EVALUATION OF ELEMENTARY SCHOOL LAWN GROUNDS IN OSAKA URBAN REGIONS

Noriko Umemiya[1]; Akemi Nakanaga[1] ; Yuta Sakurai[1],; Ryota Matsui[1];
Toshiki Naotsuka[1] ; Takayuki Harada[1] ; Ryoji Okura[1]

[1] Osaka City University
3-3-138, Sugimoto,Sumiyoshi-ku, Osaka city, Japan, 558-8585, +81-6-6605-2710,
umemiya@arch.eng.osaka-cu.ac.jp

INTRODUCTION

Osaka city is known as the city with the lowest share of park area among major cities of Japan. More green areas are needed, but producing them is expected to be difficult because urban areas are too crowded to accommodate new parks. Under these circumstances, school grounds have lately attracted considerable attention for use as green areas [1]. Several government grants for schools have been awarded to launch lawn planting for school grounds with anticipation of beneficial effects on child education, local community formation, biological environment, and thermal conditions. Nevertheless, lawns on school grounds are not increasing in fact. This study assessed Osaka city elementary school lawn grounds in terms of their sunshine duration and sky factors using questionnaire surveys administered to physical plant managers.

METHODS

Questionnaire sheets were sent to all 297 elementary schools in Osaka city during September–October, 2009. We asked school maintenance managers to answer several questions.

Investigation items were the following: 1) basic school attributes such as location, area, school buildings, numbers of pupils and classrooms; 2) conditions of the grounds, e.g. status and evaluation of lawn planting of the school grounds; 3) subjective evaluation of the schools, e.g. pupils, local community, environmental conditions of the classrooms and the school; and 4) attitudes about lawn grounds, e.g. for or against, problems, and expectations [2][3].

We took photographs of the school grounds' centers and the corners using a camera with a fish eye orthographic projection lends. The camera was directed to the sky 1.5 m high from the grounds. Photographs of the corner points were taken from 1.0 m inside the corner points of the grounds. Sky factors and sunshine duration for the summer and winter solstice, the vernal and autumnal equinox at the pictured points were estimated from pictures obtained using calculation charts [4].

Of the schools which answered the questionnaires, 24 were 'not-planned' schools (NP), 2

were ‘planned’ schools (P) and 8 were ‘completed’ schools (C) gave permission to take pictures.

RESULTS OF QUESTIONNAIRE SURVEY

Of 297 elementary schools in Osaka city, 100 responses were received. Assistant Principals usually serve as school maintenance managers. Of the schools, 11 had completed lawn planting, 8 schools had planned and examined lawn planting, and 80 schools had not planned for lawn planting on school grounds. Those in favor of planting lawns were 13% of ‘planned’ (P) and 12% of ‘not-planned’ schools (NP). In contrast, those against planting were 13% of ‘planned’ (P) and 28% of ‘not-planned’ (NP).

Table 1 presents means and standard deviations of the sizes of the surveyed schools. School areas for ‘completed’ schools (C) were largest. Ground areas were largest for P. Numbers of pupils and classrooms were smallest for C. C therefore had larger grounds and fewer pupils.

Subjective evaluation of the pupils on five-point-scales such as a lack of outdoor exercise, emotional disturbances, indifference toward life and nature, lack of communication ability and weak constitution did not differ among data for C, P, and NP. In subjective evaluation of the classroom environment, NP were evaluated as less calm than C ($p=0.10$) and P ($p=0.06$) according to t-test results. Other evaluation items of classrooms such as crowded, spacious, bustling, wide, prone to echoes, well lighted, and well air conditioned did not differ among schools.

Figure 1 presents subjective evaluations of school environments. Interchange between parents and teachers was evaluated as less active for NP than for either C ($p=0.13$) or P ($p=0.15$). Exchanges between schools and their respective local communities were evaluated as less active for NP than for either C ($p=0.07$) or P ($p=0.05$) . These results show that PTA activity and connection with neighbor communities are important factors to launch lawn planting on school grounds.

Figure 2 portrays the degree of obstructing launch and maintenance of lawn planting in terms of finance and time. NP feel a heavier burden both in finances and time, both in launching and maintaining than P ($p<0.01$). The NP and P feel heavier financial burdens in maintenance than C ($p=0.05$ and 0.08 respectively). It can be said that NP might find lawn planting easier when they plan it in actuality. The C report less of a financial burden in maintenance. However, they report a burden in time for maintenance that is as heavy as P and NP expect.

Figure 3 presents data related to the merits and expectations of lawn planting. No difference was found among three groups in ‘increasing the will to exercise’, ‘improvement in communication ability’, ‘healing’, ‘stabilizing emotion’, ‘mitigation of allergy’, ‘increasing interest for life’, ‘enrichment in environmental education’, ‘lowering classroom temperature in summer’, ‘improvement in air contamination of classrooms’, and ‘decreasing accidents’.

