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# Training Mode of Aquaculture Professionals in Local Applied Marine Colleges and Universities

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**Abstract** In the training of aquaculture professionals, there are problems such as unreasonable structure of teachers, unclear understanding of aquaculture by parents and students, poor practical ability of students, lack of grass-roots aquaculture talents, and imperfect multi-party cooperation training mechanism. In view of the above situation, the training mode of applied talents in aquaculture needs to be reformed and innovated. In this paper, some measures to establish the training mode of aquaculture professionals were proposed, including strengthening students' correct understanding of the major, improving the curriculum system for cultivating applied talents, establishing a training model for practical teaching, improving the practical ability of teachers, increasing the provision of high-quality educational resources, and adopting school-enterprise cooperation, so as to cultivate high-quality and high-tech aquatic talents under the training mechanism of applied talents.

**Key words** Transformation, Marine colleges and universities, Aquaculture, Talents, Training, Model

## 1 Introduction

Aquaculture is a highly practical applied major. The training goal of undergraduate colleges is to cultivate senior professionals who have basic theories, basic knowledge and basic skills in aquatic biological aquaculture science and other aspects and can engage in scientific research, teaching, aquaculture development and management in aquaculture production, education, scientific research and management and other departments<sup>[1]</sup>.

"Aquaculture is the fastest growing animal source in the world's large agricultural sector in the past three decades, and it is an important means to meet the demand of population growth for animal protein". Marcio, senior official of the Department of Aquaculture and Fisheries Management of FAO, believes that feeding the world depends on agriculture, especially aquaculture. Judging from the world development situation, most of the natural fishery resources have been fully utilized or over-utilized. In the future, the development of fishery and the supply of aquatic products will mainly rely on aquaculture. Therefore, under the premise of establishing a big grain concept, there is a lot to do in the development of aquaculture with Chinese characteristics.

Zhang Fusui *et al.*<sup>[2]</sup> pointed out that in 2000, the output of China's aquaculture reached 25.78 million t, accounting for 60.2% of the country's total fishery output. In 2018, China's total aquaculture production exceeded 50 million t, accounting for more than 78% of the total production of aquatic products, and China is the only major fishery country in the world where the total production of aquaculture products exceeded the total catch (Fig. 1)<sup>[3]</sup>.

At the on-site meeting on the green development of the aquaculture industry, Yu Kangzhen pointed out that it is necessary to make aquaculture a model for the country to develop a green and low-carbon economy, improve the breeding environment, reduce breeding pollution, and achieve a win-win situation in production and ecology<sup>[4]</sup>. Through the investigation and research on the Beibu Gulf aquaculture industry, Lin Han<sup>[5]</sup> found that with the development of aquaculture technology, the marine aquaculture industry in the Beibu Gulf has developed rapidly, and the aquaculture area, output and scale have increased significantly. It can be seen from the above research that aquaculture industry occupies an increasingly important position in China's agricultural field.

Aquaculture is also a "main business" of large agriculture in Hainan Province, and it is the main means to ensure supply, increase income and develop marine economy. However, on February 26, 2019, the fourth annual meeting of the Hainan South China Sea Fish Seeds Association and the "Industry" Forum pointed out that "the proportion of enterprises (or individuals) with breeding licenses in Hainan Province is extremely low, perhaps less than 10%, which will cause Hainan's aquaculture to lose the rationality of its existence"! In the next few years, the market will require enterprises (or individuals) to work with certificates, which will be both an opportunity and a challenge for enterprises (or individuals). Huang Hai *et al.*<sup>[6]</sup> believed that it is necessary to promote the construction of characteristic courses in local colleges and universities and cultivate applied talents for aquaculture that meet the requirements of the new era. Wang Youji<sup>[7]</sup> took Shanghai Ocean University as an example, and described the importance of constructing undergraduate applied talents. Therefore, in order to change this situation, it is necessary to cultivate relevant professional talents, establish talent advantages, and promote industrial rationalization on the basis of professional talents to better seize the opportunity and develop the marine economy.

