

Historical, Geographical, and Biocultural Values of ‘Doksal’, Korean Stone Tidal Weirs

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Abstract

The sea is a space where ‘humans, materials, and information’ come and go. Given the abundant resources it provides, the sea has been significant in human culture until the present day. In particular, humans have made great advances in technological development and knowledge acquisition in relation to the use of fishing grounds. A characteristic example is the use of stone tidal weirs, a traditional fishing method that utilizes tidal differences and can be found all around the world. Stone tidal weirs have played an important role as a means of subsistence in the lives and livelihoods of islanders. This study, part of a bio-cultural diversity research study on the ecological and cultural characteristics of primitive traditional fisheries in island areas, was conducted in the island region of Shinan-gun, which has the largest number of islands in Korea and a sizeable tidal range. The study comprised a literature review, interviews with residents, and field surveys. Currently, there is no place where this traditional and primitive fishing method is used except for tourism purposes such as fishing village experiences. However, with the growing attention for nature-based solutions and community cooperation for marine ecosystem conservation, these traditional fishing methods are gaining renewed interest. This paper aims to discover the original fishing methods of the Southwest Sea islands and shed new light on their value in different respects, so that they can be used for ecotourism, education, exhibition, and scholarly activities in the future.

Keywords

Korea, nature-based solutions, Shinan-gun, Stone Tidal Weirs, traditional fishing

History and Ecological Features of Stone Tidal Weirs

Tidal differences and Stone Tidal Weirs

A common traditional fishing method involves the use of traps (Desmond 1960; Erickson 2000; Bak 2011). Thin, long poles are installed in a river or sea, and rope is woven in between, to catch fish moving along with the flow of the water (Nishimura 1975; Hong G. 1999; Tawa 2010; Park 2012; Park 2014; Luo 2015; Yu et al., 2015). In general, fish traps are known in Korean as 'eosal' (or 'eojeon'). Stone tidal weirs are a particular type of fish trap (Joo 2006; Lee 2006; Lee et al., 2010). With stone being the main material, the weirs are called 'dolsal' in Korean (Hong 2015). As 'dol' means 'stone' and 'sal' means 'trap', the name literally means 'stone trap'. Locally, in the Jeolla region, the weirs are called 'doksals' due to the Jeollanamdo's dialect in which the word for 'stone' is 'dok' (Jung 1994; Hong 2015).

The use of traps as a fishing method has been passed down since the Three Kingdoms period (三國時代, AD 4~7C), and during the Goryeo Dynasty (高麗時代, 918~1392), as historic records frequently mention 'eoryang' (魚梁), which means 'eosal'. It also continued to be a popular fishing method during the Joseon Dynasty during which it was known as 'eojeon' (魚箭, 漁箭).

'Eojeon' was a representative form of production in the medieval Korean fishing industry (Hong 2015). For instance, in waters with large tidal differences, so-called 'eojeon-ryu' (漁箭類) fishing gear were used to trap fish that follow the tide. Fish enter the trap at high tide and are obstructed from leaving at low tide. *Eojeon-ryu* (漁箭類) fishing gear is installed by fixating a wooden pole, building a stone wall, and placing a 'bal' (an object made by weaving long, thin ropes into a line, or by stretching several lines side by side) or a net made of woven bamboo in a place where the bottom is exposed or the water depth becomes shallow at low tide. It is clear that a wide variety of fishing gears were used for fishing activities from early on along the west and south coasts of Korea, which are characterized by large tidal differences. There are two main types of fish weirs, depending on the material used to block the water. One uses a 'bal' woven from mainly bamboo (Bak 2013), and the other is made by stacking stones in the shape of a wall with a trap gear installed on one side (Kang et al., 2002, 2018). The latter ones are often called 'stone tidal weirs' and they are a representative type of fish traps found along both the west and east coasts of Korea (Hong 2015).

Installation and Structure of Stone Tidal Weirs

Essentially, stone tidal weirs could be called 'stone nets' to catch fish, as they use a stone wall to trap fish by blocking their path at low tide in a concave bay or bend in the coastline with a sandy seabed (Hong G. 1999). They represent a nature-friendly fishing method that dates back to prehistoric times, giving them great value in terms of fishing heritage (Desmond, 1960). Still, the use of stone tidal weirs remains a common fishing technique used in many island areas of Korea. In particular, because they make use of tidal differences, stone tidal weirs are still commonly used in the tidal flats on the southwestern coast of Korea (Hong 2012).

