



School garden programs supporting sustainable agricultural intensification through knowledge transfer and family engagement

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Abstract

Background and Objective: This study explores the role of a school garden program in facilitating the transfer of information on Sustainable Agricultural Intensification (SAI) from students to their families. The study investigates three key objectives: (1) assessing whether students shared SAI-related knowledge with their families and explore how parental demographic were related to receiving knowledge from their child, (2) exploring the types of SAI technologies parents reported hearing from their child and the benefits they expected after receiving that knowledge, and (3) analyzing the factors that influence parent's willingness to apply SAI at home.

Methodology: This research was conducted in Siem Reap province, Cambodia, and involved 120 families. Data were collected through face-to-face interviews in June 2024. Data were analyzed using descriptive statistics, chi-square tests, independent t-tests, and logistic regression models.

Main Results: The results show that 70% of parents received SAI-related information from their child. Parents' gender ($\chi^2 = 9.30$, $P = 0.002$), occupation ($\chi^2 = 5.09$, $P = 0.024$), and farming experiences ($t = 2.72$, $P = 0.007$) were significantly associated with their child sharing knowledge with them. Among the families who received information, most parents

recognized specific SAI techniques and perceived benefits such as increased crop yield, reduced chemical use, and improved environmental outcomes. Logistic regression analysis in the full model shows that parent's occupation ($\beta = 6.584$, $P < 0.001$), perceived benefits of SAI ($\beta = 3.969$, $P < 0.001$), and social influence from peers and community ($\beta = 1.888$, $P < 0.05$) were significant predictors of parent's willingness to apply SAI practices at home.

Conclusions: These findings highlight the potential of school garden programs to promote SAI through the school context by training students, increasing their knowledge, and empowering them to act as a knowledge bridge to their families. This study also shows the importance of reinforcing the perceived benefits of SAI and leveraging social networks to enhance adoption at the household level.

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INTRODUCTION

School garden programs are increasingly recognized as effective educational platforms that promote experiential learning, enhance environmental awareness, and encourage sustainable agricultural practices among students. A core focus of these programs is Sustainable Agricultural Intensification (SAI), an approach that aims to increase agricultural productivity while minimizing environmental degradation and conserving natural resources (Hamazakaza *et al.*, 2022; Prasad, 2022). SAI seeks to improve agricultural yield while ensuring both environmental and economic sustainability in the long term. In recent years, SAI has become an important part of the critical response to the challenges of global food security, environmental protection, and population growth. SAI consists of three main dimensions: genetic, ecological, and socio-economic intensification, each targeting different pathways to improve productivity and resilience (Prasad, 2022). While technological innovations are important,

it is not sufficient to focus solely on technological solutions; it also depends on participatory and community-driven approaches that build local capacity. In communities where there is resistance to change, the adoption of SAI practices may be slower (Hancock *et al.*, 2023).

In Cambodia, the agricultural sector continues to face constraints, particularly due to limited access to extension services, which hinders the promotion of SAI practices such as crop rotation, intercropping, mulching, and integrated pest and disease management (MAFF, 2015; Chhinh *et al.*, 2022). Agricultural extension services play an important role in spreading knowledge and providing advisory services to achieve specific goals. These services are often provided by the government, NGOs, or the private sector, and are crucial but often insufficient to reach all farming families effectively (Tran *et al.*, 2025). There is growing interest in alternative pathways for knowledge transfer. Evidence suggests that school gardens can complement

traditional agricultural extension by providing experiential learning for students and informal demonstration for the wider community. School garden programs not only foster agricultural knowledge but also strengthen family and community relationships, which are important for intergenerational knowledge sharing at home (Knapp *et al.*, 2019). These gardens are often integrated into the school curriculum, enabling students to participate in experiential learning activities such as planting, caring for crops, and exploring ecological principles (Holloway *et al.*, 2023). Students often share what they have learned at school with their families and friends (Losasso *et al.*, 2014). Through these activities, students gain practical knowledge that they can share with their family, creating a pathway for intergenerational knowledge transfer. Moreover, schools that actively involve families in garden activities and provide resources and training are more likely to see family-level adoption of SAI practice at home (Maliotou and Liarakou, 2026). The cultural context is important. In many communities, including Cambodia, intergenerational learning is valued, and children are often viewed as agents of change within their families (Sharp *et al.*, 2024).

