

## **Towards a Robust Intellectual Property and Technology Commercialization Platform at the University of the Philippines Los Baños (UPLB): The Case of DOST-PCAARRD-funded Research Projects**

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An intellectual property (IP) audit was conducted among 212 research projects funded by the Department of Science and Technology–Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development (DOST-PCAARRD) and implemented by the University of the Philippines Los Baños (UPLB) from 2010–2015. A total of 71 (33%) have the IP component only, while 17 (8%) have both IP and technology commercialization (TC) elements. Of the 17 research projects, 12 (71%) have undergone the technology readiness level (TRL) and are included in the 19 technologies funded by DOST-PCAARRD currently being prioritized by Technology Transfer and Business Development Office (TTBDO) for IP rights (IPRs) protection and TC. Of these technologies, six have ongoing licensing agreements with the private sector, and another three are groomed for a spin-off. All nine have undergone fairness opinion board (FOB) examination, while the remaining 10 are in various stages of IP protection and commercialization. A notable surge in patent application occurred in the first three quarters of 2017 when 14 applications representing 33% of the total patent applications in the last 16 years were filed in the IP Office of the Philippines. As of 2012, with financial support from local and foreign funding, UPLB has produced more than 200 technologies ranging from agriculture and biotechnology to machinery and postharvest technology plus other allied fields. Included in the list are Sinta papaya, BIO-N, Mykovam, virgin coconut oil, and *Trichoderma*. Some of which have reached the international market earning substantial income for the university and its inventors and breeders principally through royalties ranging from 3–10 % of the licensee's gross sales. Additional seven technologies funded by other government funding agencies ripe for commercialization are open to manufacturers, distributors, and research service agreements.

Keywords: intellectual property, intellectual property audit, technology readiness level, technology commercialization

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## INTRODUCTION

A prevailing challenge in developing countries like the Philippines is the evident lack of innovative technologies aimed at improving the social and economic conditions of the country. The refinement of the IPRs landscape through the enactment of Republic Act (RA) No. 8293, also known as the IP Code of the Philippines, is one of the few schemes aimed at addressing this national issue. The law recognizes the vital importance of intellectual and industrial property in national development through creative activity, transfer of technology, foreign investments, and market access to domestic products.

UPLB embarked on a pioneering effort in the IP and commercialization scene through the filing of patents and entering into licensing agreements. On 27 Jul 2007, with the UP Board of Regents' approval, the UPLB TTBDO was established with the mandate to "integrate programs, policies, and activities towards the protection, promotion, and successful disposition of the university's technologies through licensing and technology business incubation to both the private and public sectors" (OVCRE 2008).

This mandate was reinforced further through the enactment of RA 10055 or the Technology Transfer Act of 2009 allowing research and development institutions (RDIs) ownership of IPRs arising from government-funded research with the end goal of catapulting IPR and TC in the national and global arena. This act specifically calls for all RDIs that perform government-funded research and development to take on technology transfer as their strategic mission and to effectively translate results into useful products and services for the benefit of the Filipino people (DOST-IPOPHL 2010).

Prior to the enactment of the RA 10055, the UP Charter of 2008 was signed into law declaring UP as the national university to "lead in setting academic standards and initiating innovations in teaching, research, and faculty development." As a research university, UP is tasked to conduct basic and applied research and development and contribute to the dissemination and application of knowledge ([www.ovcre.edu.ph](http://www.ovcre.edu.ph)).

In 2012, the Revised IPR Policy of the UP System was approved by the UP Board of Regents with the intention of promoting and supporting the university's research function, providing an institutional mechanism for recognition of research outputs, protecting IPR resources, and establishing a protocol for resolving competing interests among various constituencies and markets (TTBDO 2012). The enactment of relevant legal instruments and functional administrative issuances also provided an enabling environment for IP and TC in a university setting, allowing it to flourish. For example, in

the first three quarters of 2017 alone, a significant increase in patent applications was realized through the filing of 14 said applications comprising 30% of its total from 2002 to the third quarter of 2017.

At present, there are several technologies being distributed to the public and private sectors through various commercialization schemes such as joint ventures, licensing agreements, marketing agreements, and product sales. While they provide substantial benefits to the university, its inventors, and breeders through royalties derived from commercialization, the main beneficiaries are the Filipino farmers and technopreneurs. For all intents and purposes, IPRs referred to in this paper are only limited to inventions and trademarks and may not necessarily refer to other forms of IPs. Plant varieties mentioned in this paper are covered by the Plant Variety Protection.

