employed to determine species richness. Distribution maps of mango varieties were developed. The compound areas could be classified into three classes as small, medium and large; were not correlated with species richness of all horticultural crops, but there had significant correlation with richness of mango varieties ($p = 0.01$, $r = 0.32$). Potential area for home garden development was highest in large gardens (41%) followed by medium (16%) and small (9%). Out of total 480 species, richness was highest in ornamentals (46%) followed by vegetables (10%), fruits (8%), shade-trees (8%), medicinal-plants (6%), spices (3%) and unidentified species (20%). Among fruit trees, mango was the most dominant species and 90% of home gardens were growing a total 361 plants (young 37% and adult 63%) of 15 local varieties namely Ma Chit Su (39%), Sein Ta Lone (24%), Sein Sar Thee (20%), Yin Kwe (9%), Ma Naw Nwe (3%), Waso, Padamyar Nga Mauk, Mya Kyauk and 4 unknown varieties (1% each) and Wet Ta Kaut, Pan Swae and Pyo Ta Ngone (0.3% respectively). Three types of leaf attitude and 8 different leaf characters of mango varieties were identified. Diversity index of total species was 1.57 and 1.40 for mango varieties. It was concluded that species distribution was sufficient; however, there is remaining available space to extend home gardening in the study area.

Keywords drone, species diversity, potential area

INTRODUCTION

Home gardens (HG) are sites of plant species diversity and also serve to conserve different species and varieties. Richness of horticultural crops species can be attained not only for self-sufficiency in food production but also nutritional status by diversification to those crops. Saving and exchanging seeds/planting materials from home gardens with neighbours are able to conserve a considerable amount of crop species. Being labour-intensive, horticultural crops provide job opportunities, besides having great export potential and therefore create more income for rural people. In order to promote the growth of horticulture sector, there are necessities to document the existing horticultural crops, to calculate the richness of those crops species and also to assess potential area for further expansion. To know the richness of horticultural crops species and the potential areas for home gardens development, the existing kinds of crops species and sizes of home gardens are needed to investigate.

The potential area for home garden development is the basic unit of species conservation in rural sustainable development. Therefore also the exploration of relationship between the home gardens areas and species richness has becoming importance for developing of the home gardens. Scientific investigations on richness of species and sizes of home gardens are severely lacking in the country.

In a statement of Helen Keller International/Asia-Pacific program, 2010, "the vegetables and fruits in the home gardens contribute considerably to increased consumption of these types of foods in many Asian countries". Among fruit trees, mango is one of the most important commercial crops in Myanmar and peoples' choicest fruit due to its agronomic and cultural value. Myanmar mangoes are assumed to be traditional varieties as they has historical origins, distinct identity, are genetically diverse, locally adapted and associated with traditional farming systems (Hirano et al., 2011). The total planted area of mango in Myanmar was 93,890 hectares and was 30% of total cultivated area for fruits (MFFVPEA, 2013). There are about 300 different mango varieties and 20 kinds of mango species in Myanmar. Leaf morphology of the mango species is highly variable depending on the cultivar. There is broad genetic diversity of mangoes in Myanmar that needs to be identified (Hirano et al., 2010). Research based on genetic resources of mango is very scarce in Myanmar. Moreover, there have been no reports of detailed information on spatial varietal distribution and identification on land-usage. By analysing the spatial distribution, the current land use of this area can be identified and has great potential in efficient utilization of land (Sana Iftikhar and Hafiz Zahid Mahmood, 2017). The determination of spatial distribution will help in determining the ecological suitability of an area for fruit growing. Geospatial technology such as Global Positioning System (GPS) and Geographical Indicating System (GIS) is one of the most widely used tool to provide updated information in identifying suitable sites for various crops and mapping for fruit trees distribution (Singh et al., 2017).

OBJECTIVE

The aims of this study were to explore the relationship between the size of home gardens' and species richness of horticultural crops and to study the distribution of mango varieties in the selected area.