Several international programs have demonstrated this potential advantage of the school-based programs to influence family practices. For example, the School-Plus-Home Gardens project in the Philippines provided training and support to parents, leading to a significant increase in home garden establishment (Calub *et al.*, 2019). Similarly, the TX Sprouts program in the United States demonstrated the effectiveness of school-based gardening, cooking, and nutrition interventions in influencing parents' willingness to apply SAI practices at home. In Nepal, participatory action research through school gardens empowered students to influence their families' farming practices (Acharya *et al.*, 2022). These examples underscore the potential of school-based programs to act as catalysts for broader agricultural change. In the existing literature,

most research has focused on student learning outcomes; fewer studies have examined how school garden programs influence family behavior, particularly in the Cambodian context. Factors such as parental involvement, socio-economic conditions, and social or community norms are known to affect knowledge adoption, but there remains a gap in understanding the specific mechanisms of knowledge transfer from students to parents (Pekarcik *et al.*, 2023). Also in Cambodia, there has been significant investment in agricultural education and extension efforts aimed at improving farming systems and promoting SAI (Gill *et al.*, 2017).

As a result, school-based programs, particularly school gardens, are increasingly recognized as promising alternatives to support agricultural outreach and build community awareness. Prior research in Cambodia has shown that school garden programs can facilitate knowledge transfer from students to parents (Wells *et al.*, 2022; Pekarcik *et al.*, 2023). Schools can act as platforms to introduce SAI concepts to students, who may then share this knowledge with their families, especially in farming communities where households can contribute to broader agricultural development goals. Yet, there remains a lack of research on whether this knowledge leads to behavioral change or application of SAI practice at the household.

This research advances beyond existing literature in three important ways. First, while prior studies in Cambodia and elsewhere have documented student learning outcomes and, in some cases, reported evidence of intergenerational knowledge sharing, few have empirically examined whether such knowledge transfer translates into measurable changes in parental attitudes and behavioral intentions regarding SAI. Second, this study moves beyond descriptive accounts of knowledge exchange by analytically linking student participation in a school garden program to parental awareness, attitudes, and willingness to apply SAI practices at the household level. Third, by situating the analysis within the Cambodian context,

where formal extension services remain limited and schools may serve as alternative knowledge hubs, this research provides context-specific evidence on how school-based agricultural education can complement national extension efforts. In doing so, the study contributes new empirical insight into the mechanisms connecting school-based learning to household-level agricultural decision-making.

MATERIALS AND METHODS

Based on the reviewed literature and the Cambodian context, this study hypothesizes (H) that school garden programs can act as effective tools for intergenerational transfer of sustainable agricultural knowledge. Specifically, we hypothesize that: H1; students who participate in school garden programs will report sharing knowledge of SAI practices with their parents; H2: parents who receive SAI information from their children will demonstrate greater awareness and more positive attitudes toward SAI; H3: parental demographics (e.g., education, farming experience, and household livelihood reliance on agriculture) will significantly influence the likelihood of receiving SAI knowledge from their child; and H4: parents who receive SAI knowledge from their children will express a stronger willingness to apply SAI practices at the household level. These hypotheses will be empirically tested to advance understanding of how school-based agricultural education contributes to broader community adoption of sustainable agricultural practices in Cambodia by examining how participation in a school garden program influences parents' willingness to apply SAI practices at home. Although school garden programs have been widely studied for their impact on student learning outcomes, there is limited empirical evidence, particularly in Cambodia, examining whether knowledge transfer from students to parents leads to measurable changes in parental attitudes and intended adoption of Sustainable Agricultural Intensification (SAI) practices. While prior Cambodian studies (Wells

et al., 2022; Pekarcik *et al.*, 2023) suggest that knowledge transfer may occur, the mechanisms and behavioral implications at the household level remain underexplored. The hypotheses (H1–H4) are logically derived from the cited literature. H1 builds on evidence that students share school-acquired knowledge with families (Losasso *et al.*, 2014; Knapp *et al.*, 2019). H2 and H4 are grounded in studies demonstrating that exposure to school-based agricultural interventions can positively influence parental awareness, attitudes, and willingness to adopt related practices (Acharya *et al.*, 2022). H3 is supported by literature highlighting the role of socio-demographic and contextual factors in shaping agricultural knowledge diffusion and adoption (Tran *et al.*, 2025). Together, the hypotheses form a coherent progression from student participation to knowledge transfer, to parental perception, and ultimately to intended behavioral change, thereby directly addressing the identified research gap.

This research focuses on a secondary school in Siem Reap, where many students come from farming families. The school garden program is used as a platform to provide students with agricultural knowledge, which they may share with their parents. Specifically, the study aims to: (1) assess whether students share knowledge of SAI practices with their families, and examine how parental demographics were related to whether they received SAI information from their child; (2) explore parents' received information channels, the types of SAI technologies they received from their child, and benefits they expected with SAI after hearing about it; (3) analyze households' willingness to apply SAI practices at home and identify the factors influencing this intention.

Implementation

A training program on SAI practice was implemented in a secondary school garden in Siem Reap province, Cambodia. The program targeted tenth-grade students and aimed to improve their

understanding of key SAI techniques. During the training program, students were encouraged to share the knowledge they gained with their families. The program intentionally promoted intergenerational knowledge transfer by instructing students to communicate what they learned at school to their parents.

