Volume 4, Number 10 (Cumulative No.40) October 25, 2012 ISSN:1553-992X

# Academia Arena

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Academia Arena 2012;4(10)

Volume 4, Number 10 October 25, 2012 ISSN:1553-992X

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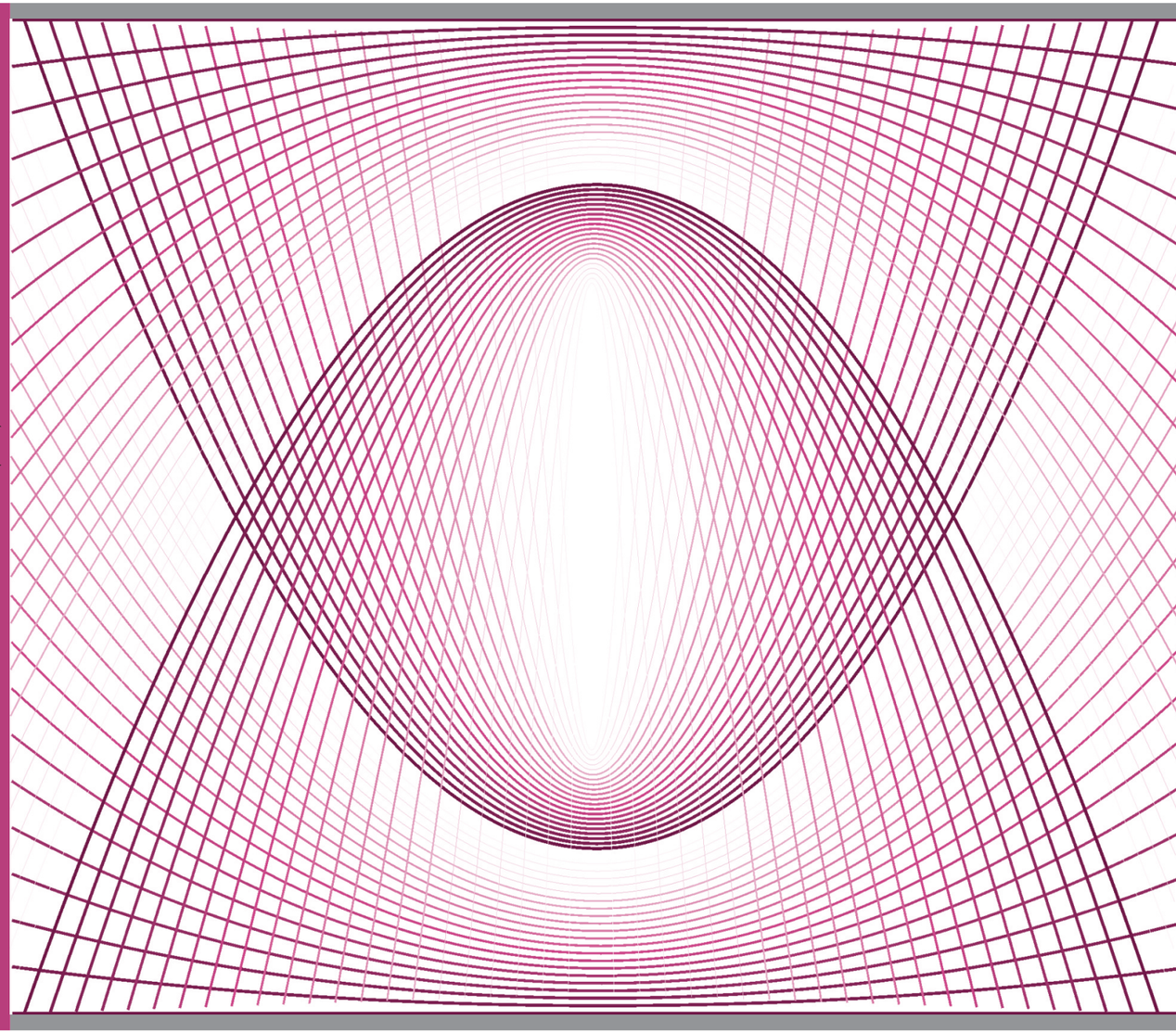

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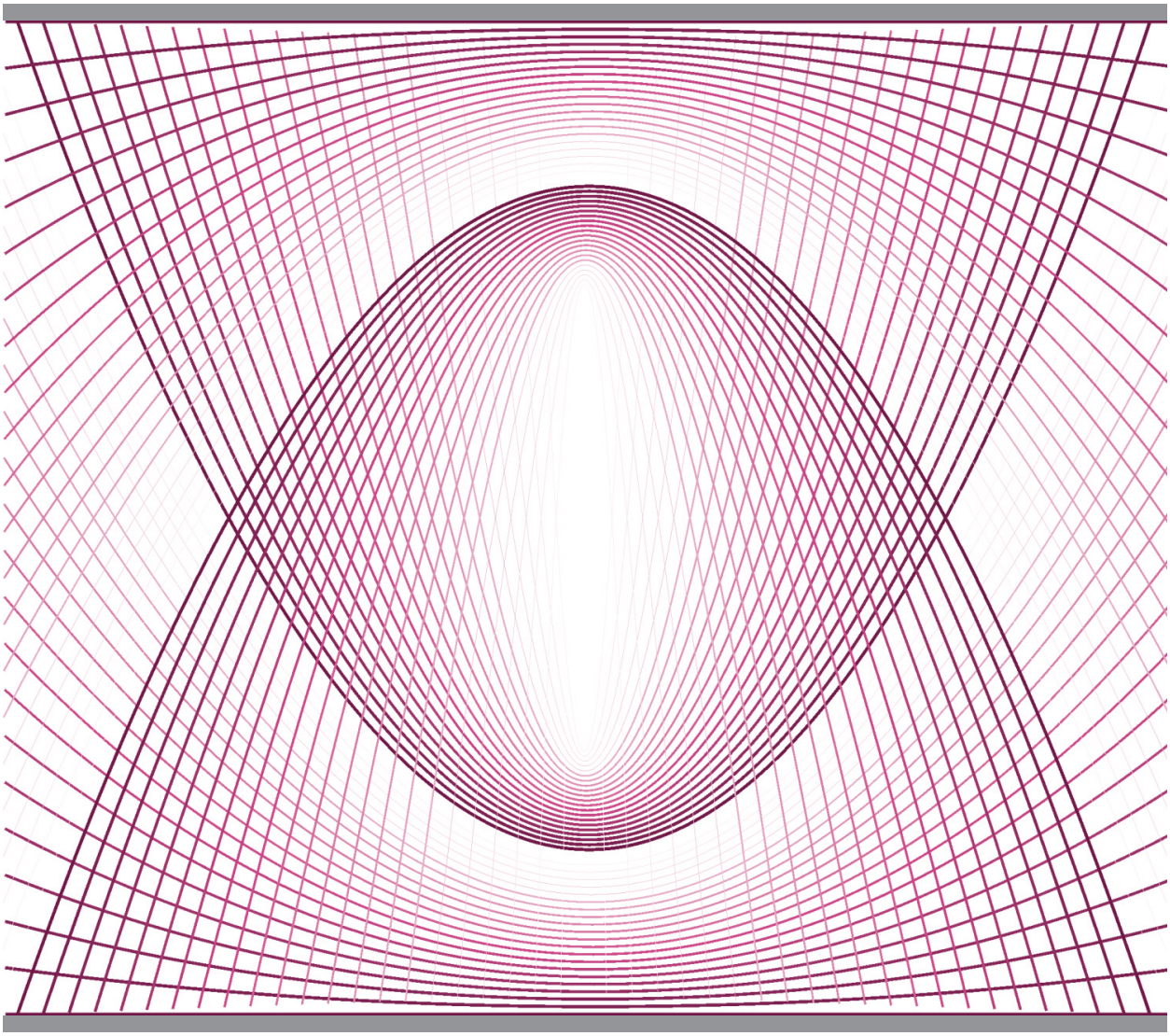

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(*Academ Arena*)
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# Genetic Variation, Heritability and Interrelationships of Some Important Characteristics in Syrian Tomato Landraces (*Solanum lycopersicum* L.)