Regarding their structure, stone tidal weirs appear in two main forms. According to *Korean Fisheries*, there are stone tidal weirs with a 'horseshoe-shaped' (or U-shaped) stone wall, implying that the wall is built in an oval shape from the tip of the coast toward the sea (Jung 1994; Hong 2015). In contrast, there are also stone tidal weirs that have walls built in two rows with different heights, blocking the bay 'in a straight line. Of these two main forms, the 'horseshoe-shaped' form is the one that has been most commonly used in Korea (Lee 2006; Hong 2015). It takes advantage of the characteristics of the coastal terrain most optimally, not only benefitting fishing, but also saving time, manpower, and money in construction (Lee 2007; Kim 2022).

Formation and Cultural Features of Stone Tidal Weirs - The Case of Shinan-gun

In order to install and operate stone tidal weirs, two conditions must be met. The coastal water should be shallow and subjected to tidal differences, and it should serve as a spawning ground for fish. The island-coastal region of Shinan-gun, Jeollanam-do (Figure 1), meets both of these conditions, and therefore many stone tidal weirs have been built there since ancient times (Figure 2). Traces of stone tidal weirs can be found in most areas of Shinan except for the Heuksando Islands (Lim 2018). They are rather evenly distributed throughout the entire region. Representative places where the remains of stone tidal weirs in their original form have been preserved are Bokryong-ri (Shinyong, Yongyong Village) Abhae-eup, Daepojakdo island, Anjwa-myeon, Bakjido-myeon, Anjwa-myeon, Hanun-ri (Dunjang Village, Jaeun-myeon), and Bangchuk-ri (Jeungdo). However, due to a lack of management, only traces of these stone tidal weirs remain today. This is regretful because of their interaction with marine ecosystems (Hong et al. 2010).

