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Indikator
Iptek Riset
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Indonesia

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INDONESIA
SCIENCE, TECHNOLOGY, RESEARCH, AND INNOVATION INDICATORS
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E-mail: penerbit@brin.go.id
Website: penerbit.brin.go.id

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EDITORIAL TEAM INDONESIA SCIENCE, TECHNOLOGY, RESEARCH, AND INNOVATION INDICATORS 2024

Advisor:
Boediastoeti Ontowirjo

Person in Charge:
Khairul Rizal

Technical Person in Charge:
Yudi Widayanto

Team Leader:
Tri Handayani

Editor:
Yudi Widayanto
Nani Grace Berliana

Authors:
Tri Handayani, Nani Grace Berliana, Yosa Permata Shafira, Zulfika Satria Kusharsanto, Anggitya Vitasari, Fitriana Rachmawati, Socia Prihawantoro.

Data Processing:
Faris Nabil Hakim, Yoana Rachel Octalirena Surbakti, Vadya Azzahra, Shabrina Trixie Rustandiputri, Goldfried Marchelino, Chairul Djamil, Davina Intan Aurelya, Mutia Rachma, Seibah Humayyah, Mutiara Fitria Azzahra.

Cover and Layout:
Dhevi E.I.R. Mahelingga

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EDITORIAL TEAM
INDONESIA SCIENCE, TECHNOLOGY, RESEARCH, AND INNOVATION INDICATORS 2024 v

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FOREWORD
HEAD OF THE NATIONAL RESEARCH AND INNOVATION AGENCY

Assalamu'alaikum warahmatullahi wabarakatuh

I gratefully welcome the re-publication of the *Indonesia Science and Technology, Research, and Innovation Indicators of 2024*. This book is one of BRIN's flagship reports that is regularly published to provide an in-depth overview of the achievements and developments of science, technology, research, and innovation in Indonesia.

This book portrays the development of research budgets and expenditures, human resources (HR) for science and technology, as well as the performance and contribution of science and technology, research, and innovation in Indonesia. The figures show the investment that has been put into science and technology, research, and innovation, as well as the quality and quantity of the HRST involved.

In 2023, the national research expenditure reached 20.39 trillion IDR, with the largest proportion coming from the higher education sector at 46.02 percent. Meanwhile, research expenditure in the business/industrial sector reached 21.56 percent, an increase from the previous year which was only 17 percent. This increase shows the potential of that sector in contributing to the innovation and technological development. Applied research collaborations that are relevant to industry's needs must be improved to encourage economic growth and innovation.

The performance of the country's science and technology, research, and innovation is measured by the number of international scientific publications and intellectual property. In 2023, the amount of international scientific publication in Indonesia increased significantly. Furthermore, the issuance of patents provides opportunities for further growth in the future.

This book also showcases data related to the contribution of science and technology, research, and innovation to the national economy as shown by the export and import of industrial products based on technological intensity. In 2023, Indonesia's exports were still dominated by products with low technological intensity. The contribution of science and technology, research, and innovation is also shown from the growth of Total Factor Productivity (TFP). Indonesia's TFP growth has improved after the end of the pandemic period.

This book does not only provide quantitative data and information , but also function as an important foundation in evaluating and designing national science and technology, research, and innovation policies towards the Golden Indonesia 2045 vision.

I hope that the *Indonesia Science and Technology, Research, and Innovation Indicators of 2024* book can be used as widely as possible by all development stakeholders, including ministries/institutions, local governments, business owners, academics, and international institutions. I hope that this book can be used as a reference in policy formulation, planning, and research as needed.

Finally, I would like to express my deepest gratitude to all parties who have contributed to the preparation of this book.

Wassalamu'alaikum warahmatullahi wabarakatuh.

Jakarta, August 8, 2024

Head of the National Research and Innovation Agency

Laksana Tri Handoko

DEPUTY FOR RESEARCH AND INNOVATION POLICY

Science, technology, research, and innovation are the foundation for the progress of a nation. Through relentless efforts, the Deputy for Research and Innovation Policy of the National Research and Innovation Agency (BRIN) are proud to present the *Indonesia Science and Technology, Research, and Innovation Indicators of 2024*. This book presents the latest data on the development of science and technology, research, and innovation in Indonesia throughout 2023.

By the grace of God Almighty, we have successfully published this book. The preparation of indicators of science and technology, research, and innovation in this book is guided by the *Frascati Manual* (2015). The biggest challenge we faced was the continuous collection of data, especially from the business/industry sector. For this reason, in the future, we will build collaboration with ministries and data agencies in the business/industry sector so that data can be available more consistently. With the availability of better and more accurate data, we are optimistic that we can present a comprehensive picture of the progress of science and technology, research, and innovation in Indonesia.

Our commitment is to continue to improve the quality of science and technology, research, and innovation data. We appreciate the contributions of various parties who have been involved in this process and thank you for the support provided.

Jakarta, August 8, 2024

Deputy for Research and Innovation Policy, BRIN

Boediastoeti Ontowirjo

EXECUTIVE SUMMARY

The *Indonesia Science and Technology, Research, and Innovation Indicator of 2024* book is one of the primary reports published by the National Research and Innovation Agency (BRIN). This book provides a comprehensive overview of the achievements and developments of science, technology, research, and innovation in Indonesia. The data presented includes various indicators such as research budget and expenditure, human resources (HR) in science and technology, performance and contribution of science and technology, research, and innovation in national economic growth.

In 2023, national research spending reached 20.39 trillion IDR, with the largest proportion coming from the higher education sector at 46.02 percent. Although research expenditure in business/industrial sector was only 21.56 percent of the total national research expenditure, this sector experienced a significant increase of 48.39 percent from the previous year. The percentage of national research expenditure to gross domestic product (GDP) was still relatively small and had not changed from the previous year, which was around 0.10 percent.

The number of national Human Resource in Science and Technology (HRST) in 2023 was 445,521 people, with a ratio of 1,595.83 HRST per one million population. HRST in the higher education sector are the most dominant, covering 95.28 percent of the total national HRST.

The performance of science and technology, research, and innovation can be measured through international scientific publications and intellectual property (IP) such as patents, copyrights, brands, industrial designs, and plant variety breeding. In 2023, Indonesia's international scientific publications grained a significant increase of 13,975 documents. Meanwhile, the number of patents in

2023 stood at 10,594 patents, thus providing opportunities for further growth in the future.

The contribution of science and technology, research, and innovation in the national production system can be seen through technological intensity-based trade (exports and imports). The export value of products with high and medium technological intensity showed an increase from 2022. In 2023, Indonesia's export value was still dominated by products with low technological intensity. This highlights the need to increase the capacity of internalization of science and technology in the national production system.

Total Factor Productivity (TFP) is used to measure the impact of science and technology, research, and innovation on the country's progress. TFP's contribution to indicator's economic growth reached 15.24 percent. Indicator's TFP growth has improved after the end of the pandemic period. This year, there is a new indicator, IP royalties, which are rewards for the use of IP and are part of the contribution of science and technology to the economy. Countries with high IP royalty income tend to be the main exporters of IP, this shows the strength of innovation and competitiveness of the country. In 2023, IP royalties reached $212,170,004 or equivalent to 3.33 trillion IDR.

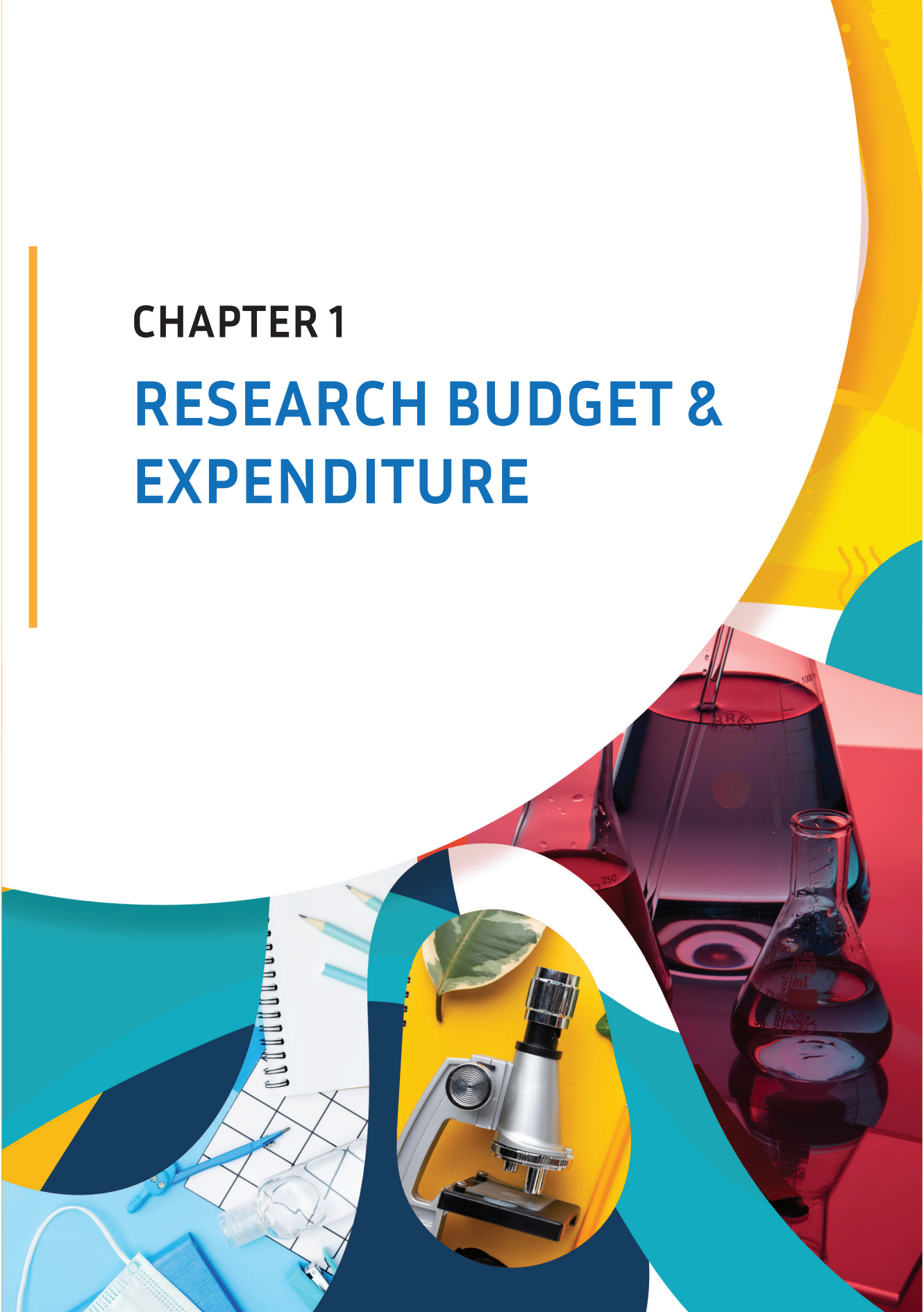
LIST OF ABBREVIATIONS

APBN	:	*Anggaran Pendapatan Belanja Negara* (State Budget)
BPS	:	*Badan Pusat Statistik* (Statistics Indonesia)
BRIN	:	*Badan Riset dan Inovasi Nasional* (National Research and Innovation Agency)
DGIP	:	*Direktorat Jenderal Kekayaan Intelektual* (Directorate General of Intellectual Property)
GBARD	:	Government Budget Allocations for Research and Development
GDP	:	Gross Domestic Product
GERD	:	Gross Expenditure on R&D
HRST	:	Human Resources in Science and Technology
IP	:	Intellectual Property
KBLI	:	*Klasifikasi Baku Lapangan Usaha Indonesia* (Indonesian Standard Industrial Classification)
KISTEP	:	Korea Institute of S&T Evaluation and Planning
LAKIN	:	*Laporan Kinerja* (Performance Report)
LPDP	:	*Lembaga Pengelola Dana Pendidikan* (Indonesia Endowment Fund for Education Agency)
OECD	:	Organisation for Economic Co-operation and Development
PTA	:	*Perguruan Tinggi Agama* (Religious Higher Education Institution)
PTK	:	*Perguruan Tinggi Kedinasan* (Government Higher Education Institution)
PTN	:	*Perguruan Tinggi Negeri* (State Higher Education Institution)
PTS	:	*Perguruan Tinggi Swasta* (Private Higher Education Institution)
Pusdatin	:	*Pusat Data dan Informasi* (Center for Data and Information)

R&D	:	Research and Development
SIINas	:	*Sistem Informasi Industri Nasional* (National Industry Information System)
S&T	:	Science and Technology
UIS	:	UNESCO Institute for Statistics
WIPO	:	World Intellectual Property Organization

CHAPTER 1

RESEARCH BUDGET & EXPENDITURE



1.1 R&D BUDGET

One indicator that can describe a country's R&D activities is by how much the country allocates and spends its budget on R&D activities. For developing countries, the government sector plays an important role in budget allocation for R&D activities. Government Budget Allocations for R&D (GBARD) is the overall allocation of R&D funding provided by the government to all sectors of the economy, namely the higher education sector, the business sector, the public sector, and international R&D programs.

The government sector R&D budget includes employee spending, capital, goods, and R&D carried out by the Central Government (in this case, the National Research and Innovation Agency [BRIN], local governments, and the Public Service Agency of the Education Fund Management Institution [BLU LPDP]). The total government sector R&D budget is around 7.92 trillion IDR.