METHODOLOGY

The study was conducted in 60 selected home gardens out of total 370 in Kyee-Inn village, Nay Pyi Taw Union Territory, Myanmar from September, 2018 to October, 2019. Drone (DJI Phantom 4PRO) was flown above 50m to generate geographical information. The location of each selected home garden and mango varieties were recorded by Global Positioning System (GPS) GARMAN, GPSMAP 62 device. Drone photos were merged and arranged with Pix 4D software to determine the base map of the study area. ArcCatalog and ArcMap softwares (10.3.1 version) of ArcGIS were used to map the distribution of selected home gardens and mango varieties.

The composition of each home garden such as compound and building areas were measured; residential (social) and crops covered areas were visually estimated by drone images and the potential areas for home garden development were calculated. Primary data were gathered by both direct observations to acquire information on all horticultural crops especially mangoes: including local names, growth stages and number of individuals, and by interviewing people with semi-structured questionnaire sets. Descriptive statistics of the Statistical Package for Social Scientists (SPSS), version 23 was used to examine the relationship between the home gardens areas and species richness. The Shannon-Wiener' index was employed to determine the species richness by use of the following equation.

$$H' = -\sum_{i=1}^{s} pi \ ln \ pi$$

where H′equals diversity index, *s* equals the number of species and *pi* equals the ratio of individuals of species *i* divided by all individuals *N* of all species.

For growth stages of mangoes, less than 5 year-old trees were regarded as young and those above 5 years were regarded as adults. Finally, three representative leaf samples of each mango variety were

collected and leaf attitudes and leaf characters such as shapes of blades, apexes, bases and margins, were evaluated using mango descriptors (International Plant Genetic Resources Institute, IPGRI, 2006). Leaf lengths and widths were measured manually.

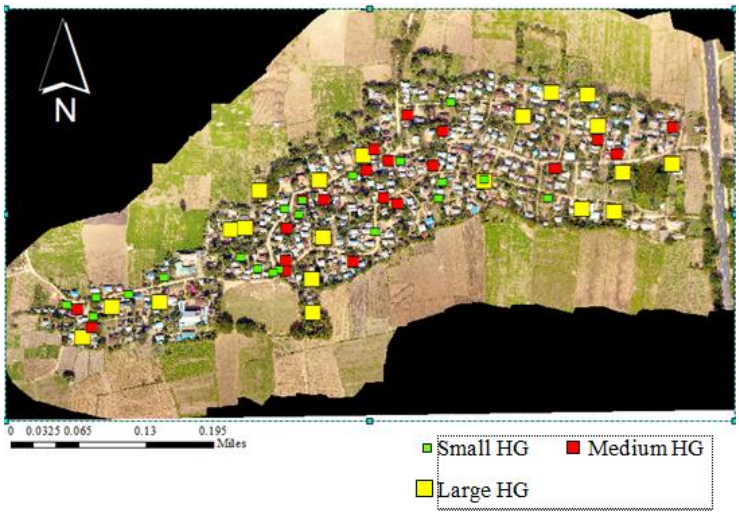

Fig. 1 Distribution of selected 60 home gardens (small, medium, large) in the study area

RESULTS AND DISCUSSION

Figure 2 shows three groups of home gardens (n=20) categorized from small (1400-4000 ft^2), medium (4001-6400 ft^2) to large (6401-21,500 ft^2). Potential area for home garden development was highest in large home gardens group (41%) followed by medium (16%) and small (9%).

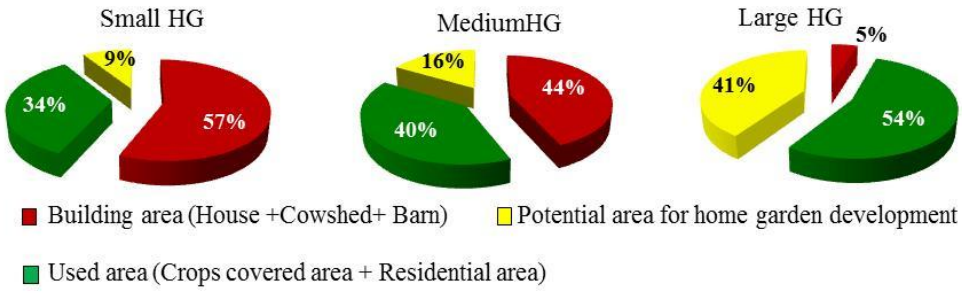

Fig. 2 Different areas that comprised home gardens in the 3 categories (n= 20)