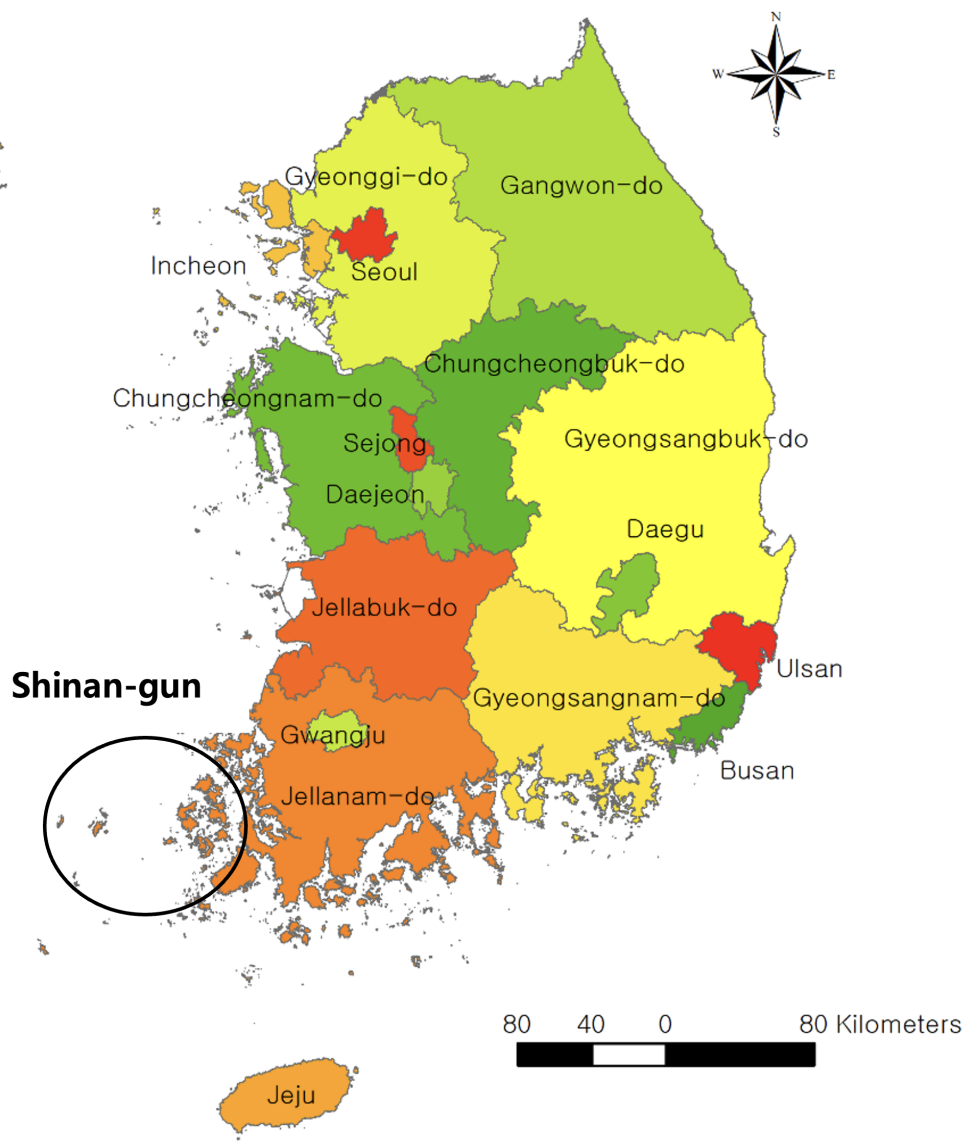


Fig 1. Location of Shinan-Gun



Fig 2. Location of Stone Tidal Weirs in Hanun-ri, Anjwa-myeon, Shinan-gun (Shinan-Gun, 2017)

Stone tidal weirs also represent a part of the history of island village development as practiced by earlier generations (Nishimura 1975). During the late *Goryeo* and early *Joseon* Dynasties, the so-called "empty island" policy prohibited people from living on the islands to prevent Japanese looting, but after the Imjin War (1592~1598, War caused by Japanese invasion), it became possible for people to live on the islands again. 'Stone tidal weirs' reveal traces of the life wisdom of residents who reentered the islands during this period. Through the use of stone tidal weirs, they actively utilized the sea and natural processes to create a living space where people could gather and live on an island that had not been inhabited for a long while. The marine products obtained with the stone tidal weirs were a very important resource for sustaining livelihoods.

Stone tidal weirs are best placed where the coastal terrain is undulating and small islands are in close proximity. The tidal flats should be gently sloped so that some water remains in the trap at low tide (Nishimura 1975). The stone walls are usually around 100 meters long, although some extend to around 300 meters. The wall is usually built having a width of three rows of large stones at the bottom, and then gradually smaller stones with a narrower width stacked on top. The gaps between the stones are usually filled with pebbles or gravel to structurally strengthen the wall. The construction method of stone tidal weirs reflects the wisdom and traditional knowledge of the islanders.

Knowledge System and Function of Ecosystem Conservation of Stone Tidal Weirs

The sea is a space where "humans, materials, and information" come and go and where abundant resources are present, and it has been significant in human culture up to the present day (Erickson 2000; Tawa 2010; Bak 2011, 2013). In particular, in relation to fishery resources, humans have accumulated a vast amount of technology and knowledge related to the use of fishing grounds. Stone tidal weirs are a typical example of a traditional fishing method. As mentioned, it cleverly utilizes the difference in tides, and it has played an important role in the local people's life and livelihood as a means of subsistence (Kim 2013).

Fishing by means of stone tidal weirs is very simple. Twice a day, at low tide, people go out to the weir site with a basket ("jorak") and a fishing net (or floating net also known as 'jokbaji' or 'jjokbaji'), walk along the stone wall to the pool, and catch the fish that have gathered in the net and put them in the basket (Jung 1994; Luo et al. 2015). Except during the harsh winter months, it is possible to catch fish at low tide all year round. In the case of the stone tidal weirs in Dunjang, Jaeun-myeon, Shinan-gun, when the water recedes, people go to the water gate of the weirs and use the said floating net to capture the trapped fish (Figure 3; Shinan-Gun 2017). Catches usually include blue crab, large-eyed herring, gray mullet, tonguefish, cuttlefish, and sometimes also yellow corvina, croaker, and other species. The village women also collect the many oysters that tend to cluster on the outside of the stone tidal weirs. These naturally occurring oysters attached to the walls also reinforce the structure, holding the stone tidal weirs together so that they do not collapse due to the tide.