Differences were found between P and C for all items. The NP and C differs in two items: ‘increasing outdoor exercise’ ($p=0.16$) and ‘activation of the local community’ ($p=0.09$).

P and NP differ significantly in eight items: ‘making pupils more positive’ ($p=0.09$), ‘lowering air

temperature of the grounds' ($p=0.03$), 'decreasing noise' ($p=0.02$), 'mitigating reflected sunshine' ($p<0.01$), 'decreasing sand dust' ($p=0.16$), 'increasing scholastic ability' ($p<0.01$), 'activation of local community' ($p=0.18$), and 'activation of local sports' ($p<0.01$).

P report expectations of 'lowering air temperature of the grounds' more intensely than NP do ($p=0.03$). However, C responded that lawn planting is not so effective in lowering air temperature of the ground as P had expected. The evaluation by C is the lowest among the three groups. Both C and P respondents reported feeling that lawn planting makes the local community more active than NP respondents felt ($p=0.09$ and 0.18 respectively).

RESULTS OF SKY FACTOR AND SUNSHINE DURATION MEASUREMENTS

Figure 4 shows the distribution of sky factors measured at the centers and corners of the grounds. Means and standard deviations are 69.1% and 9.9% for the centers and 51.5% and 14.5% for corners. Sky factors at the center of the grounds are less than 60% for six schools out of 36 schools. The minimum is 37.0%. Sky factors at corners are distributed more evenly than those at centers.

Figure 5 portrays the distribution of sunshine duration at the summer and winter solstice, the vernal and autumnal equinox. The sunshine duration of more than four hours per day is believed to be necessary to raise a lawn [5]: 35.3% at the center and 15.8% at the corner of the measured grounds satisfy those conditions on the winter solstice.

DISCUSSION

Subjective evaluations of sunshine duration were assessed on five-point-scales: 'much too sunny' and 'too sunny' were classified into the sunny group (SG), and 'not too sunny' and 'not at all sunny' were classified into the not-sunny group (NSG). Subjective evaluation of sunshine of classrooms in summer and winter is independent from the measured sky factors and sunshine duration of the ground for all seasons. However, sky factors differ between SG and NSG for grounds in summer ($p<0.01$). Sunshine duration at summer solstice (SS), equinox (E) and winter solstice (WS) also differ between SG and NSG for grounds in summer ($p<0.01$, $p=0.01$, and $p=0.04$ respectively). Sky factors differ between SG and NSG for grounds in spring and autumn ($p<0.01$). Sunshine duration at SS, E, and WS also differ between SG and NSG for grounds in spring and autumn ($p<0.01$, $p<0.01$, and $p=0.03$ respectively). Sky factors of SG and NSG differ for grounds in winter ($p<0.01$). Sunshine durations at SS, E, and WS also differ between SG and NSG for grounds in winter ($p<0.01$, $p<0.01$, and $p<0.01$ respectively). Sky factors are greater for SG in grounds. The sunshine duration is longer for SG in grounds for all seasons. It can be said that subjective evaluations reflect actual sky factors and the sunshine duration. Evaluation in winter sunshine is most critical.

Subjective evaluations of contentment with grounds were classified into a content group (CG) and a not-content group (NCG). Sky factors differ between CG and NCG ($p<0.01$). Sunshine durations at SS,

E, and WS also differ between CG and NCG ($p<0.01$, $p<0.01$, and $p=0.07$ respectively). Sky factors are greater for the CG; sunshine durations are longer for CG for all seasons. Sunshine conditions are related to contentment of grounds.

Sky factors and sunshine duration were compared among ‘completed’ (C) and ‘not-completed’ schools (NC). The NC consists of P and NP. Sky factors are smaller for C than NC ($p=0.14$). Sunshine durations are shorter for C than NC at SS ($p=0.07$), E ($p=0.16$) and WS ($p=0.12$).

Sunshine is important for lawn growth. It is strongly related to contentment with the grounds, but results of this study reveal that sunshine is not always a critical condition to spur schools to undertake lawn planting. The burden of finance is not so great as NC expect, but the burden in time for maintenance is as great as expected by the NC, although ‘planned’ schools are the most anxious about the burden.

The burden of finances is not so great as respondents of NC expect. Lowering the burden of time in maintenance by activating an exchange between school and local community is important for promoting lawn planting. Active exchange is also the merit of lawn planting as well as increasing the outdoor exercise.

However, it is noteworthy that completed schools do not highly evaluate the effects of lowering ground temperature as planned schools expect. No group expects mitigation of the heat island problem that exists in Osaka. These are the feelings of school maintenance managers. Measuring actual thermal mitigation effects of lawn planting is necessary.

