Policy Planning and Management of Agricultural Science and Technology in Taiwan

Hwang-Jaw Lee, PhD
Board Director, Taiwan Flowers Development Association

Introduction

Agriculture leverages natural resource to produce products, such as: food, lumber, fabric etc. The overall agricultural GDP has degraded since the rapid development of industrialization and commercialization in Taiwan, but the importance of agriculture remains critical to the lives of its citizens. Agriculture not only provides food and other related products, but also promotes added-value of associated industries, safeguards the health of citizens, stabilizes society, maintains eco system, and provides leisure activities. It is the most fundamental economic aspect of a nation, and the most critical business to sustain a nation.

In general, there are two major factors that increase agricultural production: additional input factors in agricultural production; and technical improvement in production. However, with the natural limitation of Taiwan: limited natural resources, lack of farming land, and the diminishing returns; it is extremely difficult to increase agricultural production by capital injection and more manpower in the farming land. Taiwan has to leverage science and technology development and production technical improvements to enhance its overall agricultural production, R&D of agricultural science and technology and innovation become the primer of agricultural development of Taiwan. Agricultural development policies are different at times which have been based on domestic and international conditions. The policies for science and technology development and innovation need to be adjusted according to the overall requirements of agricultural development. Agricultural science and technology programs or projects need to be aligned with other nationwide science or technology policies in order to maximize the available resources and achieve its intended goals. The Council of Agriculture is the overall owning organization to develop agriculture science and technology policies, set directions of R&D, and the overall management of this endeavor.

The R&D system of agricultural science and technology

Holistic planning and separation of duty are the basic principles of R&D for science and technology development. The consulting group in Executive Yuan evaluates directions of policy development for science and technology, while the National Science Council is responsible for the overall planning, and all owning ministries and departments are responsible for delivery of identified science and technology R&D projects. The Council of Agriculture is responsible for planning and promoting of agricultural bio-science and technology research based on the directions from the National Science Council. The identified core

basic researches of agricultural bio-science and technology are conducted by universities, Academia Sinica and R&D departments of private sectors; R&D of application, practicality and deployment belongs to the 16 research institute subsidiaries of the Council of Agriculture and its regional agricultural research and extension stations.

To promote the R&D of agricultural science and technology development, the Department of Agriculture Science and Technology, under the Council of Agriculture, manages, monitors and evaluates the following administrative tasks:

a. Policies and regulation drafting;
b. Preliminary planning and budget appropriation;
c. Communication with downstream research institutes;
d. Evaluation and supervision of R&D projects;
e. Planning and monitoring of foresight and cross sectors businesses;
f. Business coordination of science and technology parks;
g. IP protection, management and deployment.

To better address agricultural science and technology development endeavors, a dedicated team, the Science and Technology Evaluation Team (STET), was formed by the Council of Agriculture, whose key responsibilities are:

a. Evaluation of agricultural R&D directions;
b. Evaluation of development of agriculture technical solutions, policies, systems; regulations, strategies and major programs;
c. Evaluation of allocation of resource for agricultural science and technology projects;
d. Evaluation of project execution/results of agricultural science and technology projects.

Science and Technology Evaluation Team (STET) consists of 27 to 31 team members. It is a combination of scholars, specialists and departmental workers. COA leader acts as the assembler for the team; assembly cadence for evaluation is based on the actual needs. It has multiple tiers of operation which is considered as N-tier management model, under the STET, one tier: specialty, provides thought leadership of specific agriculture area; one tier: deployment, provides practical feedback from the field level; another tier: planning, provides domestic/international trends of industry, policy and direction alignment, as well as strategy outline, STET then evaluates the total package from the N-tier. Specialty and deployment tiers will drive and manage the follow up tasks once the decisions have been made by STET. The N-tier management model of agricultural science and technology evaluation team is shown in Fig. 1.