The observed horticultural species were categorized into 7 groups. Of the 480 species that were observed, species richness was highest in ornamentals (46%) followed by vegetables (10%), fruits (8%), medicinal plants (8%), shade trees (6%), spices (3%) and unidentified species (20%) (Fig. 3).

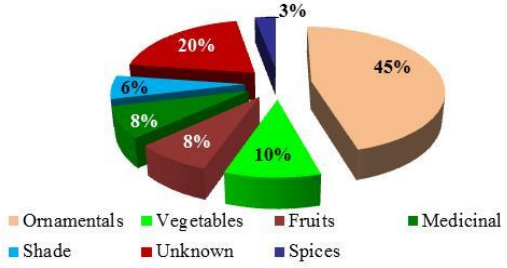

Fig. 3 Classification of horticultural crops identified in selected home gardens

Among fruit trees, mango species were the most dominant and 90% of home gardens were growing a total of 361 trees which included 15 local varieties: namely, Ma Chit Su (39%), Sein Ta Lone (24%), Sein Sar Thee (20%), Yin Kwe (9%), Ma Naw Nwe (3%), Waso, Padamyar Nga Mauk, Mya Kyauk and four unknown varieties (1% each) and Wet Ta Kaut, Pan Swae and Pyo Ta Ngone (0.3% respectively). These respective proportions in each group of home gardens are presented in Fig. 4 (a). A base map of the village was produced and then the distributions of the 15 mango varieties are shown in Fig. 5. Mango varieties were well distributed over the whole study area. Out of a total 361 mango trees, mostly propagated by seeds, 37% were at the young stage and the remaining 63% were adult (Fig. 4 (b)). Almost in all varieties, the juvenile period usually ended after 4th years and flowering started in the 5th year. This finding is consistent with the report by Mukherjee and Litz, (2009) who stated that the juvenile period of seedling trees usually ranged from 3 to 7 years.

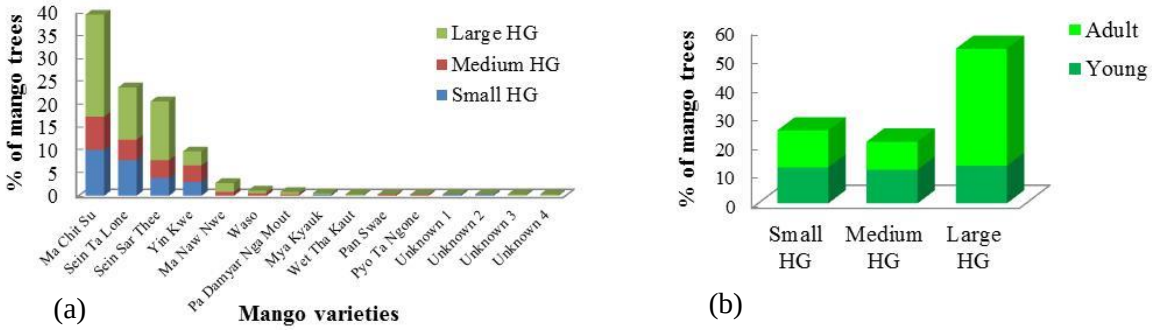

Fig. 4 Fifteen mango varieties in 3 groups of home gardens (a) and growth stages (b)

