Assessment of Socio–Economic Values of Agricultural Experience Services in School Garden Education

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Abstract

Background and objective: This study intends to assess the socio–economic monetary value of school garden education services by converting them into market values using assessment indicators for school gardens, which are spaces for students to engage in various experiences and urban agricultural activities.

Methods: We identified the characteristics and current status of urban school gardens through literature review, collected opinions from a total of two rounds of expert advice, determined willingness to pay (WTP) and the importance of detailed values based on the parent survey, estimated the monetary value of each detailed value using the contingent valuation method (CVM) of WTP, and estimated three economic values.

Results: The total amount of educational, health, welfare, and environmental values provided by school garden education for participating students was estimated to range from a minimum of 193.1 billion won to a maximum of 978.4 billion won. The total amount of economic value provided to farm households, related industries and the economically active population was estimated to be 476.1 billion won. The job creation effect was the highest at 266.2 billion won, followed by the industrial ripple effect (157.3 billion won) and the farm household income increase effect (52.6 billion won). The evolution of school gardens is expected to reduce problems in urban areas such as environmental issues, promote community spirit through agriculture, and produce industrial ripple effects such as an increase in farm household income and job creation, raising the need to maintain multiple functions of school gardens. The total socio–economic value of school garden education seemed to range from 669.2 billion won to 1.4545 trillion won based on the operating fund, government budget, and value–added tax (VAT) of 2020.

Conclusion: The results of this study can be used as basic data to assess the overall value of agricultural experience services in school garden education.

Keywords: contingent valuation method, assessment indicator, replacement cost method, urban agriculture, willingness to pay

Introduction

Our society is facing urban problems due to the rapid urbanization, such as environmental problems caused by the increasing population, destruction of the ecosystem such as decrease and severance of habitats, and lack of green spaces. In this situation, urban agriculture can be an alternative to solving urban problems and restoring the urban ecosystem. In particular, school gardens serve as a space for various experiences and urban farming activities among
students by forming small garden spaces for education in cities that lack green spaces (Jang, 2019). The Act on Development and Support of Urban Agriculture (Article 8) refers to urban agriculture by utilizing the land or building of a school for students’ learning and practice as “urban agriculture for school education.”

People with greater interest in growing plants at a school garden tend to show a stronger sense of responsibility and creativity, which was more effective in cultivating personality when applied to classes (Youn and Ryu, 2005), while also having a positive impact on children's self-esteem and achievement motivation (Woo et al., 2010; Park, 2005; Son and Lee, 2008). Studies on this topic were mostly conducted with regards to psychological effects such as increased environmental sensitivity of students or positive emotional change (Kim et al., 2007; Hazzard et al., 2011). School gardens, which include values such as protection and restoration of urban environment, leisure activities, ecological education, and community revitalization based on agriculture beyond cultivation, serve as a space to provide education that can recover biodiversity and change the perception and attitude toward preservation of biodiversity for growing future generations. However, although school gardens are emerging as a practical alternative to create educational and sociocultural values and promote revitalization of the community through agriculture in urban areas, there are insufficient systems and infrastructures to promote use of school gardens (Choi et al., 2018). There is almost no research on valuation indicators (Hong et al., 2020), and most studies on school gardens were about educational functions or emotional and psychological changes (RDA, 2014; Kwack and Park, 2017; Hong and Kim, 2017; Cotugna et al., 2012), while none comprehensively analyzed the multiple functions of schools with gardens that are used by students and teachers for educational activities such as education, health, welfare, economy, and environment (Hong et al., 2020). Accordingly, it is necessary to identify the characteristics of urban school gardens and assess socio-economic values of school gardens through assessment indicators.

Therefore, to categorize the values of school garden education for systematic management, this study validated the performance types and assessment principles (Office for Government Policy Coordination and The Korean Association for Policy Studies, 2015), through which it developed 5 value indicators such as educational value, health value, welfare value, economic value, and environmental value as well as detailed indicators for each value. We developed 5 indicators for educational value such as improving learning ability, cultivating character, promoting sociality, cultivating agricultural literacy, and promoting ecological sensitivity; 2 indicators for health value such as promoting physical health and promoting mental health; 3 indicators for welfare value such as enhancing landscape value, promoting cultural benefits, and social integration; 3 indicators for economic value such as increasing farm income, industrial ripple effect, and job creation; and 3 indicators for environmental value such as improving environmental quality, alleviating climate change, and promoting biodiversity. Ultimately, we proposed total 5 values and 16 detailed indicators (Hong et al., 2020, 2021a, 2021b), based on which we conducted a perception survey on parents. Most parents responded that they wanted their children to learn about agricultural issues in which social interest is recently increasing, such as climate crisis, agriculture, characteristics and importance of sustainable agriculture, and multiple functions and public values of agriculture. They also responded that school garden education provides students with experiences in gardening and crop cultivation, and that it is important in promoting understanding about agriculture in Korea. In light of this, the central and local governments are providing various policy support and systems to promote use of school gardens. In particular, the Ministry of Education and the Ministry of Agriculture, Food and Rural Affairs began to fund school garden projects in 10 schools aligned with the free school year system of middle school since 2018, which has annually increased up to 70 schools by 2021.

