Subjective Evaluation of Local Natural Resources with the Concept of Ecosystem Services

Re-visiting Environmental Education as a method of local sustainability

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Abstract: The purpose of this report is to present a method of subjective evaluation of local natural resources with the concept of Ecosystem Services among high school students. In this report, we take a closer look at 1) differences in students’ evaluations of local natural resources based on personal experiences of conservation of resources and environmental education, and 2) whether or not students also show interest in local historical disasters. A workshop was held for high school students in Shiga Prefecture, Japan, who received Environmental Education on local water environment. The workshop aimed to find out how the high school students perceive functions and services of ecosystems by making a matrix to categorize the services and functions of ecosystems based on their learning experiences. The participating students consist of the 1st and 2nd grade of a high school students in Shiga Prefecture, Japan. The workshop contents are lectures, a group work to make a matrix, a group presentation, and discussion based on those group presentations. The results of the workshop made it clear that students’ perception of ecosystem functions shares a similarity to the findings from the Millennium Ecosystem Assessment reports, that is, some functions of provisioning service used or needed in their daily lives are regarded as more important and close to them; whereas, regulating services, especially functions related to disaster risk mitigation, and cultural services are perceived as rather less important and not-close to the individual student as the scale of those functions are too large to see. Students learned that people have different views and place different values on local natural resources through peer-discussion. Such methods can contribute to helping younger generations think more deeply about local natural resource conservation and the relationship between those resources and their lives as well as a sound manner to understand different views regarding their conservation for local sustainability. Also, using the concept of ecosystem services could guide their attention to disaster risk reduction through the characteristics and functions of local natural ecosystems.

Keywords: Environmental Education, Ecosystem Services, Matrix, Workshop, High School students

1. INTRODUCTION

Environmental Education (EE) has long been playing an important role in many educational aspects. EE has been implemented not only in school curricula but also for the purpose of nature conservation as well as the sustainable development, and has become one of important methods of community planning and development. Focusing on EE as a method of rural planning, Shigemura states that education through natural environment and agricultural experience plays a significant role as an indispensable concept in nurturing independent individual actions such as daily-checking, evaluating, creating and managing local environment where both children and adults can have a new place of learning.

Regarding the relationship between the natural environment and human well-being, the concept of ecosystem services (ES) has been increasingly recognized as a means to contribute to sustainable development since the Millennium Ecosystem Assessment released its synthesis in 2003. Ecosystem services (ES) is defined as “the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other nonmaterial benefits.” In order to promote ecosystem management, it is necessary to employ not only natural scientific views such as ecosystem dynamics and structures but also perspectives of Social Science, Humanities, and engineering regarding how people evaluate and are benefited by their respective ecosystems. This allows us to identify the system as a socio-ecological one within which natural systems and social systems are linked.

Discussions around ecosystem-based approaches have been of growing interest in recent years. An example is Ecosystem-based Disaster Risk Reduction, a concept defined as “the sustainable management, conservation and restoration of ecosystems to reduce disaster risk, with the aim to achieve sustainable and resilient development.” Implementing such a concept requires cross-cutting viewpoints on both sound
management and conservation of ecosystem and disaster risk reduction with mutual understanding\textsuperscript{4, 5}. The type of activities has become more diverse and targeted group has expanded from adults to children and youth in many communities. Although youth and/or children’s participation is significantly important\textsuperscript{6}, as youth are to be especially highly regarded as partners for disseminating information and communicating knowledge\textsuperscript{7}, their participation has been underestimated\textsuperscript{8}.