Table 1.1 Government Sector R&D Budget (% in GDP), 2023

Component	R&D Expenditure (IDR)
Central government	6,356,162,008,000
Local Government	1,163,443,825,814
LPDP	409,485,000,000
Total Government R&D Budget	**7,929,090,833,814**
GDP by business sector	20,892,400,000,000,000
Percentage of Government R&D Budget to GDP	0.04%

Data processed from:

Central Government : LAKIN BRIN, 2023

Local Government : Directorate of Regional Budget Planning, Ministry of Home Affairs, 2023

LPDP : LAKIN LPDP, 2023

1.2 R&D EXPENDITURE

1.2.1 NATIONAL R&D EXPENDITURE

National R&D expenditure is the main indicator of research activities comparation between countries. For each performing sector, each country compiles R&D funding sources consisting of five sectors, namely the government, higher education, business/industrial institutions, private *non-profits*, and international institutions. The national R&D expenditure in this report is an aggregate of R&D expenditure in the government, higher education, and business/industry sectors. In 2023, national R&D expenditure was 20.39 trillion IDR, with the proportion of R&D expenditure in the government sector at 32.42 percent, higher education at 46.02 percent, and business/industrial institutions at around 21.56 percent. Table 1.2 displays data on the distribution and percentage of national R&D expenditure based on the three sectors in 2023.

Table 1.2 National R&D Expenditure, 2023

Sector	R&D Expenditure (IDR)	Percentage (%)
Government	6,611,817,610,505	32.42
Higher Education*	9,385,943,837,278	46.02
Business Enterprise/Industry	4,397,217,936,223	21.56
Total National R&D Expenditure	**20,394,979,384,006**	**100.00**

*Provisional data
Data processed from :
Central government : LAKIN BRIN, 2023
Local Government : Directorate of Regional Budget Planning, Ministry of Home Affairs, 2023
LPDP : LAKIN LPDP, 2023
Higher Education : Pusdatin - Ministry of Education, Culture, Research, and Technology, 2023
Business Enterprise/Industry : SIINas, Pusdatin - Ministry of Industry, 2023

Furthermore, the percentage of national R&D expenditure to GDP in 2023 is 0.10 percent and is shown in Table 1.3.

Table 1.3 National R&D Expenditure (% to GDP), 2023

Sector	Research Expenditure (IDR)
Government	6,611,817,610,505
Higher Education*	9,385,943,837,278
Business Enterprise/Industry	4,397,217,936,223
Total National R&D Expenditure	**20,394,979,384,006**
ADHB GDP by Business Sector (IDR)	20,892,400,000,000,000
Percentage of National R&D Expenditure to GDP	**0.10%**

*Provisional data
Data processed from :
Central government : LAKIN BRIN, 2023
Local Government : Directorate of Regional Budget Planning, Ministry of Home Affairs, 2023
LPDP : LAKIN LPDP, 2023
Higher Education : Pusdatin - Ministry of Education, Culture, Research, and Technology, 2023
Business Enterprise/Industry : SIINas, Pusdatin - Ministry of Industry, 2023

1.2.2 GOVERNMENT SECTOR R&D EXPENDITURE

Government R&D expenditure is the overall cost of HRST, R&D activity expenditure, and R&D capital expenditure (machinery/equipment and buildings/structures used for research) in the government sector. Government R&D expenditure includes central government R&D expenditure, in this case BRIN, Local Government, and BLU LPDP. In 2023, government sector R&D expenditure and its percentage to GDP are shown in Table 1.4.

Table 1.4 Government Sector R&D Expenditure (% to GDP), 2023

Component	R&D Expenditure (IDR)
Central government	5,176,786,171,552
Local Government*	1,090,379,553,553
LPDP	344,651,885,400
Total Government R&D Expenditure	**6,611,817,610,505**
ADHB GDP by Business Sector (IDR)	20,892,400,000,000,000
Percentage of Government R&D Expenditure to GDP	**0.03%**

*Provisional data
Data processed from :
Central government : LAKIN BRIN, 2023
Local Government : Regional Development Information System, Ministry of Home Affairs, 2023
LPDP : LAKIN LPDP, 2023

1.2.3 HIGHER EDUCATION SECTOR R&D EXPENDITURE

R&D expenditure in the higher education sector includes the overall cost of HRST in the higher education sector, expenditure on R&D activities, and R&D capital expenditure. Table 1.5 shows R&D expenditure in the higher education sector and its percentage to GDP in 2023.

Table 1.5 Research Expenditure in the Higher Education Sector (% to GDP), 2023

Sector	R&D Expenditure (IDR)
Higher Education*	9,385,943,837,278
ADHB GDP by business sector (Rp)	20,892,400,000,000,000
Percentage of government R&D expenditure to GDP	**0.04%**

*Provisional data
Source: data processed from Pusdatin - Ministry of Education, Culture, Research, and Technology, 2023

1.2.4 R&D EXPENDITURE IN BUSINESS ENTERPRISE/INDUSTRY SECTOR

R&D expenditure in the business enterprise/industry sector is all expenditure on R&D activities in the business enterprise/industry sector, including human resource costs, science and technology, and R&D capital expenditure. R&D expenditure on the business/industry sector and its percentage of GDP are shown in Table 1.6.

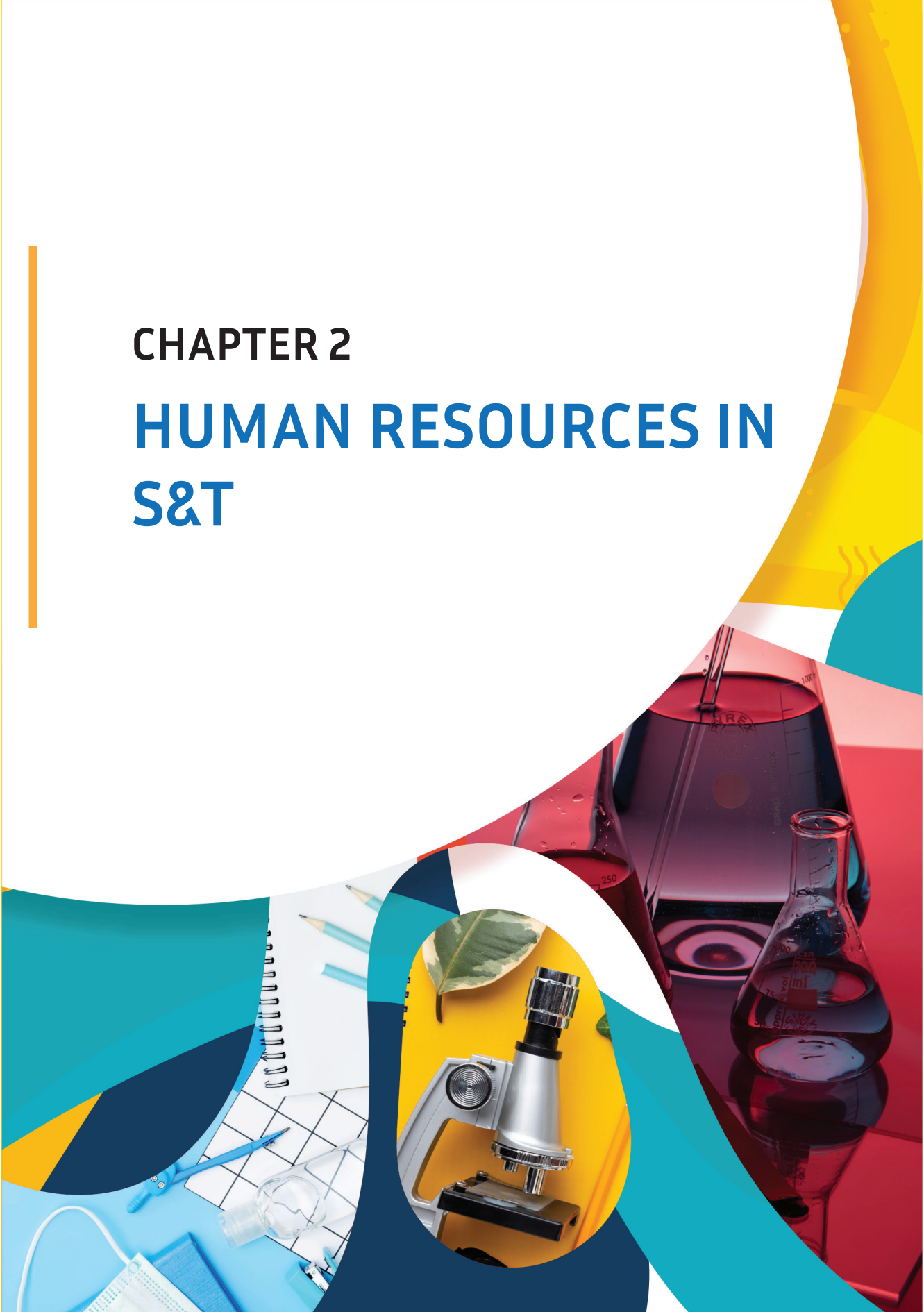
Table 1.6 R&D Expenditure on the Business/Industrial Sector (% to GDP), 2023

Sector	R&D Expenditure (IDR)
Business Enterprise/Industry	4,397,217,936,223
ADHB GDP by business sector (IDR)	20,892,400,000,000,000
Percentage of business enterprise/industry sector R&D expenditure to GDP	**0.02%**

Source: processed from SIINas - Pusdatin - Ministry of Industry, 2023

CHAPTER 2

HUMAN RESOURCES IN S&T



2.1 HUMAN RESOURCES IN SCIENCE AND TECHNOLOGY (HRST)

Based on Law Number 11 of 2019 concerning the National System of Science and Technology, Article 50, HRST are classified into researchers, engineers, lecturers, and other HRST. In addition, if referring to the Frascati Manual, the terminology of HRST is equivalent to R&D Personnel. HRST include personnel who are directly involved in research activities, including R&D services (such as R&D managers, administrators, technicians, and administrative staff). Therefore, this year's number of HRST has perfected the 2023 Science and Technology, Research, and Innovation Indicators which did not include personnel related to R&D services (Attachment 1).

National HRST consists of HRST in the central and local government sectors, higher education (full-time lecturers and enrolled Doctorate students), and HRST in the business/industry sector.

Table 2.1 National HRST in 2023

Sector	Component	Total (People)	Percentage (%)
Government		**14,789**	**3.32%**
	Central (BRIN)	14,083	
	Local	706	
Higher Education		**424,481**	**95.28%**
	Full-time Lecturer	339,305	
	Enrolled Doctorate Students	85,176	
Business Enterprise/Industry*		**6,251**	**1.40%**
TOTAL		**445,521**	

*Provisional data
Data processed from:
Central government : BOSDM and SDMI BRIN, 2023
Local Government : Directorate for Functional Position Fostering and Professional Development (DPJFPP) – BRIN, 2023
Higher Education : Pusdatin - Ministry of Education, Culture, Research, and Technology, 2023
Business Enterprise/Industry : Science and Technology, Research, and Innovation Indicator Book, 2023

Based on Table 2.1, the total number national HRST is 445,521. HRST in the higher education sector occupy the largest portion, namely 95.28 percent of the total national HRST. The proportion of government and business/industry HRST is 3.32 percent and 1.40 percent of the total national HRST, respectively.

Table 2.2 Ratio of HRST to Population and Labor force

Component	Total (People)
National Population	279,179,042
Labor force	147,710,000
Ratio of HRST per 1 million Population	**1,595.83**
Ratio of HRST per 1 million Labor Force	**3,016.19**

Source processed from:
HRST : BRIN and the Ministry of Education, Culture, Research, and Technology, 2023
Population and Labor Force : BPS, 2023

Based on Table 2.2, in 2023, when compared to the number of populations, there are 1,596 HRST for every 1 million population. Meanwhile, when compared to the number of labor force, there are 3.016 HRST for every 1 million labor force.

Table 2.3 Percentage of Postgraduate to Undergraduate Students

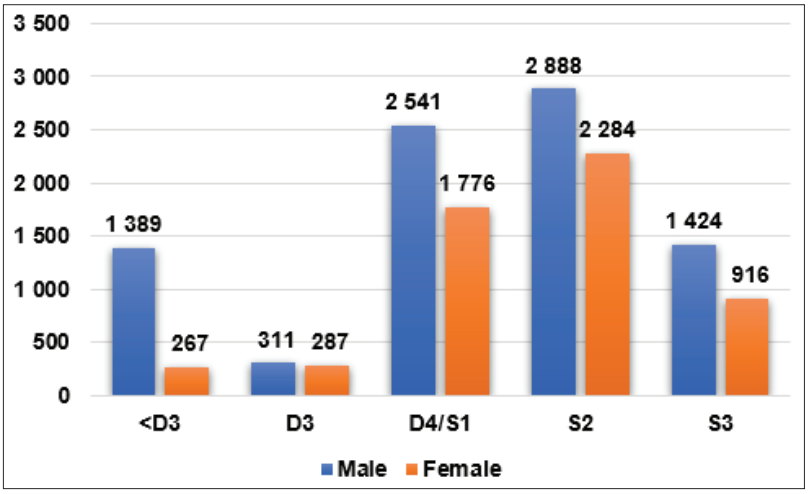
Component	Total (People)
Enrolled Undergraduate Students (Bachelor)	10,443 590
Enrolled Postgraduate Students (Master/S2)	1,228 750
Enrolled Postgraduate Students (Doctorate/S3)	85,176
Percentage of the Number of Postgraduate Students (S1) (Master's + Doctorate) to the Number of Undergraduate Students	**12.58%**

Data processed from:
HRST : BRIN and the Ministry of Education, Culture, Research, and Technology, 2023
Population and Labor Force : BPS, 2023

Based on Table 2.3, the percentage of the number of postgraduate students (master + doctorate) to the number of undergraduate students (bachelor) is 12.58 percent.

