Dynamic and Diverse Conservation Approaches for an Historical Irrigation System: A Cultural Landscape in Taiwan

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Abstract
An historical irrigation landscape with its irrigation facilities, water engineering works, and irrigated farms, could be considered a cultural landscape that records the process of interactions between the people and land, and the resulting influences on the environment. Dynamic and diverse conservation approaches may be applied in a cultural landscape, due to various features, characters and values of the elements within it. Using the strategy of sustainability, concepts of preservation of historical testimonies and maintenance of the operational and integral instruments, a cultural landscape may be conserved through the approaches of monument-based conservation, operation-based conservation, sustainable management and planning. The Jianan Irrigation System, an historical irrigation cultural landscape in southern Taiwan, is illustrated to describe these arguments.

Keywords: cultural landscape; conservation; irrigation system

1. Introduction
A cultural landscape, which encompasses various elements in a specific area, represents the combined works of nature and man. Monuments, linear and spot elements, even a wide area related to the theme of cultural landscape may be of great value. Conservation of an historical cultural landscape would mean various approaches might be used with different concepts.

An irrigation system could be seen as a cultural landscape, an organically evolved cultural landscape especially — the water stored with the limit of the natural landform, flowed through the waterways with gravity, and was used for agriculture, which reflected the limitation of the natural environment and the interventions from man. An irrigation cultural landscape may consist of tangible irrigation facilities, intangible knowledge and technology of operation and construction, and the management, operation and intervention by people for the continuous functioning of the system. Thus, an irrigation cultural landscape may record the process and results of the interactions between people and the land, and the diverse influences on the environment. An historical irrigation cultural landscape may achieve the funding objective and contribute to the relevant social, economic and environmental aspects.

2. Research Objectives and Methods
An historical cultural landscape is not a simple object. The first objective of this research will be to analyze various elements in a complex irrigation cultural landscape, which may have significant values and attributes. Secondly, it is also necessary to explore different protection approaches in an historical irrigation cultural landscape.

An empirical research method is used in this study, which includes a literature review and site observation. The feature of various elements in a cultural landscape will first be explored. Then the various values in an historical irrigation cultural landscape will be analyzed, while the strategy of sustainability is applied in regard to the conservation concepts and works. Finally, possible methods of conservation and protection will be argued. Discussions will focus on the Jianan Irrigation System, an historical irrigation cultural landscape in Taiwan, registered as a living cultural heritage site of Taiwan in 2009.

3. The Jianan Irrigation Cultural Landscape and Its Various Elements
3.1 A Brief History of the Jianan Irrigation System
The southern part of Taiwan is a flat plain area, which is good for farming. An irrigation system may ensure the supply of water, which contributes to the development of farming and income derived

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Before the Jianan Irrigation System was built, there were only local irrigation systems in the rural area, which depended on the occasional rainwater. In 1920, the Japanese Colonial Government decided to build an irrigation system to improve the agricultural productivity of the plain. The construction work started in 1920 and was completed in 1930. More than 150,000 hectares of dry farmland, which had depended on rainfall in the past, were transformed into productive paddy fields (Association of Public Jianan Irrigation Waterway, 1930:3-5). The system, stretching over 160,000 kilometers, consisted not only of the reservoir, waterways, water gates, tunnels, aqueducts, inverted siphons and other facilities, but also the irrigation operating systems and the management organization which still function today (Fig.1.). The water, which supplies the production process of cultivation, is collected by the reservoir and flows to farms through main waterways, water gates, aqueducts, and tributary waterways, while excess water overflows through a spillway.

To build and operate the system, the Jianan Irrigation Association was founded in 1920. This association, which is still functioning today, controls, operates, and manages the system, according to the water demands. The Association is also responsible for the renovation of related facilities and the repair of the waterways. The original state of the main structure and important elements of the system, such as the reservoir, main waterways and aqueducts continue to be preserved.

Besides the irrigation system itself, the rural area along the irrigation system is also part of the irrigation cultural landscape (Fig.2.). The plain covered by the system has become the major agricultural production base in Taiwan. The conservation of an irrigation cultural landscape is important for the future as the whole irrigation system services farmlands. If the agricultural process declines, the function of the irrigation system would also be threatened.