1. 1 Environmental Education on Local Natural Resources

Regarding the linkage between human activities and natural resources, in the field of EE, Fujioka\textsuperscript{9, 10, 11} has emphasized the significance of including such linkages and interaction from a socio-economical perspective together with the other two items in EE: the two sides of nature “benefits and disaster,” locality and local natural resources. The characteristics of the local area is a strong influential factor in selecting EE sites. Consolidation with the school curriculum is also needed to maximize the learning outcome of EE\textsuperscript{12}. EE on potent local natural items (e.g., oceans, rivers) inspired the children’s willingness to learn more about their environment and increased their pride in local products as well as in the likelihood of their intention to remain as residents in their local area after growing up\textsuperscript{13}. Based on their EE experiences and learnings, it is expected that they have an opportunity to see their local natural environmental background through the existing ecosystem of their local area and rethink how their ecosystem and human activities have interacted, as well as how humans benefited from the ecosystem.

As for EE for high school students, studies have found that they developed environmental consciousness and a deeper sense of understanding of natural resources through EE programs\textsuperscript{14} and that EE for the younger generation is very important to their building a reasonable base for local development through opportunities of facing actual problems in their subjective rural society and pondering solutions for such problems that have many different answers depending on the situation and/or position of the individual\textsuperscript{15}.

1. 2 Ecosystem Services and Evaluation

Subjective value and knowledge are key to behavioral change\textsuperscript{16, 17}. ES has been used to measure the outcome of EE, EE experiences in the past and how targeted individuals perceive their local natural resources. Out of their study on farmers’ perception of local natural resources, Hartel et al.\textsuperscript{18} are concerned that the tendency to prioritize provisioning services for the purpose of economic value may hamper sustainability of local ecosystems. Imai et al.\textsuperscript{19} measured the general awareness of ecosystem conservation. Ito and Hayashi\textsuperscript{20}, Ota et al.\textsuperscript{21}, Hasegawa and Hayashi\textsuperscript{22} and Okada et al.\textsuperscript{23} used ES to measure the subjective value of cultural services of each targeted site of local natural resources. Yet, there have been few studies using ES in both learning and measuring consciousness with a viewpoint of disaster risk reduction.

In anticipation of integrating ES (provisioning, regulating, and cultural services) and learnings of EE, it is vital to provide young generations with education on those topics and to raise their awareness of the tangible natural environmental background of their local area. It is important for the young generation, namely early youth\textsuperscript{24} or high school students, to understand these lessons as they are soon to be the next leaders in their local societies.

In light of these points above, this report introduces a method using the concept of ES for a subjective evaluation of local natural resources (benefiting the side of nature) among youth. It aims to identify differences made in their evaluations of local natural resources based on their EE/conservation experiences and their interest in local disaster risks as another perspective of nature. This method expects to encourage youth to share various ideas, have constructive discussions and a mutual understanding of conservation of local natural resources among people with various ideas.

2. METHOD

2. 1 Selected Site and Targeted People

We selected a small town in Shiga Prefecture as the site of our study for two reasons. Firstly, Shiga Prefecture is home to Lake Biwa, which is a source of fresh water for about 14 million people in the down-shed of its basin. Shiga Prefectural Government has been enthusiastic on education related to the lake’s water, its varied ecosystems, and the greater water environment. Secondly, high school students received environmental education about Lake Biwa and its surroundings during their elementary school and junior high school years, which share the same curriculum and same materials disseminated by the Board of Education of Shiga Prefecture.

We employed a workshop-style approach. The participants were 19 high school students in the 1st and 2nd grades, and
their ages were 15 to 17 years old. We selected only students who had received EE on Lake Biwa during their elementary school and junior high school years through consulting with their high school teachers beforehand. Though ES was a new concept to them, they had gained enough basic knowledge to comprehend ES as well as personal interaction with ecosystems and academic experience in subjects such as biology, geography, geology, and social sciences. We did not specify the gender balance in the consultation with high school teachers, and most of the participating students were female eventually. We accepted it as this workshop looks at the difference in the subjective evaluations and whether or not they show interest in local disaster risk issues. We held the workshop on two separate days in August 2015 and November 2015 due to the school’s schedules and students’ club activities. The workshop was held from 13:00 to 16:00 with the same contents on both days.

