Challenges Faced by Government Research Institutions and Public Universities in the Commercialization of Agricultural Innovation in the Philippines

Noel A. Catibog
Supervising Science Research Specialist,
Technology Transfer and Promotion Division (TTPD),
Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD),
Philippines

ABSTRACT

Public research and development institutions and state universities and colleges in the Philippines do not fare well in the protection and commercialization of agricultural innovations. There are a few laudable success stories but much more are left to be desired due to particular constraints. Among the factors identified are the low overall agricultural R&D funding and challenges at the institutional, organizational and personal (researcher) level. A national law was enacted to address some of these challenges. Supporting policies and programs were crafted and implemented that include technology business incubators, grants, financing mechanisms and provision of pre-commercialization initiatives to facilitate commercialization of priority agricultural innovations.

Keywords: Technology transfer, commercialization, agricultural innovation, research and development institutions, state universities and colleges

INTRODUCTION

The Department of Agriculture (DA) is the delegated agency responsible for promoting agricultural innovation in the Philippines. It has a network of 48 organizations comprising the Bureau of Agricultural Research (BAR) and DA attached agencies in charge of developing specific commodities and industries, among which are carabao, coconut, cotton, dairy, fiber, fisheries, food, irrigation, livestock, meat, rice, sugar and tobacco.

The Department of Science and Technology (DOST) is another department in the Philippines involved in agricultural innovation. DOST-attached Research and Development Institutes (RDIs) have varying levels of agricultural R&D activities include the Forest Products Research and Development Institute, the Philippine Nuclear Research Institute, the Food and Nutrition Research Institute, the Metals Industry Research Institute and the Industrial Technology Research Institute.

One of DOST's planning councils on research and development (R&D) concerns is the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD). PCAARRD operates mainly through state universities and colleges (SUCs) by

offering scholarship grants for graduate degrees, providing funds for R&D, and helping universities develop facilities for research in agriculture. The council also has the capacity to execute large-scale national programs through the mobilization of the regional R&D consortia across the country (Briones and Carlos, 2013) consisting of more than 100 SUCs and RDIs.

In terms of the number of higher education institutions (HEIs), the country is not lacking if sheer number is considered as basis. As of July 2012, the Commission on Higher Education (CHED) reported that there were 2,282 HEIs in the Philippines consisting of 110 main and 426 satellite campuses of state universities and colleges, 94 local universities and colleges, 16 other government HEIs and 1,636 private colleges and universities (Vitriolo, 2013). On the other hand, Cruz et al (2013) indicated that as of 2011, there were 97 SUCs offering forestry and other related courses, and at least 106 SUCs implementing agriculture programs such as BS Agriculture, Diploma in Agriculture, MS Agriculture and PhD in Agriculture.

The DA consistently accounts for the largest share of public spending on agriculture in 2000-2014. About 86% of the budget is dedicated to the Agriculture and Fisheries Modernization Plan (Ravago and Balisacan, 2016). Public agricultural R&D spending in the Philippines was US$129 million 2005 PPP dollars in 1996, US$139 million in 2002, and US$133 million in 2008 (Flaherty et al, 2013). Ravago and Balisacan (2016) reported that the Philippine government's spending on agricultural R&D remains low at about 0.13% of gross value added (GVA) in agriculture from 2003-2011. R&D intensity or the ratio of R&D spending and agriculture GVA had been fluctuating during this period, recorded at 0.14% in 2003, 0.12% in 2005, 0.11% in 2007, 0.16% in 2009, and 0.09% in 2011.

For public R&D, public HEIs contributed almost 43% of total, on average to agricultural R&D. Overall, in the government, HEIs and private non-profit sectors, the top socio-economic objective of R&D was for agricultural production and technology with 23% of total expenditures (Estella, 2013).

CHALLENGES IN COMMERCIALIZING AGRICULTURAL INNOVATION

Overall, Philippine agricultural innovation is generally characterized by low level of technology generation and commercialization. The succeeding sections discuss the challenges faced by the sector.

Low level of agricultural R&D funding

Arguably, the main challenge in Philippine agricultural innovation is the low R&D base. As mentioned, the level of agricultural R&D funding is quite low with an intensity ratio of only 0.13%. The low R&D funding is definitely a challenge in establishing, developing, or nurturing a productive innovation system in the country. Meeting the 1% of GDP benchmark set by the World Bank and UNESCO for developing economies remains a challenge for the Philippines. Compared with other ASEAN member states, the Philippines has a much lower R&D-spending-to-GDP ratio compared to Myanmar (0.16%), Vietnam (0.19%), Thailand (0.27%) and Malaysia (0.63%). Singapore of course is at the end of the spectrum with a ratio of 2.27% (DOST, 2012).