Therefore, this study will convert socio-economic monetary value of school garden education services1) to market value using assessment indicators of school gardens that are recently becoming an issue for future generations. This will raise the need for policies to promote use of school gardens based on their multiple functions and provide basic data for financial support.

1) School garden education services refer to education services providing various educational programs on nutrition, dietary life, and cultural events along with agricultural experiences using school gardens.
Research Methods

Research flow before the assessment of socio-economic values

To assess the socio-economic values of agricultural experience services in school garden education, this study obtained expert advice twice based on the assessment indicators proposed by Hong et al. (2021a) (Table 1).

The first advice was obtained from 4 experts in agricultural economics in July 2021 to review the adequacy of the questionnaire for parents, after which the parent survey was conducted. The second advice was obtained from 3 experts in valuation of agricultural economics, collecting opinions about the adequacy of the valuation methods, after which the socio-economic values of agricultural experience services in school garden education was ultimately assessed (Fig. 1).

Survey for assessment of school garden education values

This study conducted a survey on 600 parents of elementary and middle school students (300 with gardening experience, 300 without experience) in 4 areas of Korea from October 18 to 22, 2021 (5 days) to assess the value of school garden education. To obtain representativeness of samples, we selected the samples based on the population ratio of each region through a Korean research company M located in Seoul and conducted a non-face-to-face online survey considering the COVID-19 pandemic. There were total 8 items on demographic characteristics such as gender, age, occupation, final education, average monthly income, type of family, number of household members, and number of children. The survey was conducted in a self-report study in which respondents read the question and select a response by themselves, which in this case was their willingness to pay (WTP) for school garden education and importance of each detailed value (Table 2). We considered maximum WTP for three cases (parents paying the voluntary operating fund, the government using the budget for school garden education, and increasing the VAT rate used as the source of education taxes for school garden education), the importance of 4 detailed values such as educational, health, welfare, and environmental values, maximum WTP in each type, and average importance of each detailed value.

Methods of assessing socio-economic values of agricultural experience services for school garden education

To identify urban school garden characteristics, this study conducted a literature review on studies examining the school garden space and educational facilities by Rural Development Administration (2014), school garden activity programs based on the press releases by the Ministry of

Table 1. Selected professional panels

| Period | Field                          | Number | Career |
|-------|-------------------------------|--------|--------|
| 1     | Agricultural Economic         | 4      | 18 - 38|
| 2     | Agricultural Economic - Value Evaluation | 3  | 23 - 38|

Table 2. Organization of survey items

| Survey No. | Contents                              | No. of Items | Reference           |
|------------|---------------------------------------|--------------|---------------------|
| DQ1 - DQ8 | The respondent's demographic characteristics | 8            | Hong et al. (2021b) |
| V1 - V3   | Willingness to pay for school garden education | 3            | Lee (2017), Hong et al. (2021a) |
| V4 - V7   | Importance and satisfaction by detailed value | 4            | Jang et al. (2017), RDA (2014) |

Fig. 1. Research process.
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Agriculture, Food and Rural Affairs (2020), school garden education facilities and agricultural materials by Kim (2019), area and operating status of gardens in elementary/middle/high schools by Choi et al. (2018) and Heo et al. (2017), and school garden formation cost and operating cost by type provided by the Nongsaro portal (www.nongsaro.go.kr) (Heo et al., 2017). Through the literature review, we defined the standards of school gardens such as garden size, number of users, and number of managers; investigated the stakeholders of school garden education such as students, farms, upstream and downstream industries, and economically active population; estimated the monetary value of each detailed value with the contingent valuation method (CVM) considering the average importance of 4 detailed values based on data usage possibility; and used the replacement cost method (RCM) to estimate the economic values of the agricultural income increase effect, industrial ripple effect, and job creation effect through the increase in consumption of domestic agricultural products.

CVM is used in various fields of study such as environment, transport, sanitation, health, education, and natural and cultural resources in many countries of the world since it was first applied in 1989 to estimate the loss caused by the oil spill in the United States (Hanemann, 1994). The values of the detailed indicators are added to present the total monetary value of school garden education. The valuation methods for each detailed value are as follows.

