TEMASEK LIFE SCIENCES LABORATORY LIMITED & AGRI-FOOD AND VETERINARY AUTHORITY OF SINGAPORE JOINTLY ANNOUNCE GRANT AWARD FROM NATIONAL RESEARCH FOUNDATION ON APPLIED AQUACULTURE GENOMICS RESEARCH AND DEVELOPMENT

Temasek Life Sciences Laboratory Limited (TLL) and Agri-Food and Veterinary Authority of Singapore (AVA) are pleased to embark on a project to further improve the productivity and quality of the Asian seabass (*Lates calcarifer*) and the Mozambique tilapia (*Oreochromois mossambicus*). The project is made possible with the S$10 million grant awarded by the National Research Foundation (NRF) Competitive Research Programme Funding Scheme on applied aquaculture genomics research and development.

2. The objective of this project is to achieve a quantum leap in food-related R&D for improved productivity and quality of two important food-fishes in Singapore: the Asian seabass and the Mozambique tilapia. By assembling and developing proprietary and other cutting-edge tools of genomics, we have and will continue to identify various fish individuals that carry the right genetic variants that make them, and their offspring/hybrids, grow faster and less susceptible to diseases.

Research programme on Asian seabass and Mozambique tilapia

3. TLL and AVA have been working on the improved growth rate of the Asian seabass since 2003, and have similarly started working on the Mozambique tilapia since 2010. TLL and AVA have collected naturally occurring, genetically diverse varieties of Asian seabass from different regional locations. Many mass crosses are performed and the best collections of individuals are selected from among their offspring using proprietary as well as state-of-art genomic tools. This process of selection is termed as selective breeding and it does not involve genetic modification. Biotechnological tools are used to assemble the unique information encoded in the genome of the fish that are selected. This helps to speed up natural selection process to increase the average yield of the farms in the shortest time. Using similar approach, we are also hoping to select for fast-growing and saline tolerance in the Mozambique tilapia in our research program.

Benefits of R&D research project

4. The potential economic and societal benefits include creating superior broodstocks that are fast-growing with increased resistance. The fingerlings produced by these superior broodstocks are expected to vastly outperform those originating from unselected stocks. With increased efficiency and greater productivity, safe and good quality seafood can be made available at a more affordable cost.

5. As fish is a healthy source of food, many people worldwide have chosen fish as their main supply of protein, resulting in an increasing demand for safe and quality food fish. By using genomics tools to improve production of fish in a shorter time span of time and thus reducing risk, we hope to increase food supply for the region and improve food security for Singapore.

6. Prof Laszlo Orban said, "We are grateful to the NRF for giving us this chance to translate and accelerate our research work to address issues of food security and safety for Singapore. It is important that research ultimately lead to economic and societal benefits. We hope to apply the latest, cutting edge methods of genomics in our research to develop superior lines of food fish so as to improve quality and increase productivity. Today we are opening a new chapter of fish research in Singapore that will likely further increase our existing lead in the area of marine aquaculture internationally".

7. "The AVA is pleased to share our expertise on this project, as partnerships such as this, complement our Marine Aquaculture Centre's efforts in applied research in areas such as breeding, hatchery and grow-out technologies. Local commercial fish farms can apply these combined technologies for the production of faster growing popular food fish to enhance their supply," added Dr Philip Chew, Director of Technology & Industry Development Department, AVA.

8. "We are delighted to be a recipient of the NRF's grant award. With this research funding, we look forward to working with AVA to develop technologies that can help address future food fish demand, ensuring food security and supply for Singapore and the region. We also hope to translate our R&D efforts into commercial applications and develop local enterprises." says Prof Chan Soh Ha, Executive Director of TLL.