Low number of researchers and scientists

Of the total number of R&D personnel (10,277) in three sectors - government, higher education and private non-profit institutions in 2011, almost one-fifth (24%) or 2,480 worked as researchers in the field of agricultural science. Of this number, 1,283 (52%) are in the government, 47.8% worked in the public (1,145) and private HEIs (41), while 11 researchers (0.44%) are in private non-profit organizations (Estella, 2013).

Overall, the number of R&D personnel increased from 165 per million populations in 2003 to 181 in 2009. In terms of number of key researchers, the number increased from 108 per million populations in 2003 to 142 per million populations in 2009, still below the UNESCO requirement of 380 per million populations (DOST, 2012).

Low level of R&D collaboration between public and private institutions

The level of collaboration between public and private institutions in the country is practically non-existent. Patalinghug (2003) noted that government RDIs do not have the flexibility, accountability, incentives, and fiscal autonomy to create opportunities for cooperative research with the private sector, or with the universities. On the other hand, the private sector proves nill in responding to opportunities particularly in business ventures requiring the use of new technologies.

Cultural barriers exist between government academia and RDIs and the industry, and entrepreneurs and business leaders have been slow to embrace academic entrepreneurship. Collaboration among local R&D institutions will be necessary for improving national R&D capacity and for increasing R&D budget efficiency. Also, Gonzales and Yap (2011) reported that the Philippines, at present, does not have specific policy measures targeting the promotion of R&D from abroad thus impeding collaboration with R&D institutions of developed countries.

Low level of scientific and technological outputs

Low level of technology development is observed among RDIs and SUCs as most of them are engaged in adaptive research and not so much on basic researches that generate new technologies. This is also reflective of the low budget allocated to R&D in these institutions.

True enough, in 2000-2011, intellectual property rights (IPR) applied by local inventors recorded averages of 175 per year for patents, 509 per year for utility models (UM) and 512 per year for industrial designs. For patents alone, most or around 95% of applications were received from foreign applicants while only 5% were applied by local inventors. IPRs approved or granted to local inventors from 2000 to 2011 recorded averages of 17 per year for patents, 352 per year for utility models, and 367 for industrial designs. Again, for patents alone, more than 95% were granted to foreign inventors. From 2008-2011, the numbers of patents filed and granted have even gone down (DOST, 2012).

What is more alarming is that there was even a three-year period (2005-2007), based on IPOPHL data, wherein only one patent per year was granted to an RDI, none from any SUC, an institution that is supposed to develop the bulk of scientific knowledge and technologies.

Based on the IPOPHL website (www.ipophil.gov.ph, accessed 10 September 2016), there are only 494 IPRs filed by and granted to SUCs in the Philippines covering agricultural innovation. These include industrial designs (86), inventions (71) and UMs (337). Among the SUCs, the top filers include Benguet State University (40) with 6 inventions and 34 UMs; University of the Philippines Los Banos (18) with 16 inventions and 2 UMs; Isabela State University (18) with four industrial designs, two inventions and 12 UMs; Mariano Marcos State University (13) that includes one invention and 12 UMs; and Capiz State University with 22 UMs.

On the other hand, there are only 351 IPRs filed by and granted to government RDIs in the agriculture sector, which includes 64 industrial designs, 15 inventions and 272 UMs. The Philippine Rice Research Institute has the most number of invention patents with 11 and one UM. On the other hand, FPRDI has 17 IPRs under its name that consists of one industrial design, three inventions and 13 UMs.

Some researchers cite the tedious and protracted period of time to obtain a patent as one of the reasons they are not too keen in applying for protection. This is despite pointing out to them that it is a worldwide issue borne out of the 18-month waiting period before applications are published in the official gazette coupled with the office actions and communication between the examiner and the applicant before a patent is finally acted upon.

The sub-par performance in intellectual property (IP) protection in public RDIs and SUCs is highly influenced by the "publish or perish" mindset that is still prevalent among these institutions where publication in technical journals is a major consideration for promotion of faculty and researchers. As such, technologies are publicly disclosed prematurely, making them ineligible for IP protection. The Philippine IP Code mandates that technologies and inventions should be filed for patent before public disclosure, or to file the application before the expiration of the 12-month grace period after disclosure. Otherwise, the inventions would not qualify for lack of novelty (IPOPHL, 1998).