The reservoir and dam impound the water and provide for the operation of the irrigation system (Fig.3.). The features and functions of these structures have been preserved and have functioned since they were built with only minor repairs. If the water needs to cross over a river, an aqueduct will be built. Most aqueducts of the Jianan Irrigation System are still functioning in a similar condition as they were built.
Waterways were built to guide water flow. A whole irrigation system consisted of main waterways and other tributary waterways which covered the whole irrigated area. The water flow is controlled by shutting down the water gates, which also control farms to be irrigated or not. Like water pipes under a dam which transport water to waterways, maintenance, repair and replacement would be necessary for these facilities. Irrigated farms are the private properties of farmers, and are used to cultivate rice, sugarcane and other crops. This also means that farmers may choose to grow different crops, a fact which leads to various landscapes and scenery in the area.

Some other memorial elements witness different stages of developmental history. A memorial statue of the founder of the Jianan Irrigation System – Hatta Yoichi, ruins of dormitories, and a statue to remember those who died during its construction have enhanced the image of this system.

Although conservation of the irrigation system had great importance, the elements in the system were not preserved as monuments under the Cultural Heritage Preservation Act in Taiwan. Thus some of the elements have been renewed and changed due to the deterioration. Even though other elements were preserved, the repair works did not meet cultural heritage conservation standards.

### 3.2 Analysis of an Historical Irrigation Cultural Landscape

An historical irrigation cultural landscape like the Jianan Irrigation System may be analyzed in different ways. Geometrically, the elements may be classified as dotted, linear, or planar, which could be analyzed according to the scale in relation to the whole landscape. Water gates, aqueducts, and other single objects could be considered as dotted elements, since they are comparatively small dots compared to the whole irrigation system (Fig.4.). At the same time, waterways stretching in fields could be seen as linear elements. The reservoir is a small planar element, while the irrigated farms of the system are broad planar elements.

Functionally, the elements could be categorized as "providing services" and "receiving services". However, for irrigation cultural landscape purposes, the supply parts survive due to the human demands. The protection of irrigated farms may also contribute to the functional preservation of the whole irrigation system.

The characteristics of the elements can also be analyzed from different aspects. Some elements may be fixed with very limited change, and some may have significant meaning for the whole landscape. Some elements, on the other hand, may be in continual operation, which will need repair and maintenance regularly to provide services. The farms irrigated by the irrigation system are part of agricultural activities, which may have different management requirements from the preservation of an historical irrigation system. The concept of a living cultural landscape is important to the conservation of nature and cultural heritage management, which may also affect different legislation and conservation tools (Jones & Daugstad, 1997:275). An historical irrigation cultural landscape, which is still working, may also involve conservation concepts and methods for the elements in it, which differ from each other.

Moreover, as change is one of the most important characteristics of a landscape, it may result in different approaches to the conservation of landscape. Since the concept of cultural landscape in terms of the scope of cultural heritage developed much later than that related to buildings and structural monuments, many conservation concepts which apply to the conservation of buildings and monuments may not be suitable for cultural landscapes. In the system and history of cultural heritage preservation in Taiwan, the
management of the cultural landscape, especially under the concept of "managing changes" is rather unfamiliar. These concepts on "changing landscapes" are not only important to the irrigation system, but are also relevant for the irrigated farms. A living cultural landscape may not be frozen in its state at the time when it is inscribed or registered, nor will it exclude the introduction of new facilities or infrastructures, which may be necessary for the continuing functioning of the system (Cleer, 1995:58). It is necessary to connect the operation now with the broad features of the past, while keeping the historical features in the cultural landscape intact. Different conservation methods may be applied to the elements through the analysis of values and the determination of conservation strategies and concepts.

4. Values and Conservation Strategies of Irrigation Cultural Landscape

4.1 Values of an Historical Irrigation Cultural Landscape

The term "cultural landscape" embraces diverse manifestations of the interaction between humans and the natural environment (World Heritage Centre, 2013). The concept of cultural landscape interprets how a place was shaped and formed under various factors, and reflects the cumulative results of continuing change and operation during a period of time. A cultural landscape is not a collection of artifacts like monuments or buildings; rather, it is an ensemble created by people under the characteristics and limits of the natural environment. A cultural landscape comprises the utilization of the land or natural environment by people.