With the TTBDO at the forefront, UPLB is now embarking on a robust IP and commercialization platform that is fully functional, aggressive in its commitment to fully utilize the university's IP resources, and assist the university in its path toward becoming a global university. PCAARRD – a government institution under the DOST that is actively engaged in partnerships with international, regional, and national organizations and funding institutions for joint R&D ([www.pcaarrd.dost.gov.ph](http://www.pcaarrd.dost.gov.ph)) – is a strategic partner of UPLB from the day of its inception up to the present time. UPLB's research support and funding from 2010–2015 covering a total of 212 research projects will be the major tenor of this paper.

This study provides an avenue to determine the status of UPLB projects in terms of IP and TC potential. The scope is limited to DOST-PCAARRD-funded projects. The study also aims to identify the major components of the IP and TC processes and categorize the DOST-PCAARRD-funded research outputs based on these components.

## LITERATURE REVIEW

### **The IP Landscape Under a University Setting**

The United States (US) Bayh-Dole Act of 1980 – considered as one of the most influential pieces of legislation to impact IP law in the twentieth century – allows universities, small businesses, and non-profit organizations to use federal funds to own rights to IPs derived from researches (Rhines 2005). In the Philippines, RA 8293 or the IP Code of the Philippines was signed into law covering the protection of all IP rights – namely, patents, copyrights, and trademarks, among others. The IP Code is put in place to protect the creative minds of

Filipinos, protect outputs of creators, and safeguard the public against pirated merchandise (Aquino *et al.* 2013). Signed in 1997, another landmark law was RA 8439 – also known as the Magna Carta for Scientists, Engineers, Researchers, and other Science & Technology Personnel in Government. The act provides incentives and motivation for scientists and researchers to make the Philippines better and not left behind (Aquino *et al.* 2013). In 2009, the RA 10055 or the Technology Transfer Act was passed, allowing RDIs as default owners of IPR arising from results of government-funded research (Ilano 2010).

### **Technology Transfer and Commercialization of University Research Products**

The technology transfer system is defined as the process by which new innovations flow from the basic research bench to commercial entities and then to public use. Inventions become commercialized through startup companies and licensing agreements with industry players (van Norman 2017). Entrepreneurial orientation characterized by innovativeness, risk-taking, and proactiveness is an important indicator in the commercialization of university research products (www.wipo.int). Commercialization is viewed as a research-industry collaboration in converting research outputs into innovations (Latif *et al.* 2016). An important factor that gauges the success of academic commercialization is the presence of a potential licensee (Dehghani 2015). Despite variations in a research capacity, economic environments, technology, and industry relations, managing IPs and TC can be achieved through a combination of policies, management support, people, and partnerships (Khademi *et al.* 2015).

Technology transfer offices in universities often aim to link the academe to the industry through memoranda of agreement or partnerships. Problems and information gaps often arise when both parties start engaging in partnerships. On the aspect of the university, a study by Siegel (2004) of US universities found challenges with regards to inventors' unwillingness to disclose information on their technologies or inventions. He also found information gaps or asymmetric information. As a consequence, the industry is uninformed of the quality of the invention while technologies that are marketable and profitable remain unfamiliar to the university. This creates a gap causing partnerships to discontinue. In this situation, the academe withholds information to protect its technologies while inventions and their potential remain unrealized, thereby hindering industries from testing them and giving feedback and recommendations. Furthermore, a study by Hockaday noted that "business people prefer interacting with a business on business issues. Business people may find interacting with universities a challenge, having concerns over (mis)perceptions of ivory towers, different approaches, and science boffins in labs."

From the technology transfer officers' perspective, it is important that these officers have the right mix of technical knowledge and business acumen. Hertzfeld and his co-authors (2006) stated that firms have great difficulty in dealing with university technology transfer offices (TTOs) on IP issues, citing the inexperience of the TTO staff, the TTO's lack of general business knowledge, and their tendency to overstate the commercial value of the patent. Without the proper technical background, the office risks impeding IP protection and hindering the technology transfer or commercialization process. Timing is of the essence as firms prefer to transfer the technology as soon as possible to gain a possible competitive advantage in the market. It is now widely known how quickly technology can become obsolete. According to Fauzan and Gooneratne (2019), "generally, outside companies may also be eager to move a licensing agreement forward quickly, while resource-constrained TTOs may need to take longer to evaluate the agreements." This expectation gap may lead to the delay or even cancellation of technology transfer agreements or licensing agreements.