9. Ms Tan Poh Hong, AVA's Chief Executive Officer, underscores the importance of such collaborations and efforts in AVA's overall strategy in ensuring food supply resilience in Singapore, and in this case fish supply. "Local production plays an important supporting role in providing Singapore with a buffer against supply disruptions. We are constantly looking at ways to help our fish farmers boost their productivity. This includes engaging in joint R&D collaboration with the industry and research institutes like TLL, to come up with technologies and better quality food fish," said Ms Tan.

About Temasek Life Sciences Laboratory Limited

TLL is a non-profit organisation established in 2002 to undertake cutting-edge research in molecular biology and genetics utilising a broad range of model organisms. TLL is affiliated to the National University of Singapore and Nanyang Technological University. Our vision is to create an environment which can

attract the brightest young minds worldwide, support their research and challenge them to be leaders in their own fields.

About Agri-Food and Veterinary Authority of Singapore

The Agri-Food & Veterinary Authority (AVA) is responsible for ensuring a resilient supply of safe food, safeguarding the health and welfare of animals, safeguarding the health of plants and facilitating agri-trade.

AVA is constantly on the lookout for new and potential food sources, through our push for source diversification in collaboration with the food industry. Simultaneously, AVA continues to help raise local agricultural productivity to enhance Singapore's food supply.

We have in place integrated food safety programmes which incorporate risk management, and leverage on industry engagement and public outreach to ensure food safety as a shared responsibility.

AVA's comprehensive animal and plant health system prevents the introduction of exotic animal and plant diseases. AVA also takes steps to ensure compliance with animal health and welfare standards.

With the world as Singapore's marketplace, AVA facilitates agri-trade through our inspection, testing and certification services.

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About the research team:

The research team will be led by Professor Laszlo Orban, Director of Reproductive Genomics Group in TLL and comprise Dr Yue Genhua, Associate Director of Molecular Population Genetics Group, Prof Jimmy Kwang, Senior Director and a few other TLL members. They will work closely with Mr Lim Huan Sein, Deputy Director, Aquaculture Technology Division of AVA and other collaborators including Professor Oystein Lie of MareLife Servicses AS and Professor Miklos Mezes of Szent Istvan University on the project.

About the seabass market:

Global Production – Asian Seabass

Based on FAO data, the global aquaculture production of Asian seabass has been on an upward trend. In 2009, global production stands at almost 50,000 tonnes and most of the production come from our region (Figure 1 and 2).

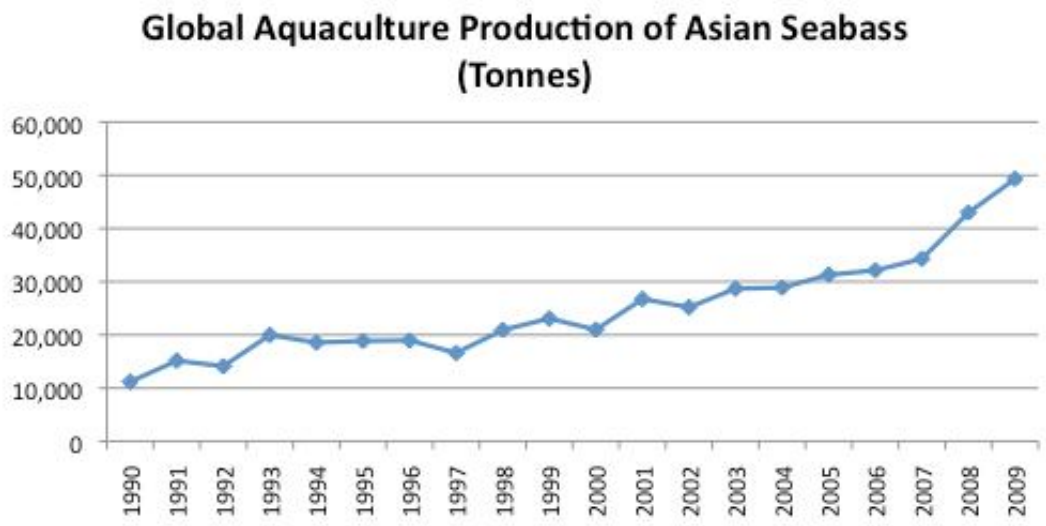

Figure 1. Global Aquaculture Production of Asian Seabass (Tonnes)