CONCLUSIONS

A survey related to school ground lawn planting was administered to elementary school maintenance managers in Osaka city. From all 297 elementary schools in Osaka city, 100 responses were received. Comparison of the answers of respondents from schools where lawn grounds had been ‘completed’, ‘planned’, and ‘not-planned’ revealed the following: 1) ‘completed’ schools have larger grounds and fewer children; 2) ‘not-planned’ schools have lower PTA and exchange activity levels between the school and the local community; 3) ‘planned’ schools are more anxious about efforts at maintaining a lawn; and 4) ‘not-completed’ schools expect lawn planting to mitigate the thermal environment in summer, but ‘completed’ schools do not regard those effects as important.

Sky factors and sunshine duration at the summer and winter solstice and the equinox were estimated for 36 schools. 5) Only 35.3% of the schools satisfy the condition of sunshine duration for raising a lawn. 6) Subjective evaluation of sunshine and contentment with school grounds strongly relate to sky factors and sunshine duration. 7) The sunshine duration is shorter and sky factors are less for ‘completed’ schools.

REFERENCES

1) Moriyama, M. 2004. Measures and technology against heat island problems, Gakugei Publishers.

2)Kurakazu, R. et al. 2006. The evaluation of classrooms in public schools from the view point of teachers, *Summaries of technical papers of annual meeting, Architectural Institute of Japan*, pp.1123-1124.

3) Munakata, J. et al. 2009. Studies on teachers' evaluation of school facilities, *Summaries of technical papers of annual meeting, Architectural Institute of Japan*, pp.125-128.

4) Architectural Institute of Japan 1977. Measurement and examination of sunshine, Pamphlet for design and planning, No 24, AIJ.

5) Snowseed Co., Ltd.: http://www.snowseed.co.jp/index/frame_kan_shiba_q&a.html

Table 1 School sizes

		Not-Planned n=81	Planned n=8	Completed n=11	TOTAL n=100
School area (m2)	Mean	7449	8494	9199	7687
	S.D.	3327	2458	5794	3581
Ground area (m2)	Mean	3502	4253	4058	3598
	S.D.	2163	3178	3434	2341
Number of pupils	Mean	393	419	373	393
	S.D.	188	238	201	192
Number of classes	Mean	14	13.8	11.8	13.8
	S.D.	5.3	6.2	5.5	5.4

