

## 〈特集〉

# Development of Community-based Watershed Management in Malaysia

## — Case Studies in Project ReViVaL and Kelab Alami Kawa —

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### Abstract

This feature introduces two case studies on community-based watershed management practices in Malaysia that actively progress and have developed impactful and sustainable frameworks: Project ReViVaL and Kelab Alami Kawa. The Project ReViVaL (Revive Varsity Lake) is conducted in Varsity Lake located at the University of Malaya campus to elucidate the long-term eutrophication and to achieve sustainable lake management. The Kelab Alami Kawa is conducted in the downstream of the Selangor River (Mukim Pasangan, Kuala Selangor) to develop citizen science programs with the local community and to sustainably conserve the firefly sanctuary. The Project ReViVaL developed a framework consisted of three phases: Phase I (Research), Phase II (Fixing) and Phase III (Life). The occurrence of pollutants causing the eutrophication was elucidated in the Phase I (Research), and the identified issues were fixed in the Phase II (Fixing) that was financially supported by the local authority. The Phase III (Life) is an ongoing practice that aims to achieve sustainable lake management with the local authority and communities. The Kelab Alami Kawa addresses two citizen science programs with the youths in the local community to train them for water quality and biological monitoring as well as for the survey of firefly abundance that are financially supported by local stakeholders. The activities are also expanded beyond the citizen science programs such as monthly river cleaning, waste separation and nursery of mangrove trees. The financial supports in both projects resulted from the good “heartware” foundation with local authorities/communities that is a potential driver for effective and mutually acceptable solutions. Thus, the Project ReViVaL and the Kelab Alami Kawa attained the impactful success with local authorities/communities and generated the heartware with them that is indispensable for sustainable and integrated watershed management.

**Keyword** : Project ReViVaL, Kelab Alami Kawa, Community-based watershed management, Heartware, Citizen science

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## 1. Introduction

This feature introduces two community-based watershed management practices: Project ReViVaL and Kelab Alami Kawa. The Project ReViVaL (Revive Varsity Lake) is conducted by University of Malaya to achieve a sustainable lake management in Varsity Lake which is a part of the campus and where eutrophication had been a long-term issue. The Kelab Alami Kawa is conducted by most of the Project ReViVaL members focusing on citizen science programs with youths in a local community (Mukim

Pasangan, Kuala Selangor) that is located near the estuary of the Selangor River basin. The Mukim Pasangan is a famous tourism spot as a firefly sanctuary, but its colony needs urgent aids to be conserved because of the water pollution in the Selangor River. Both projects were initiated by a small group of members in University of Malaya on a voluntary basis, but they actively continued their conservation activities and gradually expanded their local networks. Consequently, the projects were financially supported by local authorities and/or stakeholders, and their community-based watershed management practices

attained the impactful success. Through these projects, the authors identified community-based shared values and expanded “Heartware” that is a key for sustainable watershed management. A good heartware foundation will begin an upwardly spiraling process toward effective and mutually acceptable solutions that are more politically sustainable in the long run (Mohamad et al., 2015). Both projects still actively progress for sustaining the community-based management practices and for expanding the heartware beyond the local communities. The concept and process of both projects as well as their findings and achievements are briefly described in this feature.

## 2. Case study 1 : Project ReViVaL

### 2.1 Overview of the Project ReViVaL

Varsity Lake (length : 290.7 m ; area : 1.32 ha) is located at the center of University of Malaya campus. It is a historical and cultural landmark and the university students used to enjoy kayaking and recreations. In recent years, Varsity Lake was severely eutrophicated and a number of garbage was disposed around the lake. Therefore, a volunteer group called “Water Warriors” which consisted of students and staffs in University of Malaya addressed lake conservation activities since 2013. The Water Warriors began with water quality monitoring around the lake and cleaning activities with volunteers from the university students/staffs and local kids. Their continuous activities caught the heart of the Department of Development & Estate Maintenance (JPPHB) in University of Malaya which is the main authority to manage the lake, and consequently JPPHB held an open discussion with the Water Warriors in December 2013. The Project ReViVaL (Revive Varsity Lake) was proposed through the discussion and a framework for reviving the lake was determined with 3 phases: Phase I (Research), Phase II (Fixing) and Phase III (Life). The Phase I (Research) aimed to identify the pollution source to Varsity Lake and to elucidate its eutrophic condition. The Phase II (Fixing) aimed to solve the issues based on the findings in the Phase I (Research) and JPPHB financially supported to address the necessary countermeasures. The phase III (Life) aimed to conserve the revived lake and to achieve a sustainable lake management by the local consortium.