Source: FAO Statistics and Information Service of the Fisheries and Aquaculture Department. 2011. Aquaculture production 1950-2009. FISHSTAT Plus - Universal software for fishery statistical time series [online or CD-ROM]. Food and Agriculture Organization of the United Nations. Available at: http://www.fao.org/fishery/statistics/software/fishstat/en

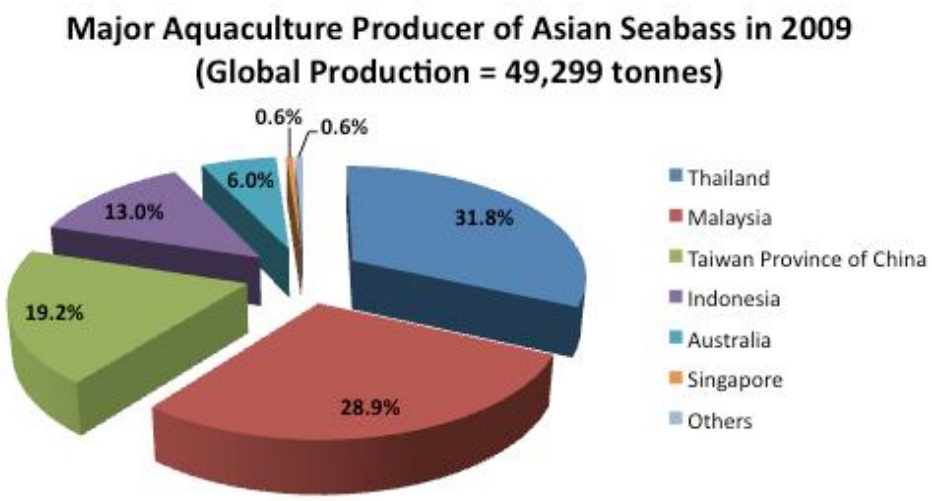

Figure 2. Major Aquaculture Producer of Asian Seabass in 2009

Source: FAO Statistics and Information Service of the Fisheries and Aquaculture Department. 2011. Aquaculture production 1950-2009. FISHSTAT Plus - Universal software for fishery statistical time series [online or CD-ROM]. Food and Agriculture Organization of the United Nations. Available at: http://www.fao.org/fishery/statistics/software/fishstat/en

About the tilapia market:

Global Production – Tilapia

The Nile tilapia is the world fourth most produced aquaculture species with global production of 2.5 million tones in 2009. However, its relative, the salt-resistant Mozambique tilapia has only seen global production of 33,000 tonnes in 2009. We believe this is due to the slow growth rate seen in current Mozambique varieties. This low production figure could also be due to classification into other tilapias categories for we know that hybrids of Mozambique tilapia with other faster-growing tilapia species are also commonly farmed. We hope that our research can help generate a fast-growing and salt-tolerant tilapia that can be reared cost-efficiently by local coastal farmers (Figure 3).