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**Abstract:** Fourteen tomato landraces provided by Bank of Plant Genetic Resources were evaluated under irrigated field conditions in two contrasting environments. The objectives were to estimate genotypic (GCV) and phenotypic (PCV) coefficients of variation, broad sense heritability ($h^2$) and genetic advance (GA) using the variance components method based on the combined analysis over locations and the variance analyses for each location for various characteristics and to determine the interrelationships among these characteristics. Because of high genotype-environment (G × E) interactions, estimates of GCV, $h^2$ and GA for most of the characteristics using combined analysis were generally lower than the estimates computed from the variance analyses made separately for each location. Based on the results of the individual and combined analysis of variance, high estimates of GCV, $h^2$ and GA (as % of the mean) were observed for number of fruits per plant, number of fruits per cluster, average fruit weight and fruit yield per plant, indicating the predominance of additive gene effects and reflecting the effectiveness of selection in the present germplasm of tomato improvement. Average fruit weight had positive and highly significant genotypic correlation with fruit yield per plant, suggesting the possibility for improvement of tomato landraces by indirect selection for this characteristic.

[Firas Al-Aysh, Hussein Kutma, Abdulla Al-Zouabi. **Genetic Variation, Heritability and Interrelationships of Some Important Characters in Syrian Tomato Landraces (*Solanum lycopersicum* L.).** *Academ Arena* 2012;4(10):1-5] (ISSN 1553-992X). http://www.sciencepub.net/academia. 1

**Keywords:** landraces; heritability; genetic advance; genotypic correlation; average fruit weight; tomato

## 1. Introduction

Landraces are often heterogeneous and composed of different genotypes which are mostly homozygous and usually exhibit considerable genetic variation for quantitative and qualitative characteristics (Frankel et al., 1995). The success of a breeding program depends upon the extent and magnitude of variability existing in the germplasm. The expression of a characteristic is the result of genetic constitution of a strain and the influence of environment on it, hence some strains can perform well under specific environmental conditions while others may not. The environmental conditions have a significant effect on the expression of yield and other quantitative characteristics. So, the evaluation of genotypes over different environments provide information regarding the relative magnitude of the genotypic and phenotypic variability and the extent of genetic advance that can be made by studying the experimental material under more than one environment and which had been earlier emphasized by Comstock and Robinson (1952); Johnson et al. ( 1955); Nei and Saykudd (1957); Athwal and Singh (1966).

The present study is a scientific attempt to understand the genetic behavior and relationships of different characteristics. Therefore, information gained will be useful in formulating selection criteria for tomato improvement.

## 2. Materials and Methods:

Fourteen tomato landraces were used for this study. These landraces selfed for several generations, were supplied by Bank of Plant Genetic Resources, General Commission of Scientific Agricultural Research ***viz.***, 20060, 20061, 20170, 20198, 20292, 20303, 20335, 20339, 20364, 20402, 20660, 20740, 20909 and 20992.

The field experiments were carried out at Jellein Agricultural Research Station (Semi-arid, 32º45' N, 35º39' E, ca 440 meters above sea level and 360 mm long-term annual average of precipitation) and Al-Somakiat Agricultural Research Station (Arid, 33º25' N, 36º25' E, ca 825 meters above sea level and 165 mm long-term annual average of precipitation) which represent two contrasting environments. The experiments were laid out in a randomized complete block design with three replications and the seeds of 14 different tomato landraces were sown in seedling trays on 1 April, 2012 and after 45 days after sowing, the transplantation of seedlings to the permanent land was done. Each genotype was accommodated in single row of 8.8 m length with distance 0.4 m between plants and 1.8 m between rows. All pre- and post-stand establishment management such as land preparation, cultivation, weeding, fertilization and drip irrigation was made as required.

Data were collected for the following nine quantitative characteristics: days to first flowering,

days to maturity, plant height (cm), number of primary branches per plant, number of leaves up to first cluster, number of fruits per plant, number of fruits per cluster, average fruit weight (g) and fruit yield per plant (kg). Data on days to first flowering and maturity were recorded on plot basis, whereas the other characteristics computed from the ten central individual plants within each plot (i.e., row). Variance components were estimated according to Nadarajan and Gunasekaran (2005). Genotypic (GCV) and phenotypic coefficients of variation (PCV), broad sense heritability ($h^2$), genetic advance (GA), genetic advance in percentage of mean (GA %) and genotypic correlation coefficients ($r_g$) were estimated as suggested by Singh and Chaudhary (1985).

**3. Results:**

For each of the characteristics evaluated, the descriptive statistics including the extreme genotype mean values and the means with their standard deviations obtained on the basis of averages of data at each of the two test locations have been presented in **Table 1** which shows highly significant differences among the genotypes for all the characteristics under study.

**Table 1. Ranges, means, standard deviations and F values of 14 tomato genotypes for 9 characteristics at the two test locations.**

| Characteristic | Location | Min. | Max. | Mean | S.D. (±) | F-value for genotypes | L.D.S. $_{0.05}$ |
|---|---|---|---|---|---|---|---|
| Days to first flowering | *Jellein* | 50.00 | 61.00 | 57.00 | 3.14 | 3.16** | 5.27 |
| | *Al-Somakiat* | 70.00 | 75.00 | 73.00 | 1.26 | 3.16** | 2.11 |
| Days to maturity | *Jellein* | 105.00 | 113.00 | 110.00 | 1.66 | 6.16** | 2.78 |
| | *Al-Somakiat* | 105.00 | 123.00 | 115.00 | 0.47 | 402** | 0.79 |
| Plant height (cm) | *Jellein* | 78.00 | 113.67 | 92.50 | 4.26 | 24.30** | 7.16 |
| | *Al-Somakiat* | 54.67 | 139.67 | 85.38 | 2.34 | 408** | 3.93 |
| No. of primary branches per plant | *Jellein* | 3.60 | 7.33 | 5.16 | 0.35 | 41.59** | 0.59 |
| | *Al-Somakiat* | 3.33 | 5.67 | 4.07 | 0.41 | 7.13** | 0.69 |
| No. of leaves up to first cluster | *Jellein* | 5.30 | 11.27 | 8.03 | 0.25 | 140.46** | 0.41 |
| | *Al-Somakiat* | 5.67 | 8.67 | 7.05 | 0.63 | 5.17** | 1.06 |
| No. of fruits per plant | *Jellein* | 21.00 | 225.00 | 74.68 | 2.52 | 2391** | 4.24 |
| | *Al-Somakiat* | 11.00 | 124.33 | 28.98 | 0.91 | 3326** | 1.53 |
| No. of fruits per cluster | *Jellein* | 2.00 | 9.43 | 3.89 | 0.29 | 175** | 0.49 |
| | *Al-Somakiat* | 3.00 | 12.33 | 4.91 | 0.55 | 58.75** | 0.93 |
| Average fruit weight (g) | *Jellein* | 9.41 | 105.28 | 63.57 | 4.32 | 179** | 7.25 |
| | *Al-Somakiat* | 11.00 | 185.33 | 91.86 | 6.38 | 252.97** | 10.71 |
| Fruit yield per plant (kg) | *Jellein* | 1.47 | 4.35 | 2.79 | 0.08 | 350** | 0.14 |
| | *Al-Somakiat* | 0.57 | 2.70 | 1.60 | 0.04 | 992.87** | 0.07 |