### 2.2 Phase I (Research)

The Phase I (Research) started from water quality monitoring in and around Varsity Lake from January to June 2014 to identify the pollution source. Community-based water quality monitoring kits were used such as LAQUAtwin (Horiba, Japan) for pH and electrical conductivity, Pact Test (Kyoritsu Chemical-Check Lab. Corp., Japan) for ammonia nitrogen, phosphate-phosphorus, chemical oxygen demand and heavy metals, and a glass graduated cylinder covered its outer wall by aluminum foils and attached with a secchi disk at the bottom for transparency. The weekly water quality monitoring revealed that the polluted water was discharged from Faculty of Engineering and a student college, and they were merged at a sump connected to Varsity Lake. Ammonia nitrogen concentrations in these drains exceeded a worst category of water quality ( $>2.7$  mg/L) established by the Department of Environment (2014), and phosphate-phosphorus concentrations were over 1 mg/L that were much higher than the range of eutrophic lakes and were equivalent to industrial effluents (Faridan et al., 2008 ; USEPA, 2000). Therefore, it was suspected that untreated sewage was discharged into these drains.

Based on the 6-months monitoring, Water Warriors investigated the water quality in drains throughout the student college and Faculty of Engineering with Okayama Joto High School students who visited University of Malaya in the end of June 2014. The water quality trend was visualized with the Eco-Heart Index (Sakai et al., 2015a) to identify the exact pollution source. Six parameters (pH, phosphate-phosphorus, heavy metals, transparency, ammonia nitrogen and chemical oxygen demand) were monitored and marked their concentration levels in the Eco-Heart Index corresponding to its classified level. The 6 marks were connected by a curve line and water quality was evaluated based on the drawn figure (*e.g.*, a full heart : clean ; a broken heart : polluted) so that the participants would be more attracted and effectively understand the water quality situation in the monitoring sites. The Eco-Heart Index clearly showed that a drain in Faculty of Engineering and another drain in the student college were heavily polluted as the Eco-Heart Index appeared a broken heart. They were merged with other drains which appeared almost a full heart, and the water at the sump was consequently polluted. The amount of the polluted water

from Faculty of Engineering was much larger than that from the student college, and it was originated from a sewer pipe that was disconnected and the untreated sewage was discharged into the drain. Therefore, the main pollution source causing the eutrophication in Varsity Lake was mostly the untreated sewage from Faculty of Engineering.

### 2.3 Phase II (Fixing)

Based on the findings in the Phase I (Research), the Water Warriors and JPPHB discussed again and summarized the issues to be solved. The Phase II (Fixing) started from a construction of an underground pipeline channeled between the sump and the Pantai River which is adjacent to the lake for diverging the polluted water immediately. After the sump had been completely closed and the untreated sewage had been diverged to a new underground pipeline, there was no more inflow to Varsity Lake and the pollution load had been completely prevented. The lake water was then pumped out into the Pantai River for a draining and all fish were caught by net fishing in cooperation with the Sports Center in University of Malaya. The number of each species was counted to create a fish inventory, and the result showed that invasive species (e.g. black tilapia (*Oreochromis mossambicus*), red tilapia (*Oreochromis niloticus*) and Javanese carp (*Puntius javanicus*)) dominantly inhabited the lake. Only a portion of fish was local species (e.g. giant snakehead (*Channa micropeltes*) and marble goby (*Oxyeleotris marmorata*)), which means that the ecosystem in the lake was significantly affected by these invasive species. They used to be released in mining pools, rivers and reservoirs throughout the country in order to sustain fish stocks and encourage recreational fisheries a couple of decades ago (Abdul Rahim et al., 2013). Therefore, they could be brought from the adjacent Pantai River because it had been frequently overflowed after a heavy rain and the river water had flowed into the lake.