2.2 Workshop – Theory and Structure

The details of the workshop’s contents are given in Table 1.

2.2.1 Theory

The workshop was based on the Constructivist Theory of learning, in particular, social constructionism. The general idea of the social constructionism is that learners obtain and develop their new ideas and concepts using their current or past knowledge and learning is not a simple knowledge transfer but a process to produce meaning, and such meaning-making activities take place in the dialectic between the individual and society. Vygotsky elaborated on the concept, referring to it as the Zone of Proximal Development (ZPD). ZPD is a learning process of children/youth and is described as a “range of tasks that are too difficult for an individual to master but can be mastered with the assistance of adults or more skilled-peers.” ZPD consists of “scientific” concepts (structured activities, e.g., classroom instruction) and “spontaneous” concepts (pseudo-concepts “emerging from the learner’s own reflection on everyday experiences”). Scientific and spontaneous concepts develop in reverse directions. While scientific concepts work their way down imposing their logic on the learner, spontaneous concepts work their way up, meeting the scientific concept and allowing the learner to understand its logic. Based on these theoretical arguments, we designed the workshop as follows: 1) Lecture (scientific concepts), 2) Group work (matrix-making), 3) Discussion (exchanging opinions, peer-learning), and 4) Questionnaire (past/everyday experiences)

(Fig. 1). The details of each activity are given in the following subsections.

2.2.2 Grouping

Before starting the workshop, we opened with an icebreaking session to form groups for the group work activity. Students were divided into several groups based on their answers to “When you hear a word ‘water,’ what comes to your mind first?” This step was implemented to facilitate forming groups with members who shared similar opinions of water because good working relationships with other group members is important in social constructionism. We aimed to see if there were any differences in their matrix-making due to their different intuitive ideas regarding ‘water’ that they might have had in their past EE or other conservation experiences.

2.2.3 Lecture

The lecture focused on freshwater environments, as they all had received environmental education related to Lake Biwa. Lectures on general information regarding water and the Lake Biwa Basin were given, and then a lecture on ecosystem services followed. As none of the students had heard the phrase ‘ecosystem service’ before, the functions of ecosystem services of freshwater environment ecosystem (Fig. 2) were outlined. Each function (numbered from 1 to 21 in Fig. 2) were explained. As they had received EE on Lake Biwa prior to these activities, we gave some representative items of Lake Biwa for each function in ES so that they could understand the functions by associating them with familiar items they had previously learned. For example, we showed the cases of dams (for water supply (No.1), irrigation crops (No.5), hydropower potential (No.6)), mountains (for wood/
fiber (No.3), fuel (No.4), sound water quality (No.13), health provisions (No.14)), marshland with reeds (for flood/drought mitigation (No.7), aquatic habitats (No.11), diverse food-chain (No.12), and ecotone buffer capacity (No.15)) to explain regulating services. Also, we provided different climates in Shiga Prefecture (with a large lake, surrounded by mountains) compared with another prefecture (without large bodies of water, yet surrounded with mountains), etc.

2.2.4 Matrix-making (Group Work)

Following the lectures on water environment and freshwater ecosystem services, each group of students worked on matrix-making. The students were to rate each function of Provisioning, Regulating, and Cultural services of their respective ecosystem (numbered 1 to 21 in Fig. 2) on a matrix based with two axes (Fig. 3) on a matrix based with two axes (Fig. 3). The horizontal axis was for “functions that are felt close” and “functions that are not felt close.” The vertical axis was for “functions that are more important” and “functions that can be less important.”

These axes are also based in social constructionism. This supports the point that one’s past experience influences their evaluation as shown in previous studies given above.

Taking this matrix-making as a part of the learning process for students, this matrix-making aims to provide the students with an opportunity to review their local natural environment and rethink how those functions are related to themselves in their past or in their everyday experience. Such an approach based on social constructionism encourages learners to use active techniques to create more knowledge and then to reflect on and talk about what they are doing and how their understanding is changing. It can even help learners to continuously assess their learning activities by themselves in the future.