### Student value

**Based on voluntary operating fund and government budget**

The i-th monetary value, which is the detailed value, was calculated by multiplying average monthly willingness to pay (WTP) per student by the annual funding period (month), the number of students, and the importance of each detailed value, and the equation is as follows (1). Conservative assessment criteria were applied, and the amount of the experience group with low WTP in the parent survey results was used for calculation.

\[
\text{Value}_i = \frac{\text{average monthly WTP per student (KRW / person)}}{\times \text{annual funding period (month)}} \times \frac{\text{number of students (person)}}{\times \text{importance}_i}
\]  

(1)

**Based on VAT rate**

The detailed value monetary value Value\text{e} was calculated by multiplying WTP tax rate per student by value added tax (VAT) amount and the importance of each detailed value. WTP of the experience group was applied for conservative valuation as did in WTP based on voluntary operating fund and government budget (2).

\[
\text{Value}_i = \text{WTP tax rate per student (%)} \times \frac{\text{VAT amount}}{\times \text{importance}_i}
\]  

(2)

**Economic value**

Farm agricultural income increase effect through the increase in consumption of domestic agricultural products

Agricultural income was calculated by multiplying vegetable and fruit production by vegetable and fruit consumption increase rate through school garden education and farm receipt rate in wholesale price (3). This was calculated based on vegetable and fruit production considering the health of elementary and middle school students, and since value of production calculated based on wholesale price, we applied the farm receipt rate in wholesale price.

\[
\text{Agricultural income} = \frac{(\text{vegetable production} + \text{fruit production})}{\times \text{consumption increase rate} \times \text{farm receipt rate}}
\]  

(3)

Vegetable and fruit production is the average value of production in the last 5 years (2016-2020), applying the average in the last 5 years considering the production variables in specific years. The production values of 2016-2019 were obtained using the "2020 Agriculture, Food and Rural Affairs Statistics" by the Ministry of Agriculture, Food and Rural Affairs, and the production values of 2020 were obtained using the "2020 Agricultural and Forestry Product Value and Production Index" by the Ministry of Agriculture, Food and Rural Affairs (Table 3).

Consumption increase rate was calculated by multiplying the ratio of students with increased consumption among students that have school garden experience in the parent survey by the consumption increase rate per student and
the percentage of elementary or middle school students from total population (4). The ratio of students with increased consumption applied here was 65.7%, which is the percentage of 197 parents who responded that their children’s consumption of domestic agricultural products increased after school garden education out of 300 parents in the experience group. The consumption increase rate per student was 10%, which is the study result by Heo et al. (2017), and the percentage of elementary and middle school students was 7.8%, which is the percentage of 4,009,562 elementary and middle school students out of 51,349,259 people registered as residents as of 2020 (Statistics Korea, 2020).

For the farm receipt rate in wholesale price for each category, aT Agricultural Product Distribution Survey results of 2019, which is the most recent survey, were applied, and the ratio of production for each category was calculated using the average production in the last 5 years (2016-2020) (5). The farm receipt rate was 64.7%, which is the weighted receipt rate that multiplied the farm receipt rate in wholesale price of k-th category by the ratio of production by category (Table 4).

\[
\text{Consumption increase rate} = \frac{\text{ratio of students with increased consumption}}{\times \text{consumption increase rate per student}} \times \text{percentage of elementary or middle school students from total population (4)}
\]

\[
\text{Farm receipt rate} = \sum (\text{farm receipt rate in wholesale price}_{k} \times \text{ratio of production}_{k}) (5)
\]

**Industrial ripple effect**

The effect of increasing the value added in related industries according to garden formation and operation was calculated by multiplying the sum of the garden formation and operation cost by the ratio of value added in all industries (6). For garden formation cost, we used 40 pyeong (132 m²; 1 pyeong = 3.3 m²) of outdoor garden as the refer-

**Table 3.** Vegetable and fruit production in South Korea (Unit : KRW 100 million)

| Division       | 2016      | 2017      | 2018      | 2019      | 2020      | Average   |
|----------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Vegetables     | 115,449   | 110,316   | 115,289   | 111,266   | 112,438   | 112,952   |
| - Leafy vegetables | 17,420   | 16,604    | 18,165    | 16,699    | 18,193    | 17,416    |
| - Root vegetables       | 6,309    | 5,958     | 6,997     | 6,836     | 6,519     | 6,524     |
| - Fruit vegetables        | 52,342   | 49,414    | 51,612    | 52,210    | 52,630    | 51,642    |
| - Seasoned vegetables     | 37,446   | 36,729    | 36,882    | 33,818    | 33,180    | 35,611    |
| - Others                 | 1,932    | 1,611     | 1,631     | 1,703     | 1,916     | 1,759     |
| Fruits                   | 44,923   | 47,356    | 45,084    | 45,266    | 45,669    | 45,666    |
| Total                    | 160,402  | 157,672   | 160,373   | 156,532   | 158,107   | 158,617   |

**Table 4.** Ratio of farm households received and output based on wholesale price by category

| Division               | Leafy vegetables | Fruit vegetables | Seasoned vegetables | Fruits       |
|------------------------|------------------|------------------|--------------------|--------------|
| Farm receipt (A, %)    | 37.5             | 55.8             | 35.8               | 54.1         |
| Shipment (%)           | 20.7             | 12.8             | 21.0               | 14.1         |
| Wholesale (%)          | 10.5             | 8.5              | 10.1               | 9.1          |
| Retail (%)             | 31.3             | 22.9             | 33.1               | 22.6         |
| Total (%)              | 100.0            | 100.0            | 100.0              | 100.0        |
| Distribution margin° (B, %) | 68.7       | 77.1             | 66.9               | 77.3         |
| Wholesale standard farmhouse receipt rate (A/B, %) | 54.6 | 72.4 | 53.5 | 70.0 |
| Ratio of 5 year average production value by category (2016-2020) Average production rate (%) | 15.3 | 32.9 | 22.7 | 29.1 |