2.1.1 HRST IN THE CENTRAL GOVERNMENT SECTOR

HRST in the government sector is divided into those of the central government and local government. BRIN's HRST include all BRIN employees as many as 14,083 people shown in Figure 2.1.

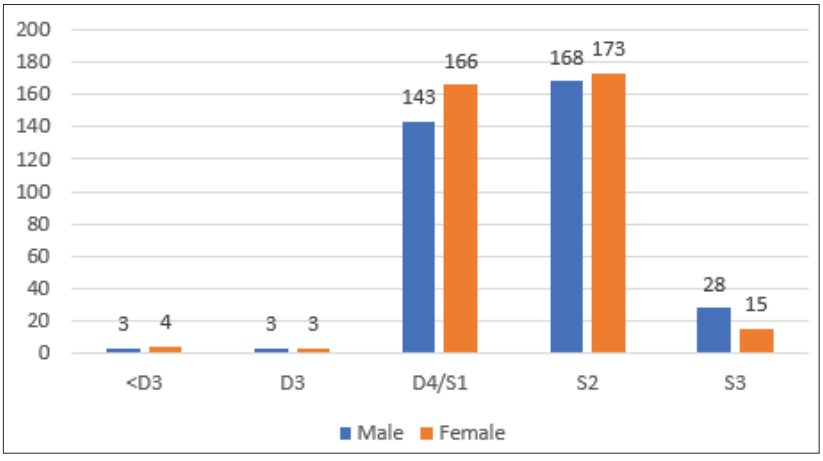


Source: Bureau of Organization and Human Resources (BOSDM) - BRIN, 2023

Figure 2.1 Central Government HRST (BRIN) Based on Gender and Education Level

2.1.2 HRST IN THE LOCAL GOVERNMENT SECTOR

Local government HRST consists of personnel who carry out R&D activities in local agencies (provincial government, local government, district government) with a total of 706 people (Figure 2.2).

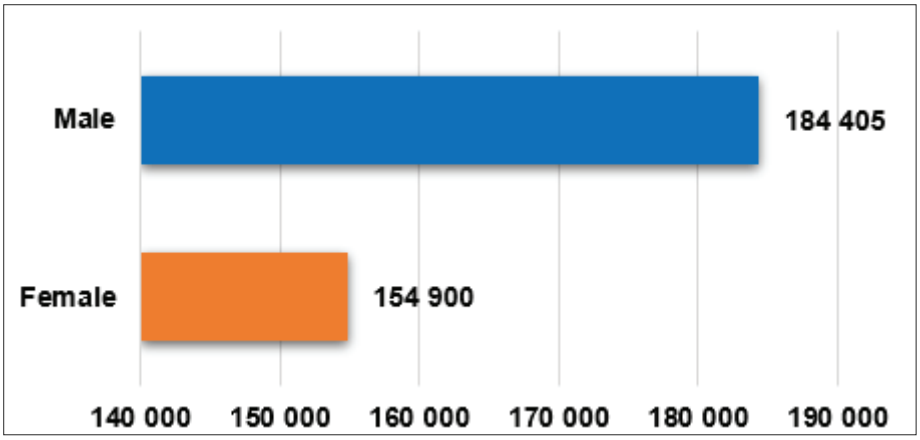


Source: Directorate for Functional Position Fostering and Professional Development (DPJFPP) - BRIN, 2023

Figure 2.2 HRST of Local Government

2.1.3 HRST IN THE HIGHER EDUCATION SECTOR

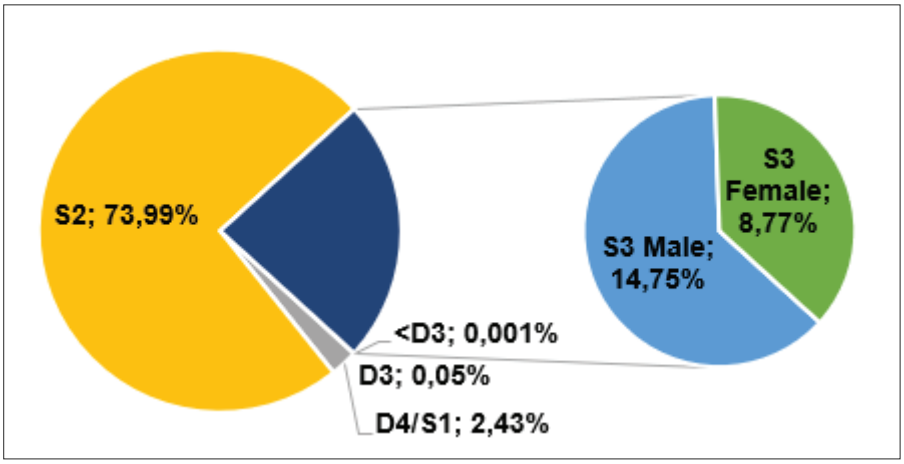
HRST in the higher education sector are personnel who carry out research activities in the higher education sector, including lecturers and doctorate students registered at public HE institutions, private HE institutions, religious HE institutions, and government HE institutions. The number of full-time lecturers is 339,305 people (Figure 2.3), while the number of enrolled doctorate students is 85,176 people (Figure 2.5).



Source: Pusdatin - Ministry of Education, Culture, Research, and Technology, 2023

Figure 2.3 Higher Education HRST (Lecturers) by Gender

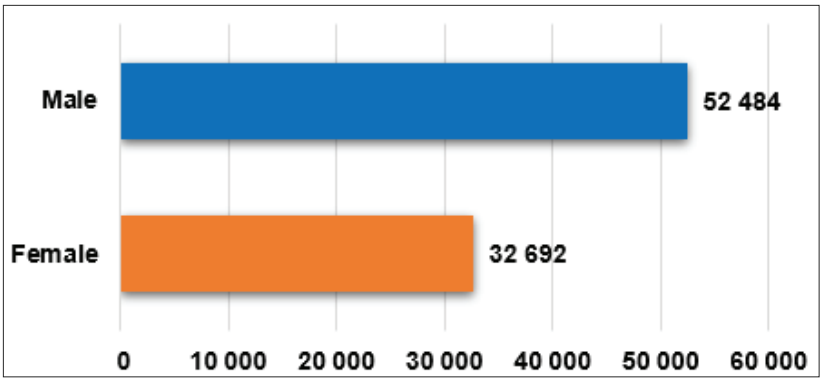
Based on the level of education, the percentage of male lecturers (54.35 percent) is slightly more than female lecturers at 45.65 percent (Figure 2.4).



Source: processed from Pusdatin - Ministry of Education, Culture, Research, and Technology, 2023

Figure 2.4 Higher Education HRST (Lecturers) Based on Education Level

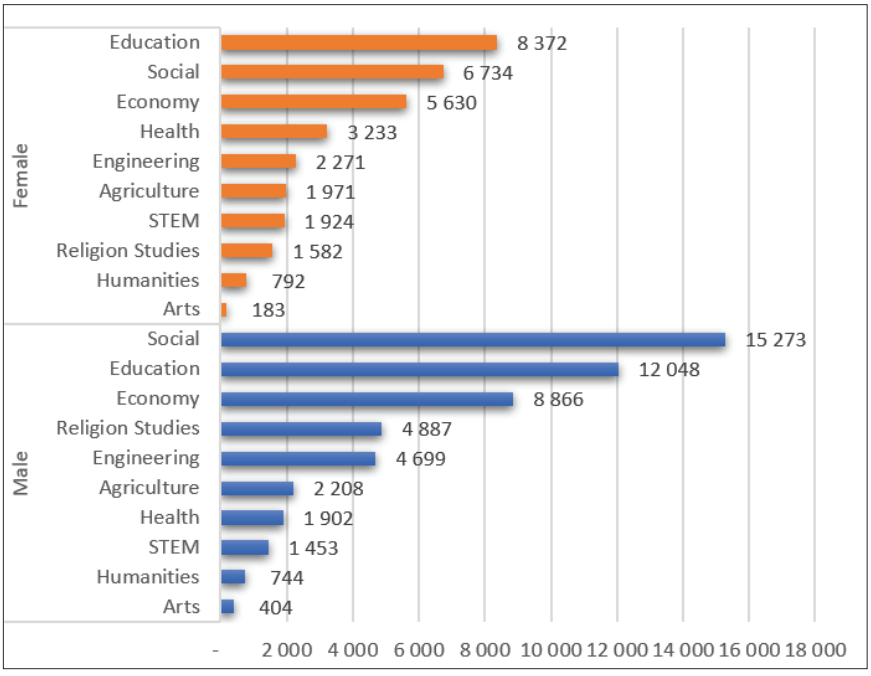
Meanwhile, from the 23.52 percent of lecturers with doctorate education level, 14.75 percent are male , while 8.77 percent are female.



Source: processed from Pusdatin - Ministry of Education, Culture, Research, and Technology, 2023

Figure 2.5 Higher Education HRST (Registered Doctorate Students) by Gender

Another component of HRST in the higher education sector is enrolled doctorate students. Figure 2.5 shows that the number of male doctorate students (52,484 people) is higher than the number of female doctorate students (32,692 people).



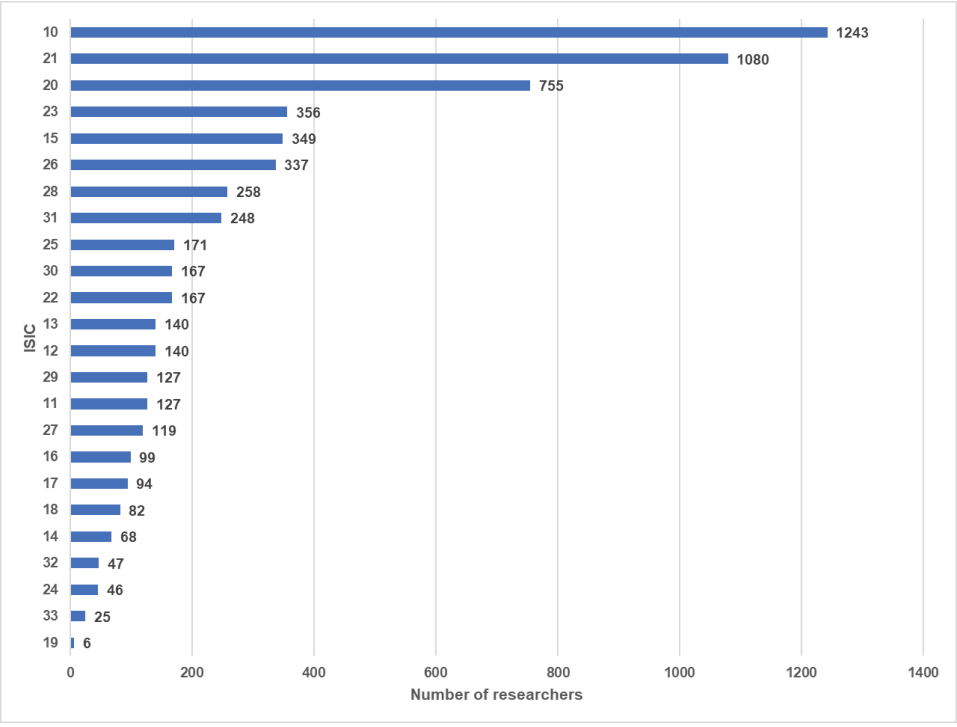
Source: processed from Pusdatin - Ministry of Education, Culture, Research, and Technology, 2023

Figure 2.6 HRST in the Higher Education Sector (enrolled Doctorate Students) Based on Subject

Figure 2.6 shows that the three fields of science that are the highest in demand by doctorate students, both female and male, are education, social, and economic fields. The difference is that the health field is more in demand by female students, while engineering is more in demand by male students.

2.14 HRST IN THE BUSINESS/INDUSTRIAL SECTOR

HRST in the business/industrial sector are represented by human resources in the manufacturing industry.



Source: Science and Technology, Research, and Innovation Indicator of 2023

Figure 2.7 HRST in the Business/Industrial Sector Based on KBLI

Figure 2.7 shows that of the 6,251 researchers in the manufacturing industry sector, 19.88 percent are concentrated in the food industry (KBLI 10), 17.28 percent in the pharmaceutical industry, chemical and traditional medicine products (KBLI 21) and 12.08 percent in the chemical ingredients and chemical products industry (KBLI 20).

2.2 RESEARCHERS

Researchers are HRST who carry out R&D activities, except for R&D service activities. National researchers consist of researchers from the government sector, the higher education sector, and the business/industry sector.

Table 2.4 National Researcher in 2023

Sector	Component	Total (People)	Percentage (%)
Government		8,617	1.96%
	Central (BRIN)	7,911	
	Local	706	
Higher Education		424,481	96.62%
	Full-time Lecturers	339,305	
	Enrolled Doctorate Students	85,176	
Business Enterprise/Industry*		6,251	1.42%
Total National Researchers		439,349	100.00%

*Provisional data
Data processed from:
Central government : BOSDM and SDMI BRIN, 2023
Local Government : Directorate for Functional Position Fostering and Professional Development (DPJFPP) – BRIN, 2023
Higher Education : Pusdatin - Ministry of Education, Culture, Research, and Technology, 2023
Business Enterprise/Industry : Science and Technology, Research, and Innovation Indicator Book, 2023

Based on Table 2.4, the total number of national researchers is 439,349 people. Researchers in the higher education sector occupy the largest portion, which is 96.62 percent of the total national researchers. The proportion of government sector researchers and the manufacturing industry is 1.96 percent and 1.42 percent of the total national researchers, respectively.