This publish or perish mindset comes with a huge consequence in view of IP protection. The International Intellectual Property Institute (2010), in partnership with the US Patent and Trademark Office, IPOPHL, and Public Interest Intellectual Property Advisors, examined 1,000 articles from nine Philippine research institutions published between 2000 and 2010. They found that 275 of the articles reviewed have patent potential. However, of all these cases, researchers decided to publish their results without filing patent applications.

The study also showed that, although the research output of Philippine institutions has steadily increased, patent filing numbers by these institutions (both public and private) remain consistently low, suggesting further that institutional research is not adequately protected and leveraged. Yet despite this mindset, the study of Lakitan *et al.* (2012) showed that the Philippines, compared to other ASEAN countries, has the lowest number of scientific articles published from 2002-2011.

Successes in commercialization are few and far in between

Consequently, the very low turn-out of technologies being applied for patent protection leads to a subsequent low rate of commercialization and adoption of intended users. This is because technologies fail to enter the mainstream market and become available to the public. At the

DOST, an internal study revealed that out of 258 technologies derived from DOST-funded R&D for the last ten years, only 3% have partnership/licensing agreements with the private sector, and only 28% are available for commercialization but have no takers yet from the private sector. Although 65% are already being utilized, including technologies that are immediately available to farmers, this falls short in pushing the level of innovation forward since these technologies are intended really for key commodities (Roxas, 2009).

Low technology adoption can be assumed to be associated with research orientation in the past which was more focused on academic purposes and rarely designed to answer users' needs or solve real problems, on one side, and low demands on the other. Citing the work of Ancog, Patalinghug (2003) reported that the technologies developed by government RDIs are simple, easy to adopt, and can be commercialized quite profitably. However, the R&D projects were chosen based on the expertise of RDIs and the interest of the scientists. In order to attract business partner, the created technology itself has to be functionally relevant to user's need, technically reliable, and economically competitive, since there may already be similar technology available in the global market.

Exploitation of government-generated innovations is viewed as significantly below its potential for evolving to later stages of research, advancing welfare of Filipinos, and spurring economic growth. Of course, there are success stories that should be celebrated, but they pale when measured against potential and opportunity and the expectations vis-a-viz government R&D investment.

These success stories are presented below:

- Bio-N, a microbial-based fertilizer inoculant, is one of the flagship technologies of the UP Los Baños -National Institutes of Biotechnology and Molecular Biology (BIOTECH) and is now being extensively used by farmers for rice, corn and vegetables. Mass distribution and marketing of Bio-N ensued through a collaborative project with the Technology Resource Center. At one point, the mixing plants established reached 65, total production were expected to cover around 648,000 hectares, and estimated fertilizer savings totalled 2,592,000 bags of chemical fertilizer, equivalent to an estimated US$28 M reduction in fertilizer importation.
- 'Sinta' is the first Philippine-bred hybrid papaya developed by the Institute of Plant Breeding-UP Los Baños. The tree is gynodioecious, semi-dwarf, highly prolific and moderately tolerant to Papaya Ringspot Virus, the most devastating disease problem of papaya, not only in the Philippines but also in other papaya growing areas in the world. This hybrid variety has been licensed to East West Seed Company for seed production and marketing. The license has been renewed several times.
- Biogroe, another product of BIOTECH, is a microbial inoculant from plant growth promoting rhizobacteria that has been recently licenSed to a commercial marketing and manufacturing company. Biogroe was developed in 2004, and known to influence root growth by producing plant hormones and provide nutrients in soluble form. It can also protect plant surfaces from colonization by pathogenic microbes through direct competitive

effects and production of antimicrobial compounds. Biogroe works well with tomato, bitter gourd, sweet and black pepper, lettuce, cassava, rice, flowers, and ornamentals.

- Developed by the Central Luzon State University, the pelletizing machine for goat feeds production has been filed for IP protection. It has also been licensed to a private machine fabricator.
- The last example, and probably the technology with the most impact in an industry, was developed by Dr. Ramon Barba of UP Los LB – the use of potassium nitrate to induce flowering in mango plants. Dr. Barba chose not to enforce his patent and instead opted to share his technology with a maximum number of people. This technology enabled the Philippines to be among the top ten mango producers worldwide. The effects are felt in all areas related to mango production – the companies selling pest control chemicals to the people who harvest, pack, bring the fruit to market, and those who make baskets for mangoes (accessed from www.wipo.int).