### **The Opportunities and Challenges**

In 2010, a joint study by the International IP Institute, the US Patent and Trademark Officer, and the IP Office of the Philippines (IPOP HL) revealed that 275 research articles out of 1000 research articles from nine research institutions published from 2000–2010 have IP patent potential. However, researchers published their results without filing patent applications. This study resulted in the establishment of TTOs among Philippine research organizations (www.iipi.org). The "publish or perish" mindset that prevailed in the past was replaced by a new mantra "patent, publish, and profit" through the Innovation and Technology Support Office program of the IPOP HL (Ilano 2010). Patent applications provide a good indicator of a country's technological innovation capacity and performance. One of the biggest challenges, however, is instilling a culture of innovation for both the RDI and the state universities and colleges. Poor TC stems from the low level of government funding of only 0.13% of gross added value in agriculture from 2003–2011, the lowest among other ASEAN member states (Catibog 2016).

## **METHODOLOGY**

The study used the developed process flow of the UPLB TTBD O in terms of IP protection and TC. Figure 1 shows the step-by-step process each technology undergoes in terms of technology transfer.

The UPLB IP audit procedure (Figure 2) is a systematic review of IPs owned by the university that is used

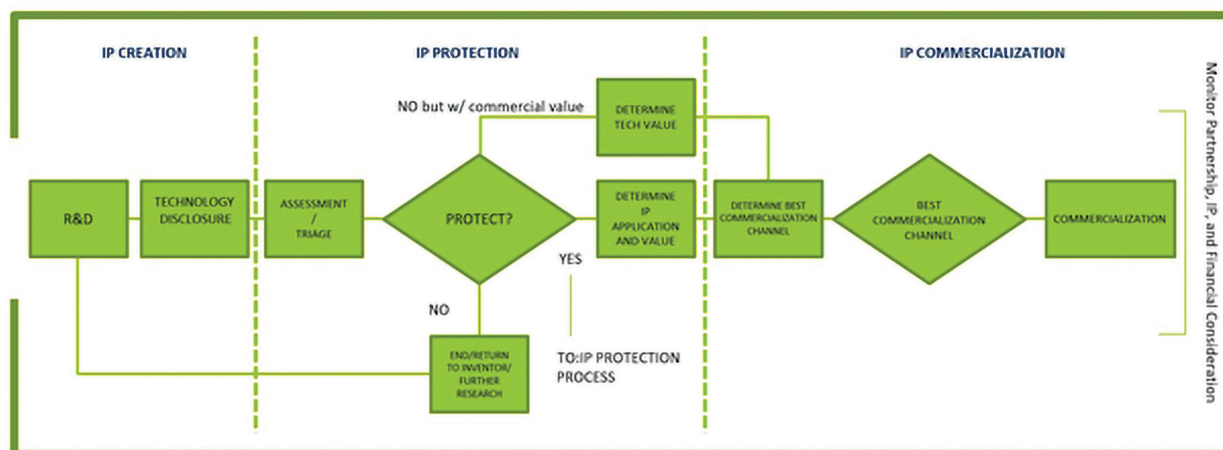


Figure 1. Comprehensive IP protection and TC process flow.