CHAPTER 3

PERFORMANCE OF S&T, RESEARCH, AND INNOVATION

3.1 INTERNATIONAL SCIENTIFIC PUBLICATIONS

Research performance indicators are measured by the number of international scientific publications in the form of journals, proceedings, and other international publications. Data from international scientific publications are presented over the last 5 (five) years to see their development.

	2019	2020	2021	2022	2023
Journal	23.663	23.697	25.019	13.541	22.183
Proceeding	24.795	28.396	27.669	30.696	35.750
Others	936	1.503	1.387	1.596	1.875
Total	49.394	53.596	54.075	45.833	59.808

Source: scopus.com, accessed May 7, 2024

Figure 3.1 Number of International Scientific Publications in Indonesia in 2019–2023

In 2023, the number of international scientific publications in Indonesia increased significantly, namely by 13,975 documents. The highest increase was in journals, with 8,642 articles, followed by proceedings, with 5,054 documents, and other publications, with 279 documents (Figure 3.1).

The top ten institutions that produce international scientific publications in 2023 consist of eight public universities, one private university, and one government research institution, namely BRIN (Table 3.1).

Table 3.1 Top Ten Institutions Producing the Most International Scientific Publications in 2023

No	Institution / Affiliation	Number of Documents
1	National Research and Innovation Agency	5,273
2	Universitas Gadjah Mada	3,483
3	Universitas Indonesia	3,341
4	Universitas Airlangga	3,306
5	Bina Nusantara University	3,055
6	Institut Teknologi Bandung	2,618
7	Universitas Diponegoro	2,219
8	IPB University	2,086
9	Universitas Padjadjaran	2,055
10	Institut Teknologi Sepuluh Nopember	1,991

Source: scopus.com, accessed May 7, 2024

Over the past five years, environmental science, engineering, as well as physics and astronomy achieved the highest number in international scientific publications (Table 3.2)

Table 3.2 Ten Scientific Fields Producing the Most International Scientific Publications in 2019–2023

No	Field	Total (document)
1	Environmental Science	54,269
2	Engineering	49,966
3	Physics and Astronomy	47,330
4	Earth and Planetary Sciences	40,927
5	Computer Science	40,856
6	Social Sciences	39,519
7	Medical Sciences	33,085
8	Agricultural Sciences and Biology	23,890
9	Business, Management, and Accounting	17,982
10	Material Science	17,014

Source: scopus.com, accessed May 7, 2024

Table 3.3 Ratio of International Scientific Publications to 100 Researchers

Detail	Total
Number of International Scientific Publications in 2023	59,808
Number of HRST	445,521
Number of Researchers	439,349
International Scientific Publications per 100 Researchers	**13.61**

Source processed from:
HRST : BRIN and the Ministry of Education, Culture, Research, and Technology, 2023
International Scientific Publications : scopus.com, accessed May 7, 2024

The number of international scientific publications in Indonesia was compared with other countries to determine Indonesia's position among ASEAN countries and two (2) other Asian countries, namely China and South Korea (Table 3.4).

Table 3.4 Number of International Scientific Publications in 2019–2023

Country	Number of Publications by Year					Total (document)
	2019	2020	2021	2022	2023	2019–2023
China	713,556	790,577	886,996	1,028,625	1,043,131	4,462,885
South Korea	92,554	96,408	101,994	102,952	101,414	495,322
Indonesia	49,257	53,226	53,706	45,436	58,224	259,849
Malaysia	38,295	39,450	42,729	45,120	45,659	211,253
Singapore	23,922	26,014	27,109	28,118	27,821	132,984
Thailand	20,277	22,232	25,466	28,686	26,904	123,565
Vietnam	12,860	18,293	18,346	18,302	19,196	86,997
Philippines	5,640	6,136	7,079	7,982	7,890	34,727
Brunei Darussalam	630	813	956	1,246	1,415	5,060
Myanmar	789	1,072	892	617	609	3,979
Cambodia	536	576	663	777	869	3,421
Lao, Rep.	359	345	359	341	336	1,740

Source: https://www.scimagojr.com/, accessed May 10, 2024

3.2 CITATION

One measure of the quality of international scientific publications is the number of publications cited. This subchapter compares the citation numbers of Indonesia's international scientific publications to other ASEAN countries, such as China and South Korea. The data on the number of citations shows the number of citations in publications published per year according to the year listed. The data used are data within the last five (5) years (2019–2023). In terms of the number of cited documents, Indonesia ranks as the highest in ASEAN (Table 3.5).

Table 3.5 Number of Cited Documents in 2019–2023

Country	Number of Publications	Number of Publication Citations	Average Citations per Publication	Cited Documents
	2019–2023	2019–2023	2019–2023	2019–2023
China	4,462,885	38,166,370	9.40	4,362,794
South Korea	495,322	4,402,711	9.08	476,159
Indonesia	259,849	781,100	3.06	253,897
Malaysia	211,253	1,583,952	7.80	197,736
Singapore	132,984	1,956,548	15.23	119,692
Thailand	123,565	795,276	6.89	117,137
Vietnam	86,997	814,046	9.90	82,781
Philippines	34,727	204,806	6.42	31,978
Brunei Darussalam	5,060	42,850	10.12	4,312
Myanmar	3,979	27,906	6.39	3,715
Cambodia	3,421	22,976	7.66	2,851
Lao, Rep.	1,740	13,828	7.85	1,577

Source : https://www.scimagojr.com/, accessed May 10, 2024

3.3 INTELLECTUAL PROPERTY (IP)

Intellectual property data is a form of output that can be used to measure the performance of research and innovation at the individual, organizational, and state levels. According to WIPO (2020), Intellectual Property (IP) is the result of the creation of a good idea from works of art, inventions, computer programs, brands, and other commercial attributes.

Countries worldwide have agreed that IP is useful as a record of new ideas and inventions to see progress and increase the capacity of human intelligence.

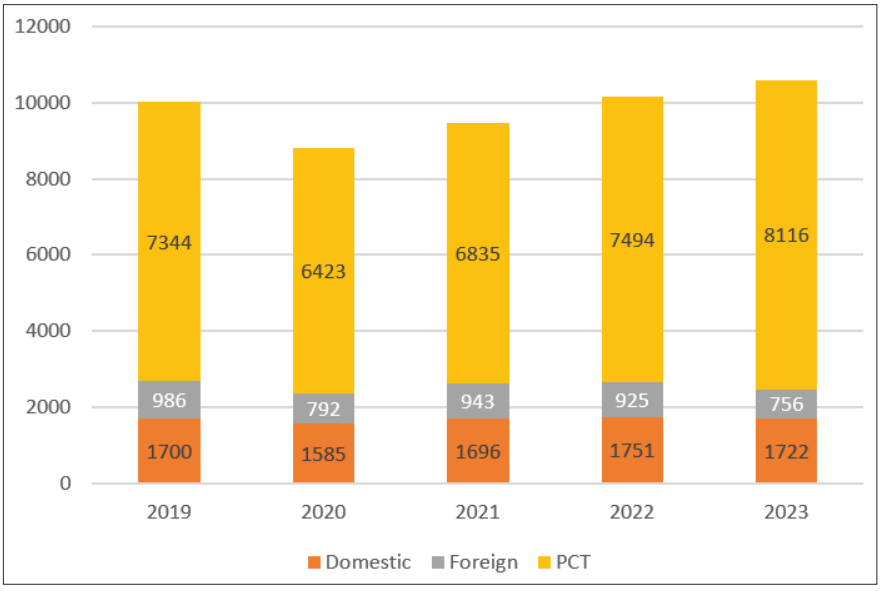
In addition, IP registration is also an effort for legal protection so that inventors are entitled to the benefits of both recognition and monetary gain from the use of their IPs by other parties, such as the industry sector.

IP consists of patents, simple patents, copyrights, trademarks, industrial designs, Plant Variety Protection (PVP), and others. The following are data on IP registration in Indonesia.

3.3.1 PATENTS AND SIMPLE PATENTS

Patents are a type of IP that was first recorded in the world's modern legal system. According to the Directorate General of Intellectual Property (DGIP), the Ministry of Law and Human Rights, as the IP registration office in Indonesia (DGIP, 2024). A patent is an exclusive right granted to inventors over their inventions in the field of technology, allowing them to operate independently or give permission to others to use the invention for a certain period.

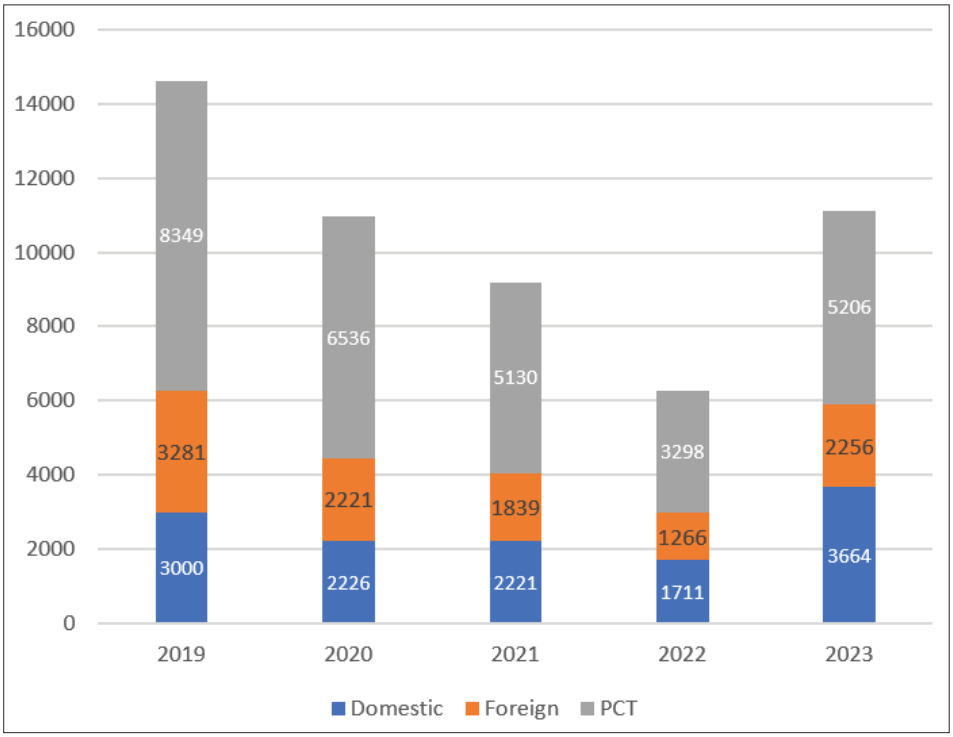
Throughout 2019–2023, the number of patent applications, both from the total domestic and foreign applicants and the Patent Cooperation Treaty (PCT), that have been nationally recorded tends to increase. However, in 2023, the number of domestic patent applications of 1,722 applications decreased by 1.65 percent compared to 2022 (Figure 3.2).



Source: DGIP – Ministry of Law and Human Rights, as of June 12, 2024

Figure 3.2 Number of Patent Applications in Indonesia

In 2019–2023, the DGIP, the Ministry of Law and Human Rights, recorded fluctuations in Granted Patent status per year[1]. The most patents granted were recorded in 2019, reaching a total of 14,630 applications. The number of patents from domestic applicants with Granted Patent status was recorded the most in 2023 or an increase of 114.14 percent (Figure 3.3).

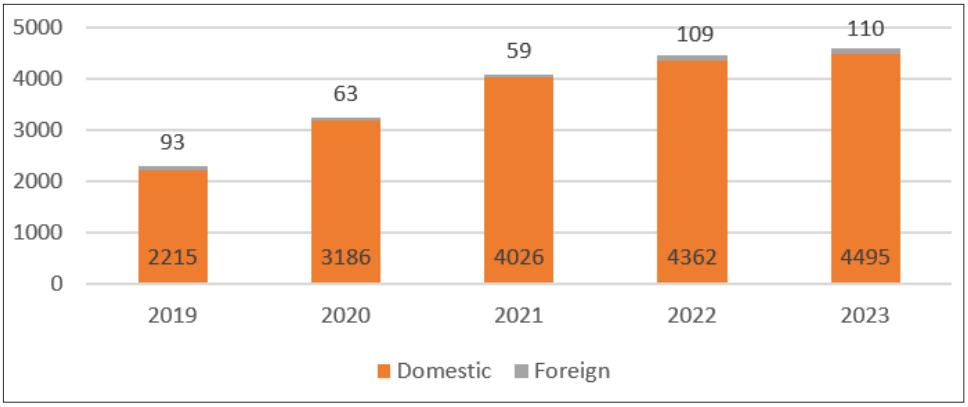


Source: DGIP – Ministry of Law and Human Rights, as of July 12, 2024

Figure 3.3 Number of Granted Patents in Indonesia

Based on the definition from the DGIP, Ministry of Law and Human Rights, a simple patent (also called the utility model in some countries) is an invention in the form of a new product or tool and has practical utility value in its shape, configuration, construction, or components. In contrast to patents that are granted legal protection for 20 years, simple patents are granted protection for 10 years. The number of simple patent applications in 2019–2023 consistently increased, especially from domestic applications (Figure 3.4).