**Table 2. Estimates of mean squares, genotypic (GCV) and phenotypic coefficients of variation (PCV), broad sense heritability ($h^2$), genetic advance (GA) and genetic advance as a percentage of mean (GA %) for 9 characteristics of 14 genotypes of tomato, combined across two locations.**

| Characteristic | Mean squares of | | | GCV | PCV | $h^2$ | GA | GA |
|---|---|---|---|---|---|---|---|---|
| | Genotypes | G x L | Error | (%) | (%) | | | (%) |
| Days to first flowering | 24.95** | 11.22 | 5.72 | 2.32 | 3.02 | 59.48 | 2.05 | 3.16 |
| Days to maturity | 109.58** | 30.09** | 6.78 | 3.24 | 3.67 | 78.08 | 5.66 | 5.04 |
| Plant height | 1999.45** | 678.32** | 11.83 | 16.69 | 19.35 | 74.34 | 22.51 | 25.32 |
| No. of primary branches per plant | 4.45** | 1.82** | 0.15 | 14.29 | 17.53 | 66.67 | 0.95 | 20.57 |
| No. of leaves up to first cluster | 7.81** | 2.76** | 0.23 | 12.20 | 14.32 | 72.41 | 1.38 | 18.25 |
| No. of fruits per plant | 14793.75** | 3248.2** | 18.15 | 84.64 | 92.24 | 84.17 | 70.83 | 136.65 |
| No. of fruits per cluster | 29.56** | 3.44** | 0.20 | 47.50 | 49.55 | 91.77 | 3.52 | 80.02 |
| Average fruit weight | 11559.23** | 2085.9** | 29.70 | 51.13 | 54.77 | 87.12 | 65.27 | 83.99 |
| Fruit yield per plant | 3.31** | 0.73** | 0.005 | 30.00 | 32.73 | 84.15 | 1.07 | 48.64 |

** Significant at the 0.01 probability level.

Estimating of GCV and PCV coefficients of variation, $h^2$, and GA expected from selecting the superior 10 % of genotypes for each characteristic computed using the variance components based on the combined analysis over the two test locations are shown in **Table 2**. The mean squares from the combined variance analysis over the two locations showed highly significant genetic variation for all the characteristics studied (**Table 2**). Locations and genotypes interacted significantly (P< 0.01) for all the characteristics except days to first flowering. GCV and PCV were high (> 20 %) just for number of fruits

per plant (84.64 % , 92.24 %), number of fruits per cluster (47.50 % , 49.55 %), average fruit weight (51.13 % , 54.77 %) and fruit yield per plant (30.00 % , 32.73 %), respectively. Heritability in broad sense was high (> 60 %) for all the characteristics studied except days to first flowering (59.48 %). Genetic advance as percentage of mean was high (> 20 %) for plant height (25.32 %), number of primary branches per plant (20.57 %), number of fruits per plant (136.65 %), number of fruits per cluster (80.02 %), average fruit weight (83.99 %) and fruit yield per plant (48.64 %).

The results of **Table 3** showed, in general, that the magnitudes of GCV, PCV, $h^2$ and GA % were higher when they were computed based on the results of the variance analyses made separately for each of the two test locations. Moreover, estimates of these genetic parameters were affected by the yield level of the environment. Out of the nine characteristics studied, days to first flowering, number of primary branches per plant, number of leaves up to first cluster and number of fruits per cluster showed relatively higher estimates of GCV, PCV, $h^2$ and GA (%) at Jellein than at Al-Somakiat location, while the other characteristics showed higher GCV, PCV, $h^2$ and GA (%) at Al-Somakiat than at Jellein location. Considering the values of GCV, PCV, $h^2$ and GA (%) simultaneously as the best estimators of the amount of advance expected, number of fruits per plant, number of fruits per cluster, average fruit weight and fruit yield per plant gave the highest values at both locations.

**Table 3. Estimates of variance components, genotypic (GCV) and phenotypic coefficients of variation (PCV), broad sense heritability ($h^2$), genetic advance (GA) and genetic advance as a percentage of mean (GA %) for 9 characteristics of 14 genotypes of tomato at the two test locations.**

| Characteristic | Location | Source of variance | | | GCV (%) | PCV (%) | $h^2$ | GA | GA (%) |
|---|---|---|---|---|---|---|---|---|---|
| | | $V_g$ | $V_e$ | $V_{ph}$ | | | | | |
| Days to first flowering | *Jellein* | 7.11 | 9.85 | 16.96 | 4.71 | 7.26 | 41.92 | 3.04 | 5.36 |
| | *Al-Somakiat* | 1.14 | 1.58 | 2.72 | 1.46 | 2.25 | 41.91 | 1.22 | 1.67 |
| Days to maturity | *Jellein* | 4.70 | 2.74 | 7.44 | 1.98 | 2.49 | 63.17 | 3.04 | 2.77 |
| | *Al-Somakiat* | 29.85 | 0.22 | 30.07 | 4.76 | 4.78 | 99.27 | 9.58 | 8.35 |
| Plant height | *Jellein* | 141.25 | 18.18 | 159.43 | 12.85 | 13.65 | 88.60 | 19.70 | 21.30 |
| | *Al-Somakiat* | 743.45 | 5.48 | 748.93 | 31.94 | 32.06 | 99.27 | 47.82 | 56.01 |
| No. of primary branches per plant | *Jellein* | 1.65 | 0.12 | 1.77 | 25.00 | 25.78 | 93.22 | 2.18 | 42.29 |
| | *Al-Somakiat* | 0.34 | 0.17 | 0.51 | 14.25 | 17.69 | 66.67 | 0.85 | 20.89 |
| No. of leaves up to first cluster | *Jellein* | 2.82 | 0.06 | 2.88 | 20.92 | 21.17 | 97.92 | 2.93 | 36.49 |
| | *Al-Somakiat* | 0.55 | 0.40 | 0.95 | 10.50 | 13.90 | 57.90 | 1.00 | 14.18 |
| No. of fruits per plant | *Jellein* | 5086.4 | 6.39 | 5092.8 | 95.50 | 95.56 | 99.88 | 125.4 | 167.97 |
| | *Al-Somakiat* | 923.6 | 0.83 | 924.4 | 104.9 | 104.9 | 99.91 | 53.46 | 184.46 |
| No. of fruits per cluster | *Jellein* | 4.98 | 0.09 | 5.07 | 57.33 | 57.84 | 98.23 | 3.89 | 100.00 |
| | *Al-Somakiat* | 5.89 | 0.31 | 6.20 | 49.49 | 50.71 | 95.00 | 4.16 | 84.73 |
| Average fruit weight | *Jellein* | 1106. 7 | 18.66 | 1125.3 | 52.34 | 52.78 | 98.34 | 58.07 | 91.35 |
| | *Al-Somakiat* | 3421. 9 | 40.74 | 3462.6 | 63.68 | 64.05 | 98.82 | 102.3 | 111.41 |
| Fruit yield per plant | *Jellein* | 0.77 | 0.01 | 0.78 | 31.54 | 31.54 | 98.72 | 1.53 | 54.80 |
| | *Al-Somakiat* | 0.58 | 0.002 | 0.582 | 47.50 | 47.50 | 99.66 | 1.33 | 83.32 |

Genotypic correlation coefficients among the pairs of characteristics studied at Jellein and Al-Somakiat locations are presented in **Table 4**. Days to first flowering at both locations had a negative and highly significant correlation with plant height, number of fruits per plant and number of fruits per cluster, but showed a positive and highly significant correlation with average fruit weight. Days to maturity at both locations was negatively and high significantly associated with plant height, number of primary branches per plant, number of leaves up to first cluster, number of fruits per plant and number of fruits per cluster, but positively with average fruit weight and fruit yield per plant. Plant height exhibited a positive highly significant correlation with number of primary branches per plant, number of fruits per plant and number of fruits per cluster at both locations. Average fruit weight had a negative and highly significant correlation with number of leaves up to first cluster, number of fruits per plant and number of fruits per cluster at the two experimental sites. The correlation of fruit yield per plant with days to maturity and average fruit weight was always positive and significant regardless of the location.