2.2.5 Group Discussion and Questionnaire

Once the groups completed their matrix-making task, we provided time for group presentations and discussions among all groups. All the groups were to give the reasons why they placed each ES function in each quadrant, in order to give them a chance to compare their choices of placement and reasoning through peer-learning.

At the end of the workshop, we conducted a small paper-based questionnaire to ask in which topics the participant...
students were interested, as well as about their background in volunteer experience. The questionnaire included 1) general questions about whether the workshop contents were easy to comprehend, 2) in which topics they were interested, 3) one topic out of the workshop that they found interesting enough to tell other people, and 4) volunteer experiences. The responses were collected on site.

3. RESULTS

3.1 Grouping

Participants were divided into five groups according to their responses to the question in the icebreaking session, “What’s the first thing that comes to mind when you hear the word, ‘water’?” Based on their answers, we had 5 groups: group ‘CLIMATE’ (5 students), group ‘FISH’ (4 students), group ‘LIFE’ (3 students), group ‘RIVER’ (4 students), and group ‘FEELING’ (3 students).

Group CLIMATE had participants who thought of ideas relating to weather, climate or other meteorological phenomena. Group FISH had participants who answered with common names of fish. Group LIFE had participants whose answers were related to practical activities in their daily lives. Group RIVER consisted of participants who gave answers relating to rivers, lakes, or oceans. Finally, participants who responded with visual aspects or colors were in a group dubbed FEELING. In these groups, the students worked together on locating each function of ecosystem services on a matrix.

3.2 Matrix of Subjective Evaluation – by Group

Fig. 4a to Fig. 4e show all the resulting matrices produced by the five groups. By and large, their evaluations and their reasons reflected a modern lifestyle. The following section gives the characteristic evaluations by each group.

3.2.1 Group CLIMATE

This group evaluated most of the ES functions as important and placed them in either quadrant I or II. They evaluated all the functions of provisioning services except hydropower potential (No.6), as “important” and “feel close”, hence placing them in quadrant I. They placed many regulating services (flood and drought mitigation (No.7), self-purification (No.8), climate mediation (No.10), aquatic habitats (No.11), ecotone buffer capacity (No.15), and fertile lands (No.16) in quadrant II, i.e., identifying it as “important” but it “feel not close” to them subjectively. As for cultural services, they evaluated recreation value (No.18) and educational resources (No.21) as important. Fig. 4a showed their evaluation and the placement of each ES function.

3.2.2 Group FISH

They placed many of the functions/capacities of ES in quadrant II, “important” but “feel not close” to it. As for regulating services, this group placed only sound water quality (No.13) and health promotion (No.14) as “important” and “feel close” subjectively (I), while the rest were placed in quadrants II and III, that is, they felt “not close” to these functions. They evaluated educational resources (No.21) of cultural services as highly “important”. They evaluated the remaining three cultural services, aesthetic and scenic values (No.17), recreational values (No.18), and spiritual values (No.20), as “less important”, although they “felt subjectively close”. Fig. 4b shows their evaluation and placement details.

3.2.3 Group LIFE

Their placement of ES functions showed the reflection of practicality in their own daily lives. They evaluated water supply (No.1), fish (No.2), diverse food-chains (No.12) as “important”. Wood/fiber (No.3), fuel (No.4), and hydropower potential (No.6) were evaluated as “less important” and/or “felt not close” (III/IV). No cultural services were evaluated as “important” by this group. Their evaluations are given in Fig. 4c.

3.2.4 Group RIVER

Their evaluation for provisioning services was similar to that of group LIFE. This was the only group which evaluated navigation routes (No.9) as “important”. They evaluated flood and drought mitigation function (No.7) and climate mediation (No.10) as “less important” and “feel not close” to the students subjectively (III). They placed aesthetic and scenic values (No.17) and educational resources (No.21) in quadrant I, acknowledging it as “more important” and “feel close” to the students personally. Their evaluations are shown in Fig. 4d.