Data Collection

Data for this study were collected through face-to-face interviews conducted in June 2024 using a structured questionnaire. At the end of the year, as part of the agricultural training program, students finished the SAI training program at school. The researchers then travelled to the houses of each of the 120 students and interviewed one of the parents in their family. The interviews with parents were conducted using a structured questionnaire developed by the researcher based on the research objectives, literature review, the researcher's personal experience, and input from the researcher's dissertation committee.

Sampling Technique

A structured sampling approach was used to identify participants connected to the school garden program (Acharya *et al.*, 2013). Schools were first identified from a list of institutions implementing the mini-Agricultural Training Program (mini-ATP) school garden initiative. This list was provided by the Center of Excellence on Sustainable Agricultural Intensification and Nutrition (CE-SAIN), the organization responsible for implementing the program. The program was active in four provinces: Oddar Meanchey, Kampong Thom, Siem Reap, and Prey Veng.

Within the selected program schools, administrators and agricultural teachers compiled a list of grade 10 students (classes 10A–10J) who had participated in the school garden program. From this list of participating students, individuals were randomly selected to participate in the study. Each

selected student was then asked to identify one of their parents or guardians to participate in a household-level interview. These parents constituted the final study sample.

To estimate the required sample size and guide the number of students to be selected, Slovin's formula was applied with a 5% margin of error (Israel, 1992). Based on this calculation, a total of 120 students were selected, resulting in 120 corresponding parent respondents. This sampling approach ensured that all respondents were directly connected to the school garden program through their child's participation, allowing the study to capture household-level perspectives related to the program (Etikan and Bala, 2017). Because the sample was drawn from households whose children participated in the school garden program, the findings should be interpreted within the context of program participants rather than the broader population. As a result, the results may not be fully generalizable to all households in the provinces of Oddar Meanchey, Kampong Thom, Siem Reap, and Prey Veng, but they provide insights into the experiences and perspectives of families directly engaged with the school garden initiative.

Data Analysis

The data analysis process in this paper consists of three main stages, each responding to one of the three research objectives. Data analysis utilized the Statistical Package for the Social Sciences (SPSS) (Li *et al.*, 2024), and basic computations employed Microsoft Excel. First, descriptive statistics were summarized to report the proportion of families who reported receiving SAI-related information from their child after the school garden program. Frequencies, percentages, mean, and standard deviations were calculated to describe the demographics of the parent sample and summarize social influence factors, including peer encouragement and community influence. These statistics were also used to summarize parents'

report channels of SAI-related information, the type of SAI technologies received from their child, and their level of agreement with statements about the expected benefits of SAI.

Second, Chi-square tests and independent samples t-tests were used to examine whether parental demographic and social influence factors were associated with receiving information from their child (Yadav and Ali, 2016). Chi-Square tests were applied for categorical variables, including gender and occupation. Independent-samples t-tests were applied for continuous variables, including age, household income, family size, farming experience, and sources of social influence. These analyses were designed to answer objective one by assessing whether a child shared information about SAI practices with their families after participating in a school garden program, and how parental demographic and social influence factors were related to whether they received SAI information from their child. Statistical significance was determined at $P < 0.05$.

Third, to address objective 3, a binary logistic regression analysis was conducted to identify the factors that significantly influenced parents' willingness to apply SAI practices at home. The dependent variable was coded as 1 if parents were willing to apply SAI and 0 if they were not willing. This method is appropriate for examining how multiple independent variables influence the likelihood of a binary outcome. Logistic regression is appropriate for predicting a binary outcome based on categorical and continuous predictors. Before presenting the model produced by logistic regression, an initial examination of the descriptive statistics and bivariate relationships between the dependent and independent variables was conducted (Withanage and Damayanthi, 2019). This step helps to understand the distribution of the

data and identify any potential associations that may influence the final model (Peng *et al.*, 2002). Table 1 shows the summary of variable measurements.

Validation Process

To ensure validity, the questions were reviewed by three agricultural experts with Ph.D. degrees, all of whom had years of experience in agriculture research and education. This method of validation, called the Index of Items Objective Congruence (IOC), was used to calculate the content validity of the interview questions based on the expert's comments and suggestions. Experts were asked to score a checklist to indicate items they thought were acceptable, those they thought were unacceptable, and those they thought were questionable. The value of all items was arranged between (0.067) and (1.00), which exceeded the acceptable score threshold of (0.50). Some items were revised if their IOC value was lower than 0.67. Items whose IOC values were lower than 0.33 were eliminated from the final version of the interview. Revision of interview questions followed the experts' suggestions. The multi-item variable measuring expected benefits of SAI (7 items; 5-point Likert scale) demonstrated acceptable internal consistency (Cronbach's $\alpha = 0.82$). The social influence variable (2 items) also showed good reliability ($\alpha = 0.79$). Composite scores were calculated by averaging item responses, with higher scores indicating stronger perceived benefits and social influence. Explanation and definitions of all variables are presented in Table 1.