**Table 4. Genotypic correlation coefficients ($r_g$) among the various pairs of 9 tested characteristics in 14 tomato genotypes at the two test locations.**

| No. | Characteristic | Location | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Days to first flowering | *Jellein* | 0.301 | -0.704** | -0.738** | -0.297 | -0.852** | -0.800** | 0.530** | 0.027 |
| | | *Al-Somakiat* | 0.684** | -0.394* | -0.226 | -0.772** | -0.760** | -0.811** | 0.689** | 0.580** |
| 2 | Days to maturity | *Jellein* | | -0.793** | -0.785** | -0.852** | -0.880** | -0.814** | 0.927** | 0.505** |
| | | *Al-Somakiat* | | -0.696** | -0.495** | -0.282 | -0.514** | -0.415* | 0.657** | 0.389* |
| 3 | Plant height | *Jellein* | | | 0.845** | 0.673** | 0.847** | 0.894** | -0.960** | -0.640** |
| | | *Al-Somakiat* | | | 0.832** | 0.293 | 0.726** | 0.620** | -0.608** | -0.203 |
| 4 | No. of primary branches per plant | *Jellein* | | | | 0.625** | 0.821** | 0.923** | -0.896** | -0.460** |
| | | *Al-Somakiat* | | | | 0.000 | 0.755** | 0.592** | -0.293 | 0.182 |
| 5 | No. of leaves up to first cluster | *Jellein* | | | | | 0.754** | 0.587** | -0.714** | -0.243 |
| | | *Al-Somakiat* | | | | | 0.586** | 0.556** | -0.831** | -0.712** |
| 6 | No. of fruits per plant | *Jellein* | | | | | | 0.909** | -0.885** | -0.423* |
| | | *Al-Somakiat* | | | | | | 0.964** | -0.623** | -0.171 |
| 7 | No. of fruits per cluster | *Jellein* | | | | | | | -0.915** | -0.556** |
| | | *Al-Somakiat* | | | | | | | -0.566** | -0.162 |
| 8 | Average fruit weight | *Jellein* | | | | | | | | 0.686** |
| | | *Al-Somakiat* | | | | | | | | 0.796** |
| 9 | Fruit yield per plant | *Jellein* | | | | | | | | 1.000 |
| | | *Al-Somakiat* | | | | | | | | 1.000 |

*, ** Significant at the 0.05 and 0.01 probability levels, respectively.

**4. Discussion:**

The highly significant differences observed among the genotypes evaluated indicates existence of good deal of variability with respect of the nine characteristics assessed and offers ample chances for the genetic improvement of the tomato germplasm. Similar diversity among tomato genotypes was reported by Dar and Sharma (2011), Saeed et al. (2007).

Because of high genotype-environment interactions, estimates of genetic parameters i.e., GCV, PCV, $h^2$ and GA (%) using combined analysis of variance for most of the characteristics were generally lower than the values computed based on the results of the variance analyses made separately for each of the two test locations. Significant genotype-environment interaction was observed by Mulge and Aravindakumar (2003) for plant height and number of primary branches per plant and by Kalloo et al. (1998) for average fruit weight and fruit yield per plant.

Although, range can provide a preliminary idea about the variability, coefficient of variation is more reliable as it the independent unit of measurement. Also, absolute variation values of different characteristics do not reveal, which of them showing the high variability which could be assessed through standardizing the genotypic and phenotypic variance estimates by obtaining the coefficients of variation. A comparison of GCV and PCV in the present germplasm computed using individual and combined analysis of variance for nine characteristics indicated that the estimates of PCV were generally higher than the corresponding estimates of GCV for all the characteristics. This may be due to involvement of environmental effects and genotype-environment interaction in the expression of characteristic. The high estimates of GCV and PCV for number of fruits per plant, number of fruits per cluster, average fruit weight and fruit yield per plant can be attributed to the predominance of repulsion phase of linkage for these characteristics. Our results confirmed earlier findings of Prema et al. (2011), Ghosh et al. (2010), Pradeepkumar et al., (2001).

The high estimates of GCV, $h^2$ and GA(%) were observed for number of fruits per plant, number of fruits per cluster, average fruit weight and fruit yield per plant regardless of the location which suggests the predominance of additive gene effects and selection would be useful for the improvement of these characteristics. Similar results have also been reported by Dar and Sharma (2011), Saeed et al. (2007), Mohanty (2003).

Significant and positive association observed between average fruit weight and fruit yield per plant indicated a strong genotypic relationship between them and fruit yield can be increased by simple selection for this characteristic. In addition to, negative and significant correlation was observed between number of fruits per plant and average fruit weight at both locations indicates apparently impossibility to improve number of fruits per plant and average fruit weight simultaneously to ameliorate the fruit yield of tomato and suggests that selection should be practiced for plants owning more number of fruits with optimal weight. These findings were in conformity with the results of Singh et al. (2004), Mohanty (2002).

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8/10/2012

# Challenges of Property Rating in Shah Alam-Malaysia

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**Abstract:** The Malaysians' Local Government Act 171 of 1976 was primarily enacted to be a guiding legislation for the operations and practices of Local Authorities for the discharge of their official responsibilities to the public under the supervision of State Government for the purpose of achieving uniformity and equality as was contained in article D of the preambles to the Act. Contrary to this policy objective, the researcher observed inadequacies that negates the attainment of primary objective of the Act. The study is designed on a case study approach to cover the rating system operation in Majlis Bandaraya Shah Alam with a surface comparison with other local authorities within peninsular Malaysia to buttress the identifiable challenges in the policy capable of negating its success. The study also covers objection/ appeal cases determination. The Researcher was the instrument of research used in conducting Interviews with valuation officers of the local authority, Document analysis, field notes and observation were used to collect data and analysed using descriptive analysis. The study revealed lack of adequate skilled and technical manpower in the department in addition to non utilization of modern technologies in the administration of property rates due to the non listening ears of the local authority administration as advanced by the valuation officers to provide the requisite technology support. The research has synthesize International best practices using decided case laws and provisions to buttress discussions in order to enhance the policy frame work for rating assessment system in peninsular Malaysia on the property classification, progression on taxation pattern and others.
[Sani Habibu Muhammad, Mohd Bakri Ibn Ishak. **Challenges of Property Rating in Shah Alam-Malaysia.** *Academ Arena* 2012;4(10):6-15] (ISSN 1553-992X). http://www.sciencepub.net/academia. 2

**Keywords:** property assessment, Technology, policy, Administration

## 1.0 Introduction

The philosophy of property rates collection is an old and ancient practice in peninsular Malaysia even though in an informal manner dates back to the 1786 during the Malacca Empire when the whole of peninsular Malaysia was considered as a single political unit ruled by Malay Sultans or by the other Malay Royal rulers drawn from the long established dynasties on a three Level of Governance with the largest political unit been the present NEGERI State headed by a Sultan. Property rating in Malaysia is constitutionally authorized by section 74 (2-4) of Malaysian constitution as revised up to 2006 whose origin is traced back to 1801 when a voluntary committee of assessors was set up at Penang who functioned more as a local Government on the areas of planning, implementing urban development on the island, preserving law and order, as well as raising revenue through property rates, until 1827 when the Government recognized the committee by way of regulation such as the Municipal Rates Act and the Indian Legislation Act which was only applied to Penang, Malacca, and Singapore in 1848. Subsequently, the local authority Act 171 of 1976 was enacted to operate throughout the territory of peninsular Malaysia(Habibu & Bakri, 2012).