A dredging by an excavator was conducted after the draining and the surface sediment was removed from the lake. The surface sediment was dominated by silt particularly near the overflow point of the Pantai River. The silt contained a higher amount of organic and inorganic matters compared to clay, sand and gravel in other areas of the lake. Therefore, the overflow of the Pantai River also caused sedimentation and produced nutrients which could be a significant

source for accelerating the eutrophication. A wetland compartment (0.013 ha) was constructed at the west side of Varsity Lake and 600 plants of 3 species (*Cyperus haspan*, *Hanguana malayana*, *Lepironia articulata*), which had been adopted for deep marsh (0.6-1.0 m) in Putrajaya Lake where the biological treatment had effectively works (Abdul Rahaman et al., 2010), were planted for absorbing nutrients in the lake. Additionally, riprap was placed along the lake-side to prevent from soil erosion. All the works in the Phase II (Fixing) were conducted during August until early October 2014. After the completion, surface water in the Pantai River was pumped into Varsity Lake in mid-October 2014. Consequently, the water quality in Varsity Lake had been much improved after these fixing works and the lake had restored its beautiful scenery. Furthermore, an old well that used to supply the groundwater to the lake was repaired in June 2015. The groundwater is supplied to the lake since then to provide clean water as well as for generating the water flow in the lake.

### 2.4 Phase III (Life)

The Phase III (Life) has started from an opening ceremony of Varsity Lake in November 2014. The Project ReViVaL members jumped into the revived lake and a swimming competition among the university students and staffs was held. A duck and goose farm was developed and 30 ducks and geese were released in the lake, while local fish species was also introduced into the lake. After the opening ceremony, many requests to exchange with the Water Warriors or to participate in their activities come to them as this success story has been gradually recognized worldwide through local media (The Star Online, 2014; Star2.com, 2015), international conferences (Sakai et al., 2015a; Sakai et al., 2015b) and its websites (<https://www.facebook.com/umwaterwarriors/>; <http://www.t.kyoto-u.ac.jp/acore/en/publications/revival-revive-varsity-lake-project-in-university-of-malaya-integrated-lake-management-with-hardware-software-and-heartware>). For example, 3 Japanese high school students (Okayama Joto High School, Shibata High School and Hita High School) had joined the water quality monitoring using the Eco-Heart Index, and Kyoto University, University of Tsukuba, United Nations University and the Restoration of Elizabeth River Project members (USA) had an exchanged session with Water Warriors to discuss about Project

ReViVaL. The Water Warriors continue to address the cleaning activities with university students, and they also invite local people to organize a variety of lake activities such as open classrooms, fishing competitions, kayaking and bird watching. JPPHB still financially supports this project and has created a tree house, an observation deck and a maze around the lake that were made of recycled wood materials. Thus, the heartware among this project members and local community has been tightly formulated and been further expanding for achieving a community-based lake management in a sustainable manner.

### 3. Case study 2 : Kelab Alami KAWA

#### 3.1 Overview of Kelab Alami Kawa

Kelab Alami Kawa is an environmental youth club, established since 2013. Kuala Selangor — a sub basin in Selangor River was chosen as the site for Kelab Alami Kawa — is popular for the mangrove *Sonneratia caseolaris* (locally known as berembang) which is associated with the dominant firefly *Pteroptyx tener*. The Malay word *alami* both means to 'experience and feel' and, as part of the word *alam*, the environment. While *kawa*, the Japanese word for river, was chosen as suggested by a local community leader to reflect the exemplary Japanese way of respecting nature in their everyday lives. Together, both the words were chosen for the club's name in line with the objective of nurturing the youths to experience and appreciate the river.