Ethical approval for the research study was obtained from the Kasetsart University Research Ethics Committee, and all research was carried out in compliance with the international guidelines for human research protection, as the Declaration of Helsinki.

Table 1 Summary of variable measurements

Outcome variable	Description	Measurement
Objective 1: Assess whether child share knowledge of SAI with their families		
Dependent variable	Child shared SAI with family	1 = yes, 0 = no
Parent's gender	Gender of the parent interviewed	1 = male, 0 = female
Parent's age	Age in years	Years
Parent's occupation	Main occupation	1 = farmer, 0 = other
Household income	Monthly income	USD
Child in the household	Total children in the household	Number
Farming experience	Engaged in farming	Year
Objective 2: Parents received information channels, the types, and benefits of SAI		
Perceived channels	Where families received SAI info (e.g., NGOs, TV, Gov.)	8 items, each coded 1 = yes, 0 = no
Information from the child	SAI techniques shared by a child (e.g., mulching, irrigation)	10 items, each coded 1 = yes, 0 = no
Expected benefit of SAI	What came to mind after hearing SAI from a child? (e.g., yield, cost)	5-point Likert scale: 1 = SD to 5 = SA
Objective 3: Factors influencing parents' willingness to apply SAI at home		
Dependent variable	A parent is willing to apply SAI	1 = yes, 0 = no
Parent's gender	Gender of the parent interviewed	1 = male, 0 = female
Parent's occupation	Main occupation	1 = farmer, 0 = other
Student shared SAI info	Child shared SAI with families	1 = yes, 0 = no
Expect the benefits of SAI	Beliefs in the outcomes of applying SAI at home (e.g., yield, cost)	5-point Likert scale: 1 = SD to 5 = SA
Social influence: 2 items	1. My friend encouraged me to apply to SAI	5-point Likert scale: 1 = SD to 5 = SA
	2. Seeing people in my community apply SAI makes me more likely to do the same	

Note: 5-point Likert scale: 1 = strongly disagree (SD), 5 = strongly agree (SA)

RESULTS AND DISCUSSION

Demographic

Table 2 shows the demographic profiles of the parent respondents. In terms of gender, (74%) of the participants were female. The average age of the parents was 45 years (SD = 8.4). Most of them are farmers (65%), as their main employment, while 35% reported other types of main employment and only agriculture as a secondary occupation. The mean household income was \$284.33 (SD = 317). Households had an average of three children (SD = 1.2), and parents reported an average of 15 years of farming experience (SD = 10.5). The mean score for peer encouragement

reflecting social influence was 3.1 (SD = 0.5), indicating neutral to slightly positive perceptions of encouragement from peers. The community influence score averaged 3.4 (SD = 1.1).

These demographics reflect a typical household profile, where farming remains central to livelihoods. Female respondents also align with household dynamics in which women play key roles in agricultural decision-making and child interaction. Similar studies showed female caregivers often serve as primary recipients of agricultural knowledge within families (Short-Meyerson *et al.*, 2016).

Parental Demographics Related to Whether They Received SAI from Their Child

Out of the 120 families surveyed, 70% of the parents reported that the child shared information about SAI practices after their child participated in the school garden program, while 30% responded that they did not. Statistical tests revealed significant associations between family background and knowledge sharing (Table 3). Parent gender was strongly related to information sharing ($\chi^2 = 9.30$, $P = 0.002$); a larger

proportion of female parents (82%) received SAI-related information from their child compared to male parents (18%). Similarly, occupation was significant ($\chi^2 = 5.09$, $P = 0.024$), with farming parents (66.7%) receiving information from their child compared to other/non-farm primary occupations. Farming experience also mattered; parents who received information from their child had, on average, more years of farming experience (Mean = 17.0) than those who did not (Mean = 11.4) ($t = 2.72$, $P = 0.007$).