3.2.5 Group FEELING

This group placed the most functions of ES in either quadrant I or III. This is the only group that evaluated fish (No.2) as “less important” and “feel not close” (III), while the other groups placed it in quadrant I. Also, they evaluated fertile lands (No.16) as rather more “important” and “feel close” (I), whereas the other groups placed it in quadrant II. Like group RIVER, group FEELING evaluated climate mediation (No.10) as “less important” (IV) and regarded educational resources of cultural services as “important” (I).
3.3 Group Discussion – Reasons and Peer-Learning

Each group presented their evaluation matrix and the reasons for it. This section gives some characteristic differences found in their reasons of evaluation.

For provisioning services, their expression and wording were simple and direct, but they were reflections of socio-economic trends of their own lives. Especially regarding water supply (No.1), fish (No.2), and crop irrigation (No.5),

More details are given in Fig. 4e.
all of the groups gave the same reason that they simply need them for drinking and eating, thus evaluating them as “highly important” and “feel close”. For wood/fiber (No.3), fuel (No.4) and hydropower potential (No.6), group LIFE evaluated them as “less important” and “feel not close” (III) because they do not have physical access to these resources in their everyday lives. On the other hand, group CLIMATE evaluated wood/fiber (No.3) and fuel (No.4) as “important” and “feel close” (I), citing reasons that they use books, notebooks and stationery tools made from wood/oil, they use transport that require fuel, as well as their need for kerosene for heating in winter. This shows that the students in group LIFE made evaluations based on ‘their own’ daily activities, while the students in group CLIMATE gave evaluations with wider viewpoints and attention not only to the production process but also to their lives throughout the year.

With respect to regulating services, discussion was focused on the functions related to disaster risk reduction, namely, flood/drought control (No.7), climate mediation (No.10), and buffer zone capacity (No.15). It was agreed by all the groups to conserve the natural environment with such functions. However, they said that they were not sure about exactly which natural resources in their area they should conserve for those functions. Also, they gave a reason that the scale of those functions is too large for them to realize whether such functions are really happening. For example, group RIVER evaluated climate mediation (No.10) as “less important” and “feel not close” (III) because they thought that it was a global-level issue and there may not be much they can do about it at local level. Other groups responded that it is a global issue, but that Japan as well as Shiga are a part of this world, hence, our actions do make a difference. Exchanging these opinions, the participants came up with an idea that they need to know our actions do make a difference. Exchanging these opinions, the participants came up with an idea that they need to know

Other students looked a little puzzled, but gave several answers from their learnings and understanding through their past EE experiences, i.e., “the endemic species exist only in Lake Biwa, and they have lived there for hundreds of years, they are an important part of the local culture. Besides, our way of living influences their survival, so we should protect them.” This indicates that there was a good level of peer-learning and dialectic occurring in this workshop. This helped students to recognize and comprehend the relationship between human society and natural resources, thus, realizing that scientific concepts and the spontaneous concepts of students are indeed met. This exercise helped students to develop a deeper understanding and appreciation for their natural environment.

Reasons for evaluation of cultural services were similar among all the groups. Only groups RIVER and FEELING evaluated aesthetic/scenic and recreational values (No.17) (No.18) as well as educational resources (No.21) as “rather important” as they provide students with a relaxing environment and learning targets. Religious sites (No.19) and spiritual values (No.20) were evaluated as neither “important” nor “feel close” (III) by all groups because they do not have such practices at all.

By and large, differences in evaluation seemed to have derived from the range of their viewpoints, more precisely, the extent of their recognition of the linkages between their daily activities, society, and ecosystems.