Property rates accounts for the greater proportion of revenue generated by Majlis Bandaraya Shah - alam. These revenue generated in addition to other sources are channelled towards the provision of such public facilities and services as the waste collection and Management, landscaping, recreational parks and facilities, public health and fumigation as well as the emoluments of the employees overseeing the operations of units and departments under the Majlis. The levy and operations of property rates in shah alam is closely guided by the content of the Local Authority Act 171 of 1976 which empowered all local authorities within peninsular Malaysia to levy property rates on such holdings or ownership of landed property within the rating area of the local authority as contained in section 127 of the local authority Act of 1976 (Pawi, et al 2011). (Table 1)

Table 1. Total Assessed Revenue

| S/NO | Year | Total Assessed Revenue (RM) |
|---|---|---|
| 1 | 2006 | 140,274,893.82 |
| 2 | 2007 | 145,387,400.42 |
| 3 | 2008 | 144,439,821.30 |
| 4 | 2009 | 146,734,417.90 |
| 5 | 2010 | 156,564,856.65 |
| 6 | 2011 | 167,648,038.20 |

Source: Majlis Bandaraya Shah Alam

Figures shown above reveals the total revenue generated from the local authority's rateable holdings which accounts for between 65% - 75% of the revenue generated by the local authority for those years coated above. This is signifying the importance of the source requiring the requisite attention of the authorities in a form of investment on those issues as policy enhancement, manpower deployment and training as well as the acquisition of right and up to date technology capable of enhancing performance.

**2.0 Aim of the Study**

The aim of the study is to identify the inherent challenges occasioned by the rapid urban development experienced within rating area of Majlis Bandaraya Shah Alam as it affects property rating Administration. The study therefore covers areas of policy content and operational resources geared towards an efficient service delivery. The study is expected to synthesise findings with successful experiences elsewhere in the world especially in the united Kingdom.

**3.0 Research Methodology**

The research was conducted on the concept of case study basis in order to have an in depth knowledge and understanding of the situation to provide articulated analysis of findings. The researcher was the primary instrument of the research while interview and document analysis were the employed research tools( Merriam, 2009). Valuation officers of the rating authority otherwise called Shah Alam were interviewed to a point of saturation on the various aspect of their operations which was critically studied alongside other practices across the globe with a view to identifying current challenges in order to proffer articulated analysis and possible solution. Field observation both within and outside the local Authority office was conducted to validate some of the findings from interview while documents were analyzed to validate others, this aspect is emphasized by Strauss (1988). Therefore the principal method of data collection was interview and validated with other methods to aid objective data analysis and congruent findings capable of improving the system. Interviews conducted covered such area as the policy content, its inadequacies to smooth operations, method of property assessment, revenue generation from property rates, manpower adequacy and training, working technology and determination towards a better rating system

**4.0 Requirements of a Rating System**

A rating system is such an organised bounded legal entity structured on procedural framework of set of rules, policies, laws and guiding principles geared towards attainment of developmental objectives as identified by the rating authority or by national development objectives. It is therefore an integral component of nation building and development. A viable rating system should therefore be structured on the following guiding principles(Lichfield & Connellan, 1997).

1. An articulated policy framework with a proviso for regular review to address identified shortcomings as the real operations demands. This is necessary as policies are prepared to stand the test of time and thus should always reflect reality through constant performance monitoring using the input - output indicators

2. Engagement of reputable manpower both in number and in substance fully equipped with technical knowhow to address the ever growing operational challenges in the assessment of properties and the determination of complaints in form of objections by the rate payers. These manpower must maintain an acceptable level of professionalism and competence in the discharge of their official responsibilities to cut consequential cost of operations from objections/ litigations as well as barred debt recovery. Therefore standard performances and practices is inevitable in any productive rating system.(Lorenz & Lu, 2008)

3. Documented procedure: A system is formulated for not only the present generation but for the yet unborn generation to study, use and possibly make improvements to reflect contemporary requirements or the requirement of their time, thus the documented procedure serves as the starting point and a reference to the past which can shape the future. Absence of documented procedure results in repetition, loss of initial value records, dearth in property comparables and thus non reliable data and property rate charges leading to constant disagreement. These records could be greatly voluminous and difficult to handle thus the need for computerisation of these records for easy retrieval and fast application/analysis. However data cleansing and editing may be needed over time to accommodate changes in the physical properties or location improvement whether positive or negative to avoid under or over assessment leading to high or low rate charge(McCluskey, Almey, & Rohlickova, 1998).

4. Effective communication and public Enlightenment. The public are the expected beneficiary and financier of the system by payment of their rates which accounts for the funds utilized in the provision and maintenance of services and facilities

which are used and enjoyed by the public. Thus either of the ways , the public or rate payers are the major stake holders in the operations and success of any rating system thus the need to ensure effective communication between the rating authority and the rate payers to get acquainted for he who is involve is better committed to the attainment of a course as against who is not involved.

5. Rate payers fee back/ check and balances. A perfect rating system should be structured in such a manner that public satisfaction and outcry can be obtained with a view to enhancing the operations so that either of the parties would have no reason to feel short changed. The mechanism should therefore maintain an equilibrium position that rate payers could visibly identify and appreciate benefits accrued from rate payment, this does not necessarily mean generally acceptable by the public but fairly appreciated with adequate justifiable benefits beyond flimsy contention by non obedient members or payers.

Attainment of such enormous responsibility by the local authority council is apparently difficult without the deployment and proper utilization of requisite resources in a coordinated manner with lots of coherency and advancements as reality dictates. This will no doubt produce the desired result at the appropriate gestation time. These resources identified as inevitable operational members complementing the strength of one another are thus identified in the schematic diagram

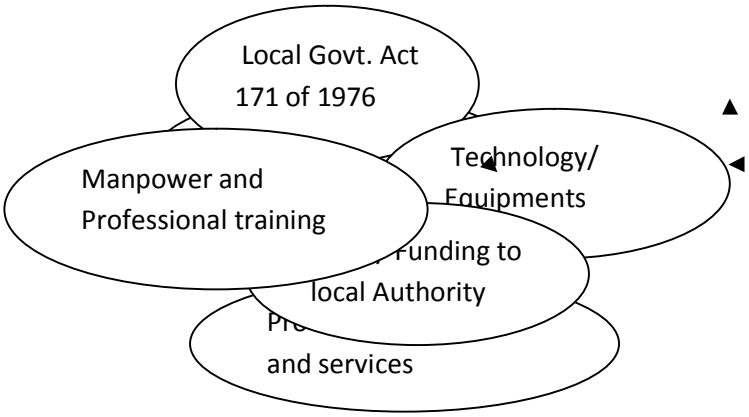


Figure i: Showing a typical requirement of a rating System

A tax system is expectedly dynamic as its operations dictates and therefore not static thus the need for flexibility to accommodate changes capable of enhancing its operations and output which can be translated to a societal wellbeing and overall improvement in environmental quality, public health and adequate resources for local authority to meet up with her primary obligations as enshrined in the local authority Act 171 of 1976.