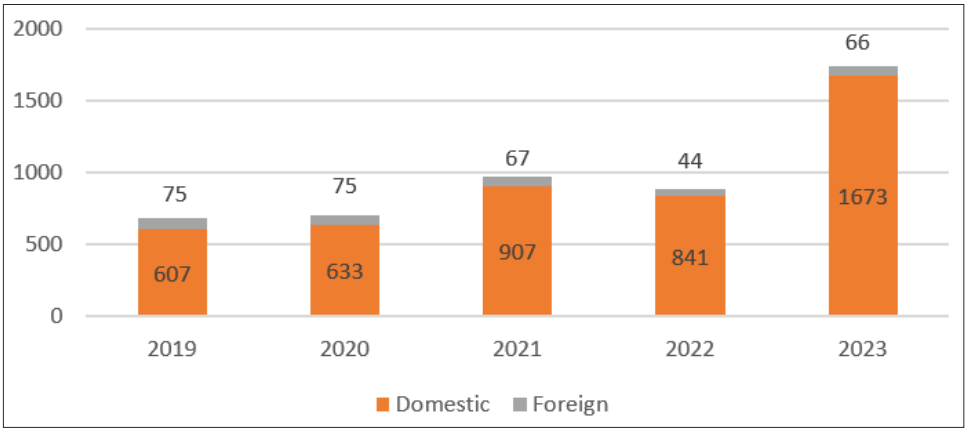
[1] The number of patents granted in the year listed is not directly correlated with the number of patent applications in that year as well. Patent status granted in that year may come from patent applications in previous years.



Source: DGIP – Ministry of Law and Human Rights, as of July 12, 2024

Figure 3.4 Number of Simple Patent Applications in Indonesia

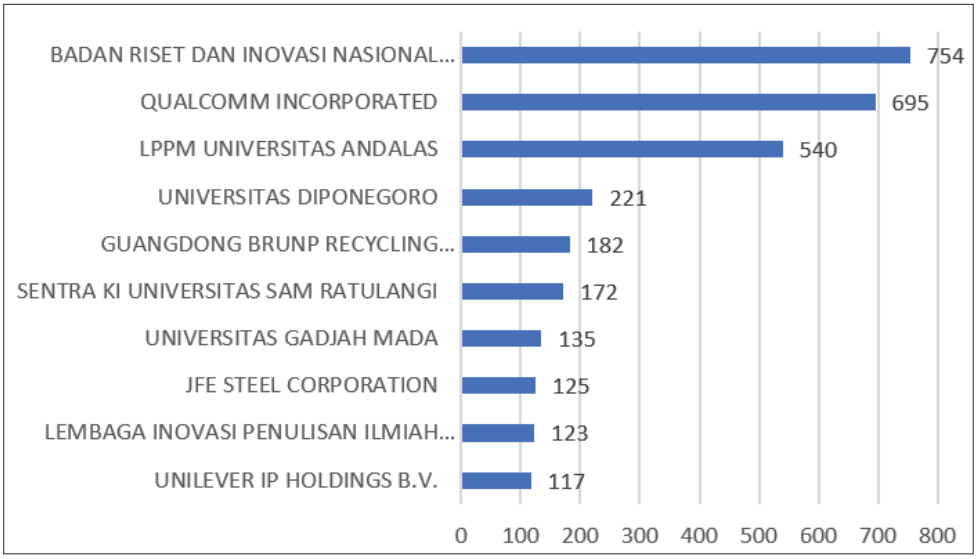
The number of simple patent applications granted has also increased in the 2019–2023 period per year, except in 2022. In 2023, simple patents from domestic applications with granted status reached 1,673 applications, which increased by 98.92 percent from 2022 (Figure 3.5).



Source: DGIP – Ministry of Law and Human Rights, as of July 12, 2024

Figure 3.5 The number of granted simple patents in Indonesia

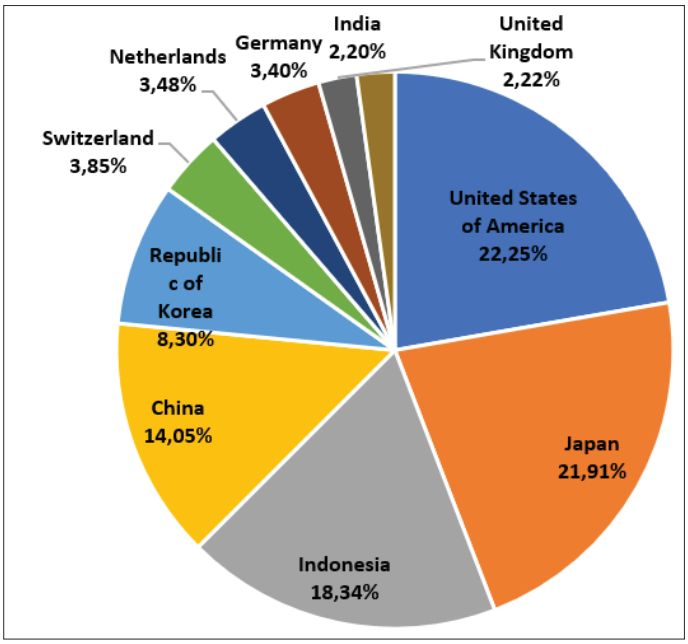
Based on the applicants, in 2023, BRIN filed the most patent and simple patent applications in Indonesia, with 754 applications. The agencies with the top 10 most patent applications are shown in Figure 3.6.



Source: DGIP – Ministry of Law and Human Rights, as of April 1, 2024

Figure 3.6 Top Ten Patent Applicant Institutions in Indonesia in 2023

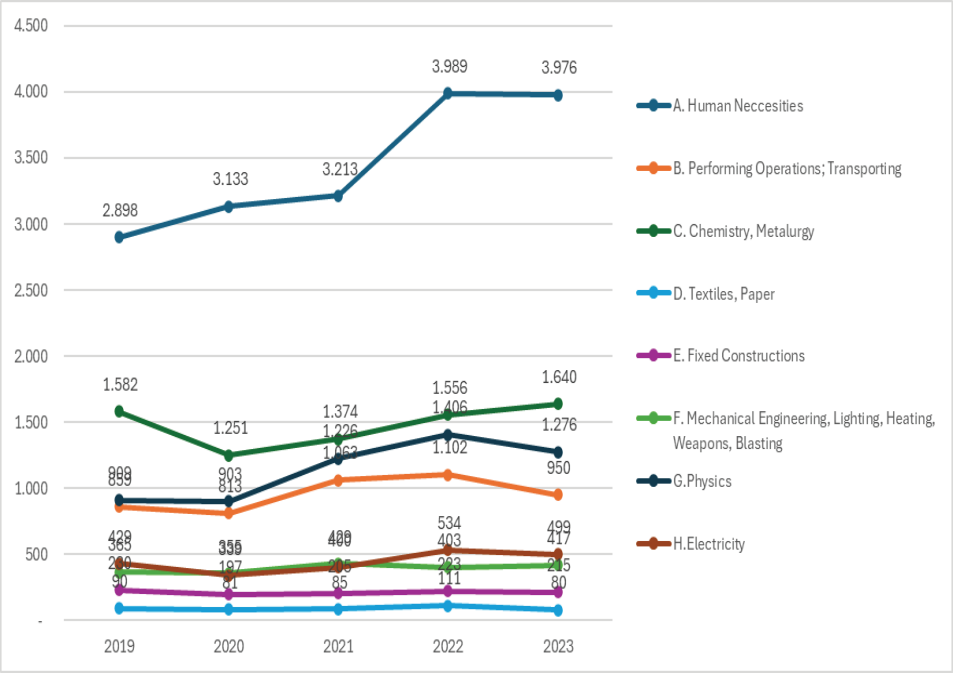
Based on the applicant's country of origin, in 2023, the DGIP, Ministry of Law and Human Rights received the most patent applications from the United States, which amounted to 22.25 percent of the total applications. The next largest applications came from Japan, Indonesia, China, and South Korea (Figure 3.7).



Source: DGIP – Ministry of Law and Human Rights, as of April 1, 2024

Figure 3.7 Top Ten Patent Applicants Based on Country of Origin in 2023

Based on the international patent classification, patent applications in Indonesia from 2019 to 2023 were still dominated by the Human Necessities class, followed by Chemistry and Metallurgy, and then Physics. The incoming applications may belong to one or more classes (Figure 3.8).



Source: DGIP – Ministry of Law and Human Rights, as of April 1, 2024

Figure 3.8 Number of Patent Applications Based on Classification in Indonesia

Table 3.6 shows the ratio of IP per 100 researchers in 2023. The IP compared is the number of patents, and it can be easily adjusted to various world measurement indicators (such as the UNESCO Institute for Statistics or UIS and the Organization for Economic Co-operation and Development (OECD).

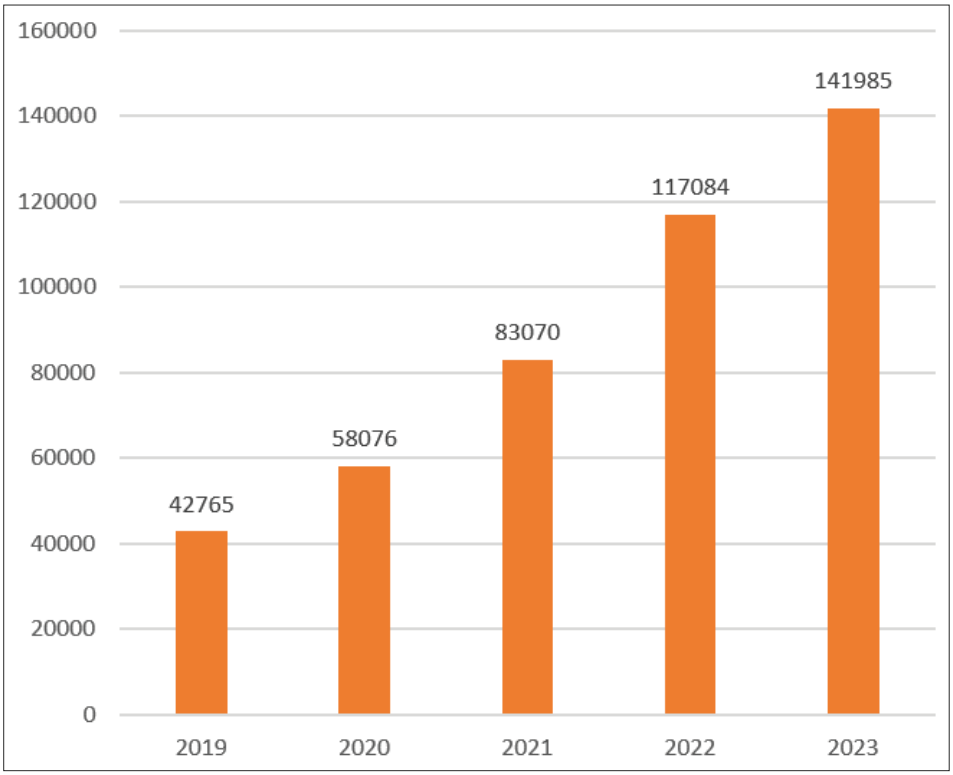
Table 3.6 Number and Ratio of IP per 100 Researchers in 2023

Detail	Number
Patents and Simple Patents (Application)	6,217
Patents and Simple Patents (Granted)	5,337
Number of Researchers of 20243	439,349
IP Ratio (Patents and Simple Patents) per 100 researchers	1.41

Source: DGIP – Ministry of Law and Human Rights, as of April 1, 2024

3.3.2 COPYRIGHT

Copyright is a part of Intellectual Property with the broadest scope of protection objects because it includes works in the fields of science, art, and literature, including computer programs. In 2023, domestic copyright applications reached 141,985, which increased 21.27 percent from 2022 (Figure 3.9).



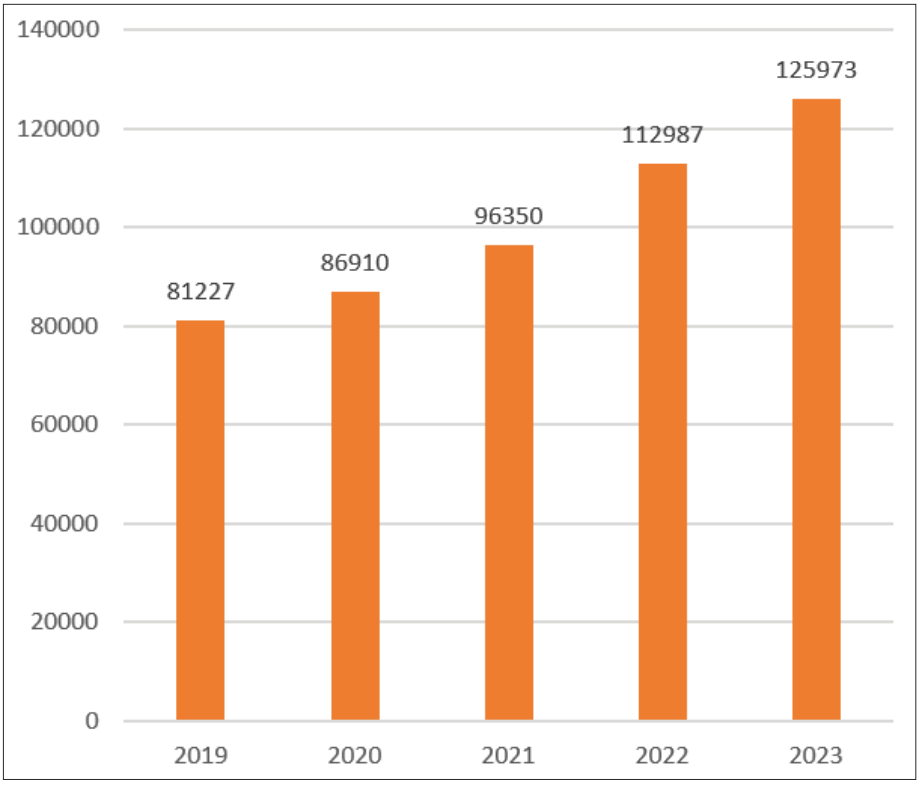
Source: DGIP – Ministry of Law and Human Rights, as of April 1, 2024

Figure 3.9 Number of Domestic Copyright Applications in Indonesia

3.3.3 TRADEMARK

A trademark is a symbol that can be visually described, such as an image, logo, name, word, letter, number, or color arrangement, in the form of two-dimensional and/or three-dimensional, sound, hologram, or a combination of two or more of these elements. Many companies invest a lot of time and money to build their trademark because it provides originality from the product or service offered and can affect its selling value.