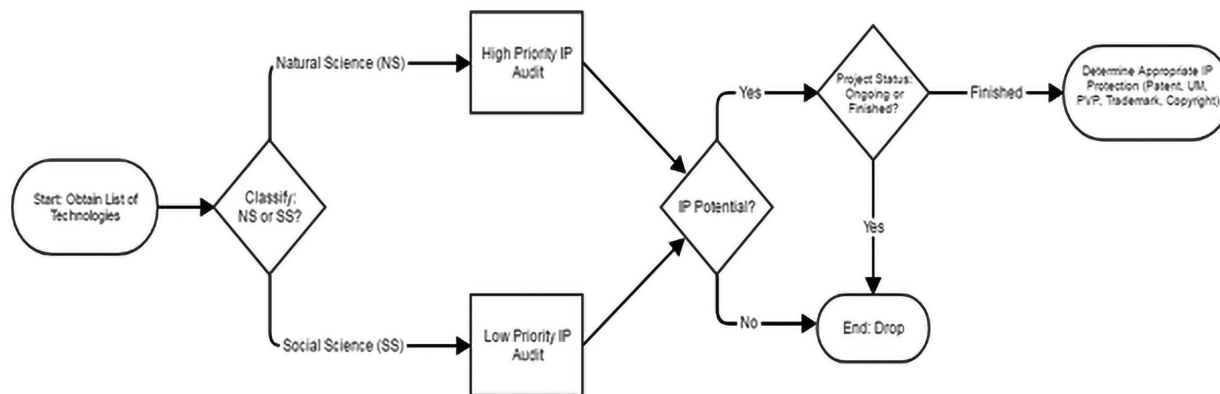


Figure 2. IP audit process procedure.

to assess and manage risks, remedy problems, and implement best practices in IP management. The TRL (Figure 3) is the basic instrument used to determine the status of the technology in terms of IP protection and commercialization. The IP audit was conducted in 2017 covering eight colleges and one institute.

The IP audit conducted made use of two documents – namely, the invention disclosure form and the IP audit form. Research projects were evaluated using the following categories: 1) classification of the technology, 2) kind of technology, 3) areas of application, 4) technology description, 5) development status, 6) technology audit [which includes the following: a) maturity of the technology, b) potential technical or legal issues, c) investment required by the licensee, d) size of the market, e) advantages over existing technology, f) IP protection, g) existing licensees, h) resident expert/helpful professional, i) key strategic relevance to R&D, and j) repeatability/scalability], 7) IP protection/registration, 8) other registrations (National

Seed Industry Colleges, Bureau of Plant Industry, Fertilizer and Pesticide Authority, and other accreditation agencies), 9) mode of transfer/commercialization, 10) technology takers/licensees, 11) areas/regions where it is being used and its impact, 12) awards/citations/recognition received and dates of conferment, and 13) financial analysis.

Technologies with lower TRLs require further research and development compared to those with higher TRLs.

The TC process flow in Figure 4 shows the six major steps in the entire TC procedure. These include market validation, technology valuation, pitching, negotiation, licensing agreement, and fairness opinion report (FOR).



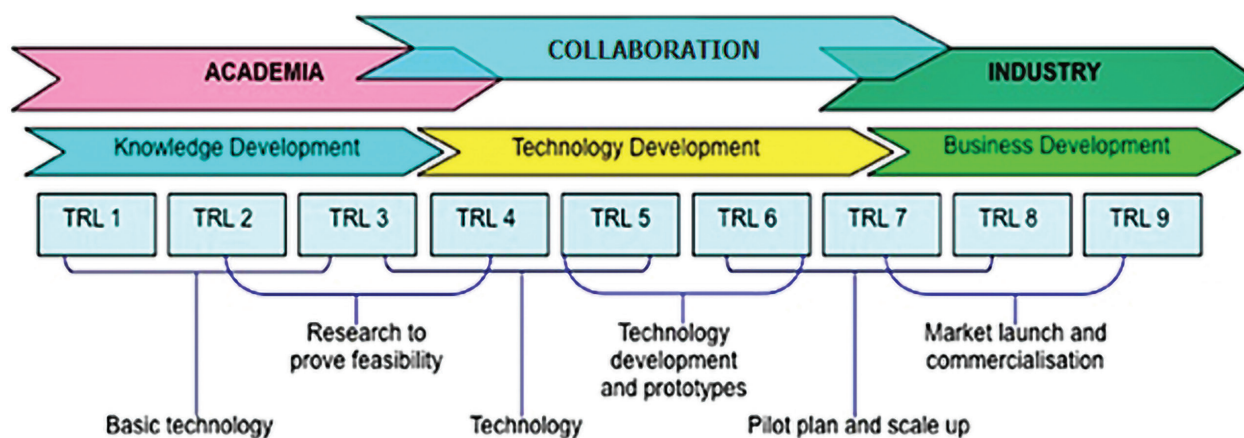


Figure 3. TRL (www.uk-cpi.com).

