Ramsar Wetlands-Rice Paddies and the Local Citizens of Osaki-Tajiri Area as a Social-Ecological System in the Context of ESD and Wetland CEPA

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Abstract

The midway point has arrived of the Decade of Education for Sustainable Development (DESD, 2005-2014) launched to advance the goals of Education for Sustainable Development (ESD). Also, the Wetland Convention's Communication, Education and Public Awareness (CEPA) Program has begun its third 6-year program, ending in 2015. The results of these two programs, a mix of successes and obstacles, have relevance for ecological sustainability knowledge acquisition and the subsequent sustainable use or 'wise use' of natural resources within and across scales.

This paper attempts to reflect on the wetland CEPA (WCEPA) program of Osaki-Tajiri, near the Kabukuri, Izu and Kejo wetlands, from the perspective of ESD. It also tries to identify ESD-related WCEPA learning processes, interrelations and interactions of the WCEPA program with the biophysical/ecological components of the wetland-paddy rice ecosystem and the outcomes, including co-benefits. Examples of activities or social-ecological interactions that portray an adaptive co-management and co-benefit approach toward sustainability are identified. Using ESD principles, WCEPA needs to improve its future activities to bring about an overall increase in resilience of the Osaki-Tajiri social-ecological system and, simultaneously, achieve its sustainability targets/goals.

Key words: ESD, Greater Sendai RCE, Ramsar wetland, rice paddy, social-ecological system, Wetland-CEPA

1. Introduction

Environmental deterioration, particularly that due to global climate change, is expected to exacerbate the loss and degradation of many wetlands and lead to the loss of biological species in many regions. Increases in alien invasive species and excessive nutrient loading are additional problems expected to pose a growing threat to these wetlands (MA, 2005; EEA, 2005). Because environmental protection is critical for the continued use of wetlands, which are an essential natural resource for human well-being, calls are increasing for development and implementation of strategies and plans that will allow human societies to deal with changing wetland ecosystems more effectively. The requisite adaptation strategies must focus not only on coping with or reducing the biophysical drivers of change through political reforms and codes of organizational practice but also on personal behavioral changes, for which capacities to think critically, analyze problems and reflect on current understanding must first be fostered (Fazey *et al*., 2009). These capacities are acquired through formal, non-formal and (to some extent) informal learning. Strengthening the implementation of Education for Sustainable Development (ESD) – related and the Wetland Convention's Communication, Education and Public Awareness (CEPA) programs could enhance the resilience of the local people. When the acquired knowledge and skills are, in turn, applied to sustainable use of the wetlands resources by the entire 'community of practice' (Reed *et al*., 2010), the resilience of the ecosystem – as well as its link with humans that depend on it – could be maintained or even increased. Through lifelong learning (individual, social, experiential, cognitive, etc.) for sustainability, local people gain an opportunity to explore how complex socio-economic systems can achieve both continuity in the short to medium term and ecological integrity in the long term.

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2. Wetland CEPA and ESD

2.1 Wetlands

Wetland ecosystems are estimated to cover more than 9% (1,280 million hectares) of the Earth's land surface. It is generally estimated that more than 50% of the world's original wetlands have been destroyed or degraded globally in a relatively short period of time, for example during the twentieth century in parts of North America, Europe, Australia and New Zealand (TEEB, 2008; MA 2005). Water determines wetland formation, processes and characteristics and wetlands have diverse physical characteristics and geographical distributions. They are critical resources important for delivering a wide range of ecosystem goods and services including regulating, provisioning, livelihood services and cultural services that contribute to general human well-being (MA, 2005; Fiksel, 2006; López-Hoffman *et al*., 2010). Wetlands, such as mangroves and floodplains, can play a pivotal role in the physical buffering of climate change impacts. They can also contribute to the economic well-being of the local citizens. When both the marketed and non-marketed economic benefits of wetlands are included, the total economic value of unconverted wetlands is often greater than that of converted wetlands (Washitani, 2007; MA, 2005; Costanza *et al*., 1997). Although the rate of wetland loss seems to have slowed down, particularly in some industrialized countries (Hotes, 2007), and despite an increasing global awareness of their importance, wetlands continue to face serious threats of loss and degradation owing to human activities. In fact, the degradation and loss of wetlands and the associated species is more rapid than that of other ecosystems (MA, 2005; GACGC, 2001).

2.2 Wetland Communication, Education and Public Awareness (WCEPA) program

Through its 'wise use' concept and its accompanying wetland communication, education and public awareness (WCEPA) program, the Convention on Wetlands (also called the Ramsar Convention, after the Iranian city where it was signed in 1971) may halt, at least in part global wetland degradation. The mission of the Convention on Wetlands is "the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world" (Ramsar Secretariat, 2007). As of December 2010, 160 nations have joined the convention as Contracting Parties and more than 1,911 wetlands around the world, covering nearly 187 million hectares, have been designated for inclusion in the Ramsar List of Wetlands of International Importance (Ramsar Secretariat, 2010). The first WCEPA program (Resolution VII.9) gave a call for the development and implementation of action plans for WCEPA. The second WCEPA program (Resolution VIII. 31) which was adopted by the 8*th* Conference of the Contracting Parties (COP8) in Valencia, Spain, in 2002 was intended to operate for the period 2003-2008. The latest WCEPA program (Resolution X.8), adopted at COP10 in 2008, in Changwon, Korea reiterates the call for Parties to formulate their own WCEPA Action Plans for priority activities that address international, regional, national, and local needs (Ramsar Secretariat, 2008). Although only five countries, namely Australia, Germany, Hungary, Spain and China have submitted their National WCEPA Action Plans to the Ramsar Secretariat as of 2009, Japan and other countries are currently working towards that goal (Ramsar Secretariat, 2010).