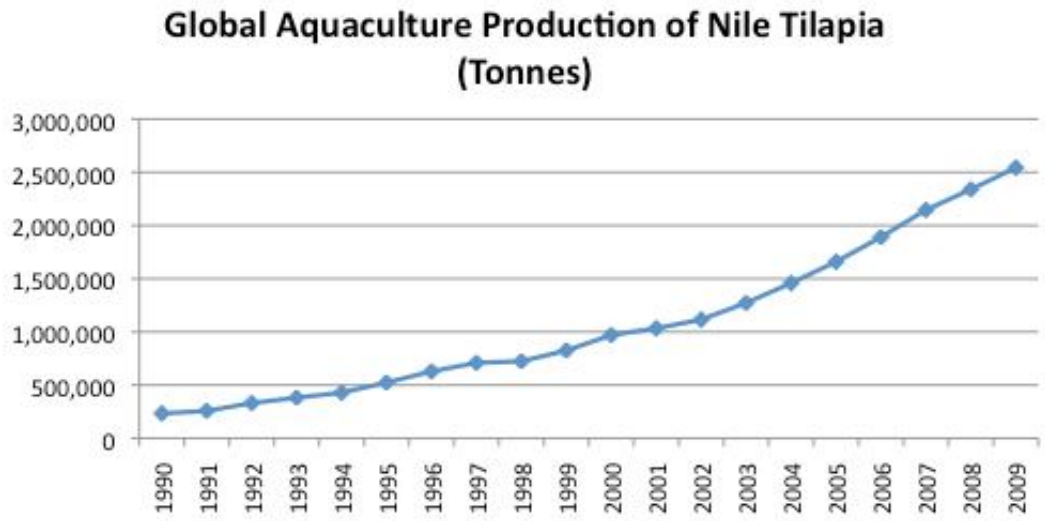

Figure 3. Global Aquaculture Production of Nile Tilapia

Source: FAO Statistics and Information Service of the Fisheries and Aquaculture Department. 2011. Aquaculture production 1950-2009. FISHSTAT Plus - Universal software for fishery statistical time series [online or CD-ROM]. Food and Agriculture Organization of the United Nations. Available at: http://www.fao.org/fishery/statistics/software/fishstat/en

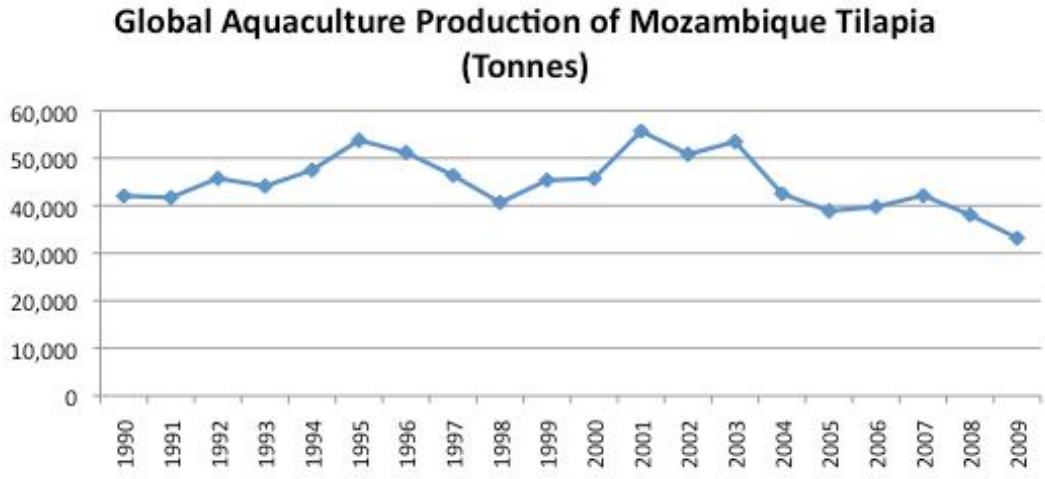

Figure 3. Global Aquaculture Production of Mozambique Tilapia

Source: FAO Statistics and Information Service of the Fisheries and Aquaculture Department. 2011. Aquaculture production 1950-2009. FISHSTAT Plus - Universal software for fishery statistical time series [online or CD-ROM]. Food and Agriculture Organization of the United Nations. Available at: http://www.fao.org/fishery/statistics/software/fishstat/en

About the local consumption:

Based on AVA website, Singapore's per capital consumption of fish in 2010 is 15.3kg. This is based on total population (resident and non-resident) and consumption of fish (live fresh and chilled fishes). If taking fish (all types) into consideration, the per capital consumption for Spore in 2010 is 23.6kg.