Table 2 Demographic profile of parents (n = 120)

Variables	Description	Frequency	Percentage	Mean $\pm$ SD
Gender	Male	31	26	
	Female	89	74	
Age	Years of age			45 $\pm$ 8.4
Occupation	Farmer	78	65	
	Others	42	35	
Household income	USD per month			284.33 $\pm$ 317
Child(ren) in household	Persons			3.0 $\pm$ 1.2
Farming experience	Years			15.3 $\pm$ 10.5
Social influence	Peer encouragement			3.1 $\pm$ 0.5
	Community influence			3.4 $\pm$ 1.1

Note: SD = standard deviation

Table 3 Comparison of parental demographics by whether they received SAI-related information from their child (n = 120)

Parent's characteristics	Shared (n = 84)	Not shared (n = 36)	Test statistics	P-value
	n (%) / Mean $\pm$ SD	n (%) / Mean $\pm$ SD		
Gender				
Male	15 (21.7)	16 (9.3)	$\chi^2 = 9.30$	0.002
Female	69 (62.3)	20 (26.7)		
Age (year)	45.9 $\pm$ 8.7	44.7 $\pm$ 7.6	$t = 0.74$	0.462
Occupation				
Farmer	56 (50.4)	16 (21.6)	$\chi^2 = 5.09$	0.024
Non-farmer	28 (33.6)	20 (14.4)		
Household income (USD per month)	255.54 $\pm$ 291.47	351.53 $\pm$ 365.24	$t = -1.53$	0.129
Family size (person)	5.3 $\pm$ 1.3	5.2 $\pm$ 1.1	$t = 0.35$	0.729
Farming experience (year)	17.0 $\pm$ 10.7	11.4 $\pm$ 9.0	$t = 2.72$	0.007

Note: Values are presented as frequency (percentage) for categorical variables and mean $\pm$ standard deviation (SD) for continuous variables. The χ^2 test was used for categorical variables and the independent sample t -test was used for continuous variables.

These findings highlight the importance of household roles and agricultural background in shaping intergenerational knowledge transfer. Children were more likely to share with their mothers. Gender roles influence the type of communication between parents and children, which may also apply to how children share knowledge about topics like SAI at home (Zeman *et al.*, 2010). A study of Gandasari *et al.* (2020) found that 75% of full-time farmer parents discussed agricultural topics with their children. Calub *et al.* (2019) highlights that factors influencing the sharing of information include families that have already established farms and home gardens. Another related study indicates that over 80% of students said they share what they learned with their parents about food safety (Calberry *et al.*, 2016). These results emphasize that the effectiveness of school garden programs by students sharing information with family partly depends on family context, particularly gender dynamics and farming experience, which influence whether information is transmitted and valued. Findings highlight that family background factors contribute to the likelihood of SAI knowledge being shared at home. They suggest

that effective school garden programs can have a broader influence when they build student knowledge, confidence, and interest, and consider how family context might shape communication pathways.

Parent's Received Information Channels, Type of SAI Technologies Received from Their Child, and the Benefits They Expected from SAI after Hearing It

Perceived information channel relates to SAI

(*n* = 84)

Parents reported receiving SAI-related information from multiple sources. The most frequently reported channel was their child sharing information (*n* = 84), highlighting the important role students play in transferring knowledge from school to home. Other commonly selected sources included demonstration plots (*n* = 71) and smartphone applications (*n* = 58). Traditional media such as TV or radio were selected by 35 parents (*n* = 35), while collaborations with NGOs (*n* = 32) and public sector institutions like DAE and MAFF (*n* = 23). Visiting the school garden (*n* = 22) and phone calling (*n* = 11) were less common (Figure 1).

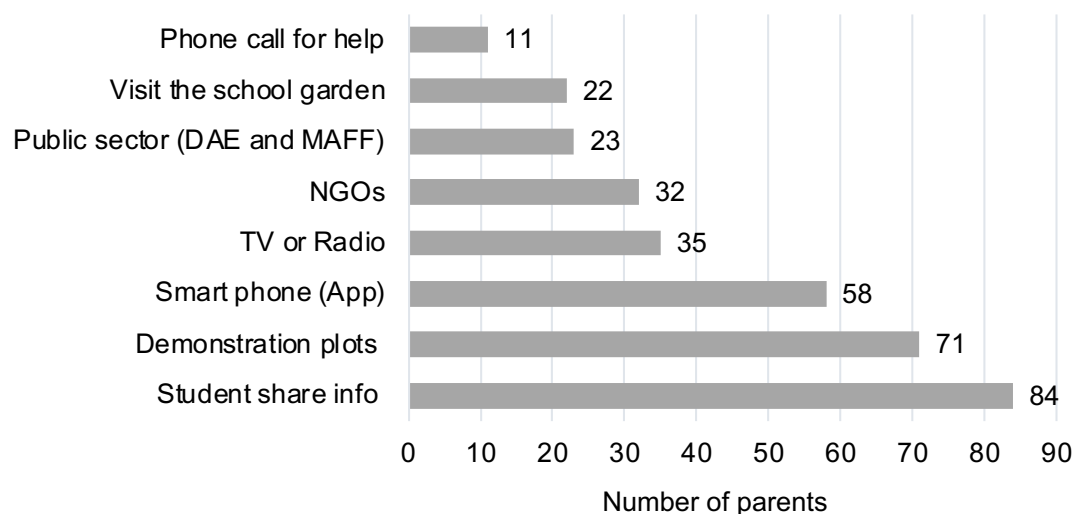


Figure 1 Information channels SAI-related, field survey 2023. Values represent raw counts of the number of parents. Multiple responses were permitted.