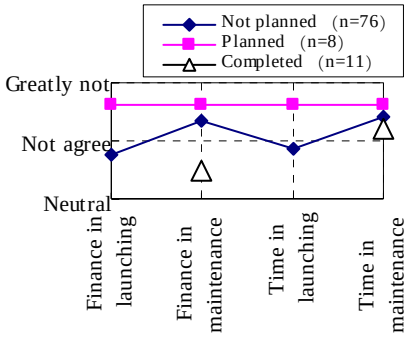


Fig.2 Burdens of lawn grounds

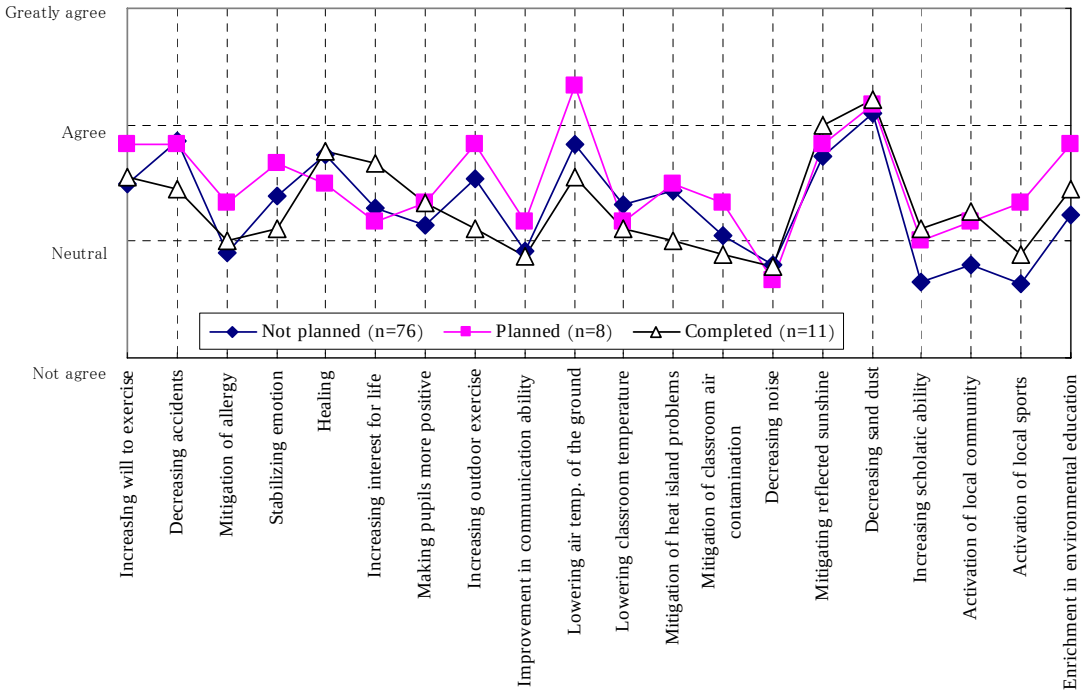


Fig.1 Subjective evaluation of school environments

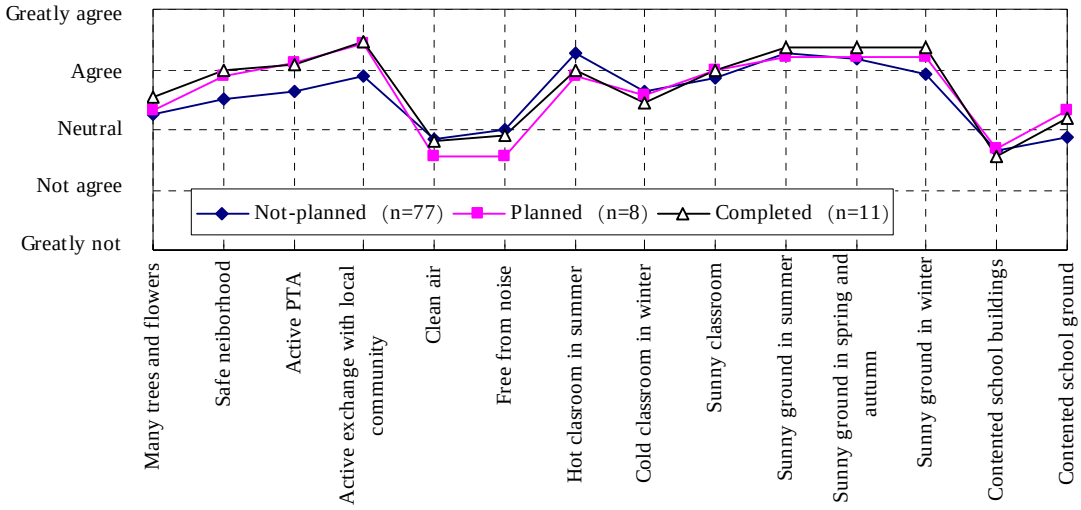
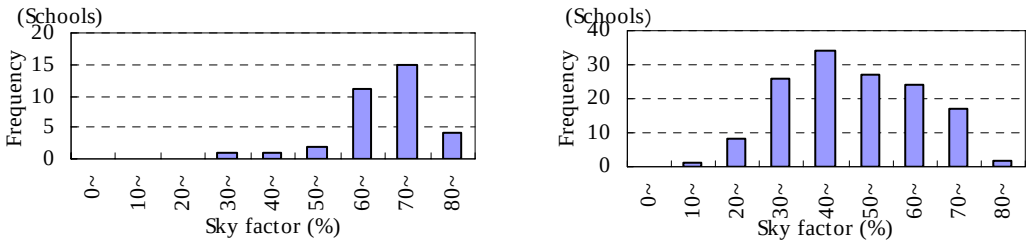
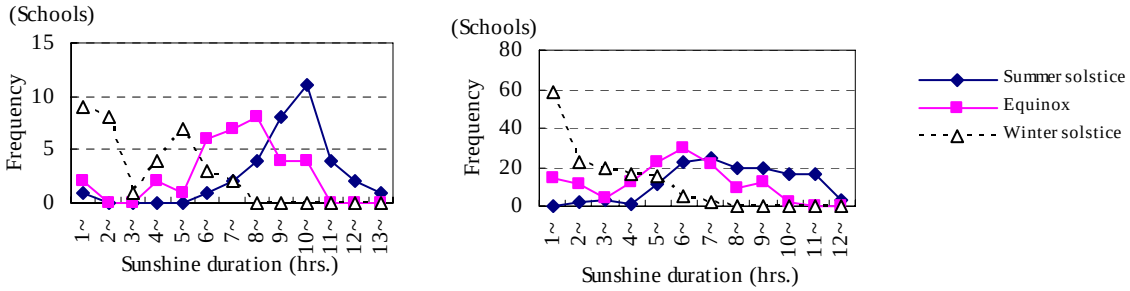


Fig.3 Merits of lawn planting



(a) Centers of the grounds (b) Corners of the grounds

Fig.4 Measured sky factor



(a) Centers of the grounds (b) Corners of the grounds

Fig.5 Estimated sunshine duration