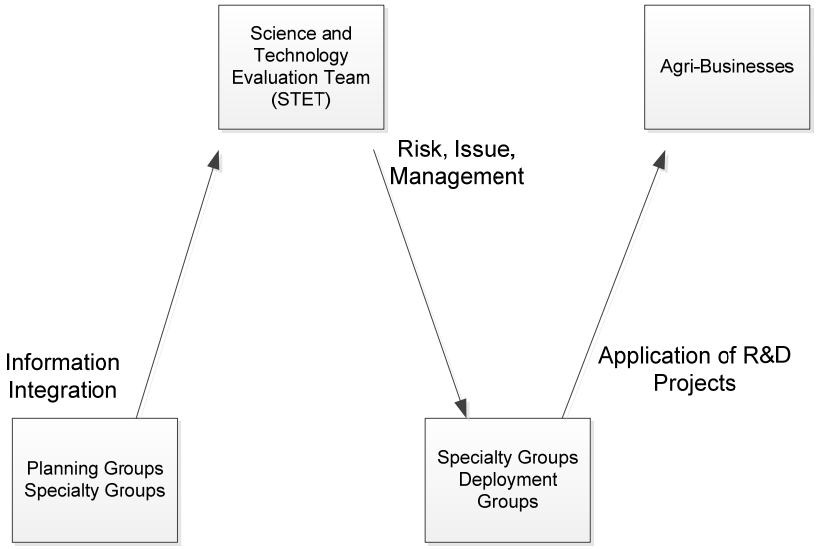

Figure 1: Overview of N-Tier Management Model of Agricultural Science and Technology Evaluation Team

The scope of agricultural science and technology R&D

Agricultural science and technology development in Taiwan has been designed according to the following categories:

a. Agriculture
   - Improving techniques of crop breeding, growing, production and harvesting
   - Developing and nurturing technologists
   - Cooperation at international level

b. Forestry and nurturing of associated resources
   - Establishing a repository to hold the state species
   - Conducting core R&D of nature resources
   - Enhancing the management of carbon footprint
   - Utilization and management of bio resources
   - Management and monitoring of eco system
   - Management and monitoring for foreign invasive species
   - Utilization of telemetry

c. Fisheries
   - Management and utilization of marine (both inshore and offshore) fishery
   - Safety management of premium fishery and aquatic related products

d. Livestock science and technology development

- Strengthening livestock breeding, associated management, and science and technology R&D for improvement of quality
- Strengthening research related to animal protection and humane management
- Establishing a livestock and poultry animal supply system for associated pharmaceutical needs

e. Health inspection and quarantine
- R&D and risk assessment on disease monitoring of plants and animals
- Identification, diagnostic and preventive actions for plants and animals diseases
- R&D of process for product quarantine and meat inspection techniques
- R&D and deployment of strategic solutions to address diseases across human and animal (zoonosis)

f. Bioscience and technology
- R&D and development of bio science and technology
- Development and promote industrialization of bio science and technology

g. Food
- Science and technology development on healthy food, certification of agricultural product, food processing
- Establish information system on food industry and consuming knowledge

h. Resource conservation and environment
- R&D for slope land protection and warning systems
- Agricultural waste reduction, recycling and utilization
- Pollution prevention
- R&D on agricultural irrigation system
- Strengthen ecological engineering methods and rejuvenate damaged eco system

i. Agricultural policy and science and technology management
- Developmental policies of agricultural industry
- R&D, rollout and promotion of agricultural innovation
- Integration of industry, academic and incubator of agri-business

j. Electronic based operation
- Promotion and rollout of agricultural value-added electronic system
- Establish management system to address safety of agricultural products
- Leverage RFID for agricultural management

Foreseeing planning of science and technology, policy formation, industrial needs, talent development and early stage operational outline are considered as the top tier endeavor. The next tier consists of high priority project delivery, development and industrialization of agricultural science and technology, and operational plans (basic needs, specialized and integration of industry and academic) The last tier

includes: coordination and cooperation with science and technology parks, intellectual property management, assistance to innovative incubator centers, financial support and performance evaluation.

