

S2. The Current Development of Deep Ocean Water in Taiwan:

Issues, Themes and Strategy

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ABSTRACT

Taiwan is located at the west coast of Pacific Ocean. The sea-bed topology in the east coast of Taiwan is characterized by a steep slope so that the water depth reaches nearly one thousand meters just about several kilometers off the coast. Therefore, the east coast of Taiwan is considered to be one of the best locations to obtain deep ocean water in the world. In viewing of the development of deep ocean water industry in USA and Japan since 1980s, and already resulting in a certain level of output values, the Taiwan government has initiated and embarked the development starting 2005. However, after ten-year development, it has only reached a few fractions of its expected output values, mainly due to the failure of water-capturing systems in the governmental sector. Despite of the setbacks, the facilities constructed in the civilian sectors have been running well, and there are now three well-developed companies in the Hualian county. Through a serious consideration, the deep ocean water community has decided to activate a second phase development, with a backup of a special budget allocated by the government to boost the industry. The purpose of this article is to discuss the current development of deep ocean water in Taiwan, including the issues encountered, the on-going project themes, and the strategy for the near future development. We hope that through international cooperation with Japan and Korea under the supports of MOU and interchanging experiences, the development of deep ocean water industry in Taiwan may reach fruitful results in the years to come.

I. Current Key Issues and Recommendations for Solution

The deep ocean water (DOW) is characterized by low temperature, cleanness, and abundant nutrients. These characteristics may be broadly applied to various areas, such as ocean thermal energy conversion (OTEC) for power generation, low temperature agriculture and aqua-cultural farming, and many other areas in biotechnology, biomedical and health science, and various food products etc. However, the DOW industry in Taiwan is currently limited in the utilization of its high-nutrient property only, and a full DOW industry chain has not yet been developed. The DOW agriculture and aqua-cultural farming industry are affected by insufficient amount of DOW, the varieties of DOW-related products are limited due to insufficient investment for R&D, and the sales are low due to insufficient experience on DOW product marketing. These are important issues upon which the Taiwan has faced, and are awaited for further solution.

Based upon the above description, the key issues faced upon Taiwan DOW development, and the recommendation for solution are as follows:

1. **The DOW-taking system in the public sector must resume to steadily operate as soon as possible:** There are two DOW-taking operation institutions and facilities in Taiwan set up by government, both located in Taitung county of southeast of Taiwan. One is the Eastern Taiwan Deep Sea Water Innovation & Research Center (ETDIC) administrated by the Ministry of Economic Affairs (MOEA) (Figure 1), and the other is Aquatic Generic Resource Bank in the Eastern Marine Biology Center of Fisheries Research Institute, administrated by the Commissioner of Agriculture (COA) (Figure 2). Unfortunately, both water-taking facilities were unable to sustain the typhoon attacks, and the supply of DOW was terminated since 2012. This has caused devastating effects on DOW development in Taiwan in the past ten years. Without DOW supply from public sector, the cost of DOW supply from private sector is too high, hindering the advancement of DOW industry such as aqua-farming. Currently, a new project on laying a DOW pipe in ETDIC is on going, and it is expected to be completed in October of 2020.



Figure 1: The Eastern Taiwan Deep Sea Water Innovation & Research Center(ETDIC), administrated by the Ministry of Economic Affairs (MOEA).



Figure 2: Aquatic Generic Resource Bank in the Eastern Marine Biology Center of Fisheries Research Institute, administrated by the Commissioner of Agriculture (COA).

2. The R&D investment in the private sectors is insufficient so that the varieties of the DOW products are too narrow: The sizes of DOW companies are generally small so that the companies cannot afford R&D investment, resulting in high similarities of DOW products and high cost of production process. Therefore, it is important that the industry must collaborate with universities and research institutes to conduct the basic and applied research to support DOW industrial development. Currently, there are several research projects supported by the Ministry of Science and Technology (MOST) in some areas of DOW, such as biotechnological and biomedical applications (Figures 3 & 4), and these researches has already reached certain mature level. It is important now to integrate academic research with industrial applications, in particular, commercial products, so that the capacity of R&D on DOW may be raised.

3. It is urgent to enhance the water supply mechanisms in the private sectors so that

DOW industry may be continued: Despite the fact that the water supply systems in public sector failed and are now under re-construction, there are three companies in Hualian county having the capacity of taking 3,160 ton per day. If this amount of water may be fully utilized, the DOW industry may still be operating well. Therefore, both the public and private sectors should now seek and develop a mechanism to share the use of DOW, so that the development may be maintained.