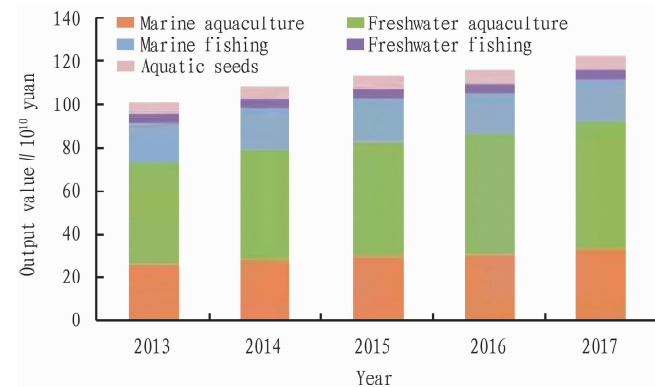
Since 2006, the biological science major of Hainan Tropical Ocean University has consecutively trained 7 years of undergradu-

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ate graduates in the direction of aquatic products, with a total of 356 undergraduate graduates. In 2015, the school changed its name and became a marine college. It opened aquaculture undergraduate major in 2016, and there are currently more than 300 students. Since 2016, relying on the advantages of suitable climate and high-quality water environment in Sanya, this major aims to promote the development and utilization of germplasm resources of tropical aquatic seeds in the South China Sea and the sustainable development of aquaculture, and carries out the teaching and scientific research work in key directions such as aquatic seed breeding and new variety development, development of new technologies for aquatic ecological aquaculture, development of intelligent technology in deep-water cages, aquaculture of aquatic resources, and protection and utilization of fishery resources. Outstanding talents in the aquaculture field with a correct view of aquatic ecological aquaculture and the concept of environmental protection and sustainable development of fishery resources, as well as theoretical and practical abilities are cultivated to contribute emerging forces to the cultivation of talents in the aquaculture industry in Hainan and even China.



Note: The data is organized by Foresight Industry Research Institute.

**Fig. 1** China's fishery output value and composition from 2013 to 2017

## 2 Current situation and problems of talent training in aquaculture

In recent years, China's aquaculture profession has a new increasing trend. Among the educational institutions involved in aquaculture in the country, the goal of junior college, undergraduate and above education is mainly to cultivate high-skilled practical talents related to aquaculture. At present, among the aquaculture majors in Chinese universities, the top three in 2018 were Ocean University of China, Huazhong Agricultural University and Shanghai Ocean University. These colleges and universities have common characteristics, are the main promoters and practitioners of the revolutionary waves of aquaculture industry in China, and regard aquaculture as one of the core and important characteristic disciplines. In the past half century of development, aquaculture discipline has always stood at the forefront of field development and has become the core and banner of China's aquaculture industry. In the process of talent training in aquaculture, many problems have also emerged in recent years. The main problems are as follows.

**2.1 The structure of teaching staff is not reasonable** In the teaching staff of colleges and universities, due to the development of professional disciplines, people with doctoral degrees are generally required to enter colleges and universities. Those with doctoral degrees have strong scientific research ability, but generally lack opportunities to exercise at the grassroots level and practical experience in production. When leading undergraduate students to learn basic knowledge, they only explain the knowledge in the book, and cannot teach the students the applied knowledge of the production line<sup>[8]</sup>. There is a serious phenomenon of "inbreeding" among professional teachers. The discipline is single, and the cross-cutting is not strong. The integration of industry and education is still only at the level of completing teaching practice, and the multi-party cooperation training system of production, learning, scientific research, and practical application needs to be further innovated and improved<sup>[9]</sup>.

**2.2 The talent training in aquaculture is influenced by traditional ideas** Many parents fail to distinguish aquaculture graduates from aquaculture skilled workers. They think that after graduation, aquaculture graduates will become farming workers and have no prospects for development. This often leads to errors in students filling out their application will in the college entrance examination. Except the first choice of a small number of students in the college entrance examination is aquaculture, most of the other students are transfer students, and their foundation is not solid enough, so it is difficult to learn professional knowledge. They lack interest in the aquaculture industry, so they do not actively participate in practical internship activities, resulting in weak practical skills and ability and making it difficult to find a job after graduation. After graduation, less than 20% of the students engaged in the professional work.

**2.3 The employment of graduates is unstable** After students work in the breeding industry, most students have to go to the front line of breeding to gain experience at the beginning. Most of the students are only children, lacks the hard-working spirit, and often change careers within 1–2 months after entering the job. As a result, there is a shortage of grass-roots aquaculture talents in the aquaculture industry, and grass-roots aquaculture talents over 45 years old account for more than 65% of grass-roots personnel.