An irrigation cultural landscape was founded to supply water to widespread farms. Reservoirs, waterways, aqueducts and tunnels were built to overcome the limits of the natural landforms. Furthermore, people have to maintain the operation of this irrigation system. An irrigation cultural landscape includes various aspects of people's affairs, land, objects and time. It also records how people manage, store and transport water under the natural limits or characteristics to improve the production of farming. The ensemble of irrigation cultural landscape includes the collection of tangible buildings or structures and intangible knowledge and technology of water resource engineering; it reflects the inter-relationships among farms, villages and agricultural policies.

Many values may be revealed from this historical cultural landscape. Historical, engineering and technological, as well as social values may be most significant. From the historical value point of view, the Jianan Irrigation System and its cultural landscape is the testimony of an important period under the colonial government, which has changed the context and features of this region profoundly. Especially, the change of agricultural production has influenced the life of farmers, and realized the agricultural policy of the Colonial Government (Association of Public Jianan Irrigation Waterway, 1930: 1-2).

As for the engineering and technological value, many of the important elements in this irrigation system have been preserved in their original state and continue to work well (Fig.5.). It is therefore possible to understand the irrigation engineering technology used during that time. Large-scale transportation and storage of water could only be achieved using gravity and traditional technology. Ways of overcoming natural limits and/or utilizing natural characteristics and opportunities could also be seen and provided as examples for civil engineering today.

The historical irrigation cultural landscape may also have social value. The founding of this irrigation system has benefited the agricultural production in this area, which has provided better living conditions for the farmers and their families. It has also provided the basis for the industrial evolution in Taiwan. Some parts of the system have become modern tourist attractions while the agriculture sector has continued to decline.

With the conservation of this historical irrigation cultural landscape, it will be possible to protect the good illustration of evolution of the land through the harmonious work of its people. Different values within the historical irrigation cultural landscape may also reveal various conservation concepts according to the specific characteristics of each element.

4.2 Conservation Strategies

The conservation of cultural landscape should not mean the protection of "objects" only. It should also be expanded to broader aspects. Conservation works no longer involve the preservation of buildings and facilities alone, the related environment and the function of industry should be considered as a whole (Wang & Fu, 2011:6). The core of the management of cultural landscape focuses on the relationship of the interaction between people and their environment (Mitchell, Rössler & Tricaud, 2009:35). From the integrity and authenticity point of view, the conservation of cultural landscape should remain whole, which includes all those features, patterns and
dynamic uses and management processes which are directly associated with outstanding value; besides, the material genuineness, genuineness of organization of space and form, continuity of function and continuity of setting should also be involved in conservation strategies (Stovel, 2007:34). The conservation of cultural landscape should conserve the characteristics of landscape in their entirety as well as their ever-changing features, rather than the static condition of "objects". The functions which may continue the operation of landscape should be kept so that the objects and sceneries derived from the functions may be preserved or represented.

The strategy of "sustainability" may inspire the conservation of cultural landscape. The Declaration of San Antonio (1996) stated: "sustainable development may be a necessity for those who inhabit cultural landscapes, and that a process for mediation must be developed to address the dynamic nature of these sites so that all values may be properly taken into account." Selman (2007:107) argued that the essence of sustainable cultural landscapes is that they need to "regenerate" themselves rather than trend inexorably towards banality and dysfunction. From the strategy of sustainability, the conservation of cultural landscape implies that besides the preservation of the historical aspects of cultural landscape, the ability to adapt to change over time is also necessary; the character of the landscape should not be frozen; rather, the functions in cultural landscape should be maintained with the changes. In this sense, three major conservation concepts are discussed as follows.

First, the historical testimony should be preserved. Many historical testimonies should be preserved as connections between the past and the present.

Second, the working or functioning system in a cultural landscape should be kept operational. A cultural landscape is dynamic and evolves continuously. If the primary historic function(s) of a landscape contributes to its outstanding value, then every effort should be made to ensure continuity of these functions over time (Stovel, 2007:34).