In 2023, the DGIP of the Ministry of Law and Human Rights recorded 125,973 trademark applications nationally. Throughout 2019–2023, trademark applications per year tend to increase (Figure 3.10).



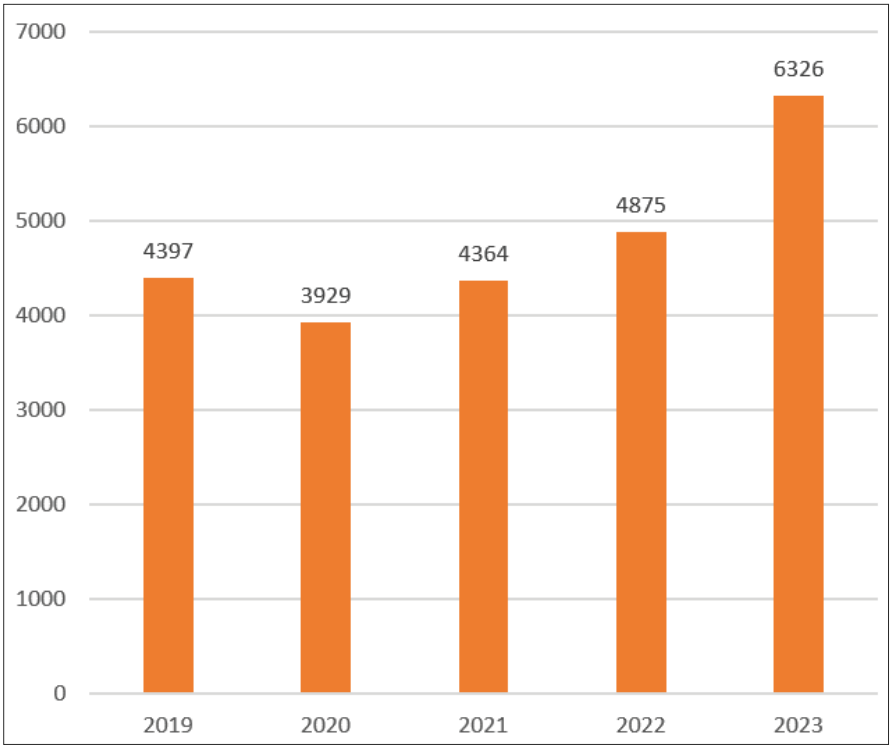
Source: DGIP – Ministry of Law and Human Rights, as of April 1, 2024

Figure 3.10 Number of Domestic Trademark Applications in Indonesia

3.3.4 INDUSTRIAL DESIGN

Industrial Design is work that involves shapes, configurations, or combinations of lines and colors, which can be three-dimensional or two-dimensional, giving an aesthetic impression. These designs can be applied to three-dimensional or two-dimensional patterns and are used to produce products, goods, industrial commodities, or handicrafts.

The number of industrial design applications in Indonesia from 2019–2023 consistently increased yearly, except for 2020. In 2023, there were 6,326 industrial design applications recorded at the DGIP, Ministry of Law and Human Rights (Figure 3.11).

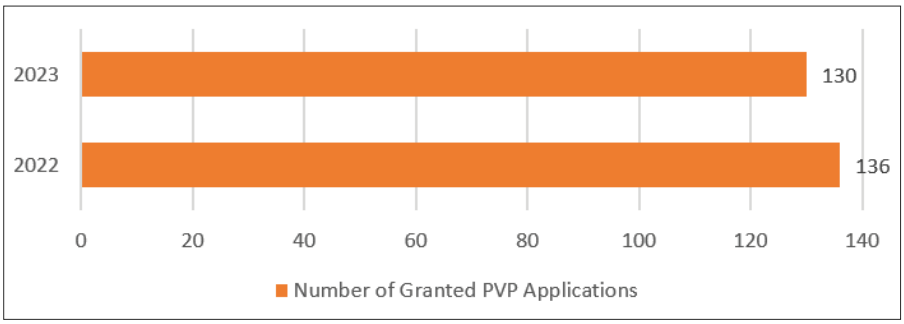


Source: DGIP – Ministry of Law and Human Rights, as of April 1, 2024

Figure 3.11 Number of Domestic Industrial Design Applications in Indonesia

3.3.5 PLANT VARIETY PROTECTION (PVP)

Plant Variety Protection, or PVP, is a special form of protection provided by the state, represented by the government, and managed by the PVP office. This protection is provided to plant varieties produced by plant breeders through the breeding process. In 2023, the number of PVPs granted by the PVP office of the Ministry of Agriculture was 130 applications (Figure 3.12).

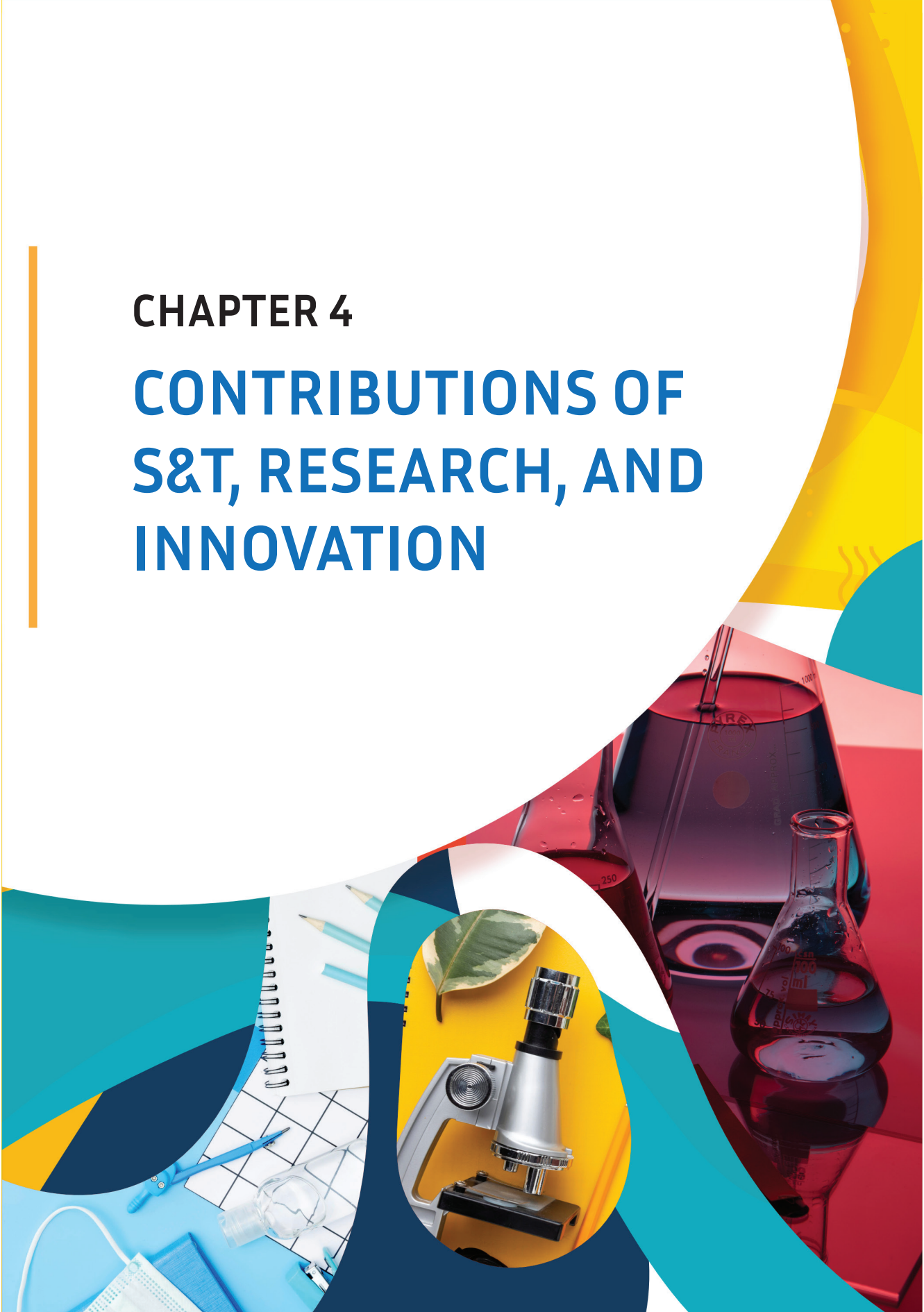


Source: PPVTPP - Ministry of Agriculture, 2024

Figure 3.12 Total PVP Applications ***Granted*** Domestic in Indonesia

CHAPTER 4

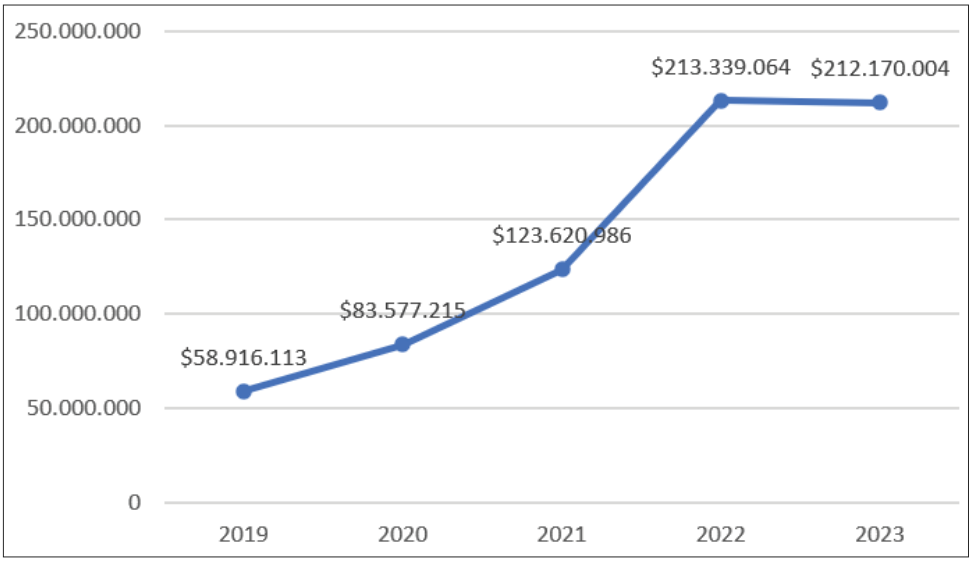
CONTRIBUTIONS OF S&T, RESEARCH, AND INNOVATION



4.1 INTELLECTUAL PROPERTY ROYALTIES

Charges from the use of Intellectual Property (IP) show the country's achievements in distributing knowledge to other parties. Data from the World Bank (*World Bank*, 2024) on the rewards of using IP reveals the importance of IP transactions in the economy, indicating how much a country depends on it as a source of income or expenditure. Countries with high revenue sourced from IP use tend to be major IP exporters, reflecting the country's strength of innovation and competitiveness. This data includes the revenue for the use of IP, such as patents, trademarks, copyrights, and original and derivative works, including related rights such as live television, radio, or digital media services.

In 2023, Indonesia was recorded to receive revenue of 212,170,004 US dollars or equivalent to 3.335 trillion IDR (assuming the January 2024 exchange rate, 1 USD = 15,720 IDR) from the use of IP. This value decreased from 2022, but it still showed a very high increase from 2019, 2.6 times in a 5-year period (Figure 4.1).