°Distribution margin includes farmhouse + shipment + wholesales.
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enced area, which is the average garden area (131.2 m²) of 599 elementary, middle, and high schools in Seoul according to Choi et al. (2018). For formation cost per unit area, we applied 136.3 billion won, multiplying the unit cost per category provided by Rural Development Administration's Nongsaro such as open type 18,887 won/m², fence type 56,220 won/m², and block type 110,553 won/m² by 9,343 elementary and middle schools in 2020 (Statistics Korea, 2020).

\[ \text{△ Value added} = (\text{garden formation cost} + \text{operating cost}) \times \text{ratio of value added} \]  \hspace{1cm} (6)

The school garden operating cost was calculated as 81.8 billion won, obtained by multiplying the operating cost per class by the number of classes and the number of schools. Operating cost per class was set at 470 thousand won per class based on the study by Heo et al. (2017) that investigated the operating cost per class for 15-20 students (Table 5).

The ratio of value added applied here was 43.0%, which is the average value added in the last 5 years (2015-2019) considering that it may vary depending on the year and that there are diverse industries related to school gardens (Table 6).

The effect of consumption expenditure due to the increased value added in related industries was calculated by multiplying the value added increase derived from Equation (6) by the ratio of consumption expenditure to earned and business income (7). The effect of consumption expenditure was estimated considering that value added in terms of distribution gross domestic product (GDP) becomes the income of macroeconomic agents according to Lee et al. (2020). For value added in industries related to school gardens, we applied the ratio of consumption expenditure to earned and business income as the source of earned and business income. For the effect of consumption expenditure due to the increased value added, there is actually a long-term multiplier effect, but we assumed that it only occurs once for conservative estimation.

\[ \text{△ Consumption expenditure} = \text{△ value added} \times \text{ratio of consumption expenditure to earned and business income} \]  \hspace{1cm} (7)

For ratio of consumption expenditure to earned and business income, we applied 67.8% that is the result of the quarterly Household Income and Expenditure Survey of 2019-2020 by Statistics Korea considering the recent change in the samples of statistical surveys. Earned and business income from ordinary income was applied, and consumption expenditure from household expenditure was applied (Table 7).

Job creation effect

Job creation effect was classified into instructor and garden manager hiring effect. Instructor hiring effect was calculated by multiplying instructor fee by lecture hours, number of school garden education sessions, number of classes, and number of schools (8). We applied 30,000 won per hour for instructor fee based on Heo et al. (2017), and lectures were to be given 2 hours a week, 12 times a semester, and total two semesters as did in the 2021 pilot project by the Ministry of Agriculture, Food and Rural Affairs. The result showed that the instructor hiring effect was total 250.7 billion won (Table 8).

Garden manager hiring effect was calculated by multi-

| Division | Unit price (KRW/class) | No. of classes per school | No. of schools | Total amount (KRW 100 million) |
|----------|------------------------|--------------------------|----------------|--------------------------------|
| Elementary school | 470,000 | 20 | 6,120 | 575 |
| Middle school | 470,000 | 16 | 3,233 | 243 |
| Total | | | | 818 |

Table 5. School garden operation cost calculation process in South Korea

Table 6. Value-added rate based on overall industry in South Korea

| Division | 2015 | 2016 | 2017 | 2018 | 2019 | Average |
|----------|------|------|------|------|------|---------|
| Value-added rate (%) | 40.9 | 43.8 | 43.5 | 43.2 | 43.5 | 43.0 |
plying hourly wage by working hours each time, number of sessions, and number of schools (9). Heo et al. (2017) and Choi et al. (2018) had pointed out the importance of hiring specialized managers, and the parent survey in this study also showed that 41.8% of respondents preferred management by professional managers. We applied 8,590 won for hourly wage, which is the minimum hourly wage of 2020, and school gardens were presumed to be managed once a week during the education period (total 24 times a year). We applied the basic data provided by Statistics Korea for the number of schools, and as a result, the school garden manager hiring effect was worth total 15.4 billion won (Table 9).

\[
\text{Instructor hiring effect} = \text{instructor fee} \times \text{lecture hours} \times \text{number of sessions} \times \text{number of classes} \times \text{number of schools} \quad (8)
\]

\[
\text{Garden manager hiring effect} = \text{hourly wage} \times \text{working hours each time} \times \text{number of sessions} \times \text{number of schools} \quad (9)
\]