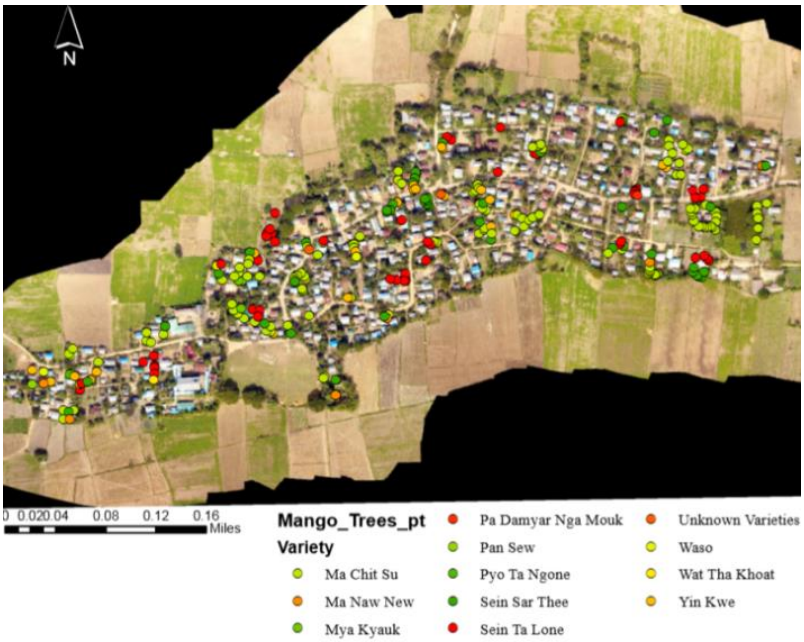

Fig. 5 Distribution map of 15 mango varieties

The evaluated leaf characters of 11 known and 4 unknown varieties are shown in Table 1. Three types of leaf attitudes and leaf characters (blade, apex, base) were observed. Both wavy and entire margins were found in all varieties. Lengths and widths of leaves ranged from 16.5-25.0 cm and 3.0-4.4 cm, respectively. Figure 6 shows the comparison of different leaf characters of the observed mango varieties.

Table 1 Leaf descriptors of 11 mango varieties and 4 unknown varieties

No.	Variety	Attitude	Blade	Apex	Base	Margin	Length (cm)	Width (cm)
1	Unknown 1	semi-dropping	oblong	acute	obtuse	wavy	19.5	4.0
2	Unknown 2	horizontal	oblong	acute	obtuse	entire	18.0	4.1
3	Unknown 3	horizontal	lanceolate	acuminate	acute	wavy	21.0	3.0
4	Unknown 4	horizontal	lanceolate	acuminate	acute	wavy	24.0	3.2
5	Yin Kwe	semi-erect	elliptic	acute	acute	wavy	19.3	3.8
6	Ma Chit Su	semi-dropping	lanceolate	acuminate	acute	entire	20.5	4.0
7	Ma Naw Nwe	horizontal	oblong	acute	obtuse	wavy	16.5	4.4
8	Pan Swe	semi-dropping	lanceolate	acuminate	obtuse	wavy	18.3	3.6
9	Pa Damyar Nga Mouk	horizontal	lanceolate	acuminate	obtuse	wavy	21.0	3.8
10	Pyo Ta Ngone	horizontal	lanceolate	acuminate	acute	entire	25.0	3.4
11	Mya Kyauk	horizontal	oblong	obtuse	acuminate	entire	20.8	4.0
12	Sein Ta Lone	semi-erect	oblong	acute	obtuse	wavy	21.5	4.0
13	Wat ThaKout	horizontal	lanceolate	acuminate	acute	entire	19.5	3.6
14	Sein Sar Thee	horizontal	lanceolate	acuminate	acute	wavy	23.0	3.2
15	Waso	horizontal	oblong	obtuse	acuminate	entire	20.8	4.0