The wise use concept of wetlands is about maintaining their ecological character through the implementation of ecosystem approaches within the context of sustainable development (Ramsar Secretariat, 2005). It depends on the recognition of the ecological functions of wetlands, which can be of value in multiple economic and non-economic ways to human society (MA, 2005). It is important to note that the Millennium Assessment's (MA) conceptual framework for ecosystems and human well-being provides a structure that supports the promotion and delivery of the Ramsar Convention's "wise use" concept, thus enabling the guidance provided by the Convention to be expressed within the context of human well-being and poverty alleviation. There is also an emerging CEPA Work Program for the Convention on Biological Diversity (CBD), and discussions are underway on a work program on education, awareness and participation for the United Nations Framework Convention on Climate Change (UNFCCC) (MA, 2005). Both programs, related to biodiversity conservation and climate change mitigation, respectively, will serve the overall protection of and enhancement of the integrity of wetlands.

In some regions, particularly at the newly adopted Ramsar sites, official adoption of WCEPA into the wetland ecosystem conservation and restoration programs in the locality has been preceded by ESD-based program activities. In other instances, WCEPA activities have been present but low-key such that they are not widely known relative to ESD-based programs in the area, as occurs in RCE Greater Sendai.

2.3 Education for Sustainable Development (ESD)

ESD, comprising formal, non-formal and informal sectors of education is about developing the knowledge, skills, understanding and values to participate in decisions about changes in lifestyles and behaviors that will improve the quality of life now and sustain the planet in the future (Goldstein, in Ofei-Manu, 2007). ESD provides the opportunity to address sustainability challenges by integrating the principles, values and practices of sustainable development (SD) directly into education. ESD is a lifelong learning process, holistic and interdisciplinary (McKeown, 2002) in nature (IGES, 2005). ESD is values-driven and built on principles of critical thinking and problem solving. It is a multi-method concept involving different pedagogies and participatory decision making; it has applicability in day-to-day personal and professional life (IGES, 2005) and is locally relevant.

ESD's implementation is informed by diverse philosophical currents and orientations that include philosophies of education and environmentalism (Babikwa, 2004), the understanding and implications of which are crucial to the sustainability concept.

Originally, ESD was described in Chapter 36 of Agenda 21 of the United Nations Conference on Environment and Development (Rio de Janeiro, June 1992) with the main thrusts of (1) improving basic education, (2) reorienting existing education programs, (3) developing public awareness and understanding about sustainability and (4) training (UNESCO, 2003). A proposal for a Decade of ESD – spearheaded by the Japanese government and NGOs – was included in the Johannesburg Plan of Implementation, which was agreed at the World Summit on Sustainable Development in 2002. This led to the initiation of the UN Decade of ESD (2005-2014) and the emergence of ESD as a global movement (Nomura & Abe, 2009). The ultimate goal of the UN Decade of Education for Sustainable Development (DESD) is to integrate the principles, practices and values inherent in sustainable development into all facets of learning to encourage changes in behavior, and organizational and institutional practices that allow for a more sustainable and just society for all (UNESCO, 2007). This goal is being pursued by an array of stakeholders at various levels: UN organizations and programs, national governments, international and national NGOs and individual activists (de Haan *et al*., 2010). In search of a strategy that would facilitate translation of the ESD agenda at the local level, the United Nations University (UNU) has championed the establishment of Regional Centres of Expertise (RCE) and has supported RCEs around the globe. The Greater Sendai RCE is one of the pioneers, established in June 2005. The RCEs were charged with several responsibilities, *i.e*., to serve as a framework for harnessing, exchange and facilitation of vertical, horizontal and lateral integration of knowledge and information through close cooperation among the constituent regional and local actors in a region or local area (Fadeeva *et al*., 2005; Mochizuki *et al*., 2005).

2.4 Comparisons of WCEPA and ESD-based programs

Table 1, which compares characteristics of the WCEPA and ESD-related programs, shows that they have some educational principles in common. It also points out opportunities for strengthening WCEPA using ESD principles and thus advancing the sustainability concept.

The WCEPA program and ESD can be implemented in formal, non-formal and informal education settings. They both deal with the concept of sustainable resource use, with WCEPA focusing on "wise use" of wetlands and ESD dealing more broadly with learning that takes into account the ecological, social, cultural and economic dimensions of sustainable development. There are also similarities in their core thrusts and objectives. Differences, however, exist. WCEPA is meant to support the implementation of the Wetland Convention (Ramsar Secretariat, 2008). It consists of "the tools for placing people's social, political, economic and cultural realities within the context of the goods and services *provided by wetland ecosystems*" (Ramsar Secretariat, 2007). This suggests its relatively 'narrow' or specialized nature. ESD, in contrast, is based on values, principles and practices of sustainability (de Haan *et al*, 2010; McKeown, 2002). It is broader in scope, creating space to address complex issues that are linked to the socio-cultural, economic and environmental aspects of well-being. In principle it is applicable to all ecosystems. In addition, by virtue of its scope, in addition to sustainable resource use, ESD also addresses cross-cutting issues such as gender, human rights, ethics and environmental security. With respect to scale, ESD – more than WCEPA – is linked from the local to the regional to global levels through the RCEs. RCEs can facilitate the duplication and dissemination of good ESD practices. For example, the Greater Sendai RCE started an annual meeting of national and regional (Asian) RCE youth leaders, as a platform for exchange and collaboration for ESD activities among the youth in Japanese and other Asian RCEs. The more "specialized" WCEPA, which has also been adopted by a couple of UN bodies or conventions (MA, 2005) in contrast, might have simpler target objectives. It avoids the complexities the broader ESD agenda might face during its implementation and requires less logistics and fewer personnel. The table might be useful in offering guidance in situations where consideration is being given to adopting the WCEPA program, an ESD-based practice or both, particularly for a Ramsar site and in circumstances where funding and resource personnel are limited.