Fig 3. Stone Tidal Weirs Photo in Dunjang, Jaeun-myeon, Shinan-gun (Shinan-Gun, 2017)

Fishing cultural values and value system of Stone Tidal Weirs

In Shinan-gun people have practiced several rituals aimed at ensuring big catches in fishing, and these rituals are closely related to the local seasonal fish markets as fishing culture resources. In other words, they are key components of the

fishery culture (Shinan-Gun 2017; Kim 2018). The cultural and historical significance of the stone tidal weirs is that they represent a fishing method that is a nature-based as it only takes what nature gives (Hong G. 1999; Erickson 2000). The amount of fish caught varies depending on the natural tides, and the installation and maintenance of the weirs requires the labor of many people, so it keeps the community culture and sharing spirit of the islanders alive and well. There was a time when Korea's islands were intentionally left uninhabited. During the Joseon Dynasty, the 'empty island policy' was implemented due to the frequent invasions by Japanese pirates. However, after the Imjin War, it was again allowed for people to enter the islands and build settlements, and the early islanders actively pioneered and utilized the sea space. The stone tidal weirs are exemplary of these activities and developments. Therefore, the stone tidal weirs are a showcase of the process of islands developing from a wasteland into a living space, and they have great human cultural value in that they have passed down the life wisdom and traditional knowledge of previous generations.

Stone tidal weirs are among the oldest forms of fishing technology, having been around since humans began utilizing the sea and developing cognitive systems (Tawa 2010; Yu et al. 2015). Although stone tidal weirs are primitive in human history, they are one of the most humane and sustainable form of fishing, utilizing the natural phenomenon of tidal changes to catch fish. It is an eco-friendly way of fishing that requires an understanding of the principles of nature, such as finding a place with good drainage and understanding the difference between waves, currents, and tides (Luo et al., 2015).

Stone tidal weirs are a well-preserved example of fishing community collaboration and an important way for people to democratically manage resources and share their benefits. Despite their cultural value, however, stone tidal weirs have become neglected due to the development of large-scale fishing industries.

Conservation and enhancement of biocultural diversity

Tidal flats are spaces where the physical terrestrial environment and the coastal marine environment coexist, functioning as a buffer zone. Therefore, tidal flats are home to a variety of organisms that utilize both land and sea (Hong et al. 2010). Shinan-gun, Jeollanam-do, is dominated by mud tidal flats, which has created the conditions for the development of a variety of benthic invertebrate fauna and algae not found elsewhere.

In particular, the more than 1,000 islands in the coastal region of Shinan-gun are used as a stopover by birds on the migratory route between Australia and Siberia, and the abundance of life in the tidal flats around the islands provides an excellent food source for these migratory birds (Lee et al. 2010). Due to this ecological uniqueness, the islands of Shinan-gun were collectively designated as Dadohae Maritime National Park on December 23, 1981, in recognition of their outstanding biodiversity and natural scenery. In 2021, the tidal flats of Shinan-gun were designated as a UNESCO World Natural Heritage Site, allowing for the systematic conservation of tidal flats biota, biodiversity, and cultural diversity.

The stone tidal weirs constructed in tidal flats around island villages are recognized as embodiments of 'traditional ecological knowledge (TEK)' by the fishing community aimed at protecting fish stocks and ensuring sustainable fishing. Although there are currently no villages that actively utilize stone tidal weirs to continue traditional fishing, there are a growing number of villages that have started to utilize the tidal flats as spaces for coastal protection experiences. The unique ecological landscape around the stone tidal weirs, including uninhabited islands utilized by fishing communities, geological landscapes, and windbreak forests, allows for the conservation and sustainable utilization of these biocultural resources (Kim and Hong 2011; Lee et al. 2016). The stone tidal weirs have a number of ecological functions that can enhance the biodiversity and sustainability of the island's coast, which includes the following:

- Stone tidal weirs are an indigenous fishing method that utilizes tidal differences to naturally harvest fish and shellfish, but also provides habitat for fishes to live and grow (Nishimura 1975).
- Stone tidal weirs, which are maintained and managed by fishing communities, are a form of sustainable fishing that protects fish stocks.
- For algae, the difference in tides allows algae spores to attach to the inside of the stone tidal weirs, acting as a kind of algae seed bank that provides resting places for fish.
- Although the species of fish available at stone tidal weirs vary by season, mullet, blue crab, eel, spotty belly greenling, red tongue sole, large-eyed herring, yellow corvina (or croaker), and cuttlefish are commonly caught, and conch, gastropods and other shellfish are also found in the area (Joo 2006).
- As part of the coastal protection experiences, stone tidal weirs not only provide a cultural perspective on the original fishery, but also reaffirm that in earlier times people practiced fishing while conserving and maintaining biodiversity, and in that sense, it highlights the importance of the stone tidal weirs as an "ecosystem service function" in the current sense (Park 2012; Yu et al. 2015).
- The local tidal differences are what determines the structure of stone tidal weirs, and many species use the gaps between the stones to not only migrate, but also to colonize. Therefore, stone tidal weirs fulfill an ecological function as habitat as well as an ecological corridor for organisms.

The Value and Use of Stone Tidal Weirs as a Future Fisheries Legacy

To assess the value and use of stone tidal weirs within the context of heritage (Shinan-Gun 2017), it is necessary to do so in relation to three broader aspects (Lim 2017). First, "agricultural and fishery heritage", which refers to the tangible and intangible agricultural and fishery systems that farmers and fishermen have formed over the years while adapting to the local environment, society, and customs, and the tangible and intangible resources associated with the core values of those systems. Second, "rural multifunctional resources", which refers to resources located in rural areas that express multiple beneficial functions, including not only food supply, but also beautiful landscapes, preservation of traditional culture, maintenance of the environment and ecosystem, harmonization of national sentiment, and provision of health recreation and learning and experience opportunities. Third, "nationally important agricultural heritage", which refers to agricultural and fishery heritage designated by the Minister of Agriculture, Food and Rural Affairs in recognition of the need to preserve, manage and utilize them at the national level.

For any site to be designated as an agricultural heritage site, it must meet six criteria:

1. A farming and fishing system with more than 100 years of tradition and continuity, used for food production and livelihoods of local people, must be present.
2. The site should enable the enhancement of biodiversity in the agro-fishery landscape.
3. Special or differentiated knowledge, skills or techniques must be available.
4. There need to be aspects of traditional culture associated with the farming system.
5. The site must represent a beautiful or special agro-fishery landscape.
6. There needs to be a plan for the maintenance, management, and utilization of agricultural and fisheries heritage by local governments and local people, and a system of cooperation.

Recently, as interest in the diversified value of agriculture and rural areas has increased both domestically and internationally, regional revitalization using agricultural and fishery heritage has become of major concern (Lim 2018). It is being used at both a domestic and international level to creatively inherit and develop local traditional culture, improve

regional image through branding, commercialize agricultural products, and attract tourists through beautiful scenery (Hakim et al. 2009; Kim 2017). In particular, agricultural and fishery heritage resources such as traditions, landscapes, and technologies that have been maintained for a long time are in crisis due to rapidly changing domestic and international conditions such as rural population decline, aging, and FTA (*Free Trade Agreement*). Therefore, various strategies are needed to maintain, preserve, and utilize these resources, and it is even more important to utilize agricultural and fishery heritage for regional revitalization.

At the same time, there has been a paradigm shift in fisheries and fishing village policy and planning around the world. In the past, fisheries policies focused on fishing activities and their outputs, such as increasing production and improving varieties, but in recent years, there has been a trend to move away from conventional fisheries and toward fisheries that improve the competitiveness of fishing villages or fishing areas, human-centered fisheries, and quality of life (Park 2012). Countries around the world are striving to preserve their traditional fishing cultures and heritage, which have long been shaped by adaptation to local communities and natural environments. These efforts are not only to maintain the traditional fishing culture, but also to create new value by linking it with modern science and technology and utilize it to revitalize the local economy. The improvement of the competitiveness of rural areas is achieved through the discovery and utilization of potential resources in the region and the imparting of cultural values, and this series of processes is possible through the rediscovery and continuous use of the functions and values of agriculture and fisheries, which are referred to as the multi-functionality of livelihoods (Kim and Hong 2011; Lim 2018).