This finding underscores the critical role students play in sharing information between schools and households. While government agencies and NGOs remain important for agricultural innovation (Hamazakaza *et al.*, 2022), the prominence of child-to-parent sharing suggests that school garden programs extend beyond the classroom to serve as household learning channels. This underscores the growing influence of digital media in rural contexts, where mobile devices increasingly provide access to videos, social media, and farming applications. Previous studies have shown that farmers receive information relating to SAI from farmer field schools, videos, and modern information and communication technologies (Shrestha *et al.*, 2021). A multi-channel approach that integrates formal institutions, digital tools, and student

knowledge sharing may therefore maximize the reach and uptake of SAI information.

Information channels parent received from their child relate to SAI techniques (n = 84)

Parents reported receiving SAI information through student sharing information of SAI practices. Among the ten techniques taught to students at school, crop rotation was the most frequently shared practice, with about 84.5% of parents reporting they were informed by their child. This was followed by mulching (81.0%), fertilizer application (76.8%), and intercropping (70.2%). In the lowest case, minimum soil disturbance was the least commonly shared technique, with only 42.9% of parents reporting they received this information from their child (Figure 2).

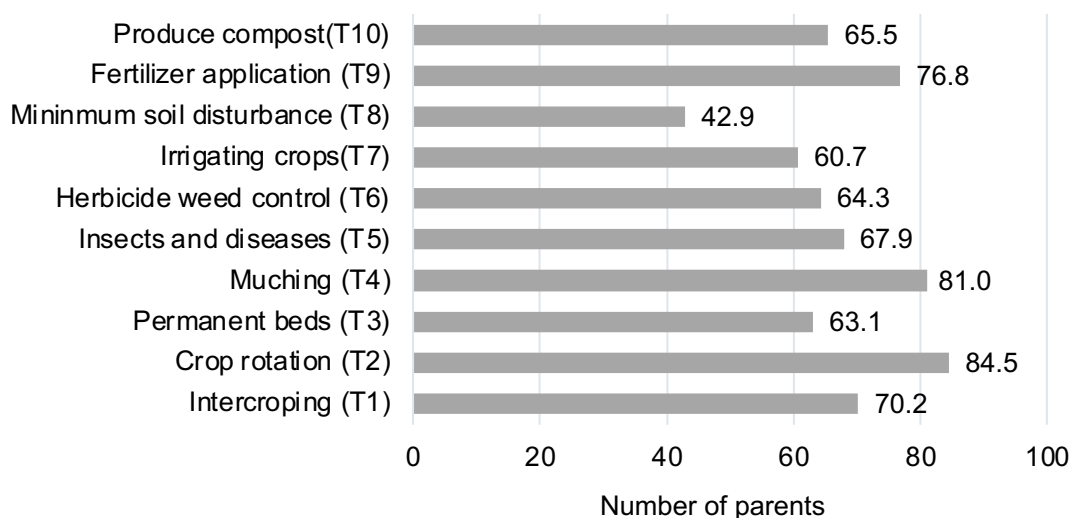


Figure 2 The types of SAI that parents received from their child. Values represent raw counts of selections rather than percentages. Multiple responses were permitted.

Similar patterns have been observed in other school-based agricultural initiatives, where students tend to emphasize simple practice when communicating with their families (Calub *et al.*, 2019). This implies that future school garden programs should provide tools for students to better explain more complex SAI practices to their families.

Parents expect benefits from SAI practices

Parents who received SAI information from their child (n = 84) expressed generally positive perceptions of its benefits (Table 4). In this term, parents were asked to rate their agreement with nine statements reflecting the benefits of their expectations using a 5-point Likert scale (1 = strongly disagree to

5 = strongly agree). The items included: (1) yield improvement, (2) lower chemical input, (3) irrigation improvement, (4) environmental protection, (5) nutrient management, (6) longer-term productivity, and (7) whole-community benefits. Mean scores and standard deviations were calculated to describe overall perceptions. Five out of seven benefit statements had a mean value of 4.00 or higher, indicating general agreement among respondents. The two statements with neutral agreement were “yield improvement” (Mean = 3.90, SD = 0.8) and “lower chemical input” (Mean = 3.98, SD = 0.8). These indicated a neutral stance compared to other statements. The highest-rated perceived benefits were “SAI benefits the whole community” (Mean = 4.27, SD = 0.8), “SAI helps protect the environment” (Mean = 4.26, SD = 0.7), and “SAI improves nutrient availability” (Mean = 4.23, SD = 0.8).