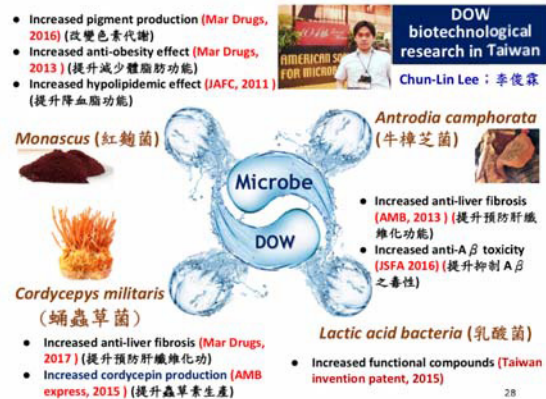


Figure 3: DOW research on biotechnological applications by Dr. Chun-Lin Lee

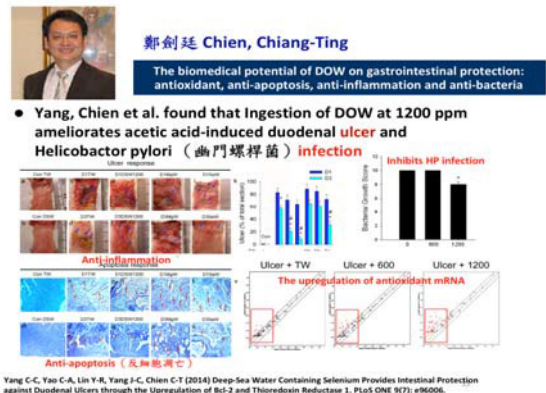


Figure 4: DOW research on biomedical applications by Dr. Chiang-Ting Chien.

4. The central and local governments must work closely to help building the DOW industrial parks: Currently the DOW products are still few and have not yet reached the so-called critical mass, both in amount and varieties, making the production cost relatively high. Furthermore, these companies and products are scattered around so that it is hard to promote to the general public, resulting in a lack of understanding about the values of DOW. Therefore, it is important at this stage to establish an industrial park for DOW—An endeavor that both central and local government must work closely together to resolve the

relevant problems, including the regulations, land use, development procedure, and tax benefit etc., making the DOW industrial park attractive for investors.

- 5. A new marketing strategy must be soon be developed to boost the sale of DOW:** During the development of DOW, the industry has once been hit hard by the criticism of its safety from academia community and public media, and therefore the DOW products are not fully trusted by the general public. Although the Taiwan Society of Deep Ocean Water Resource Applications (TW-DOWA), established in 2014, has been working hard to defend and promote the values of DOW, and the morale of DOW community has gradually been raised, the sales have not been completely recovered to reach their original levels, therefore, a new way of marketing strategy must be developed. Since the production cost for DOW products in Taiwan is relatively less in comparison with USA, Japan, and Korea, Taiwan should seek for the export sale, however, there are still many difficulties and standards needed to be overcome and established.
- 6. Due to the high cost of DOW, the aquacultural and agricultural industries should choose high-value species to grow, and incorporate into multi-purpose, multiple-stage uses of DOW:** Due to the fact that currently the amount of DOW is limited and DOW is only available in private sector, the uses of DOW in the areas of aquaculture and agriculture must be planned wisely. For example, spotted shrimps, abalone, oysters, groupers are good choices for aquacultural farming, and some low-temperature, short growing period, high economic species of vegetables should be chosen for agriculture. In view of success on multiple-stage use of DOW in Toyama Prefecture of Japan, the cold energy application in the primary DOW industry is a good example for development.

II. Recent Industrial Development Themes

Recently in order to boost DOW industry, the Ministry of Economic Affairs (MOEA) of Taiwan government has allocated a specific budget to foster the industrial development. It was open to DOW industrial community for applications. Although the budget size is not high, it has stimulated the DOW community to march forward. The call-for projects were reviewed and selected, and here we list the project titles to reveal the recent development themes in the DOW industry in Taiwan, as follows:

- The service model for DOW multiple-stage applications in a DOW industrial park.
- The development of DOW mineral functional materials and their refinements of production

process.

- The applications of DOW in the long-term care service.
- The applications of DOW in the functional drinks for gastro-intestine health.
- The applications of combined DOW on algae probiotics added-value products.
- The applications of DOW on external use medical products for trauma cares.

Since these projects are still on-going, it is not convenient to expose their detailed contents. We expect that through government promotion and collaboration with universities and research institutes, these projects should result in a good output value.

III. Development Strategy

Here we recommend a ten-year period proposal for DOW development strategy in Taiwan as follows:

2018-2020

- The government must pay close attentions on the re-construction of water-taking project in ETDIC to make sure that the water supply from the public sector may be offered after 2020.
- The government must help DOW community to develop a mechanism to fully utilize the DOW water currently available from 3 private companies, so that the pace of DOW development may be fastened.
- A DOW industrial park in Hualian with multi-purpose, multi-stage DOW applications should be developed as soon as possible, so that future investment can be made.
- The connections between fundamental research in universities and industry must be closely linked so that the research results may well applied to product development.
- To explore the DOW export market, it is required to develop protocol for the product standards, in particular, China and Southeast countries.

2021-2024

- The DOW industrial park in Hualian should have already completed by then, and should strive for excellence to serve as a model of DOW development.
- The water-taking engineering project in ETDIC is completed, and the DOW industry in Taitung county is ready for development.
- The water supply system by government should offer a low cost DOW to foster small or middle size companies.

2025-2027

- This is the period that DOW products should

- receive their identities in the market, and DOW becomes familiar resource to the public.
- High value products of biotechnological and biomedical applications are available on the markets.

IV. Concluding Remarks

Water and energy are the two most important resources for human being, and these two resources may be derived from deep oceans. Deep ocean water is characterized by low temperature, purity, and abundant nutrients, and is the origin of all life, in particular, the human beings, so that the necessary nutrients for human should be embedded in DOW. DOW applications started from USA and Japan, and now Taiwan and Korea have also join the development, and it is believed that DOW should raise more and more attentions. By working together, the cooperation among Taiwan, Japan, and Korea should become an international model for the development of DOW in the near future.

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