3.4 The Most Interested Topics

Six participants selected ES as an interesting topic in the workshop. 2 students in group RIVER found local historical disasters (LHD) interesting. 6 students felt they were likely to share ES topics with other people outside the workshop. There were no students who selected ES and LHD for both interesting topics and topics to share with other people (Table 2).

We took a look at a cross-examination of their volunteer experience with the topics that they found interesting in this workshop and want to share with other people. This is to grasp if their interested topics differ depending on their volunteer experience, namely social interaction. Overall, more students without volunteer experience found the topic of Ecosystem Service more interesting (33%) than the students with volunteer experience (12%). Students who had volunteer
experience showed a modest interest in discussion (28%) and group work (matrix-making) (26%) (Fig. 5). We also examined the relation between their volunteer experience and the topics that they want to share with other people outside of the workshop with a chi-square test. As a result, we found both factors to be significantly related at $\chi^2 = 12.390$, df = 5, $p = .03$ ($p < .05$). On the other hand, concerning the relation between their volunteer experience and the topics that they found most, second-most, and third-most interesting did not show any significant difference.

4. DISCUSSION

It was found in the group matrix-making activity that students’ perceptions of functions of provisioning services shared a similarity to highly regarded economic values and their own daily activities. This may refer to what Hartel et al.20 pointed out; that is, focusing too much on provisioning services may cause a risk in which short-term socioeconomic interests may harm other important ecosystem services. It was found that the students’ viewed regulating services, especially functions related to disaster risk mitigation, as “more important” but did “not feel close”. It suggests that they prioritize functions that protect their safety from the disaster risks, but they actually do not consider such disaster risks as risks to their own personal well-being. Rather, such functions are thought of as irrelevant to them, hence, they do not “feel close” with such functions. Two students in group RIVER showed their interest in local historical disaster topics. This can be interpreted as they recognized both the benefits and risks of rivers, as the given local disasters in the workshop were floods. Cultural services tended to be evaluated as “less important.” This also means that the students’ viewpoints were rather weighted in favor of socio-economic interests as individual or daily practices. Though they understand their way of living influences the survival of other living things, their practical understanding of both socio-economic and socio-ecological linkages may need to be reinforced.

Table 2  Participating students’ answers to the icebreaking question (general idea of water), interested topics, and volunteer experience

| Group | Student | Answer to icebreaking | Most interested topic | 2nd most interested topic | 3rd most interested topic | Volunteer experience |
|-------|---------|-----------------------|-----------------------|--------------------------|--------------------------|---------------------|
| Climate | S1 (f) | Rain | WC | OW | DS | Cleaning the river |
| | S2 (f) | Ice | G | WE | DS | Reed conservation, water quality survey |
| | S3 (f) | Rain | G | DS | D | Eco Club |
| | S4 (f) | Snow | D | DS | ES | Cleaning activities |
| | S5 (f) | Water drop | D | ES | No | |
| Fish | S6 (m) | Goat fish | BB | WC | D | J1 proposal to the prefectural Assembly (aquatic plants) |
| | S7 (f) | Aya sweet fish | ES | ND | WE | No |
| | S8 (m) | Shiromi clam | ES | D | G | No |
| | S9 (f) | Water birds | G | D | ES | No |
| Life | S10 (f) | Tap water | ND | G | D | Water quality survey, the Red Cross seminar for youth |
| | S11 (f) | Drinking water | ND | ES | G | No |
| | S12 (f) | Washing | D | HL | DS | No |
| River | S13 (f) | Lake Biwa | G | D | ES | Water quality survey |
| | S14 (f) | River, ocean | G | D | LHD | Attended a water environment summit |
| | S15 (f) | The Yodo River | D | G | WC | Water quality survey, Conservation of aquatic plants |
| | S16 (f) | The Yasu River | WC | BB | LHD | No |
| Feeling | S17 (m) | Cold, refreshing | G | ES | D | Events to remove invasive plants |
| | S18 (f) | Blue | G | D | ND | Events to remove invasive plants |
| | S19 (f) | Clear/Transparent | n/a | n/a | n/a | |