Table 7. Consumption expenditure as a percentage of quarterly labor and business income in the household trend survey in South Korea

| Division                    | 2019          | 2020          | Average  |
|-----------------------------|---------------|---------------|----------|
|                             | 1/4           | 2/4           | 3/4      | 4/4      | 1/4           | 2/4           | 3/4      | 4/4      |          |
| Income (KRW/household)      | 4,271,911     | 4,168,865     | 4,301,979| 4,284,972| 4,366,070     | 4,315,385     | 4,377,301| 4,361,723| 4,306,026|
| - Ordinary income           | 4,187,631     | 4,111,302     | 4,247,403| 4,214,941| 4,253,196     | 4,244,221     | 4,307,546| 4,280,242| 4,230,810|
| - Wage and salary income (A)| 2,767,115     | 2,715,584     | 2,790,651| 2,726,397| 2,815,578     | 2,757,278     | 2,781,474| 2,738,479| 2,738,945|
| - Business income (B)       | 774,345       | 833,315       | 852,757  | 975,135  | 779,417       | 778,438       | 853,418  | 937,250  | 848,009  |
| - Property income           | 34,095        | 45,210        | 27,562   | 25,145   | 30,012        | 26,511        | 30,159   | 24,915   | 29,614   |
| - Transfer income           | 612,075       | 517,194       | 576,434  | 488,263  | 620,189       | 862,994       | 641,594  | 579,598  | 612,293  |
| - Non-recurring income      | 84,280        | 57,563        | 54,576   | 70,031   | 112,874       | 71,164        | 69,755   | 81,481   | 75,216   |
| Household expenditure (KRW/household) | 3,458,752 | 3,191,378 | 3,386,671 | 3,287,733 | 3,264,129 | 3,181,429 | 3,284,260 | 3,227,499 | 3,285,231 |
| - Consumption expenditure (C) | 2,544,919 | 2,357,094 | 2,467,777 | 2,464,541 | 2,379,576 | 2,385,004 | 2,426,415 | 2,407,610 | 2,429,117 |
| C / (A+B)                   | 71.9%         | 66.4%         | 67.7%    | 66.6%    | 66.2%         | 71.1%         | 66.8%    | 65.5%    | 67.8%    |

Table 8. Effect of hiring school garden instructors in South Korea

| Division                  | Unit price (KRW/time) | Time per time | Frequency (time/year) | Number of classes | No. of schools | Total amount (KRW 100 million) |
|---------------------------|-----------------------|---------------|-----------------------|-------------------|---------------|---------------------------------|
| Elementary school         | 30,000                | 2             | 24                    | 20                | 6,120         | 1,753                           |
| Middle school             | 30,000                | 2             | 24                    | 16                | 3,233         | 745                             |
| Total                     |                       |               |                       |                   |               | 2,507                           |

Table 9. Effect of hiring a school garden manager in South Korea

| Division                  | Unit price (KRW/time) | Time per time | Frequency (time/year) | No. of schools | Total amount (KRW 100 million) |
|---------------------------|-----------------------|---------------|-----------------------|---------------|---------------------------------|
| Hiring effect             | 8,590                 | 8             | 24                    | 9,343         | 154                             |

Results and Discussion

Demographic characteristics of respondents

Among the parents, there were 281 men (46.8%) and 319 women (53.2%), showing that there were slightly more
women than men. Most of them were in their 40s (449 respondents, 74.8%), and 359 respondents were salaried employees (59.8%), 446 were university graduates (74.3%), and 133 had an average monthly household income of 4 million - 4.99 million won (22.2%). This result is similar to a previous study by Hong et al. (2021b), which may be the result of applying the same sample size to secure representativeness of samples.

For type of family, 575 respondents had both parents (95.8%), 369 had 4 household members (61.5%), and 385 had 2 children (64.2%) (Table 10).

### Table 10. The respondent's demographic characteristics of the research subject

| Item                          | N (%)  |
|-------------------------------|--------|
| Gender                        |        |
| Male                          | 281 (46.8) |
| Female                        | 319 (53.2) |
| Total                         | 600 (100.0) |
| Age                           |        |
| 21-29                         | 3 (0.5) |
| 30-39                         | 92 (15.3) |
| 40-49                         | 449 (74.8) |
| 50-59                         | 56 (9.3) |
| Total                         | 600 (100.0) |
| Final education               |        |
| Middle school graduate        | 1 (0.2) |
| High school graduate          | 61 (10.2) |
| University graduate           | 446 (74.3) |
| Graduate school or higher     | 92 (15.3) |
| Total                         | 600 (100.0) |
| Type of family                |        |
| Adoptive parents              | 575 (95.8) |
| Single parent                 | 17 (2.8) |
| Grandparent                   | 7 (1.2) |
| Others                        | 1 (0.2) |
| Total                         | 600 (100.0) |
| No. of household members      |        |
| 2                             | 13 (2.2) |
| 3                             | 130 (21.7) |
| 4                             | 369 (61.5) |
| 5 or more                     | 88 (14.7) |
| Total                         | 600 (100.0) |
| No. of children               |        |
| 1                             | 141 (23.5) |
| 2                             | 385 (64.2) |
| 3                             | 74 (12.3) |
| Total                         | 600 (100.0) |

### WTP for school garden education

As a result of assuming that the garden operating fund is collected for 8 months a year considering that school garden education is provided for 12 weeks per semester based on the pilot project by the Ministry of Agriculture, Food and Rural Affairs, it was found that the average monthly WTP in elementary school was 6,217 won for those with experience and 6,320 won for those without experience, and that in middle school was 5,040 won for those with experience and 5,980 won for those without experience, proving that WTP of those without experience was higher. The average WTP for a fixed amount of voluntary school
garden operating fund was 5,889 won, and maximum 30,000 won (Table 11). This is similar to the study result by RDA (2014) revealing that the cost that can be paid for school gardens was 5,000-10,000 won and by Kim (2019) presenting 3,000-10,000 won. However, it was lower than the amount in the previous study by Hong et al. (2021b), in which the amount was 12,780 won for those with experience and 13,399 won for those without experience based on income tax.