Policy deployment of agricultural science and technology

The Council of Agricultural carved out “the Golden Decade” as its agricultural goal to support the development of the country. One of the objectives is to build a youthful, energetic and competitive agriculture community which can transform itself from the production focused culture to a value-chain based culture and increase integration and innovation with other industries. The transformation will enable industrialization of agriculture and become the “green gold” industry.

The strategic objectives of agricultural science and technology for 2014 are:

A. Enhance competiveness and internationalization
   - Establish agriculture cloud computing, strengthen warning system of production and marketing, stabilize the cross sector integration and cooperation, establish value-chain of agricultural industry
   - Configure academy of agriculture science and technology, develop energy efficient innovative agriculture
   - Strengthen agricultural globalization, drive direct flights and economic cooperation framework agreements (ECFA) with China, agricultural IP and plant variety protection
   - Participate international agreement negotiation, realize agricultural structure to ensure industry advantage and sustainability

B. Adjustment of agricultural structure, development of resource consolidation
   - Establish retirement system for aging farmers, deployment of ‘Small Landlord, Big Tennant’
   - Nurture and assist new farming entities, promote ‘Farmer’s Academy’, improve the quality of farmers and operational efficiency
   - Promote rejuvenate of agriculture, establish dedicated production zones, and improve living quality of farming communities and production environment
   - Enhance farming income with a support system, promote agricultural insurance, develop assistance for natural disasters, and maintain farming income to be competitive with other industries

C. Ensure food security and safety
   - Improve self-sufficient ratio of food, establish multiple mechanisms of measure food safety
   - Promote ornateness of traditional agricultural products, food origin, diversified marketing channels and ‘Local Consumption with Local Production’
   - Promote domestic and international certification of agricultural food safety, rational

fertilization, and agricultural of friendly environment

- Promote seamless management system for food safety, enhance animal and plant disease prevention, and ensure sanitary quality

D. Rejuvenate agricultural resource utilization for sustainability

- Reuse idled land with imported substitute crops and local specialties
- Nurture premium land, strengthen 'Farming Land for Farming', maintain superior operational environment for agriculture
- Promote 'Golden Corridor', develop energy or resource efficient agriculture, disaster prevention
- Strengthen the maintenance of marine resource to sustain long term operation

Fig. 2 shows the interrelationship between strategic objectives and area projects of agricultural science and technology:

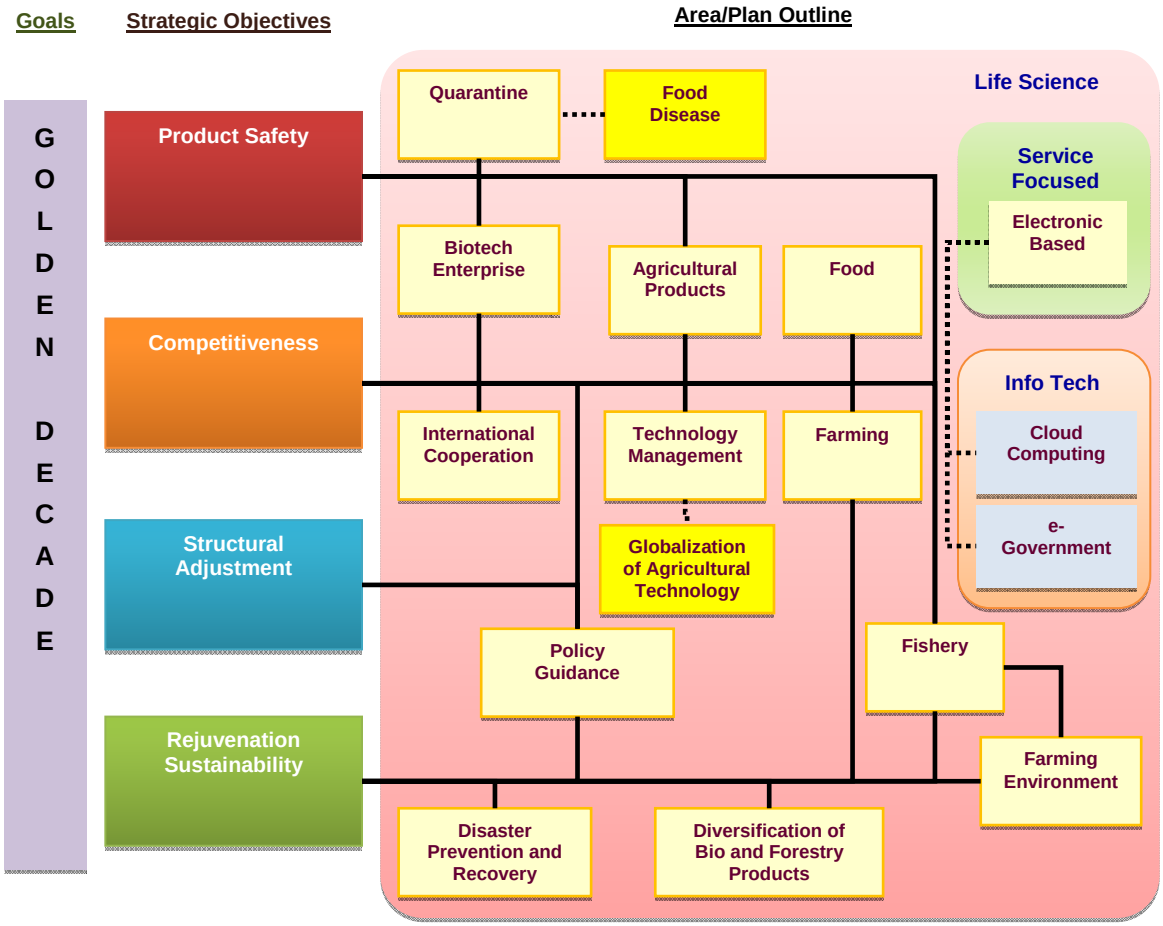

Fig. 2. The interrelationship between strategic objectives and area projects of agricultural science and technology

Source: Council of Agriculture (2013)

Budget and human resource

COA made more than 3.63 billion NTD available for agricultural science and technology development for fiscal year 2012, which is merely about 3% of the total budget for COA. The appropriated budget will be allocated to all involved organizations based on the actual involvements. Breakdowns of 2012 investment on budget and human resource based on the type of work: basic core R&D shared 10%, Application R&D shared 32%, and Science & technology Development Projects shared 58%.

Table 1. Shows breakdowns of human resource and budget allocation based on agricultural science and technology (S&T) strategic objectives of 2012 COA:

Table 1. 2012 COA resource allocation for agricultural S&T development

Strategic objective	# of projects	Head count	Budget (mil NT$)
Establishment of system of agricultural safety and internationalization	208	2,367	909
Improvement of competitiveness and R&D capability	517	4,388	1,800
Rejuvenation of agricultural community and support system	53	196	70
Diversification and sustainability of resource	299	2,520	848
Total	1,077	9,471	3,627

Data source: Council of Agriculture (2013)

Management system of agricultural science and technology projects

Fig. 3 shows the 'begin to end' high level process of agricultural science and technology project. Agricultural Science and technology Evaluation Team drives the overall organization objectives which trickles down to annualized projects. It also gets involved during project execution and evaluation. Project outcomes circle back for objective refinement at the top of the process.