3. The Case of Osaki-Tajiri, Miyagi Prefecture

3.1 Kabukuri, Izu and Kejo Wetlands

Japan has lost 61% of its wetlands over the past 100 years; Miyagi Prefecture lost 92%, most of which were converted to rice paddies (Kurechi, 2007). The losses of natural wetlands and qualitative changes in rice paddy environments have had major negative impacts on wetland-dependent species, as dry paddies are found not to be very useful to wetland wildlife. Contrary to the earlier practice of retaining water in paddies during winter, functioning as semi-natural yet important habitat for wetland-dependent wildlife, paddies in modern times have been robbed of their wetland functions when fields are left to dry out completely during winter. This has helped drive many wetland species including the Japanese Crested Ibis and the White Stork towards extinction.

The Ramsar site "Kabukuri-numa and the Surrounding Rice Paddies" in Miyagi Prefecture, Japan, is the 1,545th wetland to be added, in November 2005, to the Ramsar Convention's "List of Wetlands of International Importance" dedicated to the conservation and wise use of wetlands. Together with Izu-numa and Kejo-numa, both of which were added to the List in 2008 and are

Table 1 Comparison of the educational characteristics of the Wetland CEPA program and the ESD concept.

	CEPA	ESD
Basic description	Educational outreach program to support the implementation of the Wetland Convention (Ramsar Secretariat, 2008)	Education (learning process) for the advancement of the sustainable development concept based on values, principles and practices of sustainability (de Haan *et al*., 2010; other references)
Origin	Convention on Wetlands in Ramsar Iran in 1971	Chapter 36 of Agenda 21 (1992 Rio Earth Summit) where arguments were consolidated on the important role of education in achieving sustainable development
Date of inception	1999-2002 CEPA I (Resolution (VII.9) 2003-2008 CEPA II (Resolution VIII.31) 2009-2015 CEPA III (Resolution X.8)	Earlier than 2005 but became operational as a global education initiative with the launch of DESD (2005-2014)
Core thrusts	Communication, education, public awareness	Quality basic education, re-orienting the educational curriculum, awareness creation and training in all sectors (Chapter 36 of Agenda 21)
Core objective	Capacity building, using CEPA for promotion of valuing and wise use of wetlands	"To develop the knowledge, skills, perspectives and values that will empower learners of all ages to assume responsibility for creating and enjoying a sustainable future" (Richmond, 2010, p.19)
Adoption by other conventions or UN bodies	Adopted by CBD; adoption by UNFCCC in progress; 'wise use' concept supported and promoted by MA conceptual framework	The designated lead agency of DESD is UNESCO. The UN Inter-Agency Committee on DESD has been established. The UNU's RCE initiative facilitates ESD implementation at the local/regional level.
Implementation and adoption of national action plan in Japan	Not yet adopted and implemented; there is action at the local level, though	Adopted and implemented
Framework/medium for capacity building	Wetland education centers for learning and training about wetlands and wetland-related CEPA, *e.g*., Kabukuri Wetland Club	Elementary and secondary schools, higher education institutions, NGOs, community learning centers, etc.
Scope (types) of education	Formal, non-formal and informal	Formal, non-formal and informal education
Sectoral operation in Osaki-Tajiri area	Currently more 'established' in the non-formal sector	More popular in the formal sector and to some degree, the non-formal sector
Scope of coverage	Mainly limited to/'specialized' in dealing with wetlands at the moment	Applicable to all ecosystems; more generalized
Scope of scale	Heavily local currently and relatively less focused, though its activities are to address needs from local to global levels	More consistently linked from the local to regional to global level (*e.g*., through the RCEs and the DESD Secretariat)
Time of operation in Kabukuri, Kejo and Izu Ramsar sites	2005 to present, preceded by a form of environmental education; although an international CEPA workshop was held in 2000 (KWC, 2009)	2005 to present; preceded by a form of environmental education
Synergistic potential	Its degree of specialization will aid stakeholders of nearby ecosystems who might want to implement a similar program but are already using the more generalized ESD	Being broader in scope, might address more issues related to a sustainable society; could allow WCEPA to draw on its principles and practices
Effectiveness of program's governance of the local system	Relatively less established	More established with the backing of international organizations (*e.g*., Greater Sendai RCE)
General performance from inception until now	Mixed results at the local level where it mainly operates; requires improvement	Mixed results at both local, and regional levels, requires improvement

located in the same area, they form the "Ramsar Triangle" ("*numa*" literally means marsh in Japanese). Kabukuri-numa was the first Ramsar site to include the surrounding rice paddies as an agro-wetland buffer zone to an open-water wetland (Kurechi, 2007; KWC, 2009). Kabukuri-numa is a wintering site for the white-fronted goose and the Middendoff Bean Goose and has 409 plant species and 219 bird species. Kejo-numa, where 112 bird species have been confirmed, serves as a wintering site for the Thick-billed Bean Goose, White-Fronted Goose, Baikal Teal and Whooper Swan and has over 700 plant species (KWC, 2009). Hundreds of thousands of migratory birds, particularly geese, swans and ducks, use these wetlands in winter hence making the area an ecotourism attraction. The wetlands also support a wide range of biological diversity (Washitani, 2007). In addition to being declared a Ramsar site, it is an area that had been subject to a range of policy plans and protection efforts (Kurechi, 2007).