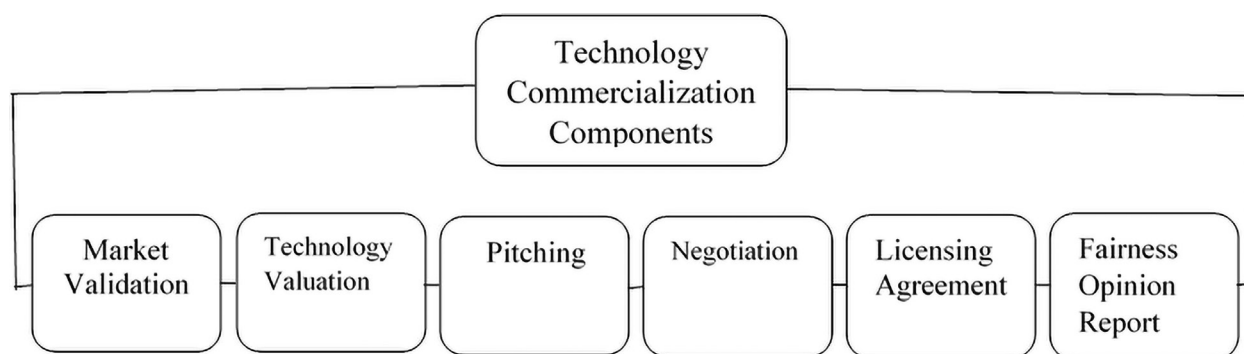


Figure 4. Major components of the TC process.

## DEFINITION OF TERMS

### Market Validation

The initial stage of commercialization is to conduct a 60-h (maximum) market validation for each of the identified UPLB developed technologies. The office has adapted the Quicklook® methodology, which is also utilized by the University of Texas in Austin, Texas. It is an efficient tool to see the snapshot of the developed technologies of UPLB and its applicable markets. The tool's main objective is to recommend if the technology should pursue commercialization.

It is also used as a screening tool to determine which among the developed technologies has the biggest potential in terms of commercialization or revenue generation.

The study includes the following:

- executive summary
- technology description

- potential benefits of the technology
- development status
- potential market, opportunities, and market interest
- competitors
- risk and barriers
- recommendations

### Technology Valuation

Once the selected technologies are screened and prioritized, each technology will be evaluated using the discounted cash flow analysis and benchmarking to determine its estimated value. This will be used for negotiating the royalty rates for each technology that will be licensed. Valuation is conducted by third-party financial consultants to avoid bias in determining the value of the technology.

### Technology Pitching

A technology pitch is a 2–3-min presentation of the technology that seeks to capture the interest of a potential industry. Technology transfer and business development officers who have adept knowledge of the technology usually do the pitching of selected technologies. TTOs attend formal and informal seminars plus symposia where industry partners and collaborators also participate. It is usually a 2–3-min “elevator pitch” that gives an overview of the technology.

### Negotiation, Licensing Agreement, and FOR

Once the industry taker or collaborator has signified their intent to commercialize the technology, negotiations can proceed. This is when the value of the technology, pathways of commercialization, and royalty rates are discussed. The TTOs of UPLB TTBD use the value of the technology from the discounted cash flow analysis conducted by a third-party consultant or benchmarking during negotiations. Once both parties agree to the terms in accordance with the IP policy of UPLB, the university and the entity can enter into a licensing agreement. This is one of the requirements needed to secure the FOR that is issued by the DOST in accordance with the Technology Transfer Act of 2009. The licensing agreement is a legal and binding document that includes all the roles and responsibilities of the licensee and licensor. It is an agreement between the university and a person or company who wishes to use the technology. The FOR is

an assessment of whether a licensing agreement between an RDI and a technology adopter is fair to the government.

The prevailing pathways for TC at UPLB are the following:

1. Direct product sales involve the marketing and selling of products directly to the consumer.
2. A joint venture is a form of commercial enterprise undertaken jointly by two or more parties that retain their distinct identities.
3. A marketing agreement is a kind of contract where one company markets another company’s products.
4. A licensing agreement is a legal contract between two parties where one is the licensor and the other is the licensee.
5. A spin-off is a creation of an independent company from an existing business or parent company.