Due to the number and complexity of the projects, automation of project management is one crucial factor to ensure transparencies and traceability of project execution, spending and results. Leveraging 'The Agricultural Strategic Science and Technology Management System', all execution departments are required to report status at a defined frequency (quarterly, mid-term, and final) to show project progress in terms of timing, spending, and deliverables; at the same time, evaluations are conducted as well. To demonstrate results and creditability, COA publishes annual reports which details results of R&D, application, deployment, assessments of results and future plans.

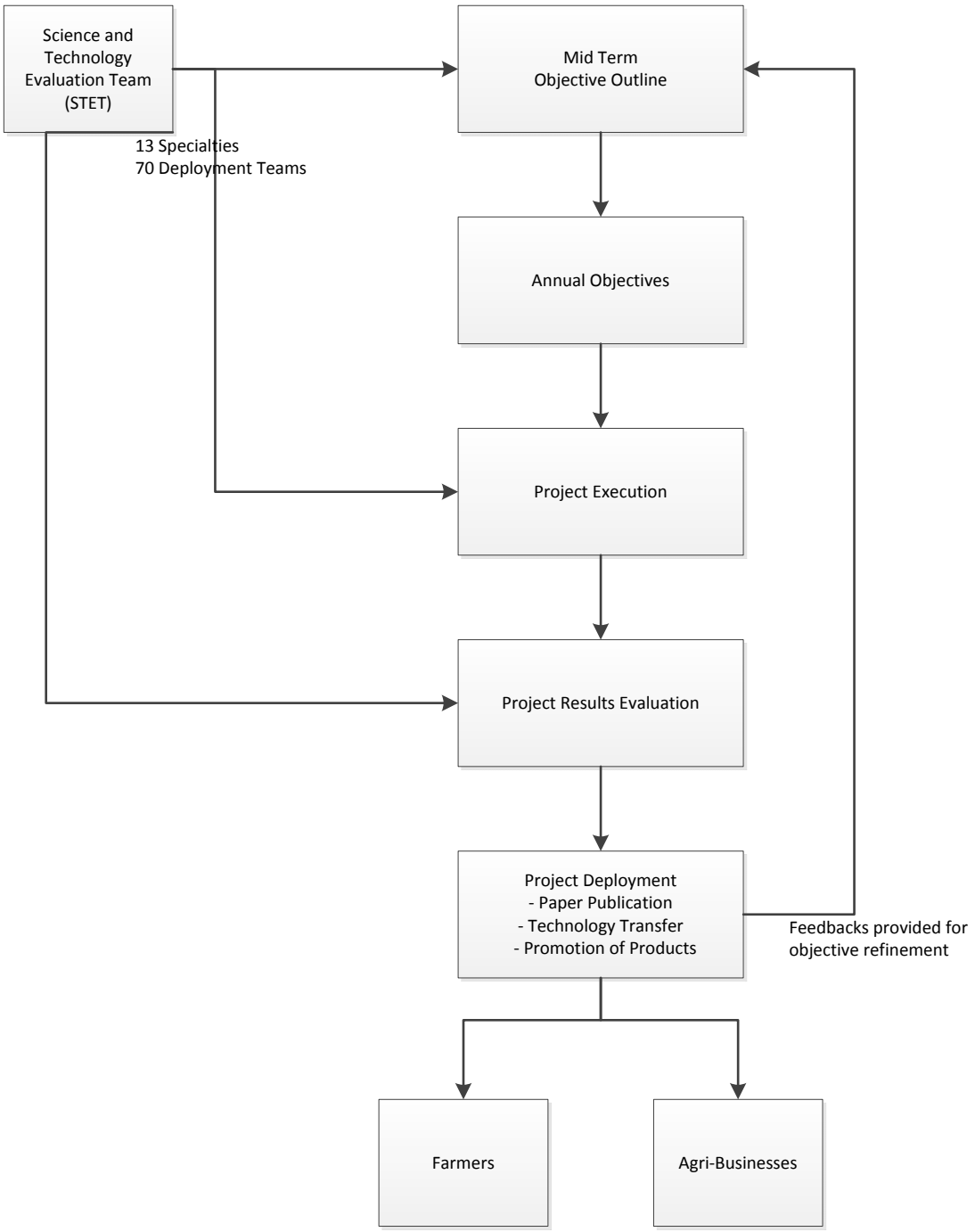

Fig. 3. Management system of agricultural science and technology projects
Source: Lee, Hung-Shih (2013)

