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Taiwan Agricultural Technology Foresight 2025

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Purpose

This was the first time that Taiwan conducted a large-scale expert opinion survey using the Delphi approach. The goal was to identify research topics relevant to shaping the future of agriculture in Taiwan. Applying roadmapping, the project presented policy suggestions at the end of 2011. The suggestions have been incorporated into the Taiwanese government's Council of Agriculture (COA) research agenda as evidenced by COA's call-for-projects announcement.

The Role of Agriculture in Taiwan

Taiwan was one of the leading countries in subtropical agriculture several decades ago, but now agriculture has lost its importance in job creation, domestic production and international trade. However, agriculture is still at the root of the economy and has many functions beyond production – it provides the food we eat, conserves the environment we live in and is a force of social stability.

Taiwan, with a nominal GDP of \$427 billion dollars and a GDP (PPP) per capita of \$35 thousand US dollars in 2010, is known for its manufacturing capabilities today, but it used to export a large number of agricultural products and technologies to many countries a long time ago. Since 1959, more than 100 agricultural missions have been dispatched to more than 60 countries, about half of which are currently at work in Africa, the Middle East, Latin America and Asia-Pacific.

In fact, Taiwan's total land area is about 36,000 square kilometres, most of which is mountainous or sloped. Therefore, agriculture is practiced mainly in the plains,

which comprise 29 percent of the country. As a subtropical island characterised by high temperatures and heavy rainfall, Taiwan offers biodiversity for agriculture but also lends itself to the breeding of insects and diseases. There are also frequent typhoons that cause natural disasters in the summer and autumn every year.

There have been significant changes in Taiwan's agricultural exports over the years, however. Years ago, Taiwan exported sugar cane, rice and canned mushrooms or asparagus. Now Taiwan's main exports are aquaculture products (e.g., tuna, eel, tilapia), leather and feathers, and its main agricultural imports include corn, soybeans, wine, tobacco, cotton, lumber, beef and wheat. In 1953, the average value of agricultural production increased by 7.3 per cent annually, and exports increased at a rate of 9.3 per cent. Beginning in 1970, however, agricultural exports fell behind agricultural imports. In 2010, imports were USD 12.8 billion and exports were USD 4 billion. The production value based on agriculture is estimated at approximately 11.2 per cent of GDP while primary production accounts for only 1.5 percent of GDP in Taiwan.

The Revitalisation of Agriculture in Taiwan

In order to revitalise the agricultural sector to meet the challenges of trade liberalisation, globalisation, the knowledge-based economy and, particularly, climate change, the Taiwanese government's Council of Agri-

culture (COA) commissioned a project – *Taiwan Agricultural Technology Foresight 2025* – to the Taiwan Institute of Economic Research (TIER). This four-year project (2008–2011), with an annual budget of USD 350,000, conducted foresight-related activities, including demand



surveys, trend and policy analyses, horizon scanning, visioning, essay contests, training workshops, two-round Delphi surveys, roadmapping and the development of policy suggestions (short-, mid- and long-term development plans and priorities) (see Figure 1).

The project aimed to identify R&D priorities to meet the long-term objectives for agriculture in Taiwan, such as to improve farmers' productivity and livelihoods, devel-

op resource-efficient and environmentally friendly methods of farming, and ensure food safety by instituting a traceability system. These objectives were embedded in a vision of making Taiwan a better place to live in terms of industrial development, environmental protection and quality of life in general.