Shinan-gun, Jeollanam-do, is the only administrative municipality in South Korea that is composed entirely of islands (Shinan-Gun 2017). Although some of its islands are connected to the mainland by bridges, the human geography of Shinan-gun is distinctly different from that of other coastal areas. The stone tidal weirs distributed on the island of Shinan are cultural heritage that includes traditional ecological knowledge containing the wisdom of ancestors about properly utilizing the surrounding terrain, making its biocultural value very high. In particular, they utilize the diverse terrain and geology of the island area, resulting in a superior landscape compared to stone tidal weirs in other regions. Stone tidal weirs represent a fishing method without using large-scale gears, which makes it a sustainable fishing method that contrasts overfishing, and exemplifies fish stocks protection and sustainable fishing activities. Therefore, it holds great value as a resource of fishery heritage as it is a way of life in harmony with nature that is passed on through traditional knowledge to future generations. In recent years, some islands have been promoting stone tidal weirs as a tourist attraction. It is important for future generations to experience the primitive form of fishing as a means of livelihood for islanders through hands-on learning, and for future generations to learn the fishing methods of their ancestors through this process, so that these sustainable fishing resources remain available in the future.

Conclusion: Solutions to Rediscover the Modern Value of Stone Tidal Weirs

Stone tidal weirs represent a primitive fishing method that was practiced for a long time on the west and south coasts of Korea and in the Jeju Island area (Hong 2015). Nowadays, their use has drastically declined due to the development and modernization of fishing boats, but there are some on the Tae'an Peninsula in Chungcheongnam-do, and some on the west and south coasts of Jeju Island and Jeollanam-do (Park 2012). Although the same phenomenon is occurring in most areas, the stone tidal weirs in Shinan-gun are under threat in terms of management as a result of the declining population. In addition, due to the development of large-scale commercial fisheries to maximize economic benefits, small-scale stone tidal weirs in the coastal waters are losing their economic value. At this time, traditional ecological

knowledge and skills for the management and construction of stone tidal weirs are rapidly disappearing due to intergenerational disconnections that come with population decline. Recently, attempts have been made to commercialize stone tidal weirs as tourism products to revitalize fishing villages. Some places are restoring weirs using heavy machinery, but this construction method tends to overlook essential details, causing the stone tidal weirs not to function effectively. The number of fish caught by the stone tidal weirs is absolutely small, making it difficult to expect profits, and as a result the number of sites left unattended by fishermen is increasing.

With the exception of communal stone tidal weirs, the rights to stone tidal weirs may remain with the person who customarily built them. Stone tidal weirs built by individuals have been passed down through generations of descendants or sold to others for money. However, since most of the stone tidal weirs' owners are elderly, there is little transfer of ownership or management when they die, and even though they are owned by the community, they often fall into decay due to poor management and maintenance. The authors propose the following ways to overcome these problems and to revitalize fishing villages and ensure traditional knowledge is passed on.

- Transition the stone tidal weirs from private ownership to community ownership and management, with comprehensive maintenance and support.
- Continue to strengthen community cohesion for the management of the stone tidal weirs as the population continues to decline.
- As fish stocks such as blue crab, octopus, and clam are plummeting, it is necessary to pursue sustainable fishing methods and eliminate factors that threaten the livelihoods of coastal fishermen by strengthening crackdowns on illegal fishing, introducing a fishing year off, and establishing a closed season.
- The establishment of fish stocks and the management of resources for their adequate production should be supported through voluntary decision-making processes by local communities, and local people should be encouraged to instill a sense of pride in inheriting traditional fishing methods through various educational and other programs.
- In order to protect the resources by operating a voluntary monitoring system among fishing communities, it is necessary to investigate and consider expanding the cases of traditional fishing methods, while prohibiting fishing practices such as catching all fish regardless of size in dense nets, which destroys the regenerative capacity of fishery resources, or capturing rare fish species by illegal fishing.

In order for modern society to become a sustainable society, there must be a fundamental shift in the way we use nature, the way we distribute the benefits of nature, the way we produce and consume resources, the way we dispose of waste, and the way we think about the relationship between humans and nature. A fishing community using stone tidal weirs is a way to achieve this sustainable use of nature and to value the stone tidal weirs as a future biocultural heritage of humanity. As a traditional fishery method, stone tidal weirs are a representative example of the traditional and rational use of the relationship between humans and nature. It reflects the wisdom of ancestors and should be defined as the “*old future*” to create a sustainable society and culture, developing it into a program applicable to the modern society.

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