3.2 ESD and WCEPA programs as resilience-building tools for Osaki-Tajiri inhabitants-wetlands (social-ecological) system

Human communities and the wetlands they most strongly affect can be viewed as integrated socio-ecological systems (Pinkerton, 2009). The "Ramsar Triangle" and the people of Osaki-Tajiri can therefore be analyzed from that perspective. Learning to enhance adaptive capacity – the capacity of actors, both individuals and groups, to respond to, create and shape variability and change in the state of the system (Chapin III *et al.*, 2009) – is a crucial element for maintaining the resilience of the system. Resilience is defined as the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain its function, structure, identity and feedbacks (Chapin III *et al*., 2009; Folke *et al*., 2005). Resilience reflects the degree to which a complex adaptive system is capable of self-organization and the degree to which the system can build capacity for learning and adaptation (Adger *et al*., 2005). The strategies for improving resilience include broadening knowledge sources including local knowledge, co-production of knowledge through 'social learning' and other forms of learning, all of which result in increasing human ability to cope with change (Fazey *et al*., 2007) and uncertainty. WCEPA and ESD-based programs can enhance local stakeholders' knowledge about the relationships between a wetland's biophysical system (including its hydrological system, watershed (nutrient) loadings, water clarity, use by migratory birds, etc.) and socio-economic activities (including land-water use, such as rice paddies), other ecosystem goods and services, recreational activities, local policies in the context of the role of the wetlands in the political and socio-economic dynamics in the region, economic growth through ecotourism and the sale of the more valuable organic produce (particularly rice). Thus such programs constitute a crucial part of restoring balance to the socio-ecological system.

3.3 Wetland-related social learning activities in Osaki-Tajiri

The Greater Sendai RCE in Miyagi, Japan has been coordinating its ESD practices in Osaki-Tajiri through collaboration and partnerships among many stakeholders such as (a) local authorities, farmers, teachers and students from the elementary, junior high and high schools in the area, (b) NGOs: Rice Paddies (*Tambo*), Japanese Association of Wild Geese Protection, (JAWGP) and Kabukuri Wetlands Club (*Numakko Kurabu*), and (c) Miyagi University of Education Environmental Education Centre, all representing formal, non-formal and informal education contexts in the region. The Miyagi University of Education has served as the secretariat of RCE Greater Sendai since its establishment in 2005. The RCE's objectives and focal points of activities have been location-specific: attempts have been made to introduce the concepts of enhanced community participation (school-community partnerships) and community development grassroots movement or the use of a community-based approach to social change ('*machi zukuri,*' *i.e*., 'town building') (Mochizuki, 2006). The current focal points of activities, each including several actors, are:

1) Sendai City: Under the umbrella of the Forum for Environmental Education and Learning in Sendai (FEEL Sendai) and other platforms including "Environmental Forum, Sendai," "Citizens' Forum," "Sendai Eco-challenge," "Social Experiment on the Environment" and "*Mori Mori* Environment Rescue Team Program," the aim is to raise the awareness of one million citizens regarding values and activities that lead to environmentally-friendly behavior for achieving a sustainable society. In addition, the Miyagi University of Education Environmental Education Centre, through education, research and outreach activities, attempts to assist in the development, dissemination, implementation and evaluation of sustainability education programs focusing on elementary and secondary school teachers and students in the city (Mochizuki, 2005).

2) Kessennuma City has ESD partnerships, particularly in the city schools. It also has a partnership in sustainable community development with respect to promotion of fresh, locally produced food.

3) Osaki-Tajiri Area: This area is the focus of this paper. Since its inception in 2005, the Greater Sendai RCE has been working with the local people, to equip the local community with competencies to adopt ways in which the natural environment can coexist with their human needs. This is done in three ways: (a) conservation and wise use of the wetlands in the area, (b) enhancing the conservation value of rice paddies as replacement habitat for wetland flora and fauna, while strengthening the linkages between the winter-flooded rice fields and conservation movements and formal education actors in the locality and (c) recovery of the socio-ecological integrity and enhancement of human well-being in the region. In the same vein as RCE Greater Sendai, a few local NGOs, *i.e*., Kabukuri Wetlands Club (*Numakko Kurabu*), Rice Paddies (*Tambo*) and Japanese Association for Wild Geese Protection (JAWGP) whose activities are considerably tilted towards the WCEPA program and aim at promoting the value and wise use of wetlands, have been working with farmers, teachers, students and local citizens.

These activities can be described as (a) knowledge transfer and exchange, hence co-production of knowledge, as evidenced in Example 1 below, (b) experiential and cognitive learning through 'citizen participatory research,' demonstrated in Example 2, and (c) awareness creation as shown in Example 3. They have helped the participants to acquire some level of sustainability knowledge, particularly ecological knowledge relevant to the local ecosystem.

Three examples of social learning activities in the Osaki-Tajiri Ramsar area, promoted by the ESD-based and WCEPA programs, are presented below.

Example 1:

A multi-stakeholder team project involving students, farmers, researchers, local wildlife preservation organizations, schools and NGOs. The participants conducted experiments on farms next to the Kabukuri-numa and Izu-numa wetlands. They tested how leaving winter-flooded rice fields fallow after the fall rice harvest until the following spring had an effect on the enhancement of biodiversity and improvement in the quality of the agricultural lands over a number of winter seasons (1998/99–2005/06), as compared to conventional fields.

Figure 1, largely emanating from the Osaki-Tajiri case and to a limited extent from the literature shows the ESD/WCEPA-linked social learning processes among the stakeholders, their interrelations and interactions with the biophysical/ecological components and the corresponding outcomes including co-benefits in the Kabukuri-numa/rice paddy ecosystem in connection with the nearby ecosystems. The main objective of the program was capacity building through learning for sustainable or 'wise' use of the wetlands-paddies' goods and services.