## 3 Measures to establish the training mode of aquaculture professionals

Seen from the development status of aquaculture and the existing model of talent training, aquaculture talent training needs to be transformed into an application-oriented one to adapt to social development and add vitality to the aquaculture industry. In view of the shortcomings of the current training method, the following aspects can be improved to cultivate high-quality applied talents.

**3.1 Strengthening students' correct understanding of aquaculture** In order to strengthen students' correct understanding of aquaculture, firstly, the professional connotation, market demand and development prospects of aquaculture can be comprehensively introduced on the website of a college when a college recruits students, so as to attract students who are willing to study and improve the quality of students in this major; secondly, when freshmen are enrolled, it is necessary to preach the development history

and current situation of the aquaculture industry, invite leading figures in aquaculture to share their experiences, make students see the bright future of the industry, and organize students to visit leading enterprises<sup>[10]</sup> and scientific research institutes to build students' confidence in this major; thirdly, professional basic course education should be carried out to make students understand their mission and responsibilities; fourthly, it is needed to hold aquatic culture festivals, "river crab competition"<sup>[11]</sup>, and establish ornamental fish associations to stimulate students' enthusiasm for learning and enhance their professional interest; fifthly, students should be encouraged to participate in social practice, go deep into breeding bases to experience the production process and participate in fishery resource surveys, so that students can understand the requirements of aquaculture for high-quality talents.

### 3.2 Improving the curriculum system for cultivating applied talents

Only when the trained aquatic talents can create value for the society and contribute to production can the training goal be achieved. Aquaculture colleges should focus on the central point of "applied talents", formulate systematic training plans, and provide scientific course content according to the professional characteristics of aquaculture. Aquaculture is greatly affected by the geographical environment, and there are differences in the cultivation modes and methods in different places. It is extremely difficult to find an aquaculture mode that takes into account various conditions. Only by grasping the local climate and resource characteristics, using regional advantages, adopting aquaculture models suitable for local economic development, and opening relevant courses, can the cultivation be more efficient. For example, the courses of cold-water fish culture technology and facility fishery in Northeast Agricultural University have local characteristics<sup>[12]</sup>. In addition, special cases of aquaculture under typical geographical conditions at home and abroad are added to cultivate talents with broad vision and flexibility. For instance, Guangxi University<sup>[13]</sup> also set up disciplines such as aquatic immunology, aquatic pathology, and aquatic pharmacology to cultivate talents who meet the needs of the industry. Hunan University of Arts and Sciences<sup>[14]</sup> incorporates the relevant courses of veterinary laws and regulations and professional ethics, fishery economic management and other qualification certificate examinations into teaching. It aims to strengthen students' professional knowledge and cultivate their ability to solve practical problems to meet the needs of production practice. Students have obtained all-round training of application ability and obtained the recognition of professional qualifications, which will help them to find jobs smoothly and adapt to the post more quickly.

### 3.3 Establishing the training mode of practical teaching

In order to transform into a university of applied technology, aquaculture colleges must adopt a capability-oriented training model, and practical ability is the core competitiveness of talent employment<sup>[15]</sup>. Therefore, it is very important to improve students' practical ability. Aquaculture production has strong operability. Colleges and universities should reform indoctrination teaching and adopt teaching methods (such as "on-site teaching method", "case teaching method", "inquiry teaching method", "problem teaching method", "group research" and "project teaching") to cultivate practical ability<sup>[16]</sup>, inspire students to think, analyze

situations, actively explore, and transform their thinking, so as to cultivate their ability to learn independently and solve problems.

Practical teaching is a good measure to cultivate applied talents. Practical activities can be divided into intra-curricular activities and extracurricular activities. Intra-curricular activities focus on aquaculture professional traineeship and seminars, increases the proportion of designed and comprehensive experiments, and strengthens theoretical guidance, so as to enable students to master water quality detection, aquatic disease diagnosis and other technologies, and cultivate students' ability to think independently. According to the teaching objectives, various forms of practical activities are carried out, such as holding aquatic skills competitions, and carrying out evaluation of aquatic science and technology papers. Besides, breeding training can also be included in innovation credits to stimulate students' enthusiasm for practice and improve their professional quality. Extracurricular activities focus on ability training, allowing students to participate in practical training in breeding bases, learn relevant skills, increase practical supervision, and ensure the quality of practical teaching. Applied talents in aquaculture need to have the ability of practical application, innovation and independent learning. Colleges and universities should make full use of educational resources, cooperate with enterprises and scientific research institutes, and carry out comprehensive practical teaching activities.