The amount regarding government budget for school garden education was 6,833 won for parents of elementary school children with experience and 7,080 won for those without experience, and it was 6,380 won for parents of middle school children with experience and 6,525 won for those without experience, indicating that those without experience demanded higher government funds, with the average of 6,705 won, and maximum 100,000 won (Table 11). In other words, the WTP for a fixed amount was higher in terms of government budget than voluntary operating fund, indicating that the central and local governments must provide continuous support, maintenance, and management to promote use of school gardens, such as providing financial aid and material resources or nurturing instructors with expertise in operating school gardens.

In the survey item on up to what percent the ratio of education tax must be increased for school garden education from the current 30%, parents of elementary school students with experience answered 0.531%, whereas those without experience answered 0.545%, showing no difference. However, parents of middle school students with experience answered 0.716%, and those without experience answered 1.181%, showing a 0.465% and indicating that those without experience tended to consider the education tax growth more appropriate (Table 10). This is similar to the result by Hong et al. (2021b) claiming that those who experienced school garden education service perceived more highly of the need for this service than those who did not and were also more willing to pay, but WTP or tax rate was set lower since they are already aware of the operating status based on actual experience.

### Table 11. School garden operation fund, willingness to pay based on support budget, and maximum value added tax increase rate in South Korea

| Item | Div | School garden operation fund | WTP = 0 | Government support budget | WTP = 0 | VAT | WTP = 0 |
|------|-----|-------------------------------|---------|---------------------------|---------|-----|---------|
|      |     | Willingness to pay (Won/month) |         | Support amount (Won/month) |         |     |         |
|      |     | Avg | Max | n | % | Avg | Max | n | % | Avg | Max | n | % | Avg | Max | n | % |
| x1   | A   | 6,217 | 30,000 | 20 | 13.3 | 6,833 | 50,000 | 14 | 9.3 | 0.531 | 5,000 | 27 | 18.0 |
|      | B   | 6,320 | 30,000 | 15 | 10.0 | 7,080 | 20,000 | 11 | 7.3 | 0.545 | 5,000 | 24 | 16.0 |
|      | T   | 6,268 | 30,000 | 35 | 11.7 | 6,957 | 50,000 | 25 | 8.3 | 0.560 | 5,000 | 51 | 17.0 |
|      | A/B | 0.984 | 1,000 | 1,333 | 1,333 | 0.965 | 2,500 | 1,273 | 1,273 | 0.973 | 1,000 | 1,125 | 1,125 |
| x2   | A   | 5,040 | 30,000 | 16 | 10.7 | 6,525 | 100,000 | 11 | 7.3 | 0.716 | 33,000 | 22 | 14.7 |
|      | B   | 5,980 | 30,000 | 17 | 11.3 | 6,380 | 49,000 | 15 | 10.0 | 1.181 | 49,000 | 29 | 19.3 |
|      | T   | 5,510 | 30,000 | 33 | 11.0 | 6,452 | 100,000 | 26 | 8.7 | 0.948 | 49,000 | 51 | 17.0 |
|      | A/B | 0.843 | 1,000 | 0.941 | 0.941 | 1.023 | 2,041 | 0.733 | 0.733 | 0.606 | 0.673 | 0.759 | 0.759 |
| Total |     | 5,889 | 30,000 | 68 | 11.3 | 6,705 | 100,000 | 51 | 8.5 | 0.747 | 49,000 | 102 | 17.0 |

*Abbreviation: Div = Division; VAT = Value added tax; WTP = Willingness to pay; Avg = Average; Max = Maximum.

1. x1 = Elementary school; x2 = Middle school.
2. A = Experienced people; B = Unexperienced people; T = Total.
amount of government budget was 217.8 billion won. The budget for school garden education of VAT finances was 978.4 billion won. The VAT standard was rated more highly because the amount of VAT used in estimating monetary values is big. Considering that there is a high possibility of operating budget support through education office or office of education as well as voluntary operating fund from parents when operating school garden education, it seems adequate to interpret socio-economic value provided for participating students as the total amount of valuation based on WTP for the fixed amount of voluntary operating fund and government budget.

For importance by detailed value, we applied importance in the experience group among the parent survey results, and estimated the monetary value of detailed value by multiplying the total WTP by importance. As a result, educational value was highest at 63.7-322.1 billion won, followed by health value 50.2-242.1 billion won, environmental value 47.2-248.1 billion won, and welfare value 32-166.1 billion won (Table 12).