The club was originally modeled after the success of another similar club, Kelab Alami Tanjung Kupang based in Johor. Kelab Alami is registered in Johor under the name Kelab Pencinta Alam Tg Kupang, Johor and is also registered as a non-profit organization, Anak Alami Enterprise in Kuala Lumpur in order to facilitate its replication to other parts in Malaysia. Kelab Alami Kawa first began in 2013 as part of a research study under Sustainability Science Research Cluster, University of Malaya and Japan-Malaysia Asian Core Program (ACP). After the research ended, the club manages to continue after receiving monetary support from a local industry company located on the upstream of Selangor River — Hartalega Sdn Bhd until today.

#### 3.2 Nature and local guides

Using a series of environmental education programs

guided by scientist advisors and facilitators, the youths are trained as nature guides. Places such as Kuala Selangor Nature Park (thriving with secondary forest and mangrove) and Selangor River riparian areas are now becoming a teaching site for them to learn about crabs, snails, brackish fish, mangrove and palms growing along the river. Besides that, the youths had also successfully documented local heritage and attractions at their village through a community mapping project which includes places of worship and scenes of the local economy as well as daily life (fishing jetty, traditional roofing industry, local eateries, recreational spot and many more). The culture of traditional roofing is also sustained by passing on the knowledge and know-how technique from local thatchers to the youths.

The youths are not only encouraged to learn, but to share their knowledge with the rest of the community as well. They are sometimes invited hold educational talks at local eatery, mosques and firefly jetty for their family and friends. They had also been invited to give talks to universities students and international audience during UMCares Community Exchange and Summit in 2014 and JSPS Asian Core Program International Symposium in 2016. Besides that, since its inception the youth has had the opportunity to conduct ecotourism programs with visitors from Japan, the United Kingdom, China, Indonesia and India which allows self-generation income for the club.

#### 3.3 Place-based citizen science at Kuala Selangor

Citizen science program was conducted with the youths to train them as young scientists and introducing them to scientific method. A place-based education with the youths is motivated by the idea that by engaging them to take action and conduct scientific study of a place familiar to them, it will increase their 'sense of place'. Two citizen science studies had been conducted with youths of Kelab Alami Kawa. The first is the monitoring of the river water quality using La Motte low-cost water monitoring kit with parameters such as phosphorus, nitrate, turbidity, dissolved oxygen, and pH. Three sites were chosen for their monitoring : Kampung Kuantan firefly jetty (an important ecotourism area), Tanjong Siam Watergate (one of Selangor River's feeder streams with a nearby oil palm plantation) and Pengkalan Kudud (a residential area). The water quality trend was also visualized using a modified Eco-Heart Index to suit the five parameters of the low-cost water monitoring kit. Besides

the chemical monitoring, the youths were also introduced to physical and biological monitoring. The physical monitoring was done by visual observation and taking note on any land use changes near the river while biological monitoring was done at any mini streams using bioindicators such as aquatic insects to determine the healthiness of the waterways.

The second citizen science program which was recently introduced to the Kelab Alami Kawa youths in 2016 is the night-time monitoring of fireflies *Pteroptyx tener* on the mangrove *Sonneratia caseolaris*. The non-destructive method of qualitatively estimating fireflies' abundance can be done using a comparison percentage chart (Hashim et al., 2011; Jusoh et al., 2010a; Jusoh et al., 2010b) which was adapted from Baccelle & Bosellini (1965). The comparison percentage chart consists of a few black rounds with different white dots density ranging from 1 % to 50% and is compared with the flashing abundance of the fireflies on the display mangrove tree. The youth travels using a sampan (boat) from Kampung Kuantan Firefly Jetty and estimates the abundance of the fireflies using the chart. This citizen science method of estimating firefly abundance can also be used as an educational tool for the ecotourism activity with the tourists.

In 2015, a new building was launched for the club's activity named Pusat Sains Rakyat Sungai Selangor (Selangor River Citizen Science Centre). The construction of the new building allows the activities of Kelab Alami Kawa to be done more regularly and will also act as the hub for the sharing and displaying of the citizen science data collected by the community.