Source: World Bank, accessed on July 30, 2024

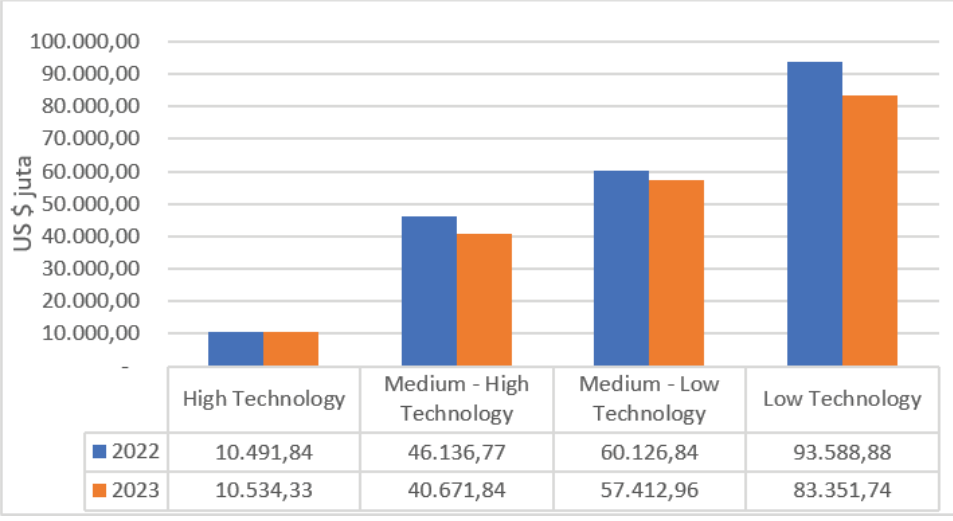
Figure 4.1 Charge for the Use of Intellectual Properties in Indonesia (Receipt)

4.2 TECHNOLOGY-BASED TRADE

Technology has become a major driver of global economic growth. Countries that can master and develop high technology tend to have a competitive advantage in the international market. Technology-based trade not only reflects a country's ability to produce high-value-added goods but also shows the level of technological adoption and innovation in its economy.

4.2.1 EXPORT AND IMPORT

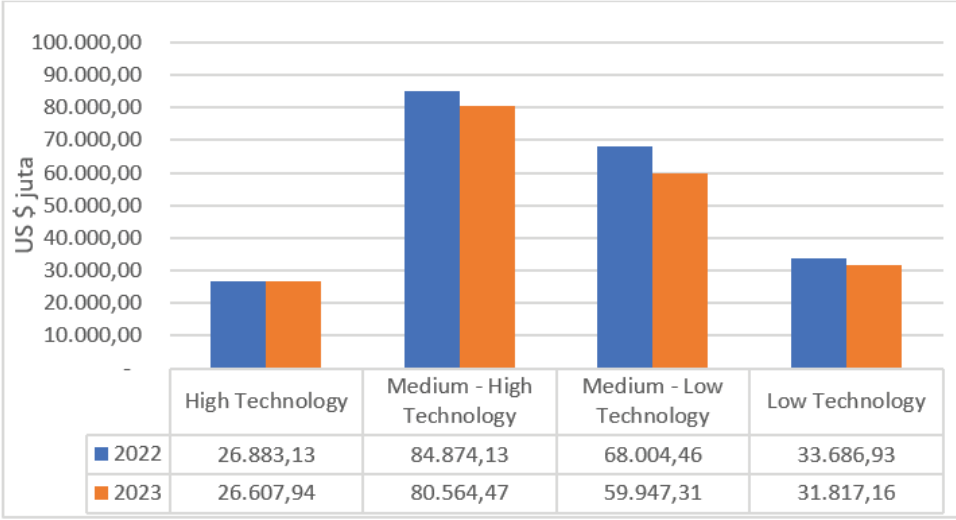
Indonesia's high-tech exports in 2023 increased by 0.4 percent compared to 2022. In contrast, low-tech exports decreased by 10.94 percent (Figure 4.2). On the import side, high-technology-based industries decreased by 1.02 percent. Overall, Indonesia's total exports for all technology categories decreased by 8.73 percent, while total imports decreased by 6.8 percent (Figure 4.3).



	High Technology	Medium - High Technology	Medium - Low Technology	Low Technology
2022	10.491,84	46.136,77	60.126,84	93.588,88
2023	10.534,33	40.671,84	57.412,96	83.351,74

Source: Processed from BPS, 2023

Figure 4.2 Export Value of Manufacturing Industry Based on Technological Intensity



	High Technology	Medium - High Technology	Medium - Low Technology	Low Technology
2022	26.883,13	84.874,13	68.004,46	33.686,93
2023	26.607,94	80.564,47	59.947,31	31.817,16

Source: Processed from BPS, 2023

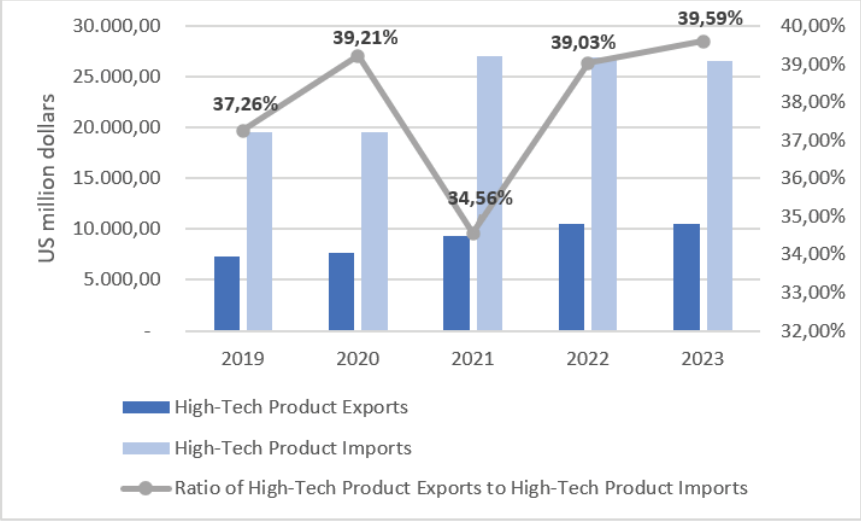
Figure 4.3 Import Value of Manufacturing Industry Based on Technological Intensity

To conduct a deeper analysis on technology-based trade, two ratios can be employed: the ratio of exports of high-tech products to imports of high-tech products (1) and the ratio of exports of high-tech products to total exports (2).

a. Ratio of High-Tech Product Exports to High-Tech Product Imports

High-tech exports are often used as an indicator to measure the extent of knowledge and technology dissemination in a country's production system and economy (WIPO, 2022). On the other hand, high-tech imports reflect the country's capacity to absorb knowledge and technology. This ratio can also be compared internationally, as used by South Korea in the 100 Main Science & Technology Indicators of Korea 2023 report (KISTEP, 2023).

In 2023, there was an increase in the ratio of high-tech product exports to total high-tech product imports compared to the previous year. This increase in the ratio shows that exports of high-tech products are growing relatively faster than imports of high-tech products (Figure 4.4).

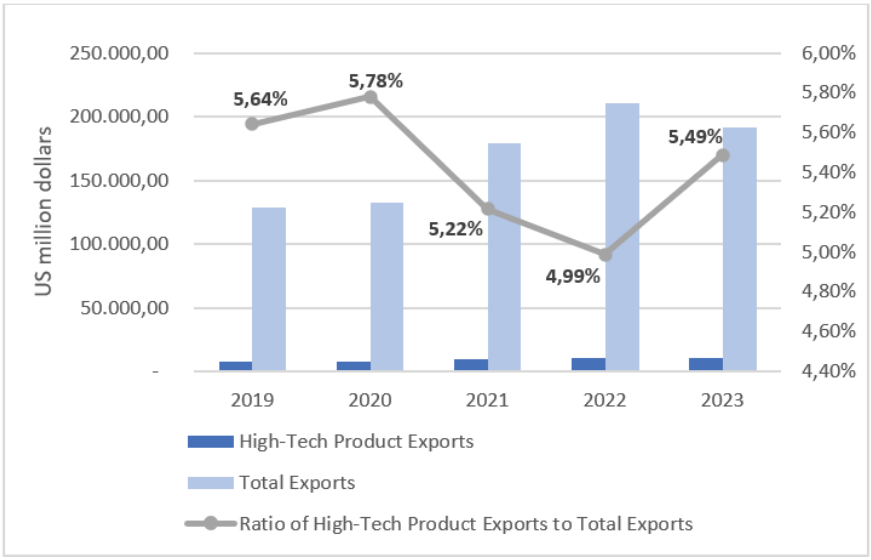


Source: Processed from BPS, 2023

Figure 4.4 Ratio of High-tech Product Exports to High-tech Product Imports

b. Ratio of High-Tech Products Exports to Total Exports

This ratio shows the extent to which high-tech products contribute to the country's total exports. The increase in the ratio in 2023 shows that high-tech exports can maintain their contribution to total exports even when they increase significantly (Figure 4.5).

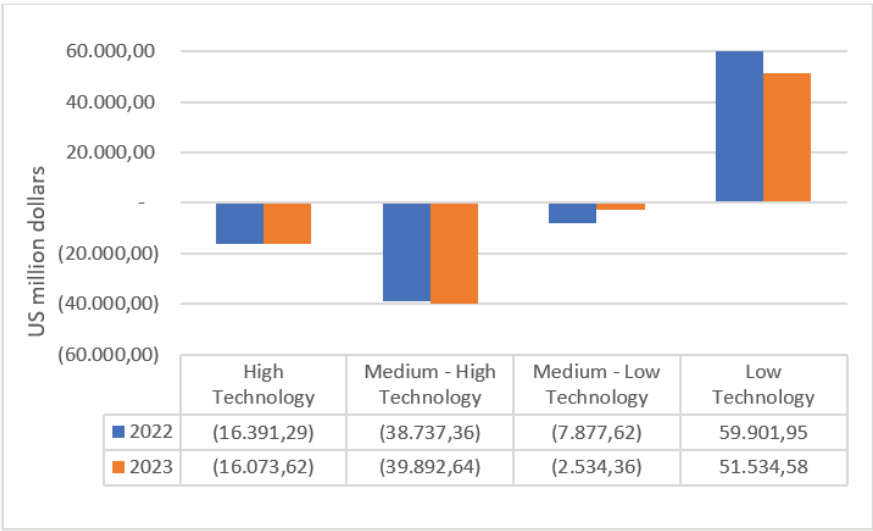


Source: Processed from BPS, 2023

Figure 4.5 Ratio of High-tech Products Exports to Total Exports

4.2.2 BALANCE OF TRADE

In the analysis of the Balance of Trade based on technological intensity, low technological intensity recorded the largest surplus, although it decreased compared to the previous year. Meanwhile, mid-high technological intensity experienced the largest deficit with a significant increase, reflecting the high dependence on imports in this sector and showing the most striking change in the Balance of Trade among other technological intensities (Figure 4.6).



	High Technology	Medium - High Technology	Medium - Low Technology	Low Technology
2022	(16.391,29)	(38.737,36)	(7.877,62)	59.901,95
2023	(16.073,62)	(39.892,64)	(2.534,36)	51.534,58

Source: Processed from BPS, 2023

Figure 4.6 Manufacturing Industry Balance of Trade Based on Technological Intensity

4.3 TOTAL FACTOR PRODUCTIVITY (TFP)

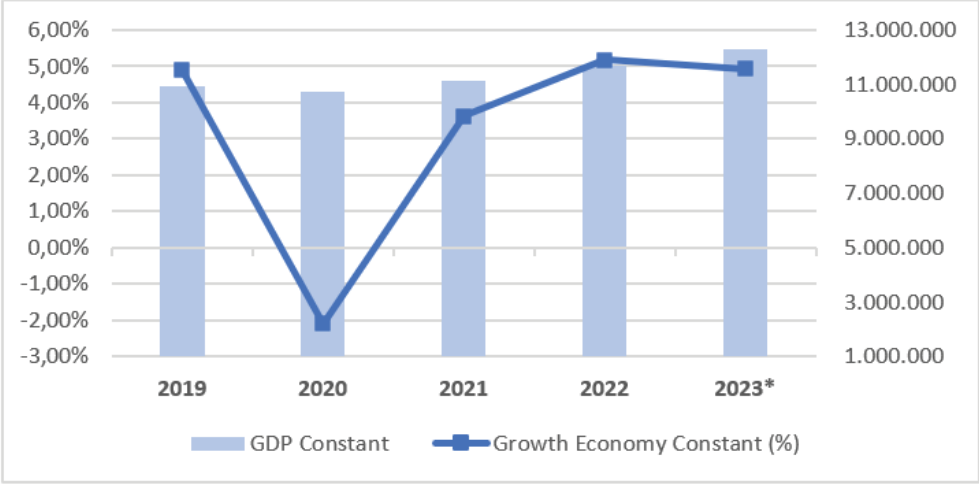
Indonesia's economic growth is often measured through changes in GDP, which reflects the total value of goods and services produced in a period. However, GDP does not fully reflect efficiency and innovation in the production process.

To understand economic growth more deeply, factors such as capital, labor, and TFP must be considered. TFP not only measures the output volume but also reflects the contribution of technology and efficiency in the use of capital and labor. As such, TFP is often considered a key indicator of technological advancement and efficiency.

TFP calculations using natural logarithms provide more accurate estimations when compared to traditional methods. Thus, the natural logarithmic method is also applied to calculate economic growth, capital, and labor. This approach ensures consistency in the analysis and produces more harmonious results.

4.3.1 ECONOMIC GROWTH

Gross Domestic Product on a Constant Price Basis, or Real GDP, shows economic growth and development results over a given period. The 2023 data shows Indonesia's economic recovery from the impact of the COVID-19 pandemic, with an increase of 4.92 percent and GDP reaching around 11.750 trillion IDR, although slightly lower than the previous year (Figure 4.7).