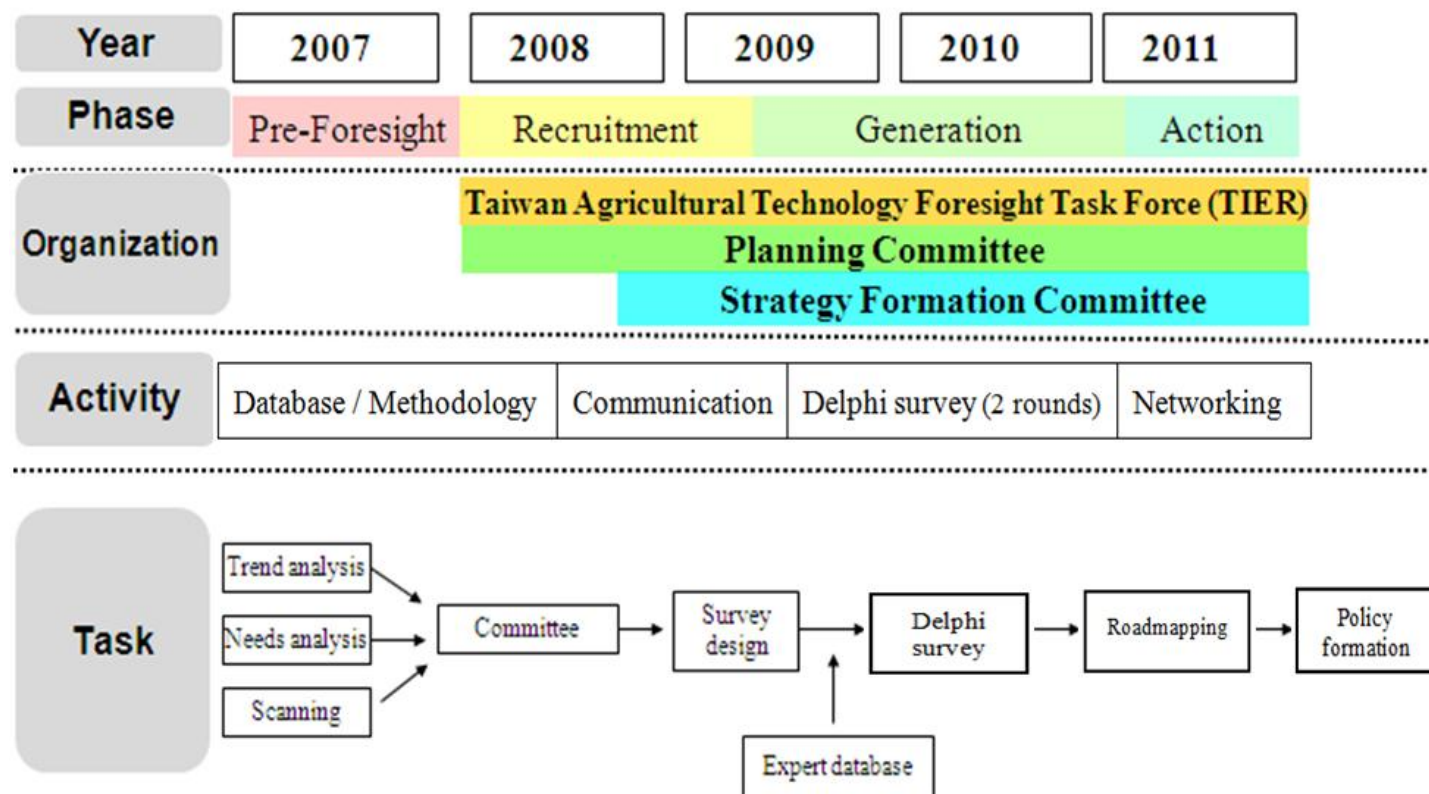


Figure 1. Structure of the *Taiwan Agricultural Technology Foresight 2025* project

The Taiwan Agricultural Technology Foresight 2025 Project

In 2008, TIER set up a task force of six researchers and two assistants to learn foresight techniques, mainly from Japan. It compiled a database of social needs, technological trends, research resources, critical issues and agricultural policies nationally and worldwide.

Under the support and approval of COA, the project set up the Planning Committee consisting of government officers, agricultural experts and senior researchers, including social scientists and an economist. The Planning Committee decided that the project's target year was to be 2025 and that the purpose of the foresight was to identify R&D priorities to meet the long-term objectives for agricultural development in Taiwan stated above.

Visioning for Research Topics

In order to link the foresight and policy, the project set up the Strategy Formation Committee, with ten sub-committees corresponding to the ten research areas of COA, each of which was comprised of agricultural experts and senior researchers. The members of the Strategy Formation Committee were nominated by the Planning Committee and then approved by COA. The Committee's task was to depict a vision for 2025 in each research area and to figure out the research topics that need to be addressed to shape the future of agriculture in Taiwan as anticipated by the Planning Committee.

In 2009, the Strategy Formation Committee proposed more than 100 research topics for the project. The TIER task force tried to consolidate some of them and organise them in a uniform format. Then, the Planning Com-

mittee identified the final 74 research topics and the related key questions for the Delphi questionnaire.

In 2010, the TIER task force developed an online survey platform and carried out two rounds of Delphi surveys. There were 675 experts and researchers on the list of the first round, 546 of whom participated in the Delphi survey (response rate of 80 percent) and 512 of whom returned valid questionnaires, which were thus included in the analysis. For the second round, 546 experts and researchers were listed, 413 of whom participated in the Delphi survey (response rate of 76

percent); 407 of them returned valid questionnaires that were included in the analysis.