**Economic value**

Economic value was classified into farm household income increase effect, industrial ripple effect, and job crea-

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**Table 12. The result of a monetary estimate of the student-provided value**

| Division                        | A'  | B    | T    |
|---------------------------------|-----|------|------|
| Number of students (number of people) |     |      |      |
| 2020                            | 2,693,716 | 1,315,846 | 4,009,562 |
| Average (2016-2020)             | 2,699,878 | 1,356,703 | 4,056,581 |
| VAT (KRW 100 million)           |     |      |      |
| 2020                            | 648,829 | 648,829 | -    |
| Average (2016-2020)             | 669,271 | 669,271 | -    |
| Willing to pay                  |     |      |      |
| Operating fund (won/month)      | 6,268 | 5,510 | -    |
| Government budget support (won/month) | 6,957 | 6,452 | -    |
| VAT rate (%)                    | 0.560 | 0.948 | -    |
| Operating fund and government budget support period (month) | 8 | 8 | - |
| Importance of each detailed value (%) |     |      |      |
| Education value                 | 33.1 | 32.8 | -    |
| Health value                    | 27.2 | 23.3 | -    |
| Welfare value                   | 16.1 | 17.5 | -    |
| Environmental value             | 23.6 | 26.4 | -    |
| Total                           | 100.0 | 100.0 | -    |
| 2020 Operating fund standard    |     |      |      |
| Education value                 | 447  | 190  | 637  |
| Health value                    | 367  | 135  | 502  |
| Welfare value                   | 218  | 102  | 320  |
| Environmental value             | 319  | 153  | 472  |
| Total                           | 1,351 | 580  | 1,931 |
| Socio-economic value by detailed value (KRW 100 million) |     |      |      |
| 2020 Standard for government budget support |     |      |      |
| Education value                 | 496  | 223  | 719  |
| Health value                    | 408  | 158  | 566  |
| Welfare value                   | 241  | 119  | 360  |
| Environmental value             | 354  | 179  | 533  |
| Total                           | 1,499 | 679  | 2,178 |
| 2020 VAT basis                  |     |      |      |
| Welfare value                   | 1,203 | 2,018 | 3,221 |
| Environmental value             | 988  | 1,433 | 2,421 |
| Total                           | 3,633 | 6,151 | 9,784 |

*A = Elementary school; B = Middle school; T = Total*
tion effect through the increase in consumption of domestic agricultural products that is the sub-indicator of economic value. Industrial ripple effect was divided into the value added increase effect in related industries according to garden formation and operation and the consumption expenditure effect due to the value added increase in related industries. Job creation effect was divided into school garden instructor hiring effect and garden manager hiring effect.

The total amount of economic value was 476.1 billion won. By sub-indicator, job creation effect was biggest at 266.2 billion won, followed by industrial ripple effect at 157.3 billion won and farm household income increase effect at 52.6 billion won (Table 13). This is higher than 82.2 billion won, the economic value of urban agriculture by Seoul citizens in the report by Heo et al. (2014), and thus can be used as the basic data for establishing support policies to promote use of school gardens.

**Total socio-economic value of school garden education**

Ultimately, the total socio-economic value of school garden education seemed to range from 669.2 billion won to 1.4545 trillion won based on the 2020 operating fund, government budget, and VAT (Table 14). Although there are limitations in comparison due to the different stakeholders and estimation methods of socio-economic value, economic value was highest at 476.1 billion won based on monetary value, followed by educational value at 63-317.8 billion won, health value at 51.2-256.2 billion won, environmental value at 46.7-240.8 billion won, and welfare value at 32.2-163.7 billion won.

According to the recent social climate, the formation and use of school gardens is expected to continuously increase. Thus, it is necessary to assess values for continuous operation and maximized effect of school gardens to increase the educational effect in group life as well as the implicit meaning of 'school' created for students and teachers to use in educational activities. There has been a stronger perception of ecological transition education that seeks coexistence of humans and the environment by cultivating the community values and competencies of students based on the revised curriculum of the Ministry of Education (2021), that is, environmental preservation to respond to climate change or environmental disasters. Accordingly, there would be a positive impact in terms of diverse values, such as respecting environmental rights as the rights of future generations, seeking creative programs aligned with curriculums and the educational image of 'living together', and improving dietary life. Therefore, it is important for agricultural agencies to promote the educational effects of school gardens and notify the Ministry of Education or other institutes related to revising the national curriculum in order to expand the scope of school garden education. Moreover, by objectively assessing the agricultural experience service values using school garden education, the results of this study can be used as data to establish more efficient school garden policies and set the direction for education.