The results showed winter-flooded paddies to be an ideal environment for waterfowl like wild geese and ducks for their feeding, nesting, resting and other activities in the area. There was also an enhancement of the wetlands' biodiversity due to an increase in plant and animal species (Fig. 1). Other possible benefits included nourishment of the water table, purification of polluted water, elimination of greenhouse gases, improved pest management and prevention of cadmium absorption (JAWGP, 2005).

As a form of knowledge transfer partnership, farmers, students and local citizens have been supported by researchers from tertiary educational institutions including Tohoku University, Miyagi University of Education and Miyagi Institute of Agriculture as well as local paddy-field wildlife organizations, namely *Tambo* and JAWGP. The tertiary institution researchers in turn received local/traditional ecological knowledge (TEK) from the stakeholders, particularly the farmers, resulting in co-produced knowledge (Fig. 1). Suzuki and Murakami (2009) cited non-formal traditional knowledge transfer from the past to the present as one of the crucial ways of

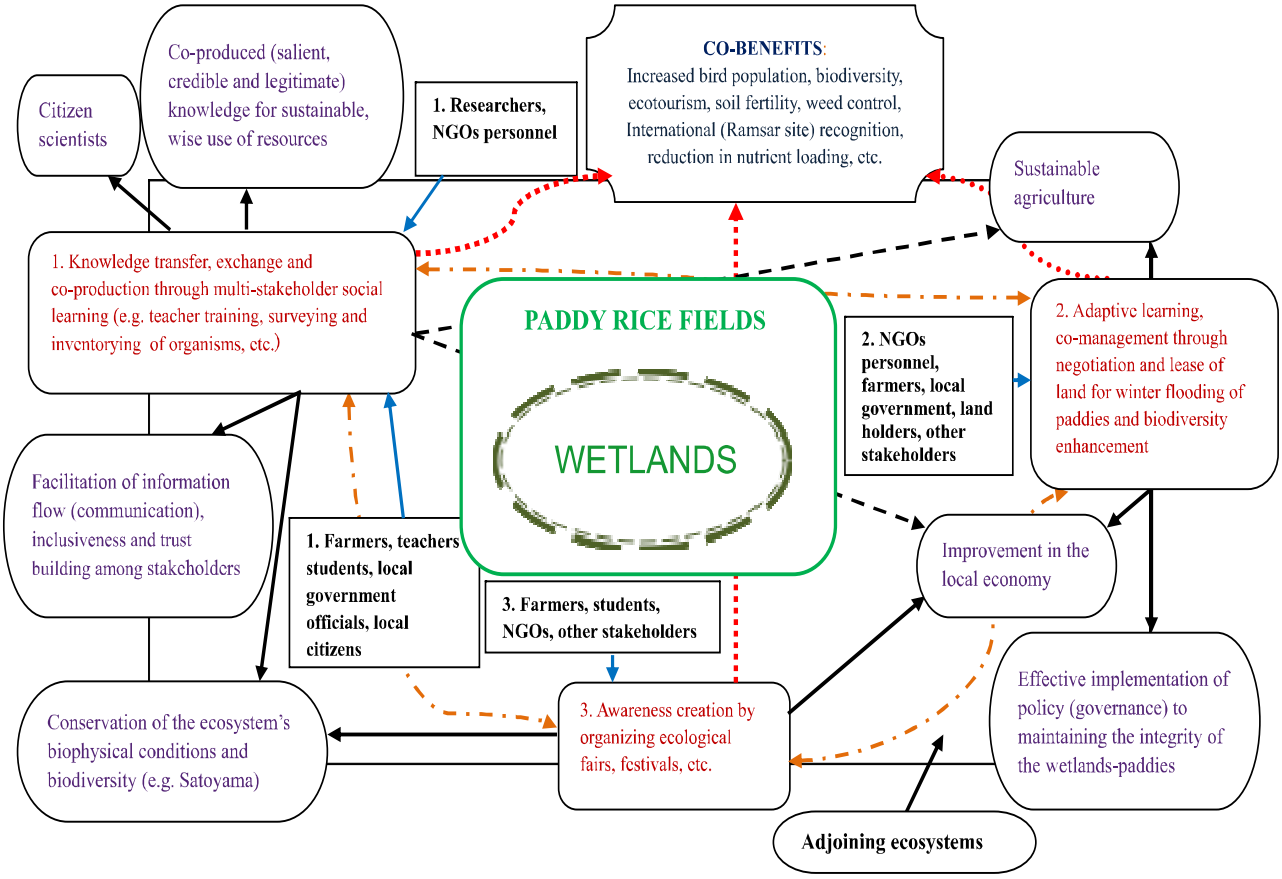

Fig. 1 Social learning at the Osaki-Tajiri Ramsar sites.

Stakeholders' ESD/WCEPA-linked **social learning** (scientific, local, innovative and experiential) **processes** (red ink, smooth-edged rectangles), their **interrelations** (black ink, rectangles) and **interactions** with the biophysical/ecological components and the **outcomes** (purple ink, ovals) including co-benefits (blue ink, 'blade') in the Kabukuri-numa/rice paddy agro-ecosystem. The learning processes and the corresponding stakeholders involved are numbered. The stakeholders include farmers, landholders, students, experts (NGOs and researchers/academics), "organic" rice and ecotourism-related business people, tourists, local government, politicians, remaining citizens, ESD/WCEPA representative authorities and stakeholders of nearby ecosystems. The main objective is capacity building through learning (awareness creation, knowledge, values and skills acquisition) for sustainable/wise use of the wetlands-paddies goods and services. Co-benefits are the result of the actualization of the several learning processes (broken red arrows) which are considered interlinked (broken brown arrows).