## RESULTS

Tables 2 and 3 show the results of the TRL conducted at the College of Agriculture and Food Science (CAFS) and the National Institute of Molecular Biology and Biotechnology (BIOTECH), respectively. Seven from BIOTECH and five from CAFS were ranked based on their scores using the prescribed criteria.

**Table 1.** Results of the IP audit based on the UPLB IP audit form.

College/ institute	Number of research projects	Number of research projects with IP component	% of total	Number of research projects with IP and commercialization component	% of total
CAFS	91	43	61	5	29
CAS	16	7	10	1	6
CEAT	10	6	8	3	18
CFNR	18	3	4	1	6
BIOTECH	18	12	17	7	41
Total	153	71	100	17	100

**Table 2.** TRL results from the CAFS.

Technology	TRL score
Multi-location performance evaluation of a new banana bunchy top virus (BBTV)-resistant “lakatan” cultivar	30
Vegetable varieties for sustainable yields, quality, and seed supply	30
Organic fertilizers and microbials for improved soil fertility in organic vegetable production	29
Mass propagation and pilot utilization of plumule-derived plantlets of tall and dwarf coconut varieties through somatic embryogenesis	28
Improving productivity and local utilization of mungbean	27

**Table 3.** TRL results from BIOTECH.

Technology	Short description	TRL score
Mykoplus®	Biofertilizer containing mycorrhizal fungi, beneficial bacteria, and others	36
Protein enrichment of copra meal (PECM)	Feed for swine and poultry	32
Endophytic bacterial inoculant as a new biofertilizer	Improved for sugar cane and eggplant	28
WiltCure®	Biopesticide against major agricultural pests and diseases	28
Biopesticide	Control agent for soil-borne pathogens and other diseases	27
Micromix®	Microbial based stimulants for improved crop productivity of bell pepper and bitter melon	26
Biocontrol agent for postharvest pathogens of fruits and vegetables	Control of postharvest pathogens of fruits and vegetables	25

**Table 4.** UPLB technologies funded by PCAARRD in various stages of IP and TC development.

Technology	IP protection	Short description	Status	Commercialization mode
BioGro™	Trademark	Plant growth promoter of vegetables and ornamentals	Provisional FOR	Licensing agreement
Nanofertilizer	Patent filed	Controlled release N fertilizer for corn production	Provisional FOR	Licensing agreement
<i>Trichoderma</i>	Patent granted	Biofertilizer and biocontrol agent for agricultural crops	Provisional FOR	Licensing agreement
Mykoplus®	Trademark	Biofertilizer that reduces synthetic fertilizer use, improves soil condition, and enhances crop uptake	Provisional FOR	Spin-off
ACTIcon	Patent and trademark filed	Biopesticide for Panama wilt of cavendish banana	Provisional FOR	Spin-off
Nutrio® biofertilizer	Patent filed, trademark	Microbial-based fertilizer	Provisional FOR	Spin-off
Protein-enriched copra meal (PECM)		Food for tilapia, milkfish, and shrimp aquaculture	For pitching	
Hybrid dryer for sea cucumber	Utility model	Mechanized system for drying harvested sea cucumber	For pitching	
Micromix®	Patent filed trademark	Biostimulant that enhances crop growth	For pitching	
WiltCure®	Patent filed trademark	Biopesticide against <i>Fusarium</i> wilt in solanaceous crops	For pitching	
High yeast biocontrol agent	Patent filed	Yeast-based biocontrol agent for fruits and vegetables	For pitching	
Meat detection kit	For patent application		For pitching	
“Kakawate” fertilizer	For patent application		For PAS, IDF	
“Kakawate” microbial inoculant	For patent application		For PAS, IDF	
Aquasave	For patent application		For PAS, IDF	
Ampalaya variety	For patent application		For PAS, IDF	
Mungbean variety	For patent application		For PAS, IDF	
BBTV resistant banana	For patent application		For PAS, IDF	
Coconut tissue culture	For patent application		For PAS, IDF	

**Table 5.** List of UPLB funded technologies, mode of commercialization, and technology licensee.

Product/technology	Commercialization mode	Adaptor/licensee
BIO-N	Distribution and marketing agreement	Ask BIO-N personnel
Sinta papaya	Licensing agreement	East-West Seed Company
Virgin coconut oil	Spin-off	O'Mark Enterprises
Mykovam	Marketing agreement	Adam Farms
Trichoderma	Licensing agreement	Biospark