### 3.4 Improving the practical teaching ability of teachers

The practical ability of the teacher team should be exercised in production. Teachers should enter the practice production link, apply for scientific research projects according to the problems of aquaculture and the insufficiency of production technology<sup>[17]</sup>, and encourage students to use experiments to consolidate theoretical knowledge, and convert theory into production value in practice. In this process, the scientific research ability of teachers and students has been exercised, and together they are approaching the practical model. In addition, "dual tutors"<sup>[18]</sup> jointly guide students to complete the graduation thesis design, which can promote students to change to the needs of enterprise development, and the practical experience of teachers is accumulated, thereby promoting the process of cultivating applied talents.

Creating a team of teachers with practical teaching ability is an effective measure for the transformation of applied universities. Qinzhou College has "double high" requirements for teachers. That is, teachers must not only master solid theories, but also learn technologies such as aquaculture and breeding, disease prevention, and research and development of nutritional feeds, and have practical production experience to provide technical support for cultivating applied talents. Huangshan College<sup>[13]</sup> adopts the method of "internal training and external introduction, combination of professional and part-time jobs" to build a "dual-ability" teacher team, and hire technical personnel with practical ability to teach. Teachers go deep into the production line for learning, training, scientific research and investigation, so as to create an applied teacher team with practical experience and teaching ability.

Enterprise mentors play an important role in cultivating high-tech talents, and it is also necessary to establish and improve the competition identification mechanism for corporate mentors. Cor-

porate mentors with technical skills and educational capabilities serve students, while schools and enterprises provide corresponding remuneration and promotion space, so as to form a positive educational environment and create favorable conditions for talent cultivation.

**3.5 Increasing the provision of high-quality educational resources** High-quality resources are an important condition for cultivating outstanding talents, and diverse, efficient and interesting resources are conducive to the shaping of high-quality talents. Multimedia, Internet and other media are used to allow students to enjoy educational resources of aquaculture; audio-visual materials about changes in different developmental stages of aquatic animals, feed selection, water quality control, disease prevention and control, *etc.* should be shared to make students be close to actual production; simulation courseware should be established to make students to observe the shape and carry out operation exercises and increase the efficiency and practicality of courses; aquaculture workers are invited to participate in courses, explain the operation methods and procedures in aquaculture, and share production experience; a distance network teaching guidance and exchange platform is established, and flipped classroom, simulation, case, on-site teaching and other means are adopted to increase the interest of the classroom and the participation of students, stimulate students' enthusiasm for learning, and create a learning atmosphere of active interaction, innovative practice, and common progress, so that students know how to discover, analyze, and solve problems to better serve production.

It is necessary to strengthen exchanges between marine colleges and universities, establish aquaculture professional alliances, and establish a school-to-school cooperation mechanism. Using the unique resources and technical support of each marine college, each partner college jointly trains aquaculture students, thereby outputting high-ability talents, and applied talents also inject fresh blood and development vitality into colleges and universities.

**3.6 Adopting the training method of school-enterprise cooperation** School-enterprise cooperation training is an important way to exercise students' practical operation ability. Students can use the high-quality resources of enterprises to master professional skills according to the needs of the industry, which can make up for the shortage of schools that cannot deeply cultivate talents due to the limitations of equipment and funds. Students participating in corporate training can not only gain an in-depth understanding of development trends and prospects of the industry, but also improve their practical innovation capabilities. This development mode that emphasizes practical skills avoids the phenomenon that the cultivated talents are out of touch with the actual production, and is an effective way to output applied talents.