forging more sustainable modern lifestyles. A notable example of traditional knowledge is the concept of *satoyama* which is a traditional rural agricultural ecosystem that was common before the rapid development and modernization of local Japanese communities. *Satoyama* consists of a mosaic of patches of forests, grasslands, paddies, ponds and creeks supplying various resources to support traditional agriculture and village life (Washitani, 2007; Washitani, 2001; Morimoto, 2009). The TEK of *satoyama* is evident in the use of landscapes to provide dual or more services. For example, rice paddy fields, and the ponds and ditches that irrigate them, provide a staple of the Japanese diet and also function as wetland habitats for wildlife. Managed woodlands harvested for firewood and charcoal also provide ideal habitats for many species of wildflowers. Furthermore, large tracts of pasture and grassland are home to small mammals, birds and insects. Restoration of *satoyama* and wetlands by local citizens has become a key component of conservation ecology practices in Japan, where practical, hands-on, community-based learning is important (Kobori, 2009). Moreover this effort is not limited to Japan: recently, the Japanese Ministry of the Environment and the United Nations University Institute of Advanced Studies have launched the *Satoyama* Initiative in an attempt to promote this concept of sustainable rural societies in harmony with nature around the world, through international cooperation.

Example 2

The second example of a social learning activity is a survey to verify harvest yields, fertilizing effects and weed-control effects, simultaneously surveying the organisms living on different rice paddy field surfaces: those surfaces of unploughed cultivated paddy fields left inundated with water in winter but not treated with any agricultural chemicals or chemical fertilizer, compared to those of conventional farming and cultivation methods (BRGSA, 2006). The resulting significant increase in tubificid worms, that "turn" the soil, produce a natural fertilizing effect through the release of bacteria into the water, enhanced by water bird droppings, the decomposition of rice straw by fungi and a massive growth of algae. Several organisms, including algae and green protoplasts such as spirogyra, euglena, duckweed, *sayamidoro*, and *amimidoro* were found to proliferate, along with water fleas, rotifers and other protozoa (BRGSA, 2006), suggesting increased biodiversity.

Volunteering students and local citizens with little or no prior scientific training acquired scientific skills and conducted research-related tasks such as surveying flora and fauna in rice paddies through observation and measurement. They were hence acting as citizen scientists (Fig. 1). Participants also learned about a more sustainable method of agriculture: abandoning agricultural chemicals and thus reducing the nutrient load. This might help revamp the local economy (Fig. 1), given that "organic" rice sells at a higher price than regular rice produced with agrichemicals. Furthermore, local NGO resource persons have shared practical and academic information on the recent subject of alien invasive species related to the area with the students, farmers and local citizens. Also, the Miyagi University of Education has started to deliver teacher training courses on rice paddies as learning sites, in collaboration with the Osaki City Board of Education.

Example 3

Awareness creation and capacity building through fairs, festivals and farm visits. As part of the awareness creation program which involves building the capacity of primary and secondary school students towards environmental and cultural sustainability, Osaki-Tajiri holds annual festivals related to agriculture, ecology and culture. They include Ramsar's World Wetlands Day and *Kodomo Biodibashiti* (Child Biodiversity) Festivals by Ramsar Center Japan, during which local and international participants, especially students, engage in awareness creating activities. They present reports on the wise use of wetland resources and rice paddies in their respective countries. They also present research about biodiversity in rice paddy environments and local cultures through an inventory of organisms found in the paddies (Shimano, 2010), and reports on alien invasive species. In winter, school children go to the wetlands to observe migratory birds that feed and nest there. During farm visits, farmers teach children about the practices of sustainable wet-rice agriculture that assist in enhancing biodiversity.

Such awareness-creating programs, currently popular among the youth, could be an effective communication strategy essential to achieve ESD/WCEPA goals especially among adults in the area. It should be noted however, that like many other parts of the region and, in fact, of the nation, ESD principles have yet to be introduced into the mainstream education curricula of primary and secondary schools (Ofei-Manu & Skerratt, 2009a). Because Japan is one of the initial sponsors of the DESD, Japan's education and environmental ministries should also lead in mutual collaboration. They should formulate a concrete ESD policy that could be integrated into existing mainstream policy, and influence the adoption of strategic frameworks in social, environmental, economic and educational policy (Tilbury & Janousek, 2007).

Overall, these interactive learning processes among the stakeholders in the context of ESD-based and WCEPA programs are resulting in capacity building of the stakeholders. This has a positive effect on the more efficient use of wetland resources for sustainable agriculture, raising the economic value of the "organic" rice and vegetables produced there for the farmers and, also, as post-harvest flooded fields for feeding and nesting sites for wintering waterfowls. The presence of the waterfowl, namely wild geese, swans and ducks in the wetlands in turn serves as a tourist attraction for the local people and visitors, offering them a "sense of pride" in the wetlands. There is also a genuine participation of stakeholders due to an increased concern for the environment as evidenced by the annual participation of about 800 people consisting of local farmers, students,

teachers, local government officials and local citizens in the formal and non-formal ESD and WCEPA programs in Osaki-Tajiri area. Additionally, a sense of inclusiveness and collective ownership through inventorying flora and fauna in the wetlands-paddies is generated among the stakeholders. Again, there is information flow among stakeholders during execution of the field projects and organization of the fairs and festivals to create ecological awareness. The information flow is later extended to nearby localities when some of the participating teachers are transferred to other school districts. The building of relationships and trust between academia and the local people makes researchers feel that they are making themselves useful to society. A sense of self-efficacy on the parts of both the local people and researchers is another social learning outcome in the case of Osaki-Tajiri, which serves to develop a foundation for a more sustainable and resilient community.