**Table 13. Economic value of school garden**

| Division                      | Ripple effect                                                                 | Economic value (KRW 100 million) |
|-------------------------------|-------------------------------------------------------------------------------|----------------------------------|
| Increase in farm household incom | Increase in agricultural income by increasing consumption of domestic agricultural products | 526                              |
| Industrial ripple effect      | Effect of enhancing added value in related industries according to the creation and operation of vegetable gardens | 938                              |
|                               | Effect of consumption expenditure by enhancing value added in related industries | 636                              |
|                               | Sub-total                                                                      | 1,573                            |
| Creating a job                | Instructor hiring effect                                                      | 2,507                            |
|                               | Effect of hiring a garden manager                                             | 154                              |
|                               | Sub-total                                                                      | 2,662                            |
| Total                         |                                                                               | 4,761                            |
Assessment of Socio-Economic Values of Agricultural Experience Services in School Garden Education

It is also necessary to manage school garden education services using the logic model proposed by Lee et al. (2020). The logic model uses concepts such as input, activity, output, short-term outcome, and mid-term and long-term outcome (Ontario, 2005). It basically has a linear logical structure of inputs (resources that go into a business), activities and processes (activities to achieve an objective or to induce outputs and results), outputs (direct and immediate results of processes), outcomes (short-term, mid-term, and long-term change according to the process), and impacts (intentional or unintentional economic and social changes due to business performance, related to the quality of people's life), and therefore it is useful in systematically analyzing the current state and performance (Office for Government Policy Coordination and The Korean Association for Policy Studies, 2015). Therefore, it would be possible to manage and assess school gardens more systematically by collecting data such as input, output (activity, participation), outcome and ripple effect (short-term, mid-term, long-term) using the logic model in school garden education service and analyzing the causal relations among indicators using the existing impact assessment methodologies.

### Conclusion

To comprehensively assess the socio-economic values of school garden education, this study used CVM applying WTP based on the parent survey for education, health, welfare, and environmental values, and RCM for economic values among the five assessment indicators derived from previous studies. We identified the characteristics and current state of urban school gardens through literature review, collected opinions on the adequacy of the survey items and valuation methods after receiving expert advice twice, determined WTP and importance of detailed values based on the parent survey, estimated the monetary value of each detailed value using CVM of WTP, and estimated the economic values of farmhouse income increase effect, industrial ripple effect, and job creation effect based on the increase in consumption of domestic agricultural products using RCM. The results of the total monetary value of school garden education obtained by adding up the values of each detailed indicator are as follows.

First, the total amount of educational, health, welfare, and environmental values provided by school garden education services can be estimated using the CVM and RCM methods. The results are as follows:

| Division | Amount (KRW 100 million) | Estimation method |
|----------|--------------------------|-------------------|
| Education value | 630 | CVM |
| Health value | 512 | CVM |
| Welfare value | 322 | CVM |
| Environmental value | 467 | CVM |
| Economic value | 4,761 | RCM |
| Total | 6,692 | |

The table above shows the total socio-economic value of school garden education based on different budget standards and VAT bases.
calks for participating students was estimated to range from a minimum of 193.1 billion won to a maximum of 978.4 billion won. Based on WTP for the fixed amount of voluntary operating fund and the fixed amount of government budget, the total amount of values provided for participating students was estimated to range from 193.1 billion won to 217.8 billion won. The value in the case of WTP for the budget for school garden education using indirect tax VAT as the finances was highest at 978.4 billion won, which is because the size of VAT used in estimating monetary value is big.

Second, the total amount of economic value provided for farms, related industries, and economically active populations was estimated as 476.1 billion won. Job creation effect was biggest at 266.2 billion won, followed by industrial ripple effect (157.3 billion won) and farm household income increase effect (52.6 billion won). The evolution of school gardens is expected to reduce problems in urban areas such as environmental issues, promote community spirit through agriculture, and produce huge industrial ripple effects such as increase in farm household income and job creation, which raises the need to maintain multiple functions of school gardens.

Third, the total socio-economic value of school garden education seemed to range from 669.2 billion won to 1.4545 trillion won based on the 2020 operating fund, government budget, and VAT. Although there are limitations in comparison due to the different stakeholders and estimation methods of socio-economic value, economic value was highest at 476.1 billion won based on monetary value, followed by educational value at 63-317.8 billion won, health value at 51.2-256.2 billion won, environmental value at 46.7-240.8 billion won, and welfare value at 32.2-163.7 billion won. Thus, socio-economic values of school gardens will provide various aids to promote use of school gardens as well as economic benefits that can be used to solve first-priority tasks and provide policy support.

This study performed valuation based on the assumption that all elementary and middle schools are participating in school garden education and are operating 40-pyeong outdoor gardens, but its limitation is that it failed to sufficiently consider the representativeness due to restricted samples in assessing the conditions and multiple values based on school conditions. Further research must obtain data on the participation of all schools and operating methods for more substantial socio-economic value assessment and perform constant monitoring. Moreover, follow-up studies must obtain data on physical and mental health improvement of students before and after participating in school gardens to assess health values using cost of illness (COI), and monitor the environmental quality, greenhouse gas emissions, and biodiversity before and after school garden education to assess environmental values using RCM. This is expected to lead to more substantial assessment of agricultural experience service in urban school garden education, while also having a positive effect on the multiple functions of urban agriculture.

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