These results indicate that parents readily associate SAI with environmental protection and sustainability rather than immediate yield gains. The findings from Pekarcik *et al.* (2023) those who reported that Cambodian parents exposed to SAI through their children valued ecological and community benefits. Other research shows that households' willingness to apply sustainable agricultural practices is influenced by trust in government support, credit constraints, spouse education, rainfall, plot-level disturbances, household wealth, social capital, labor availability, and access to plots and markets (Teklewold *et al.*, 2013). Farmer's adoption decisions are shaped not only by productivity concerns but also by perceived long-term environmental and social advantages (Dahal *et al.*, 2023). Thus, messaging that emphasizes ecological and community-wide benefits may resonate strongly with families and support adoption.

Table 4 Parental perception of the expected benefits of SAI practices (n = 84)

Rank	Statement (what readily comes to mind when I hear the term SAI)	Mean	SD	Category
1	Whole-community benefits	4.27	0.76	Agree
2	Environmental protection	4.26	0.73	Agree
3	Nutrient management	4.23	0.76	Agree
4	Irrigation improvement	4.18	0.91	Agree
5	Longer-term productivity	4.02	0.69	Agree
6	Lower chemical input	3.98	0.81	Neutral
7	Yield improvement	3.90	0.77	Neutral

Note: Multiple responses were allowed. Strongly agree = 5, agree = 4.00–4.99, neutral = 3.00–3.99, disagree = 2.00–2.99, strongly disagree = 1.00–1.99. SD = standard deviation.

Parent's Willingness to Apply SAI at Home Through Student Sharing

The overall analysis of parents' receiving information from their child regarding SAI is that 59.2% reported willingness to apply SAI at their home, while those not willing to apply SAI at their home are about (40.8%). Table 5 presents the analysis of five logistic regression models that examine the influence of various factors on parents' willingness to apply SAI

practices at home. Model 1 includes parents' gender and indicates no significance on willingness to apply SAI at home (model 1: (EXP(B)) = 0.659, P = 0.813). Model 2 includes only the control variable occupation and shows a significant positive effect (model 2: (EXP(B)) = 5.317, P < 0.001), indicating that parents' occupation was significantly associated with their willingness to apply SAI at home. Model 3 adds the variable student shares information at home,

Table 5 Regression results of the logistics regression model factors affecting parents' willingness to apply SAI at home (n = 120)

Variables	Parents' willingness to apply the SAI at home					95% Confidence interval for model 5 (EXP(B))	
	Model 1 (EXP(B))	Model 2 (EXP(B))	Model 3 (EXP(B))	Model 4 (EXP(B))	Model 5 (EXP(B))	Lower	Upper
Parent's gender	0.659	0.862	0.911	1.050	1.139	0.388	3.342
Parent's occupation	-	5.317***	5.165***	6.361***	6.584***	2.476	17.504
Student shares info	-	-	1.227	0.717	0.700	0.245	2.003
Expected benefits	-	-	-	5.066***	3.969***	1.756	8.969
Social influence	-	-	-	-	1.888*	1.054	3.383
Cox & Snell	0.008	0.140	0.141	0.287	0.316		
Nagelkerke	0.011	0.189	0.190	0.388	0.426		
-2 Log likelihood	161.321	144.233	144.034	121.639	116.752		
Wald statistics	0.813	0.000	0.506	0.001	0.033		

(P < 0.05)

Note: (EXP(B)) = odds ratio. ***P < 0.001, **P < 0.01, *P < 0.05.

which was not statistically significant (model 3: (EXP(B)) = 1.227, P = 0.506). This suggests that while parents whose children share information may not be likely to apply SAI, the effect might not be strong enough to be significant on its own. Model 4 includes the expected benefits of SAI, which show a strong and statistically significant effect (model 4: (EXP(B)) = 5.066, P < 0.001). This implies that parents who perceive greater benefits from SAI practices are more likely to apply them at home. Model 5, the variable social influence was significantly associated with parents' willingness to apply SAI practice at home (model 5: (EXP(B)) = 1.888, P < 0.05). The social influence variable was constructed from two items using a 5-point Likert scale measuring (1) peer encouragement and (2) community influence, with higher scores reflecting stronger perceived influence. Model 5, the full model, includes all predictors. In the full model, parents' occupation ((EXP(B)) = 6.584, P < 0.001), expected benefits of SAI ((EXP(B)) = 3.969, P < 0.001), and social influence ((EXP(B)) = 1.888, P < 0.05) remain significant predictors of benefits

and the influence of peer farmers and community members. In terms of model fit, the R-squared values increase across models, with the final model (model 5) showing the best fit (Cox & Snell R-square = 0.316; Nagelkerke R-square = 0.426). The -2 Log likelihood statistic also decreases from model 1 to model 5, further indicating improved model performance. The 95% confidence intervals for model 5 provide an estimate of the precision of the odds ratios and indicate the range within which the true effect is likely to lie. Confidence intervals that do not include 1.0 suggest a statistically significant association.