One problem, among a few others that need to be addressed, concerns school children, who largely determine the eventual future success of the WCEPA and ESD programs. Since wetland flora and fauna surveys are currently not included in mainstream curricula, extra time and logistical arrangements are needed to organize activities in the rice paddies. Scheduling of field activities sometimes poses difficulties because they have a lower priority than regular school activities. Also, there is no framework or mechanism in place to ensure continuity of program activities among students outside the local area or when they grow past the current participating age group.

3.4 Wetland stakeholders' adaptive co-management of and co-benefits from social-ecological system interactions

Knowledge and skills linked to the concept of adaptive co-management could be acquired by learning to use ESD-based and WCEPA education tools. Adaptive co-management systems are flexible community-based systems of resource management tailored to specific places and situations, and developed through self-organization and networking of local groups who can learn, facilitate information flows by drawing on a variety of sources of information and knowledge, and actively adapt to and shape change (Olsson *et al*., 2004a; Olsson *et al*., 2004b).

An example of an adaptive co-management system in Osaki-Tajiri was a proposal to dredge the Kabukuri-numa. It became an opportunity for stakeholders to initiate a movement towards wetland protection and co-existence of wildlife with agriculture (Kurechi, 2007; Mochizuki, 2007). To reach this goal, the first requirement was awareness, understanding and agreement among the local community that rice paddies are valuable buffer zones for wetlands. Incentives for meeting this requirement included discussions and negotiations on agricultural and environmental policies necessary to reduce environmental burdens and activate the wetland functions of paddies. Landholders agreed to re-convert tens of hectares of rice paddy fields back to wetlands. Farmers and others cooperated to implement a winter-flooding regime for nearby cultivated paddies (Fig. 1). Consequently, the number of geese using Kabukuri-numa as a roosting site increased, indicating that enlarging the area of the wetland augmented the site's wildlife carrying capacity. Thus a consensus reached by local farmers and other stakeholders through negotiation, information flow and sharing to adapt to the new reality to allow wildlife to share the benefits of the wetlands, led to the area's designation and addition to the Ramsar List (Kurechi, 2007).

The result could also be considered a co-benefit for both the local people and the wild birds (Fig. 1). A co-benefit approach to sustainability, although not necessarily a new concept, is an area of investigation where the concerned parties seek to mitigate the present environmental burdens, while simultaneously trying to make it beneficial to possibly all the parties involved. A co-benefit approach is currently being applied especially at the policy level in the energy, transportation and climate sectors. Highlighting co-benefits in sustainability decisions can win over stakeholders especially when there is conflict of interests. Some co-benefit components such as efforts to maintain clean air or water for health and reputational reasons for society and industry, respectively, however, may be considered intangible and hence difficult to quantify or demonstrate.

Another winter-flooding co-benefit relationship between human and biological life is that waterfowl such as white-fronted geese were seen not only to consume matter in the rice paddy fields but also play a part in fertilization of the paddy fields through their droppings (JAWGP, 2005; Kurechi, 2007). Also, the flourishing of geese/wildlife populations due to the increased winter-flooding area in the wetlands has contributed to a boost in ecotourism in the area. The results of wise use of the rice paddies through growing Ramsar brand rice have benefited both the wildlife and the economy (KWC, 2009). More of such relationships regarding adaptive co-management and co-benefits need to be identified in the future.

4. Discussion

The results on ESD (and WCEPA) performance with regard to attainment of their respective goals of a sustainable society through the wise use of natural resources at the local, national and regional levels have proven to be a mix of successes and failures and there is room for improvement. Some modest achievements have been made, including nations' commitment to integrating ESD into formal education, the presence of ESD in national policy documents and the establishment of national coordinating bodies for the DESD (de Haan *et al.*, 2010; UNESCO, 2009; Suzuki & Murakami, 2009). ESD practitioners, academics and policy makers as well as other informed advocates and action networks have made suggestions for a thorough reassessment of the

approaches, content and magnitude of addressing ESD at the local level (*e.g*., in schools and companies, see Ofei-Manu, 2007) and at broader scales (IGES, 2005). These suggestions have become more appropriate given that the DESD has already reached its midpoint and that WCEPA is in its third six-year program, which ends in 2015. The DESD has so far managed to raise awareness about the importance of ESD on the global education agenda. In places it has become an important aspect of educational reform (de Haan *et al*., 2010). A first evaluation of the activities has been done within the framework of DESD in 2009: the Global Monitoring and Evaluation Initiative by UNESCO has taken stock of what has been accomplished during the first five years of the DESD and at the same time has identified obstacles encountered in creating structures, provisions and conditions that enable the development, implementation and strengthening of ESD. (Tilbury, 2010; Walls, 2010; in this issue).

One aspect of ESD that needs further appraisal is the wide range of interpretations of its meanings – the need to recognize ESD as a multi-stakeholder endeavor and, also, the competencies it enables students to acquire to shape their future within the framework of sustainability, without being yet another addition to the education agenda or curriculum. Critical factors of ESD implementation include the ability to orientate present and future human behavior toward sustainability, using critical, values-driven, systems thinking and an interdisciplinary, multi-method, holistic, participatory approach to solving problems and making decisions that are locally relevant. Other challenges facing the future implementation of the ESD program include the use of appropriate indicators and methods for monitoring and evaluation, support for ESD-related research, focused capacity building, coordination and involvement of the media (who have little impact at the moment in the region of reference), regional unevenness of ESD implementation, awareness of ESD in the wider educational community and in the general public, the reorientation of curricula and the availability of sufficient funds for ESD programs (de Haan, 2010; Ofei-Manu & Skerratt, 2009a, 2009b; Mochizuki, 2006).