**5.0 Game Theory**

This theory postulate the puzzles between players in a scene geared towards making a decision, each of the players is inclined on the best bargain possible to maximize his gain and success out of the negotiation, thus every party would strive harder to win a popular argument that will be succeeded by a decision binding on all the parties. The theory is an established legal decision making tool on administration and management especially where negotiations are paramount and verdict of decisions could be challenged. It is widely applied especially on complex matters relating to a legal person and organizational matter requiring a lot of diplomacy (Armstrong, 2002). Each of the parties concerned usually weigh and appraise chances or positions visa--vie the other party to identify areas of match and conflicts with a view to scheming out best result out of the negotiations.

Critical thinking complimented with due diligence and considerations of major discerning factors in making decisions on rates payable by property owners is paramount. This does not necessarily means compromising the objective of the policy and taxation principles as well. This is because property taxation system is established on certain goals and objectives that may not be generally accepted but the Government has the legal machinery to ensure compliance if it is convinced of the public benefits regardless of individual reservations (Plimmer et al 2008). Taxing authority being a coordinating and service providing agency from the rates collected would like to render best and adequate services to the public which is only achievable with adequacy of resources especially finances. While the public or rate payers would like to enjoy the best services possible at minimal charges or price and thus have more/surplus net income that would have been saved from objecting assessed rates if successful. This is evident in the persistent committed aggression/clamoring for downward bid from the assessed rates through the advancements of all sort of complaints portraying reasons why it should be lower than what was presented. Either of the parties would adopt best strategy at his or her disposal using the available information and avenues as a support to his position.

Other strategies used by the rate payers as a game is false declaration of income especially for such property owners whose mode of assessment is based on income generation as declared and

supported by the evidences, while the authorities in their bid to win the game may object the declaration and adopt another mode of assessment however incongruent it may appear. Ill feelings between either of the parties lead to raising objections and eventual hearing and negotiations in a court like manner forum administered by the objection appeal committee of the council. Where no consensus emerged, the most aggrieved party proceed to court which as well involves the game theory like philosophy. Success by any of the parties after these rigorous processes pronounce the party as the winner of the game with consequential effect of saving money from rates payment if won by the rate payer and increased revenue in the case of rating authority(Goodspeed & Witte, 1999).

Game theory principle in this circumstance portrays competition and cooperation. It is a competition because either of the parties is struggling to maximizing income while the rating authority is struggling to maximum income for provision of public service to the benefit of all citizens including those evading or avoiding rates payment. The rate payers are competing with the tax authority to secure more saving and thus increase income for personal use. It is however more beneficial where both parties commonly agreed to the charges and payment for the common benefit of all through the provisions of basic services to the public from rates paid by the property owners.

**6.0 Methods of property Assessment**

**6.1 Rental Comparison method of valuation**

The method is not considered most appropriate where there are no adequate suitable and reliable market rental evidence, yet the method is the most popular method of valuation that is widely applied in rating assessment valuation especially on those properties whose comparables in usage are let though not necessarily exactly the same in structures, condition or sometimes even location(French, 2004).

Notwithstanding the popularity of the method, It is easier applied when there are enough data on recent rental values of similar or comparable properties within the same or closely similar neighbourhood (Almy, 2002). Such rental values are usually adjusted to cater for the differences between the comparable and subject property mostly at a lump sum figure and thus dependant on the Educational training of the assessor, Experience, objectivity and comprehensiveness of the available data on both properties cutting across parameters as; Physical condition of the properties, age and structural layout of the property, location advantage/weakness, Internal planning, amenity and value of the premises, property size and accommodation details/characteristics, internal finishing and facilities, functional efficiency and essential services as well as the date of fixing the existing rent(Zealand 2002;Houses & Accommodation, 2011) .

The need for taking into accounts the aforementioned parameters while making comparative analysis makes it necessary to reduce both comparables and subject premises into a common standard that is universally adopted called the superficial or floor area usually in square meter and thus determine the rate on each square meter from the comparable properties before it is the applied on the area of the subject property after making the necessary adjustments(Yau 2009). There are cases where unit of accommodation are used rather than the superficial floor area such as the case of profit oriented or private hospital or cinema and theatre halls where there are such requisite evidences, otherwise the Depreciated replacement cost method is best used as will be seen later. Other special premises such mining and mineral exploration/extraction sites exist which usually operate on licenses grants, these kind of properties are better assessed on their turnover of how many barrel/tonnes sold annually(Standards 2010).

**6.2 Profit/Account method**

Originated from the Ricardo Theory of rent which states that profit is a long determinant of rental value of Agricultural land. But in rating valuation however, it is assumed that the rental bid of a hypothetical tenant is related to the profit earning capacity of the hereditament owned by the hypothetical land lord, thus based on the income and expenditure of a business operated in a property (Jarvis, 2001). It involves the determination of gross receipt from all the sections of the business and then deduct the operational expenses to arrive at the gross profit/divisible balance from which a proportion is taken to represent the rateable value. Where the business operator did not make any profit it does not mean that the rating authority should automatically accept no rateable value for a simple fact that there are other business operators who are well willing to take over the premises for a certain rent payment which the economist termed as the opportunity cost of using the premises (Goodspeed & Witte 1999). The Guideline of the professional institutions and Rating valuation forum 1997 of the united kingdom clearly made a position that the method can only be applied where there is no direct or reliable market rental evidence on the property but the method is most appropriate where there is location or legal monopoly while the presence of income and

expenditure are paramount considerations as well(P. K. Brown, 2008), this position is buttressed in the case of ***Port of London Authority v. Orsett Union* 1920,** Lord Dunedin ruled that,

"What will the hypothetical tenant give for the subject? If the subject is an ordinary one, similar in character to other subjects which have stood the test of the markets, the inquiry is simple. But when the nature and circumstances of the hereditament in question do not admit such a test, some other way must be found. Now there are several ways of attacking the problem. One way is to consider what profit the hypothetical tenant could make out of the hereditament, not in order to rate that profit, but in order to find out what he was likely to give in order to have the opportunity of making that profit. Another way is to see what it would cost an owner to produce the hereditament in its present form and then to see what a tenant who had not himself the money to be an owner, would give the owner yearly, it being assumed that that sum must bear some relation at ordinary rates of interest to what has been spent. No question of law is necessarily involved in either of these methods"(Sayce & Connellan 2003).

The method suffer a challenge of accessing proper books of account as business operators find it pretty hard to disclose their true and undistorted accounts although the valuer could make estimate of reasonable income and expenditure to manage such an enterprise by a hypothetical and efficient tenant with a view to arriving at a hypothetical rent payable on the property and thus be used as estimated rateable value. It is most preferable how ever to use comparative analysis where exist evidences of rent on similar kind of property. Although the method is mostly applied on properties developed for business operation with primary aim of making profit yet it was originally and in fact recently applied to public utilities and leisure properties that are not specifically meant to make profit as in the case of ***Kingston Union AC v Metropolitan Water Board [1926]*** as well as the cases of ***Hoare v National Trust [1998]*** and ***National Trust v Spratling [1997]***. Certain public leisure or recreational properties are operated with primary objective of making those services available to the less privilege or low income earners even though managed by private enterprises, such properties could be granted some subsidy and differential pricing even when there exist comparable rental evidences(Lichfield & Connellan 1997).