Promotion and application of agricultural science and technology R&D

In the past, R&D results of agricultural science and technology were considered “public goods” and anyone can use them without permission. With the conceptual development of ‘intellectual property’ (IP),

the Council of Agriculture has established a committee (Agricultural Science and technology IP Evaluation Committee) to address the total scope of agricultural IPs. Several key regulatory frameworks have been developed to manage R&D results, publication, ownership, and science and technology transfers. Table 2 shows the statistics of overall performance of agricultural S&T researches in IP and technology transfer.

Table 2. Performance of agricultural intellectual property and technology transfer (2006 to 2012)

Subjects/Year	2006	2007	2008	2009	2010	2011	2012
Patent	41	35	42	25	33	21	25
Trademark	11	6	4	1	2	0	0
Variety/Breed	17	30	20	14	23	18	225
technology transfer	79	85	93	103	129	126	111
Income from tech transfer (0,000)	3,378	4,726	5,845	7,138	6,319	6,965	7,646

Data source: Council of Agriculture (2013)

Directions and work involved for current stage to manage the IP results from agricultural science and technology R&D are:

A. Regulatory sevelopment of deployment of IP
    a. Management system to organize IP applications and assessment
    b. Evaluation of science and technology transfer, patent application and foreign authorization
    c. Commercialization of agricultural science and technology
    d. Development of compliance and contractual requirements of IP
    e. Maintenance of IP applications and contract management
B. Promotion for innovative product diversification
    a. Demand analysis and guidance of product commercialization
    b. Physical inventory of technology, integration and value add operation of IPs
    c. Building cross sectors development advice groups
    d. Mechanism to transform product commercialization and enterprise
C. Market channel development and trade mechanism
    a. Organize agricultural science and technology expo to demonstrate results of R&D
    b. Showcase results in international affairs

Conclusion

Agricultural science and technology is the enabler of agricultural development. The development of agricultural science and technology has to be based on the needs of agricultural development policies. A great deal of agricultural science and technology development of Taiwan has been based on both domestic and foreign environments, the trends of global science and technology development, and

internal agricultural development needs. This approach has been very effective for Taiwan and provides a sound foundation for science and technology development. With free trade, rapid growth of information and communication technology, and the challenge of knowledge-based economy, the pressure for agricultural growth heightens. Agriculture industry needs to escalate its growth via modern science and technology such as: cloud computing, eco technologies; and integrated with other industries, such as: art, tourism. Leverage technologies from other industries and transform itself into a value-chain based industry which generates more competitive advantages domestically and internationally.

References

1. Council of Agriculture, 2013.03, " Statement of 2014 Agricultural Science and Technology Budgetary Utilization" (in Chinese)
2. Council of Agriculture, 2013.03, " Report on R&D Performance of Agricultural Science and Technology in 2012" (in Chinese)
3. Lee, Hung-Shih, 2012.11, " Planning and Foreseeing of Agricultural Science and Technology ," (PPT Presented at National Chung-Hsing University) (in Chinese)
4. Lee, Hung-Shih, 2013.05, " Policies and Management of Agricultural Science and Technology ," (PPT Presented at Taiwan Seed Improvement and Propagation Station, Council of Agriculture) (in Chinese)
5. Wu, Tong-Chung, 2009.08," Planning, Execution and Management of Agricultural Science and Technology in Taiwan," National Policy Research Foundation (in Chinese) (http://www.npf.org.tw/post/2/6349)

Date submitted: February 13, 2014
Reviewed, edited and uploaded: February 14, 2014