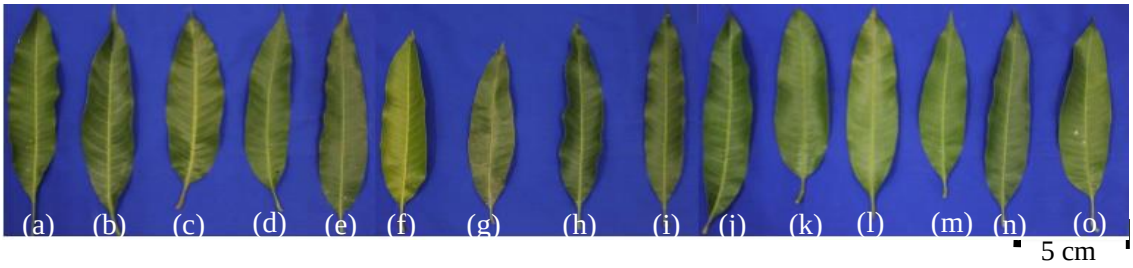

Fig. 6 Leaf characters of (a-d) 4 unknown varieties, (e) Yin Kwe, (f) Ma Chit Su, (g) Ma Naw Nwe, (h) Pan Swe, (i) Pa Damyar Nga Mouk, (j) Pyo Ta Ngone, (k) Mya Kyauk, (l) Sein Ta Lone, (m) Wat Tha Kout, (n) Sein Sar Thee and (o) Waso

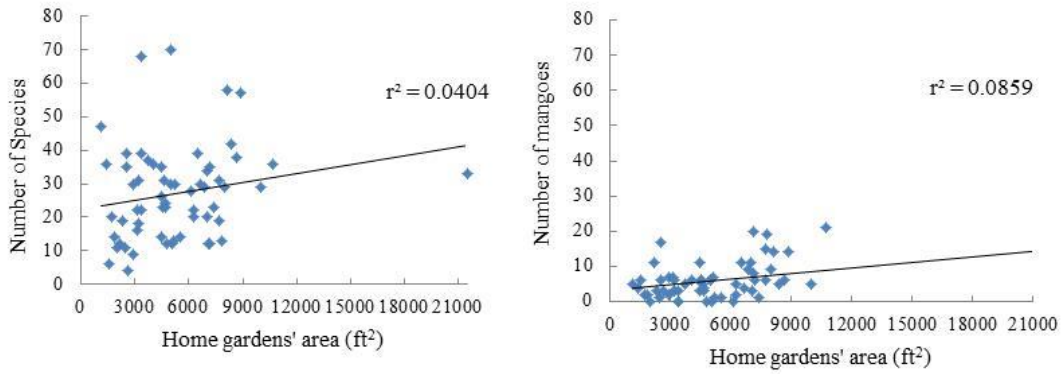

Fig. 7 Relationship between area of home gardens and number of species for all horticultural crops (a) and number of mango trees (b)

Though the sizes of home gardens had no correlation with species richness of all horticultural crops ($p = 1.24$, $r = 0.20$), there had a significant correlation with mango varieties ($p = 0.01$, $r = 0.32$). Fig. 7 shows correlation coefficient for species richness of all horticultural crops ($r^2 = 0.04$) and mango trees ($r^2 = 0.08$) which mean only 4% of the variance in species richness and 8% of mango trees is explained by the change in home garden areas. Furthermore, the slope is 0.001 in both cases,

indicating that for every unit increase in areas, number of species increases by only 0.001. The calculated diversity indices were H' = 1.57 for all species and 1.40 for mango varieties. Typical values of diversity index are generally ranged between 1.5 and 3.5 (Magurran, A.E. 2004) and the calculated indexes of the study area were reached nearly this range.

CONCLUSION

Although the results suggest that indeed, plant species richness of home gardens in the study area is high, there were more potential areas to extend home gardening especially for large home gardens (41%) followed by medium gardens (16%) and small ones (9%), respectively. While we found no correlation between species richness and the home gardens sizes, these sizes were significantly correlated to richness of mango varieties with a higher species richness in larger than in smaller-sized home gardens. This might be because large-sized gardens tend to focus on fruit tree type species and allocate more of their land to food crops, while small gardens can afford to include different types of crop species. Mango varieties were well distributed and adaptable with agro-ecology of the study area; therefore, the gardeners should try to replace with the marketable and exportable quality mango varieties in spite of existing local varieties. Home gardeners need to be made localized efforts to conserve rare native species by promoting more widespread cultivation.

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