Successful application of the method will no doubt require the availability of the preceding year accounts of the business operated in the premises excluding any income from the investment of accrued profit if any appears, then make the necessary adjustments in stock and purchases to arrive at gross profit.

The total working expenses in the course of operating the business ignoring expenses related to repair on the property except for those liable by the tenant as well as insurance to the building and other extraneous expenses which are not related to the operation of the business are then deducted from the gross profit to produce Divisible balance.

There should be a consideration for tenant share which should consist an interest on the capital invested to run the business, his remuneration for managing the business and a profit for running the business venture. All those added together are assessed at a percentage of the Gross profit or Gross receipt which is deducted from the divisible balance to produce the Residue(Plimmer et al 2002).

The Residue is what consist of the Rent to the landlord as well as the rate to the rating authority, usually the rates are determined from the residue which is considered as the assessed value of that property.

### 6.3 Depreciated Replacement/Contractors approach

This is another established method of valuation whose application is preferred on such properties that are relatively difficult to value on comparative method of valuation due to the absence of comparable transaction because they are hardly or never let and thus the validity of its application as alternative to assessing the worth of the property( Brown & Bond 2011). The depreciated replacement cost method is based on the theory that a tenant will not pay rent in excess of the annual equivalent it will cost him to build his own replica of property that satisfy his functional and occupational demand derivable from the subject property. Its operation is based on determining the cost of reproducing an exact replica or similar of the subject property in terms of physical, functional and economic satisfaction using a prevailing construction cost and depreciating it to reflect the structural disposition of the subject property at a rate of depreciation considered appropriate to the characteristics and condition of the property in question(Olusegun 2002).

Needful to appreciate is that situation may arise where you have multiple complementary structure or buildings within the same property but of different constructional standards, designs and finishing necessitating an apparent variation in the cost of construction to be adopted in order to arrive at their replacement cost, in such situation the assessor must use high level of experience and discipline due to the

complexity and difficulty to assign the appropriate rate of construction cost per square meter on each of the complementary components to under or over valuation(Emeny & Wilks 1984). An illustration is a situation for example a water corporation with multiple storey structure office complex at the frontage, water treatment bays at another part, power house, clinic, security post, restaurant and the rest, this will no doubt require different rates of construction cost for the different components due to their difference in construction standards and material consumption (Wyatt 2009).

Thereafter a value of the land is added which is usually determined through the method of comparative analysis of recent market transactions on land preferably within same vicinity and having similar characteristics. Scholars have opined that no property or land parcels are the same they must differ at least by their situates and nature either on the surface or beneath thus the need to make adjustment on all comparable parcels considered during the analysis (Bird 2006).

It is worthy of note here that the method is only applicable in the absence of direct market rental evidence and or profit/account evidence and where there is an element of monopoly on its occupation having the potential or hypothetical tenant the only possible occupier as is the case in public properties and private operational properties that seldom change hands such as the oil refineries, power stations and mining co operations to mention a few( Bird & Slack 2002).

All hereditament falling within the afore mentioned circumstance are better assessed using the method in order to determine the capital value of the property from which a proportion or percentage is adopted as rateable value. The basic challenge in the application of this method is the absence of a criteria for determining the percentage of the capital value that could be adopted as a rateable value. In ***Cardiff City Council v. Williams (VO) [1973] 18 RRC 1,*** Lord Denning, citing the Solicitor General in ***Dawkins (VO) v. Royal Leamington Spa Corporation and Warwickshire County Council [1961]*)**, described the following passage as the 'classic explanation' of the Contractor's Basis:

"As I understand it, the argument is that the hypothetical tenant has an alternative to leasing the hereditament and paying rent for it; he can build a precisely similar building himself. He could borrow the money, on which he would have to pay interest; or use his own capital on which he would have to forgo interest to put up a similar building for his owner-occupation rather than rent it, and he will do that rather than pay what he would regard as an excessive rent - that is, a rent which is greater than the interest he forgoes by using his own capital to build the building himself. The argument is that he will therefore be unwilling to pay more as an annual rent for a hereditament than it would cost him in the way of annual interest on the capital sum necessary to build a similar hereditament. On the other hand, if the annual rent demanded is fixed marginally below what it would cost him in the way of annual interest on the capital sum necessary to build a similar hereditament, it will be in his interest to rent the hereditament rather than build it"(connellan & Sayce 1995).

Application of the contractors method of valuation in determining annual value or rateable value of a property is further solidified in the case of ***East Sussex*** where the appellants challenged the approach adopted by the valuation office based on submissions from their advisor who applied the shortened profit approach where a 7% of the Gross receipt was adopted to represent the rateable value and further argued that at best could be to use a comparable rental value of similar occupation. The tribunal rejected the adoption of comparable value for the ground of insufficient comparable alternatives and favoured the contractors approach on the premise that; (a) It is a clear method for rating assessment valuation with clear intellectual justification. (b) That it is established for quite a long time and is widely understood by rating and valuation officers. (C) It is equally used by a greater proportion of local authorities especially on properties that has no sufficient rental evidences and for which receipts and expenditure valuations could not be applied. Such properties include among others; Schools, sewage works, museums, public halls, fire stations, public conveniences, cemeteries, art galleries, and bus stations/train stations (Lorenz & Lu, 2008).

Application of the method is sometimes explicitly stated in the statutes to be the basis of valuation for properties whose comparable transaction are hardly available as is the case in section 126(1) of the Rivers state local Government Edict No.13 of 1980 of Nigeria which states that "assessment in respect of a property occupied by a public utility corporation, other than tenements used as dwellings should be assessed on depreciated replacement cost method which should be reduced to annual equivalent" (Olusegun 2002).

It is worthy of emphasis that where a contractors method is used, caution must be exerted to include the necessary components as land values, cost of external works ( landscaping, fence work, swimming pool, play ground, pavements, road, passages and others), rateable plants and machinery(Plimmer et al. 2002). Contractors method of valuation for rating

purposes is not without challenges, some of which includes.

(a) Determination of the rate of construction/$m^2$: Determining the current cost of constructing new exact replica of the subject property as a desirable substitute is compulsory and challenging, because there may be quite high number of such properties with different construction standards and finishing such that what is applied in property X may not be applicable to another property without necessary adjustment and thus making some assessors to either abandoned the method or apply the rates arbitrarily. Equally important to note is that most assessors do not have the requisite knowledge to determine the prevailing rate of construction cost per square meter and thus resorting to guess work which is detrimental to the exercise and in such situation it is needful of the assessor to liaise with quantity surveyor to acquire the requisite prevailing cost of construction to apply to the subject property. Therefore construction cost must be a product of comprehensive research and analysis of building components, materials, labour, professional fee and interest on capital to avoid ill based figures that will translate itself throughout the valuation(Kong, 2011).

(b). Allowance for depreciation: Having determine the cost of constructing new replica of the subject property that is not new, it becomes necessary for the assessor to depreciate it to a certain percentage to reflect its current status and depreciated replacement cost value caused by either physical deterioration, functional inefficiency, reduced economic opportunities and aesthetics due to intensity of use, age, construction standards, maintenance practices, estimated life span of the property and the rest. It is therefore wrong for assessors or authority to pre determine rate of depreciation without recourse to peculiar differences in properties measured on the weight of the aforementioned factors (Connellan & Sayce 1995).