**Table 6.** Classification and partial number of UPLB technologies developed and generated through the years.

Classification	Number of technologies	% of total
Biotechnology	24	12
Fruit and industrial crops	24	12
Root crops	4	2
Field crops	21	10
Vegetable crops	12	6
Ornamental crops	55	26
Food, beverages, and dairy products processing	24	12
Good farming practices	12	6
Test and diagnostic kit	7	3
Nutrition	1	—
Forest products	2	1
Decision support system	2	1
Machinery and postharvest technology	19	9
Total number of technologies	207	100

## CONCLUSION

UPLB has been filing patents even before the establishment of UPLB TTBD. History has demonstrated UPLB's role as the country's premier university in the field of agriculture through its significant contribution in crop production and improvement, biotechnology, food, beverages and dairy products, good farming practices, machinery and postharvest technology, and forest products. The TTBD, through its mandate, acts as the IP protection and TC arm of UPLB. It has assisted the university in all aspects of IPR protection from prior art search to patent filing and eventual release of patent grants. In the first three quarters of 2017 alone, TTBD has filed a total of 14 patent applications, eight of which are included in the 19 PCAARRD-funded research projects prioritized for commercialization. The TTBD has supported UPLB in the conduct of various TC activities from market validation to the technical evaluation by FOB until the release of the licensing agreement. From 2010–2015, DOST-PCAARRD funded a total of 212 projects implemented in eight colleges, one school, and one institute. An IP audit was conducted in 2017, which resulted in the submission of the TRL from CAFS and BIOTECH. A total of 12 out of 17 technologies with both IP and TC potential passed the TRL criteria. They are included in the 19 technologies funded by DOST-PCAARRD currently being prioritized by TTBD for IP protection and commercialization. To date, six of these technologies have passed the FOB, three are being consummated through licensing agreements, three are bound for a spin-off, while the rest are undergoing PAS and IDF. The numerous activities conducted by TTBD show that it is indeed going towards a robust IP and TC direction.

IP audit is an effective tool in determining the commerciality of different inventions. Due to limited time and funding, this tool proves useful in helping the university to prioritize technologies with high commercial potential.

**Table 7.** UPLB technologies funded by other GFAs that are ready for commercialization.

Technology	Funding agency	Brief description	IP status	TC status
A method for extracting pectin from mango peels	PCIEERD	Utilization of mango by-products for better recovery of higher-grade pectin	Patent-pending; trademark approved	In process
Fruitect		Extend the shelf life of agricultural produce and minimize post-harvest losses	Patent pending	In process
Mykovam	DA-BAR/UP	Soil-based fertilizer effective against AMF	Patent granted	In progress
Nano-PGR	PCIEERD	Biofertilizer for high-value crops	For patent application	In progress
NitroPlus®	PCIEERD	Seed inoculant for legumes	Trademark registered	In progress
Pili Pulp Oil	PCIEERD	Local substitute for imported and expensive oil products	Patent pending	In progress
Vermicompost separator	DA-BAR/UP	Standalone separator of manure vermicompost from decomposed materials	Utility model application filed	In progress



Inventors within the university should focus on developing research with commercialization and innovation potential in order to contribute to the growth and development of the country. Based on the results of the audit, the total number of researchers with potential IP and TC potential is low. A limitation of this study is how the audited projects are ones that are PCAARRD-funded (a total of 153 projects) and does not represent the overall performance of the university. There are different funding agencies that have finished and ongoing projects with UPLB. These are DOST–Philippine Council for Industry, Energy, and Emerging Technology Research and Development), the Department of Agriculture–Bureau of Agricultural Research, and the Commission on Higher Education. It is recommended that UPLB TTBD0 conducts an IP audit on all researches to determine the TRL level and potential to IP and commercialization potential. This study can also be used by different funding agencies to properly allocate government funds to relevant studies that can contribute to the development of our country.

## RECOMMENDATIONS

1. A similar study can be done to audit projects that range from 2016–present.
2. A bigger study can be done to audit all the UPLB generated technologies.
3. The developed methodology can be cascaded to other technology transfer offices to help them prioritize which technologies will be commercialized.
4. The academe-industry gap is an issue that can be further studied by the team.

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