Culture of IP-generating institutions needs to improve

For a long time, SUCs have operated as ivory towers disconnected from practice and society with research and teaching being the core activity, and unconcerned with commercialization. Several cases have been reported about public institutions which are unable to act timely to commercialization intents of private businesses, thus resulting with fail negotiations.

RDI administrators and researchers still need to develop a deeper understanding and appreciation of IP in order to enhance IP management in their agencies. But for those who have already done, they are still short of capability to identify, protect and commercialize IPs on their own. And while some institutions have established their own technology transfer offices (TTO), the staffs manning these offices are still engaged in other organic functions such as teaching and researches of their own.

Funding gaps on IP management also exist between patenting and licensing, licensing and company formation, and company formation and joint venture due to the difficulty and confusion, high transaction cost and time consuming nature of IP management. And even if funds are available, there are not too many patent agents that can readily tap to handle the applications.

Other issues identified include the lack of incentives for IP Protection, technology transfer and commercialization milestones, unsystematic disclosure process, and distrust/lack of confidence within the agency.

Researcher mindset remains a challenge

A lot of researchers find the patenting and commercialization processes as tedious and want to focus only on research, believing that technologies developed using public funds should be made available to everyone for public good. There is also an apparent lack of entrepreneurship culture among researchers with most of them not equipped with business managerial or marketing skill, and therefore not comfortable in doing the job. Financial resource also comes into the picture as one of the impediments, hence the need for financial aid.

Hulten and Mahagaonkar (2010) believe that scientists use patents/invention disclosures as signals to gain reputation more than financial benefits. Other studies show that university scientists may be motivated to patent and pursue commercialisation if they perceive that it can enhance their reputation and progress their research.

Human capital needs a boost

Research activities among institutions do not translate to commercialization activities due to lack of manpower complement and competencies in technology transfer and commercialization among technology generators and technology transfer staff.

While simple financial analyses can be prepared for technologies generated, researchers are generally at a loss when pre-commercialization requirements involve business plans, market research, feasibility studies and technology valuation. Much more so if the activities come to negotiations and licensing agreements. Researchers need to be capacitated on these aspects. In the interim, existing expertise on economics and agribusiness within the institution should be tapped to facilitate said activities.

The need for an adequate number of certified patent agents has to be addressed. Funding donors and RDIs must be able to allocate funds to engage the services of these agents to handle the IP protection aspect of generated technologies.

Commercialization opportunities need to improve

Technology business incubators (TBI) and accelerators are important for the success of technology start-ups in government RDIs and SUCs**.** However, there is a very limited number of agri-based TBIs in the Philippines. Moreover, technology adopters outside these TBIs cannot access critical start-up services.

RECENT DEVELOPMENTS THAT FAVOR COMMERCIALIZATION

Agricultural R&D funds are increasing

Realizing R&D importance in the development of the agriculture sector, PCAARRD and DA-BAR, two of the country's top institutions for agricultural researches, have received significant increases in budget allocation in recent years. On average, the budget appropriation for PCAARRD and DA-BAR significantly increased at a rate of 41% and 53% annually, respectively, from 2010 to 2013. For PCAARRD, the dramatic increase in budget allocation was able to augment its budget for R&D and technology delivery services, from 57.77% in 2010 to 65.30% in 2012. On the other hand, DA-BAR was able to augment funding for the national programs on rice, corn, high value commercial crops and promotion and development of organic agriculture. On average, PCAARRD contributed 41% to total R&D budget, and the rest came from BAR (Aquino et al, 2014).

Agricultural researchers and scientists are increasing

To increase the number of scientists and researchers, the DOST has been providing support and has graduated thousands of scholars (DOST, 2013). The Science Education Institute, which administers the scholarship programs for the DOST, has a 2014 budget of US$37 million. This amount supported, among others, DOST scholars that consist of 12,397 undergraduate, 2,121 masteral and 712 doctorate students. It should also be mentioned that DA has allocated US$2.6 million for its Comprehensive Scholarship Program under the Agricultural Competitiveness Enhancement Fund for poor and deserving students who will take courses on agriculture, forestry, fisheries and veterinary medicine in selected state colleges and universities (DBM, 2013).