## 7.0 Findings and Discussions

### 7.1 Policy issues

The policy has a clear and unambiguous objective that should unite the operations of property rating administration throughout peninsular Malaysia except for some shortcomings that have caused diversity in the operations of property rating. They include areas of classification of landed property rateable even though there exist some description of the various uses rateable within the rating areas, such as the classification of residential properties as found in the study area to just one with single percentage rate charged on all residential properties. The argument here is that, there exist for example a block of three storey accommodating about eighteen numbers of three bedroom apartments on a total floor area of 848$m^2$ generating a total amount of RM4,032 while another residential property of three bedroom terrace house on a total floor area of 216$m^2$ is paying RM480 per year despite that the terrace house enjoys visible advantage of single occupation, more circulation area, better aesthetics and classified as medium income dwelling yet paying lower than what the block of flat is generating. This is because the tax system is not progressive thus leaving more income in the hands of high income earners than the low income earners. Therefore the policy should make a categorical classifications of properties with graduated rate charges within a set banding of property values so that high income properties are charged higher percentage rate charge in order for the system to meet a basic quality of effective tax system.

There also exist some variations among the local authorities where sub-classification are made while others do not have such or even similar classification as permanent, semi permanent and temporary residential properties with varying percentage charge of property rates even though most or even all the local authorities have similar type of properties but were not sub-classified. This situation does not reflect the theory of income redistribution where high income earners pay higher tax.

### 7.2 Manpower/ Training

Property portfolio of landed properties within Shah Alam rating area have continuously grow over period from 142,336 holdings in year 2006, 157,695 in year 2007, 167,846 in year 2008, 170,620 in year 2009, 177,922 in year 2010 and 186,205 in the year 2011. This continued increased could logically be interpreted to mean an increased revenue generation yet without corresponding increase in the manpower both in quantity and in quality. There presently exist only four personnel qualified to ascribe value to 186,205 properties annually ignoring possible increase in say year 2012 and subsequent years, yet out of the four members of staff, only three are registered valuer. The situation is no doubt a reflection of exploitation which in the long run may lead in poor service delivery largely influenced by human fatigue. The consequential analysis reveals that every of the four officers qualified to value properties will have to contained with valuation of at least 46,551 properties annually in addition to other administrative responsibilities which are equally energy and time consuming. Other members of staff are lower cadre personnel with diplomas as the working population totalling about 39 technicians as supporting staffs to the valuation officers.

**7.3 Working Technology/ Facilities**

Contemporary assessment models have been developed even though are still not generally accepted due to some identified shortcomings, yet the utilization of automated system will greatly reduce the burden on few members of staff qualified to value properties so that their operations could be made much easier and more efficient as comprehensive data base are created thus retrieval and analysis on subsequent comparable properties could be much easier and faster with limited error if not totally avoided. Unfortunately, it was found that the operations of the authority is completely manual with report production been automated while analysis of data are completely manual with most of the information kept manually thereby increasing difficulty in retrieval, longer time and energy requirement which in the end results in low productivity.

**7.4 Public benefits/ check and balances**

The policy is the root of every aspect of the operation and the resultant effect thus the need for effective harmonization of the policy with operational realities. It is so necessary because the policy have empowered the local authority to levy property rates in order to provide certain services and facilities to the public or rate payers, yet the policy did not provided an avenue for the rate payers to air the views on the adequacy and efficiency in the provision of such services and facilities as well sanctions or punishments to the entrusted authorities where they fall short in the provision of such services and facilities but have succinctly provided for the punishment that could be mated on defaulters. There is therefore the need for check and balances with adequate participation from the rate paying public so that they are adequately involved and well informed. This will to some extent makes operation easier to the local authority especially on collection and increase in rates liability occasioned by revaluation.

**7.5 Objection Hearing**

Objection is a recognized right of the rate paying public by the Act 171of 1976 to formally lay a written objection/protest on their grievances on the assessed value of their property. The objection hearing is conducted twice a year thus objecting parties are kept in suspense because policy do not explicitly states how many times objections should heard or even the maximum number of hearings in any assessment year thus local authorities does differently with others quarterly, some half yearly, monthly and others with no specifics but are treated as they come. Therefore the efficiency with which objections are treated differs greatly.

**7.6 Common reasons for Objection by Rate payers in Shah Alam**

The Act 171 of 1976 only recognize such reasons as stated in sections 134(a, b, c, d), sections 135 & 162 which centers on properties for religious worship, licensed burial ground, public school, places of charity and others so discretionary exempted by the state Government not the local authority. Section 162 exempts those properties assessed vacant as at the date of assessment provided there is enough evidence that the vacancy was not as a result of poor state of the property or exorbitant rant charge.

Unfortunately, bulk of the reasons advanced by rate payers borders on poor or absence of service delivery which is the basis of rate levy. Those reasons advanced by the objecting parties included;

1. Lack of systematic waste collection.
2. Absence of Motor able road thus have pass through neighboring residential area.
3. None maintenance of children's play ground.
4. Excessive maintenance bill by the developer which was negotiated by the Government on behalf of all.
5. The same rate charge on properties on upper floors with ground floor despite the absence of escalator.
6. Higher rate charge compared to other similar properties.
7. The assessed rental value is higher than the actual rent generated from the property
8. The land is empty, not yet developed and produce no income.

**7.7 Procedure in Objection Hearing**

The holder of the assessed property who is aggrieved must file a written objection to the local authority stating the property address, the assessed value and the grounds for objections as well as his prayers from the objection. The objection must be accompanied with an evidence of payment at least 50% of the assessed value before it is even accepted at the local authority office. Thereafter, the local authority will look at the objection to see whether it falls within the category of the allowed reasons for objections before it is considered for analysis. The content is analyzed and invitation letter is sent to the appellant to appear before the objection hearing time at a certain date, time and venue which is usually in the local authority office.

At the appointed time for the hearing, the committee members which usually consist of counsellors from the local authority, the legal advice

of the local authority, valuation officers, finance officers, service officers from relevant departments proceed to the hearing room and the hearing commences under the chairmanship of a counsellor of the local authority.

The objecting parties are ushered into the hearing room on individual case basis in a chronological order of appearance on the schedule. The appellants name and address are read out to confirm their identity and authenticity before a power point imagery of the subject property and neighbourhood is displayed for onward explanation to the appellant stating the basis and showing the location of comparable properties used to measure the value of his or her property.

Thereafter the appellant is granted the floor to present his case, he is heard thoroughly without any interruption or intimidation before he or she is discharged. The committee immediately discuss on the merit of the case and decide whether or not is granted part or whole of the appellant prayer for onward ratification by the management board of the local authority usually chaired by the president. Such Management ratification are usually done within a period of one month depending on how fast the meeting was convene and the decisions are immediately communicated to the appellant.

**8. Conclusion**

Property rating as a system is the operational back bone of the local authority which no doubt require careful and substantial investment on the areas of policy enhancement to comprehensively cover grey areas that hinders the smooth operations and viable productivity. The policy as an item can entirely bring the desired the result if not complemented by adequate manpower improvement both in quantity and in quality to be able handle the rapid increase in the property portfolio within the rating area of the local authority. However, the ability of the injected manpower into the system to achieve the target mission is largely dependent on the working environment in terms of technology, equipment, automated data bank and networking. Whereas the rate paying public need to be carried along through public enlightment and consumers feedback mechanism.

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10/10/2012

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(*Academ Arena*)
ISSN 1553-992X

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Volume 4, Number 10 (Cumulative No.40) October 25, 2012 ISSN:1553-992X

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Cover design: MA,Hongbao
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