These results suggest that willingness to adopt SAI at home is shaped more by parent's occupational background and perceptions of benefits than by child-to-parent knowledge transfer alone. Parents engaged full-time in farming were more likely to apply SAI practices, which is logical given their direct involvement in agricultural decision-making and greater ability to experiment with new techniques. A study by Issaka *et al.* (2024) on rice found social influence as a key psychosocial factor influencing

smallholder rice farmers' willingness to adopt SAI. This finding aligns with previous research showing that farmer households are more responsive to agricultural innovations compared to households engaged in non-farm work (Teklewold *et al.*, 2013; Calub *et al.*, 2019). Perceived benefits of SAI also emerged as a critical driver, reinforcing evidence that farmer's willingness to adopt new practices depends heavily on whether they see a clear, practical advantage, such as improved yields or environmental outcomes.

Although the variable "Student shares information at home" did not reach statistical significance in the logistic regression models, it still showed a positive association with parents' willingness to apply SAI practices. This trend suggests that knowledge shared by students may play a role in shaping parental behavior, even if its independent effect was not strong enough to be confirmed in this analysis. The non-significant result in this study could be due to overlapping influences from other variables, such as parents' occupation or their expectations of SAI benefits, that mediate or amplify the impact of students sharing information.

Our findings suggest that school gardens in Cambodia extend key educational theories by situating sustainability learning in culturally relevant practice. We show that Kolb's (1984) experiential learning cycle is enriched when students draw on prior agricultural knowledge (Kolb *et al.*, 2014). Also, communities of practice can bridge formal schooling with indigenous, intergenerational expertise. Evidence of students reframing agriculture from subsistence to stewardship also points to the applicability of transformative learning among youth, expanding a theory usually applied to adults (Mezirow, 1994). Finally, our results contribute to place-based education by demonstrating how sustainability education grounded in everyday food production cultivates both critical reflection and agency (Sobel, 2004).

While this study provides insights into the potential of school garden programs to facilitate intergenerational knowledge transfer of SAI practices, several limitations should be acknowledged. First, the study was conducted in a single secondary school in Siem Reap province, which may limit the generalizability of findings to other regions of Cambodia where cultural norms, farming practices, and school resources may differ. We recognize the limitations of relying on a single school and suggest that, in future research, more schools should be included. However, because of constraints on time and budget, this research only uses data from one school. Despite only including one school, the number of students in grade 10 is over 500, providing a group from which to randomly sample students. Second, the reliance on self-reported data from parents introduces the possibility of social desirability bias, as respondents may have overstated their receipt of information or willingness to adopt SAI practices. Third, the cross-sectional design captures parental attitudes and intentions at one point in time, without examining whether these intentions translate into sustained behavioural change or long-term adoption of SAI practices. Finally, the study did not directly observe the communication between students and parents, nor the actual implementation of SAI practices in households, which restricts the ability to confirm the accuracy of reported knowledge transfer and application. Future research would benefit from longitudinal designs, larger and more diverse samples, and mixed-methods approaches that combine survey with direct observation and qualitative inquiry to more fully capture the mechanisms of intergenerational knowledge transfer and household-level adoption of SAI.

Overall, these findings suggest that promoting SAI at the household level requires more than just delivering knowledge through children. Programs

must also build awareness of benefits, create supportive community environments, and consider the specific needs of farming households to enhance adoption.

CONCLUSIONS

This research highlights the school garden's role not only in educating students but also in positioning them as conduits of agricultural information within their households. Among families who received information from their child, parents demonstrated strong awareness of specific SAI techniques and identified multiple perceived benefits, including increased yield, lower chemical input, and environmental protection. The findings of this study suggest that school garden programs can serve as an important complement to traditional agricultural extension strategies in Southeast Asia by positioning youth as active knowledge brokers within their households and communities. By equipping students with both technical understanding of SAI practices and the confidence to communicate this knowledge at home, extension services can leverage the existing value placed on intergenerational learning in the region. Importantly, our results highlight that parental adoption of SAI is shaped not only by exposure to knowledge but also by expectations of tangible benefits and reinforcement from social networks. Extension strategies that integrate school-based interventions with family and community engagement may therefore accelerate adoption by aligning educational content with the livelihood realities of farming households. At the same time, youth-focused programs can amplify

the reach of limited extension services by cultivating a generation of learners who influence both current and future farming practices. In this way, integrating school garden programs into broader agricultural education frameworks holds promise for advancing sustainable intensification in Southeast Asia, where demographic shifts and resource constraints require innovative community-centered approaches.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest related to this research.

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