PCAARRD administers the AANR component of DOST's Accelerated Science and Technology Human Resource Development Program. The scholarship program was able to grant 252 scholarships from 2007-2013. From these scholars, 94 have already graduated with MS degrees (75) and PhD (19) degrees in various fields of agriculture, one scholar obtained a PhD in agricultural chemistry, while 10 obtained MS (8) and PhD (2) degrees on agricultural engineering and agrometeorology fields, respectively. For the environmental science and management fields, graduates included 26 MS and 3 PhDs, while food science graduates were 5 MS and PhDs. There were 21 graduates in the field of forestry and natural resources consisting of 16 MS and 5 PhDs, while there was one MS graduate of veterinary medicine (PCAARRD, 2013).

In year 2013-2014, there were 11 graduates of MS (9) and PhD (2) degrees on environmental science, while there were three MS graduates in the field of forestry and natural resources. For the aquatic sector, there were 52 graduates of courses in fisheries consisting of 47 MS and five PhDs, while nine graduated with MS (6) and PhD (3) degrees in the field of marine science (PCAARRD, 2015). In addition, there were 66 ongoing scholars consisting of 41 MS and 25 PhDs as of 2014.

More facilities have been established and improved in the RDIs, and there has been a substantial increase in the R&D budget for the AANR sectors (DBM, 2013).

Policy environment now favours commercialization

Republic Act (RA) 8293 or the Intellectual Property Code of the Philippines; RA 7459 or the Inventors and Invention Incentives Act; RA 8439, also known as the Magna Carta for Scientists, Engineers, Researchers and other S&T Personnel in Government; and RA 9168, the Plant Variety Protection Act are only some of the key Philippine IP management and commercialization statutory policies that provide a sound policy environment favorable to commercialization.

The most recent IP- and commercialization-related laws enacted are RA 10055 and RA 10372. Signed into law on February 28, 2013, RA 10372, which amends certain provisions of the IP Code, basically provides new guidelines on copyright and related rights. More importantly, it mandated all schools and universities to have their own institutional IP policies.

On the other hand, RA 10055 or the Philippine Technology Transfer Act of 2009, which was signed into law on March 23, 2010, aims to promote and facilitate the transfer, dissemination,

effective use, management and commercialization of IPs, technologies and knowledge resulting from R&D funded by government. The law ensures the protection of IPs by GFAs and RDIs, gives RDIs appropriate incentives, makes them default owners of IPs, and allows spin-offs by researchers.

This national policy was inspired by the enormous success of the Bayh-Dole Act of the United States. The DOST and the IPOPHL were tasked as the lead agencies in the implementation of RA 10055.

RA 10055 covers 1) all R&D activities carried out on behalf and for the interest of the Philippine Government by RDIs receiving grants directly from GFAs; 2) all IPRs derived from R&D activities funded by government; 3) all government agencies that fund R&D activities as well as provide financial, technical or material support to such R&D activities; and 4) all institutions that implement government funded R&D. In a nutshell, the law is simply about who should own and manage technologies generated from government funds and who should share in the fruits of their success. The Department of Science and Technology (DOST) and the Intellectual Property Office of the Philippines (IPOPHL) were tasked as the lead agencies in the implementation of RA 10055.

The DOST has likewise recently issued several memorandum circulars that govern IP and technology management for all DOST agencies and the RDIs that receive DOST funds. Among these include the DOST IP Policy; the Technology Transfer Protocol for RDIs; Fairness Opinion Report; and the Guidelines on IP Valuation, Commercialization and Information Sharing.

Technology transfer offices are being formed

To assist and stimulate technology transfer, the majority of universities in the Western world have established TTOs. These offices facilitate the process of commercial knowledge transfer from university to industry, and are primarily responsible for the protection of university created IP, and the management of the commercialization process.

In 2010, the IPOPHL launched a project to establish Innovation and Technology Support Offices (ITSO) within RDIs and higher education institutions. The objective was to strengthen local institutional capacity to access patent information and at the same time, to be the patent service providers in their local communities, conducting not only patent searches but also patent drafting, prosecution representation, advisory, training and over-all IP management.

Presently, there are eighty-five (85) ITSOs all over the Philippines, 41 of which are located in SUCs and five are with RDIs. It is a positive development that most of the ITSOs in these SUCs have also served as, or assisted, their TTOs.

IPOPHL also launched in March 2012 is a support program for ITSOs that waives 100% of filing fees for invention patent and fees up to the 15th year of annuity if granted patent protection. Its impact was immediately felt as patent applications from universities and RDIs rose from only 43 (2007-2011) to 107 (2012-2014).