### 3.4 Moving forward

In 2016, the club moved beyond the training of youths. Local adults/local community leaders keen on environmental issues were engaged to collaborate in several activities that would allow them to lead and take ownership on several of the projects and help to mentor the youths of Kelab Alami Kawa. The first project was the establishment of a nursery for mangrove *Sonneratia caseolaris* and palm tree *Nypa fruticans* — both are important plants at the riparian zone of Selangor River. The nursery will act as an attraction for any students or volunteers interested in learning about planting mangrove trees, and it will also become an additional learning ground for the Kelab Alami Kawa youth. Another activity led by the community is the Selangor river cleanup program, sup-

ported by Global Environment Centre and National River Care Fund. Boat rowers at Kampung Kuantan firefly jetty are engaged in bringing volunteers to conduct monthly river cleaning and perform a simple rubbish assessment and waste separation (recyclable and non-recyclable) afterwards. To sustain the club financially, the Selangor River Citizen Science Centre will also act as an entrepreneurship ecotourism site focusing on nature guiding and citizen science which will help to generate income for the club.

## 4. Conclusions

This feature introduced the two active and successful projects related to the community-based watershed management practice: Project ReViVaL and Kelab Alami Kawa. Both projects were initiated by a small group of members in University of Malaya who had neither an experience of the management practice, nor a financial support nor a clear framework. However, they continued their conservation activities that they could address, interacted with other projects and/or non-governmental organizations to learn their good management practice, and tried to generate the good heartware foundation among the local authorities as well as the local communities by devoting their strong passion and countless efforts. There is no designated framework to address the community-based watershed management practice that depends on the emerging concerns, the relationship with local stakeholders and/or a diversity of people and nature. Nevertheless, the two successful projects indicate that the heartware is an important key to open the door for connecting with the local authorities/communities and for expanding the mutually acceptable and impactful solutions. Because the watershed is an important domain as the same water resource, the same fate by water issues and the same shared value, the good heartware foundation is indispensable for the sustainable and integrated watershed management.

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# マレーシアにおける地域コミュニティに根ざした流域管理 —— ケーススタディ：ReViVal プロジェクトと Kelab Alami Kawa プロジェクト ——

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本稿では、マレーシアにおける地域コミュニティを基盤とする持続可能な流域管理の実施状況について、ReViVal プロジェクトならびに Kelab Alami Kawa の2件をケーススタディ事例として紹介する。ReViVal プロジェクト (Varsity 池再生プロジェクト) は、マラヤ大学構内の Varsity 池を対象とするプロジェクトで、長期の富栄養化過程解析と持続可能な池管理の確立を目的とする。Kelab Alami Kawa (Kawa 体験クラブ) は、スランゴール川下流域を対象とし、地域住民への科学学習の場の提供と蜚保護地区の持続可能な維持管理を目的として実施している。ReViVal プロジェクトでは、一期 (Research)、二期 (Fixing) および三期 (Life) の3つのフェーズからなる枠組みを設定し、一期では富栄養化の原因調査を、二期では解明された原因の除去を、それぞれ自治体の支援の基に実施した。現在進行中の三期では、自治体と地域コミュニティの共同活動による持続可能な池の管理を目指している。Kelab Alami Kawa は、地域のステークホルダの支援の元、青少年を対象に水質/生物相モニタリングとホタル調査の2件の学習プログラムを設定した。しかし、その後のプロジェクトの活動範囲は、科学学習プログラムの枠組みを超え、毎月の河川清掃活動、ゴミの分別収集活動ならびにマングローブ植林活動にまで広がっている。両プロジェクトは、自治体や地域コミュニティの支援を元に、good “heartware” を基盤とする活動である。このような実施・支援体制の確立によって、両プロジェクトはインパクトのある成果の創出とともに、関係する組織体がお互いに納得できる解決策の策定に成功したものであり、持続可能な総合流域危機管理体制の構築に不可欠な要素を示している。

キーワード：Varsity 池再生プロジェクト、Kawa 体験クラブ、地域コミュニティを基盤とした流域管理、ハートウェア、市民科学講座