Based on the survey responses to the questions concerning the 74 research topics, the project compiled indices of industrial development, environmental protection, quality of life, national priorities and government support respectively to measure the research topics in different respects. The standard deviations of all indices turned out smaller in the second round than in the first round. This implies that the Delphi survey produced results converging toward a consensus.

Shaping the Future of Agriculture in Taiwan

The project particularly tried to compile a 'national priority' index composed of the factors industrial development, environmental protection and quality of life, each of which was given equal weight in creating a vision of a better life in Taiwan. The ten highest 'national priority' scorings among the research topics identified in the project are shown in Table 1. These research topics reflect the needs for shaping Taiwan's agricultural future in ways to improve farmers' livelihoods (priorities 2, 6, and 8), develop resource-efficient and environmentally friendly methods of farming (priorities 3, 5, 7, 9) and ensure food safety by instituting a traceability system (priorities 1, 4, 10).

The survey shows that the government should support those research topics with higher scores in environmental protection and quality of life, particularly due to the multifunctional nature of agriculture (positive externalities). By contrast, in regard to those research topics that scored high in terms of industrial development, the respondents considered less need for government supported research since the private sector can be expected to take charge in these areas. All of these research topics have been incorporated into COA's research agenda as evidenced by COA's call-for-projects announcement.

Table 1. The top 10 research topics of the Taiwan Agricultural Technology Foresight 2025

1. Development of accurate, rapid and simple diagnostic kits for pesticide residues.
2. Research on the ecological restoration of polluted farmland, derelict rearing ponds, overdrawn groundwater areas, riverbeds and banks, and degraded forestland.
3. Elucidation of global climate change affecting Taiwan's agricultural ecosystem and the development of counter measures.
4. Improvement of integrated safety tests, a tracking system and certification for agri-food products.
5. Development of crop production systems with low energy consumption, low emission of greenhouse gases and efficient use of water resources.
6. Improvement of forecasting and monitoring techniques for slopeland debris slides.
7. Development of groundwater-saving aquaculture.
8. Development of agricultural environmental resources monitoring and early disaster warning technology.
9. Development of energy-saving and carbon-reducing preservation and shipping technologies for agricultural products.
10. Clarification of transmission modes and pathogenic mechanisms of animal and human infectious diseases.

Attracting the Young Generation

In order to attract the young generation to think about the future of agriculture, the project invited young people to participate in the *Taiwan Agricultural Technology Foresight 2025* contest (see Figure 2).

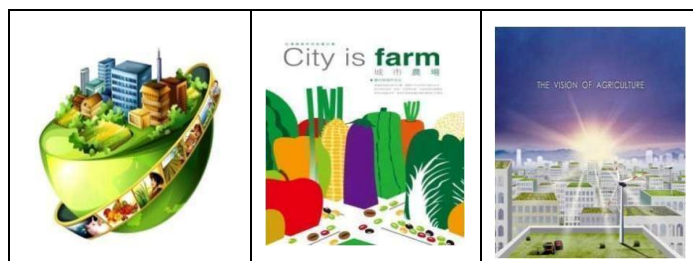


Figure 2. The winners of the *Taiwan Agricultural Technology Foresight 2025* contest

Foresight for Policy and as Policy

This was the first time that Taiwan conducted a large-scale expert opinion survey using the Delphi approach. The goal was to identify the research topics to meet the needs for shaping the future of agriculture in Taiwan. Based on roadmapping, the project presented policy suggestions at the end of 2011.

The project's major contribution has been to gain the government's support for the research topics that have been identified as 'national priorities' to promote industrial development, environmental protection and quality of life. The project is expected to improve farmers' productivity and livelihoods, particularly for smallholders, develop resource-efficient and environmentally friendly methods of farming in Taiwan's limited land area and reinforce the links between production and consumption of agricultural products by implementing a traceability system.

Sources & References

The website of *Taiwan Agricultural Technology Foresight 2025*, <http://agritech-foresight.coa.gov.tw>

COA R&D project management system, <http://project.coa.gov.tw>

About the EFP: Policy professionals dealing with RTD, innovation and economic development increasingly recognize a need to base decisions on broadly based participative processes of deliberation and consultation with stakeholders. Among the most important tools they apply are foresight and forward looking studies. The EFP supports policy professionals by monitoring and analyzing foresight activities and forward looking studies in the European Union, its neighbours and the world. The EFP helps those involved in policy development to stay up to date on current practice in foresight and forward looking studies. It helps them to tap into a network of know-how and experience on issues related to the day-to-day design, management and execution of foresight and foresight related processes.