Some of the shortcomings of the WCEPA program include the failure to: (i) develop pilot projects and evaluate different approaches for applying WCEPA in promoting the wise use of wetlands, (ii) complete a review of existing WCEPA programs, needs and capacities in areas of implementation, (iii) document the lessons learnt in implementing WCEPA programs, (iv) identify the sources of expert information and training opportunities in WCEPA, and (v) take the necessary actions to encourage synergies on WCEPA activities among international conventions and programs including ESD (Ramsar NPRF, 2005).

The Osaki-Tajiri case provides an example of jointly promoting WCEPA and ESD in the framework of the RCE initiative, building on close collaboration between formal and non-formal education. ESD and WCEPA can add value and synergy to each other, especially in sharing knowledge about how to undertake effective educational outreach programs in a specific area. For example, WCEPA in the context of ecological/environmental education could be instituted by the related local NGOs already mentioned above, while ESD-based programs implemented through the RCE could take care of the economic, socio-cultural and other aspects of the issues facing the "social-ecological system" against the backdrop of sustainability. It is imperative that synergies and complementarities between the two programs be identified in order to avoid duplication in human capacity building and program activities and, also, waste of resources and time. This is key especially when ESD is increasingly bound to coexist with WCEPA in wetlands already designated by Ramsar (as occurs in Osaki-Tajiri) or yet to be designated. To facilitate this, a prior empirical study to assess the inhabitants' level of awareness/ knowledge of ESD and WCEPA and their contribution to the sustainability of the Osaki-Tajiri social-ecological system will be appropriate for effective future implementation of these programs. One aspect of synergy between these two programs will be in the area of developing relevant indicators for monitoring and assessing the performance (resilience) of the wetlands. Some of the indicators might include biodiversity components (*e.g*., species abundance, wetland extent), ecosystem integrity (*e.g*,. water quality, river flow), ecosystem services (*e.g*., water supply, flow (flood or drought) regulation, number of visitors) and drivers and pressures (*e.g*., changes in wetland area due to urbanization and/or agriculture, water exploitation).

5. Recommendations and Conclusion

Social learning can be defined as a change in understanding that goes beyond the individual to become situated within wider social units or communities of practice through social interactions among actors within social networks (Reed *et al.*, 2010). Against this backdrop, the Osaki-Tajiri "social-ecological system" demonstrates a multi-stakeholder social learning initiative for regional sustainability based on partnerships and the mobilization and utilization of combined expertise of actors. It involves the community, NGOs and local and national governments. It offers a typical example of addressing the challenges of promoting both environmental and economic agendas of the rural community. It is a case that started as a citizen's movement to conserve wetlands but has evolved into a participatory program for engaging with the community for the preservation of biodiversity as well. It also provides an informative example of joint promotion of WCEPA and ESD in the framework of the United Nations University's RCE initiative, building on close collaboration between formal and non-formal education. Nevertheless, further capacity-building efforts are necessary at all levels of both formal and non-formal education sectors (Stevens, 2007; UNECE, 2009) in the area, particularly for decision makers, program imple-

menters and educators. Raising public awareness of sustainable development further in and through institutions of formal education as well as the community using the media and NGOs should be encouraged. The media should do well to reach the general public (Ofei-Manu & Skerratt, 2009a; UNECE, 2009) including the corporate sector (Ofei-Manu & Skerratt, 2009b) with relevant information and to engage them in confronting sustainability issues. The academic and research institutions under the umbrella of RCE Greater Sendai should strengthen their cooperation with the local NGOs and support their educational activities.

Provided all the basic conditions are met, the Osaki-Tajiri "social-ecological system" can serve as an ongoing ESD experiment on social learning which is currently one of the RCEs' main (but currently less developed) research objectives (UNU-IAS, 2009). Such research should be undertaken in a transdisciplinary manner, linking biophysical and social sciences and addressing the complex intersecting problems of the environment, economy, politics and culture. Thus the integration of resilience learning – a form of social learning of multi-disciplines that fosters society's capacity to adapt to change while maintaining sustainability of systems – into ESD/WCEPA programs, should be encouraged. Where appropriate, learning should expand from knowledge of structures to knowledge of processes that sustain the social–ecological capacity to respond to ecosystem change (Jordan *et al*., 2009; Folke, 2004). Also, indigenous knowledge should be valued and conserved as an integral part of ESD and WCEPA.

The ecosystem knowledge and understanding among farmers, local governments and citizens, NGOs, etc. in Osaki-Tajiri, which is partially used for monitoring, interpreting and responding to ecosystem dynamics, is of crucial importance for sustaining ecosystem services and for strengthening the capacity for dealing with uncertainty and change (Olsson & Folke 2001; Olsson *et al*., 2004a). Understanding the range of roles wetlands can play in the lives of the local people of Osaki-Tajiri in the context of the range of benefits and values provided by the wetland ecosystem can provide valuable information to local decision makers. This can aid in their formulation of policies and decisions that will directly affect the people and their livelihood.

Wetlands provide important goods and services which help sustain human life, conserve biological diversity, and combat the impacts of climate change. Even though they remain poorly understood, their general ecological importance is as significant as the conventionally "more important" ecosystems like the tropical rainforests. Through social learning, experimentation and innovation, ESD and WCEPA could play significant roles in letting people understand that the adjacent ecosystems are connected, constantly interacting with each other, and dependent on the sum of their parts; by removing or significantly altering one part, the whole could be detrimentally affected (SCBD, 2010). This means that stakeholders will need to extend their conservation knowledge and skills to the nearby ecosystems as well. Increasing understanding of ESD-WCEPA as a process of change beyond DESD's 2014 limit among the stakeholders in the Osaki-Tajiri Ramsar wetlands and nearby ecosystems might be the most important legacy secured for the sustainability transition in the region.

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