Third, the integral instruments for conservation should be used. The concept of 'monument' has evolved from the individual building to the cultural landscape, while the preservation work has changed to protect its environment and all the activities that have traditionally supported the life in the site (Bonnette, 2001:136).

5. Possible Methods of Conservation

While the cultural heritage preservation in Taiwan was mostly based on monuments or historical buildings, the conservation and protection policies of cultural landscape under the Cultural Heritage Preservation Act are mostly based on monument-based approaches. However, an historical irrigation cultural landscape with cultural heritage significance may not be preserved or maintained using a singular approach to conservation; multiple concepts should be applied. Possible approaches for conservation of the Jianan Irrigation System cultural landscape may provide a good example for future conservation works in Taiwan.

5.1 Monument-Based Conservation

The monument-based approach to conservation aims to preserve the appearances and materials, by which the past may be revealed through protected "objects". The protection of the landscape does not remove the need for traditional monument-based designation and conservation methods, which are still required for protecting the fabric of special features within the landscape; however, the limits of the monument-based protection would be not suitable for the entire protection of the landscape (Fairclough, 2006:70). For the conservation of cultural heritage, many tools or guidelines have been established. The test of visual and conceptual authenticity may also be passed in this concept of conservation. However, only a few elements in a cultural landscape may be applied to this concept. Some elements in the landscape may be suitable for conservation through monument-based conservation (Fig.6.).

As for the Jianan Irrigation System and its cultural landscape, the statue, which memorializes those who died during the process of construction, is a good example of monument-based conservation. It is also possible to preserve the immense concrete spillway of the reservoir, or the great dam as monuments since the vast structure remains in good condition. With monument-based conservation, the objects are protected as historical testimonies in the cultural landscape, and the cultural heritage value is further enhanced.

![Fig.6. The Memorial Statue of the Founder of the Jianan Irrigation System, Hatta Yoichi](image)

The former houses of Hatta Yoichi and other primary engineers have been reconstructed or restored (Fig.7.). The authenticity of these reconstructed houses may not meet the requirements of cultural heritage, however, they may provide a clearer image of the idea of the Jianan Irrigation System cultural landscape, and enrich the wholeness and integrity of a cultural landscape. Thus the concept of cultural landscape may be enhanced while the houses should not be considered as a cultural heritage monument in the future.
5.2 Operation-Based Conservation

A living cultural landscape should not be frozen in a fixed state. As the importance of a living cultural landscape relates to its ability to operate, its functions should be protected and maintained in an active state. However, as operational objects deteriorate through time and normal use, the necessary repair or replacement of elements in the landscape become mandatory. The methods and processes of operation may also need to be revised through time so that the main theme of a cultural landscape can be preserved. The stewardship of people concerning cultural landscapes reduces their vulnerability to environmental stresses, and the resilience of cultural landscape is enhanced (Farina, 2000:315). In some cases, if the processes of operation are not changed or revised in regard to the specific environment or limits, the particularity of the cases may be revealed since they have existed after long-term operation and passed precarious challenges.

However, large-scale changes should be avoided since the historical continuity and authenticity may be lost. An historical cultural landscape should have connections to the past in various ways. Even if the changes are acceptable, it will not be considered a cultural heritage if past traces become insignificant or are absent.

For the Jianan Irrigation System, the water gates, waterways, aqueducts and water pipes and other water engineering are suitable for conservation in this concept (Fig.8., Fig.9.). To maintain the operation and safety of the irrigation system, the water pipes under the reservoir would be partly replaced and re-welded regularly, while the momentum from the water pressure may thin the pipe from 23mm to 9 mm after years of usage.

To achieve operation-based conservation, an evaluation of different values and conservation levels of the elements becomes necessary. Replacement should be carried out only if the safety or operation process of the cultural landscape becomes threatened, and should be limited as much as possible. With operation-based conservation, the authenticity of cultural landscape may be maintained through the concept of "continuity of function". The primary function of an irrigation system is to transport water and irrigate farms.

5.3 Sustainable Management

The conservation and preservation of cultural landscape may also involve a management approach as the cultural landscape represents significant and continuous land usage by people, which should be "managed" rather than "developed". Thus, from a conservation point of view, the management measures for cultural landscape may mean taking care of daily life. In a passive manner, it is also possible to do nothing as a management strategy in a landscape (Kendle, Rose & Oikawa, 2000:290).