Aquaculture can take the form of school-enterprise cooperation in professional traineeships and internships. Hainan Tropical Ocean University cooperates with Hainan Zhongzheng Aquatic Co., Ltd., Hainan Chenhai Aquaculture Co., Ltd., Lingshui Delin Chengxin Aquaculture Co., Ltd., *etc.* to cultivate applied talents. The companies provide a training base for students, so that students can understand the aquatic industry and master production skills. The theoretical knowledge students learn in school can be verified and supplemented in the production base. In prac-

tice, students can know the position of aquaculture in society and reduce the blindness of employment. In addition, the productive experience brought about by practice enables students to fit in with the actual situation, laying the foundation for personal development. In the school-enterprise cooperation, students are familiar with the production process of a company, and directly enter the company to work after graduation. In this way, the company also obtains the talents who master the theory and practical operation, as well as high-quality and applied talents, which injects fresh blood into aquatic enterprises, which is conducive to the innovation and healthy development of aquatic industry.

## 4 Outlooks

Under the situation of "sea power", aquaculture has become a sunrise enterprise, and the demand of enterprises for talents is increasing. However, talents are relatively insufficient, and the oversupply is the current situation of this profession. In the 2011 graduate recruitment of Xiamen Ocean Vocational College, the ratio of supply and demand for aquaculture majors was 1:6. In 2014, there were too many surplus jobs provided by aquaculture enterprises to Ningbo University. The growing demand for professionals in the aquaculture industry has provided a great opportunity for the employment of aquaculture students. The industry has great prospects for development. The starting monthly salary for undergraduates is 4 000 – 5 000 yuan, and the annual salary of 200 000 yuan is not a dream when they have remarkable skills. Aquaculture students have a wide range of employment paths. Leading aquatic feed enterprises represented by Haid Group and Tongwei Group are fiercely competing for aquatic talents to stabilize their market position; fishery medicine enterprises such as Xiamen Liyang and Wuxi Zhongshun also recruit aquatic professionals to provide technical services for competition; the emerging aquarium industry and aquatic product processing industry urgently need high-tech talents. It can be seen that the aquaculture industry has broad development potential, and the prospect of outstanding applied aquatic talents is bright.

With a complete curriculum system for cultivating applied talents, a teaching model that emphasizes practical operation ability, high-quality training resources, the guidance of key teachers with practical experience, and the support of enterprises and scientific research institutes, the cultivation of applied talents is easier to achieve. With the help of various forces, technical talents with aquaculture professional knowledge, practical experience, scientific research ability and innovation consciousness can be cultivated, and applied talents who master scientific breeding technology will promote the vigorous development of the aquaculture industry in a healthy and bright direction.

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(From page 45)

obstructed, which is conducive to the popularization of new agricultural machinery and accelerating the progress of orchard mechanization. For standardization of agricultural machinery, it should produce high-level, high-precision and high-quality technical equipment and parts<sup>[2]</sup>, and improve product quality and reliability. Subsidy mechanism should be improved, making practitioners and enterprises earn money with dignity. The training of talent teams (students from colleges and technical secondary schools, new farmers who are literate and know how to operate<sup>[2]</sup>) should be enhanced, and the support of professional service enterprises (cooperatives, *etc.*) should be increased. All fruit production units need professional agricultural machinery services. With the aging population, rural areas also need enterprises that provide agricultural machinery services. At present, such enterprises have a large gap and few employees (R & D personnel, production personnel, operators). It should improve after sales service of agricultural machinery maintenance and other aspects. After the standards of agricultural machinery and tools are unified, it is no longer a factory with one specification. If the factories are unified, 4S stores and maintenance stores like the automotive industry can be established. Fruit tree production is different from grain and oil crops. It is perennial, with large plant row spacing, large crown, deep root, and woody branches. Old orchards are required to be upgraded, with strong road trafficability. The edge of a field is not

less than 4 m, so that agricultural machinery can be turned around and meet the requirements of mechanization. Cultivation mode is also standardized and suitable for mechanization, including plant row spacing, tree shape and other agronomy. For newly-built orchards, mechanization should be fully taken into account in the planning and design at the beginning of the establishment.

## 4 Conclusions

The fundamental way out for agriculture lies in mechanization. With the improvement of mechanization level, the mechanization level of orchards in North China will certainly improve. There is great potential for the fruit industry and orchard mechanization. It should vigorously promote agricultural mechanization and intellectualization, thereby helping agricultural modernization with science and technology<sup>[3]</sup>.

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