Commercialization programs have been crafted and implemented

By virtue of RA 10055, PCAARRD, as a government funding agency, has effectively acquired an additional mandate for technology transfer. Technology transfer is a component of the R&D Results Utilization Program, one of the four banner programs of PCAARRD. At least 80% of all new technologies generated in the AANR sectors reach and benefit the farmers, fisher folk and upland settlers by way of extension.

In March 2016, PCAARRD launched the DOST-PCAARRD Innovation and Technology Center (DPITC). The DPITC is envisioned to serve as a one-stop hub for technology owners and generators, investors, end users and other stakeholders to facilitate the commercialization of technologies generated in the AANR sectors. Its activities include capability building to improve the IP management and entrepreneurship capability of consortia members/RDIs; networking and linkaging with key partners and service providers to hasten commercialization; provide business development and technical services (e.g. valuation, market research, valuation, etc.); provide funds to support IP management and pre-commercialization activities; and serve as venue for technology marketing and business acceleration. More than US$ 2M has been allocated for the next five years to support projects and activities categorized as promotional, IP management and pre-commercialization initiatives. Technologies for commercialization in 2017, for example, include seven farm/aqua machineries; six test kits and biologics; three plant varieties/animal breeds; and five various crops and animal products.

The Technology Application and Promotion Institute of the DOST has strengthened its existing programs and has added more initiatives to support IP management and commercialization of technologies generated by private inventors and government RDIs and SUCs. These programs include the IPR Assistance Program; the DOST-Academe Technology-based Enterprise Development Program; Venture Financing Program wherein one can avail almost US$ 44,000 support; the Technology Innovation Program where inventors can avail of support for product development and pre-commercialization activities; Prototype Development Program; Pilot Plant Assistance Program; Small Enterprise Technology Upgrading Program; and the Invention Guarantee Fund, a tie-up with Land Bank of the Philippines wherein an inventor can avail of a loan amounting to almost US$ 220,000, half of which is interest-free.

In 2016, the DOST also launched a program to help SUCs in establishing and strengthening (if already existing) their own technology business incubators (TBIs) to facilitate the commercialization of agriculture-related technologies and inventions. This makes a total of seven agri-related TBIs. DOST has also mandated all it councils and attached RDIs to allocate at least 10% of their R&D budget to technology transfer activities, including commercialization of DOST-generated technologies.

To cap all its new initiatives, DOST has conducted the Technology Transfer Day in two separate venues in April and September 2016. The Technology Transfer Day is organized to serve as an avenue to showcase its portfolio of market-ready technologies to investors, enterprises and organizations. The activities facilitated the signing of licensing agreements to commercialize food products (at least 10) and biofertilizer (1). These licensing agreements are now completing the documentary requirements to obtain a fairness opinion from the DOST Secretary as mandated by RA 10055.

With all of these policies and programs in place, commercialization of agricultural innovations in the Philippines is expected to have an upward trend in the coming years.

CONCLUSION

The Philippines does not fare well in terms of IP protection and commercialization of agricultural innovation. This is especially true for public RDIs and SUCs. There are far too many meaningful agricultural innovations lie dormant and under-utilized. There are a few laudable success stories, but when measured against total government R&D expenses, potential and opportunities, much more must be desired.

It can be argued that the country's poor commercialization performance stems from low overall agricultural R&D funding, which remained low at about 0.13% of gross value added in agriculture from 2003-2011. For the RDIs and SUCs, one of the biggest challenges they face is instilling a culture of innovation. There also exist cultural barriers between them and the industry. Moreover, the researchers either lack of entrepreneurial mindset, or not comfortable in doing their commercialization roles, or opt to focus on R&D. They also have a limited awareness of technology transfer protocols. TTOs, on the other hand, are faced with limited manpower complement and competencies; low level of funding; lack of incentives; uneven implementation of IP policies; and inadequate industry support and engagement, among others.

The Philippine Technology Transfer Act allowed institutions receiving government research funding to own the resulting inventions and innovations, commercialize them, generate revenue, and share the revenue with researchers. The DOST and IPOPHL, have crafted supporting policies; facilitated the establishment of TTOs that so far vary in the degree of operation; provided assistance in establishing or improving technology business incubators; assisted start-ups by providing financial support through grants and other financing mechanisms; and holding market matching activities. To facilitate commercialization of priority agricultural innovation, various government agencies have kicked off different pre-commercialization initiatives that include, but not limited to, IP protection assistance, valuation, market studies, preparation of business plans and feasibility studies.

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