Legend: S=student OW = Origin of Water WE = Water on the Earth HL = history of Lake Biwa (m)=male WC = Water Cycle BB = Lake Biwa Basin ES = Ecosystem Services (f)=female G = Group Work D = Discussion LHD = Local Historical Disaster ND = “Near water” and “Distant water” DS = Drone Shooting

Fig. 5  Interested topics and volunteer experience

with volunteer exp. (%) 26 28 11 15 40
without volunteer exp. (%) 33 4 4 4 4 4 4

- ORigine of water
- OWater on the Earth
- WE Water Cycle
- BB Lake Biwa Basin
- ES Ecosystem Services
- GNear water’ and ‘Distant water’
- DS Drone Shooting
- DGroup work
- HLHD Local historical disaster

Subjective Evaluation of Local Natural Resources with the Concept of Ecosystem Services 425
ES was selected more as an interesting topic in the workshop and the topic to share with other people outside the workshop by students without volunteer experience. These results tell us that the workshop gave them an opportunity to meet a variety of opinions on local natural resources. We interpret these that this workshop played a role as social interaction through discussing with their peers. Meeting a variety of opinions and views on ES should be connected to a willingness to have more social interaction. The chi-square test also showed a significant relation between topics that students were willing to share and students’ volunteer experience.

We could not establish a decisive relation with past EE experience, ES evaluation, and local historical disasters; nevertheless, we managed to draw out the subjective extent to which the students regard ES functions related to disaster risk reduction. The workshop led them to recognize that they need to learn more about their respective local environments for such disaster risk functions in order to conserve them and to find subjective connections with them as individuals.

The workshop led the students to recognize long-term functions, relationships and interactions of human activities and ecosystems, as well as benefits we gain from natural resources and risks (disasters) through co-working, dialogue, and diverse learning topics. In this way, it might be possible to develop EE methods for learning about the two sides of nature (benefits and risks) in a given area in order to work towards local sustainability. This would support points made by previous studies (e.g., Fujioka11, 12).

In this time of required paradigm shift, an ecosystem-based approach or ecosystem-thinking, “in which all components of the ecosystem (including humans and human activities) and all known factors affecting them are considered and evaluated”13, is going to be the most important. Utilizing the holistic characteristics that ecosystem approaches possess will enable us to find new environmental problems or re-structure the existing issues as well as to create a stronger framework to cope with those complexities2, 14. The method using ES may be a good entrance point for educating the young generation, such as high school students, before facing new problems or such paradigm shifts in their local areas, so that they can learn to share their views. Their learnings from EE methods like this workshop in their early years will help them to learn to think about how to make the most of resources, for the sound sustainable development of their local areas.

5. SUMMARY

This report analyzed the results of the workshop on ecosystem services targeting high school students in Shiga Prefecture, where EE related to Lake Biwa has been promoted for many years. We summarize it as follows:

- Ecosystem services can be an effective topic to review and develop concepts of socio-economic as well as socio-ecological connections as individuals.
- A workshop with matrix-making and extensive discussions can play an important role of building social interaction skills through peer-learning.
- Further study using quantitative analysis is needed to measure the relation and to what extent subjective evaluation of ecosystem services, personal experiences, and awareness of disaster risk reduction are related.

Such a method of employing a “workshop” approach on ES for youth and outcomes could possibly be applied in consensus building processes in local natural resource conservation and sustainable development planning with a hint of disaster risk reduction viewpoints of other local areas in the future.

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NOTES

Note 1) The United Nations World Youth Report defines ‘youth’ as persons aged between 15 and 24.

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426 農村計画学会誌 Vol. 38, No. 3, 2019年12月
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Subjective Evaluation of Local Natural Resources with the Concept of Ecosystem Services 427