In an active manner, tourism would be another possibility for the conservation of the irrigation system. Agritourism, under the umbrella of "ecotourism", will provide the opportunity for local people to develop new levels of self- and place-awareness, a renewed sense of self-worth and community identity, as well as positive re-alignment with local landscape and history (Jaworski and Lawson, 2005:126). Agritourism in the irrigated farms will benefit not only the economy of the farmers, but also the conservation of an irrigation cultural landscape (Fig.10.).

5.4 Planning

Landscape is multifunctional, while planning of land use cannot be restricted to the determination of the uses of each field or land parcel (Antrop, 2000:23). For an irrigation cultural landscape, the planning of the irrigated farms is an important task, which may influence the conservation of the whole. In the European Landscape Convention, it was argued that landscape be integrated into each Party's regional
and town planning policies, and into the cultural, environmental, agricultural, social and economic policies, as well as into any other policies with possible direct or indirect impact on landscape (Council of Europe, 2000).

For detailed planning and management of land, maintaining the proper usage of farmland is the most important goal. Inefficient land planning and management finally influence the conservation of the rural area. Change to rural land becomes irreversible once land is altered for different uses, such as for real estate or factories (Fig.11.). If it is not easy to maintain sustainable farming, another choice would be to keep rural land in its original state without buildings.

Different elements in the Jianan Irrigation Cultural Landscape, its values, concepts and methods for conservation are presented in Table 1.

6. Conclusion

Historical irrigation cultural landscapes are important cultural heritages. However, the conservation approach may be different from traditional monument protection, which was initiated during the late 19th century. Diverse conservation approaches in accordance with the features of every element should be used; thus, monument or operational conservation, sustainable management and planning remain the basic approaches for conservation.

For the Jianan Irrigation System, conservation requires many works from different disciplines. The cultural heritage protection may affect the significant elements, which would ensure that the most obvious feature in a cultural landscape could be represented. Operational conservation on most elements of an irrigation system would keep the system functioning properly, thereby ensuring that the living cultural landscape may continue. Sustainable management may provide economic viability for the people within the cultural landscape area, which may create new possibilities for the future. Management and planning of agricultural land will further provide a good basic environment for a rural landscape and conservation of the historical irrigation cultural landscape.

Multiple approaches to the conservation of cultural landscape in Taiwan may provide different visions beyond the concepts in the Cultural Heritage Preservation Act. Management, planning, or operation-based conservation could preserve different aspects of the nature of a cultural landscape other than the protection of physical elements alone, which are only a small part of a cultural landscape.

Table 1. Elements, Values, Conservation Concepts and Methods in an Irrigation Cultural Landscape

| Elements                     | Values                      | Concepts                      | Methods                                      |
|------------------------------|-----------------------------|-------------------------------|----------------------------------------------|
| Memorial Elements: memorial | Historical and social values | Preserve historical          | Monument-based conservation: restoration    |
| statue, other landmarks      |                             | testimonies                  | as monument cultural heritage                |
| Immense water works: dam,   | Historical and engineering  | Preserve historical          | Monument-based conservation: restoration     |
| spillway                     | values                      | testimonies                  | only if necessary                            |
| Reservoir                    | Historical and engineering  | Keep operation / Integral    | Operation-based conservation: regular       |
|                             | values                      | instruments                  | maintenance                                  |
| Water engineering works:     | Historical and engineering  |                               | Planning: land use planning around the       |
| waterways, water gates,      | values                      |                               | reservoir                                    |
| aqueducts, tunnels, pipes,   |                             |                               | Operation-based conservation: regular        |
| etc                         |                             |                               | maintenance; replace only if necessary       |
| Farmlands                    | Social value                | Integral instruments         | Sustainable management: search for           |
|                             |                             |                               | new economic model                            |
|                             |                             |                               | Planning: land use planning                  |

Fig.10. Different Cultivation in the Irrigated Farms Provided the Opportunity for Agritourism

Fig.11. The Irrigated Farms Should be Protected Through Planning for Unexpected Changes
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