Note: the growth figure is obtained from the calculation of natural logarithms

Source: Processed from BPS, 2023

Figure 4.7 Indonesia's GDP and GDP Growth in 2019 – 2023

4.3.2 ECONOMIC STRUCTURE

In terms of production, GDP based on Prevailing Prices shows the economic structure based on fields of business. Between 2019 and 2023, Indonesia's economic structure has not changed significantly according to business sectors. The three business fields that have the most significant contribution in 2023 are the Processing Industry, with 18.67 percent, followed by Vehicle Repair businesses at 12.94 percent, and Agriculture, Forestry, and Fisheries, at 12.53 percent (Table 4.1)

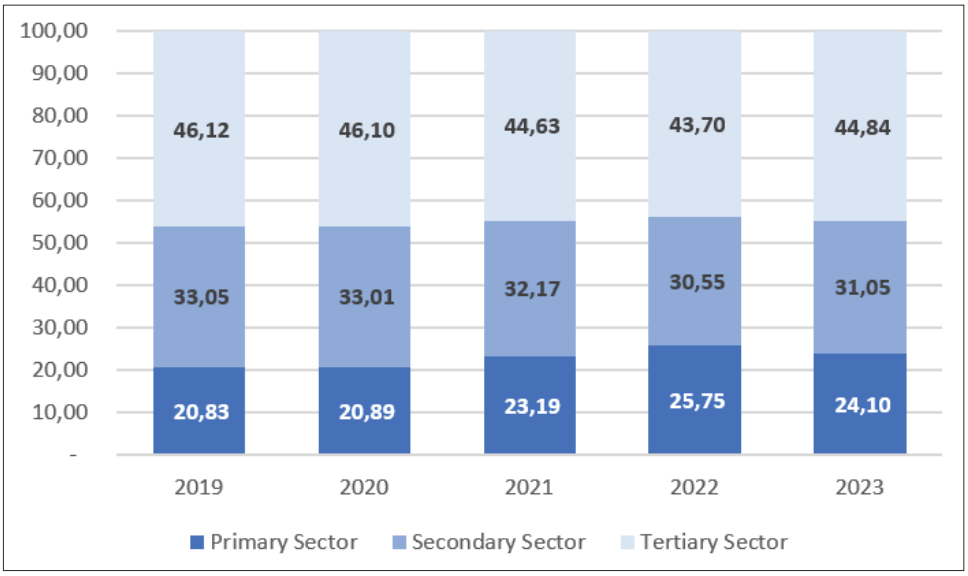
Table 4.1 GDP Distribution and Growth (%)

Business Sector GDP (2010 Series)	2019	2020	2021	2022	2023*
Primary Sector	19.98	20.13	22.26	24.62	23.05
A, Agriculture, Forestry, and Fisheries	12.71	13.70	13.28	12.40	12.53
B, Mining and Quarrying	7.26	6.43	8.97	12.22	10.52
Secondary Sector	31.69	31.80	30.87	29.21	29.69
C, Processing Industry	19.70	19.87	19.24	18.34	18.67
D, Electricity and Gas Procurement	1.17	1.16	1.12	1.04	1.04
E, Water Procurement, Waste Management, Waste and Recycling	0.07	0.07	0.07	0.06	0.06
F, Construction	10.75	10.70	10.44	9.77	9.92
Tertiary Sector	44.22	44.41	42.82	41.79	42.88
G, Wholesale and Retail Trade; Car and Motorcycle Repair	13.01	12.91	12.96	12.85	12.94
H, Transportation and Warehousing	5.57	4.47	4.24	5.02	5.89
I, Provision of Accommodation and Food and Beverage	2.78	2.55	2.43	2.41	2.52
A, Information and Communication	3.96	4.51	4.41	4.15	4.23
K, Financial Services and Insurance	4.24	4.51	4.34	4.13	4.16
L, Real Estate	2.78	2.94	2.76	2.49	2.42
M, N, Corporate Services	1.92	1.91	1.77	1.74	1.83
O, Government Administration, Defense and Compulsory Social Security	3.61	3.79	3.46	3.09	2.95
P, Educational Services	3.30	3.57	3.28	2.89	2.79
Q, Health Services and Social Activities	1.10	1.30	1.34	1.21	1.21
R, S,T,U, Other Services	1.95	1.96	1.84	1.81	1.94
GROSS VALUE ADDED ON PRICE	95.89	96.35	95.95	95.62	95.62
TAX LESS SUBSIDIES ON PRODUCTS	4.11	3.65	4.05	4.38	4.38
GROSS DOMESTIC PRODUCT	100.00	100.00	100.00	100.00	100.00

*Provisional data
Source: Processed from BPS, 2023

The primary sector processes natural resources directly but does not produce output as finished goods. The secondary sector processes the output produced by the primary sector and then converts it into finished goods ready for consumption. The tertiary sector is a sector that does not produce goods in physical form, but provides services to its consumers (Rinaldi et al, 2022).

After the COVID-19 pandemic, there has been no significant shift in the structure of Indonesia's economy. Although there was a slight increase in the contribution of the primary sector and a decrease in the secondary sector, the tertiary sector remained the largest contributor to gross added value during 2019–2023 (Figure 4.8).



Source: processed from BPS, 2023

Figure 4.8 Distribution of Gross Value Added by Sector in 2019–2023

4.3.3 INVESTMENT

In terms of utilization, the distribution of GDP has also changed. Expenditure data shows that exports of goods and services experienced the highest growth, sharply increasing from 2,275.5 in 2019 to 2,895.8 in 2023. This growth reflects the recovery and increased competitiveness in the international market (Table 4.2).

In addition, Gross Fixed Capital Formation (GFCF) also showed a consistent upward trend, from 3,597.7 in 2019 to 3,848.7 in 2023, reflecting increasing economic investment. This GFCF data is used in the calculation of TFP Growth in Indonesia in subchapter 4.4.

Table 4.2 Indonesia's GDP on a Constant Price Basis 2010 by Expenditure (in trillions IDR), 2019-2023

Types of Production	2019	2020	2021	2022*	2023**
Household Consumption	5,936.40	5,780.22	5,896.71	6,187.90	6,486.30
LNPRT Consumption	136.03	130.31	132.41	139.90	153.70
Government Consumption	855.96	874.15	911.30	870.60	896.20
Gross Fixed Capital Formation (GFCF)	3,597.66	3,419.18	3,549.22	3,686.60	3,848.70
Inventory Changes	129.95	51.33	62.71	70.70	127.70
Export of Goods and Services	2,275.49	2,083.94	2,458.80	2,858.00	2,895.80
Import of Goods and Services	2,046.24	1,686.00	2,105.10	2,420.80	2,380.90
Statistical Discretion	63.80	70.00	214.10	317.30	273.90
GDP	**10,949.16**	**10,723.00**	**11,120.08**	**11,710.20**	**12,301.40**

*: Provisional Figures
**: Very Temporary Numbers
Source: BPS, 2023

4.3.4 LABOR FORCE

From 2019 to 2023, the dynamics of the labor market in Indonesia showed several significant changes, as reflected in Tables 4.3 and 4.4. This data includes the number of employed and unemployed population, as well as related indicators such as average wages and income share.

Table 4.3 Number and Percentage of Employed and Unemployed Population, 2015-2023 (In Thousands of People)

Year	Employed Population	Unemployed Population	Percentage of Employed Population	Percentage of Unemployed Population
2014	114,628.03	7,244.91	94.06%	5.94%
2015	114,819.20	7,560.82	93.82%	6.18%
2016	118,411.97	7,031.78	94.39%	5.61%
2017	121,022.42	7,040.32	94.50%	5.50%

Year	Employed Population	Unemployed Population	Percentage of Employed Population	Percentage of Unemployed Population
2018	126,282.19	7,073.39	94.70%	5.30%
2019	128,755.27	7,104.42	94.77%	5.23%
2020	128,454.18	9,767.75	92.93%	7.07%
2021	131,050.52	9,102.05	93.51%	6.49%
2022	135,296.71	8,425.93	94.14%	5.86%
2023	139,852.40	7,855.08	94.68%	5.32%

Source: BPS, 2023

Tabel 4.4 Average Wages and Income Share

Year	Number of Employed Population	Average Workforce Wage (Million IDR)	Income Share: Annual Revenue (Billion IDR)
2019	128,755,270	2,913,897	4,502,155
2020	128,454,180	2,756,345	4,248,768
2021	131,050,520	2,736,64	4,303,380
2022	135,296,710	3,070,756	4,985,558
2023	139,852,400	3,178,227	5,333,792

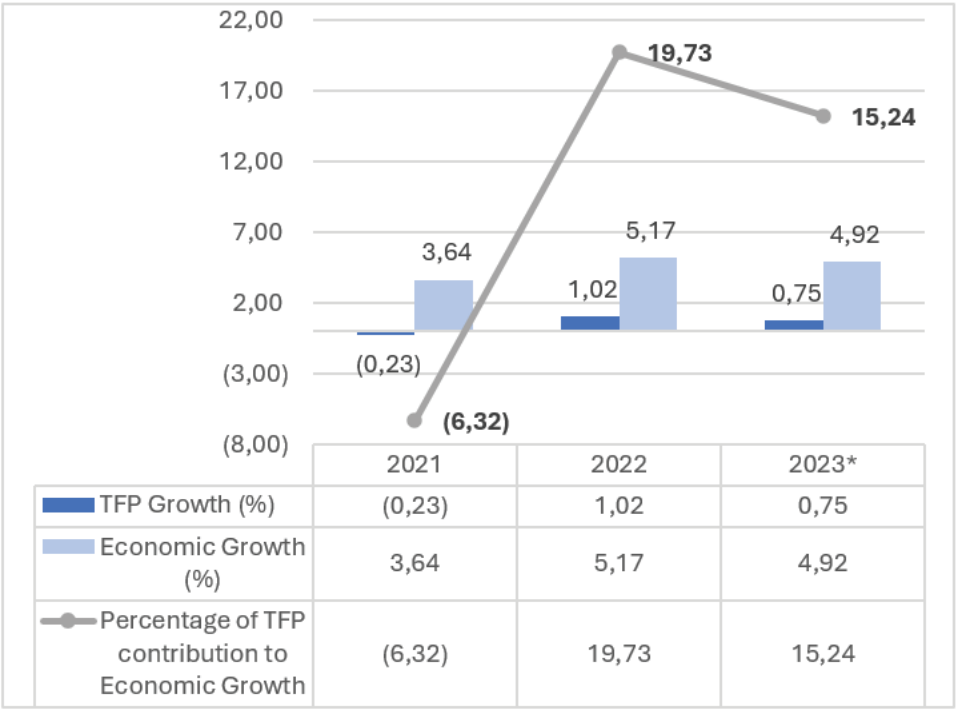
Source: Processed from The National Labor Force Survey (SAKERNAS) BPS data, 2023

Income share, or annual income from the workforce, shows positive development. In 2019, the annual revenue reached 4.502 trillion IDR and increased to 5.334 trillion IDR in 2023. This reflects not only the increase in the number of workers but also the potential increase in productivity and economic contribution of the workforce sector (Table 4.4).

4.3.5 TFP GROWTH

Total Factor Productivity (TFP) is a concept of measuring production efficiency by considering all inputs used in the production process. TFP is an important indicator in economic analysis. The Solow-Swan model explains factors such as capital accumulation, population growth, and technological advances that affect economic growth.

In 2004, Hananto Sigit introduced the TFP calculation method using the trans-log production function to calculate the economic growth rate. TFP is calculated as the difference between economic growth and capital and labor growth. To determine the TFP Growth each year, the average of TFP, GDP, capital, and labor is measured. TFP growth measures the increase or decrease in efficiency and technology over time.



	2021	2022	2023*
TFP Growth (%)	(0,23)	1,02	0,75
Economic Growth (%)	3,64	5,17	4,92
Percentage of TFP contribution to Economic Growth	(6,32)	19,73	15,24

Information:
The growth rate is obtained from the calculation of natural logarithms
Data for 2023 (*) is provisional
Source: Processed from BPS, 2023

Figure 4.9 TFP's Contribution to Economic Growth

Indonesia's TFP growth has improved since the pandemic ended. In 2023, the TFP growth value was 0.75 percent. In addition, the national economy grew by 4.92 percent in 2023, with 15.24 percent of the growth supported by technological advances (Figure 4.9).

REFERENCES

BPS. (2023, October 13). *Produk Domestik Bruto Indonesia Triwulanan 2019–2023*. https://www.bps.go.id/id/publication

DGIP. (2024, April 1). Indonesian Intellectual Property Data. Ministry of Law and Human Rights.

DGIP. (n.d.). *Pengenalan Paten*. Retrieved May 10, 2024, from https://dgip.go.id/menu-utama/paten/pengenalan

DGIP. (2024, June 12). Indonesian Intellectual Property Data. Ministry of Law and Human Rights.

KISTEP. (2023, June 29). *100 Main Science & Technology Indicators of Korea 2023*. https://www.kistep.re.kr/board.es?mid=a20402000000&bid=0047&act=view&list_no=43398&tag=&nPage=1

Rinaldi, N., Erfit, E., & Rosmeli, R. (2022). Transformasi struktural perekonomian Indonesia. *Jurnal Ekonomi Aktual*, 1(3), 26-12-2021. https://doi.org/10.53867/jea.v1i3.19.

Scopus. (n.d.). *International Indonesian Publications 2019 – 2023*. Retrieved May 7, 2024, from https://www.scopus.com

Scimago. (n.d.). *Indonesian Citation*. Retrieved May 10, 2024, from https://scimagojr.com

Sigit, H. (2004). Total Factor Productivity Growth. *Report of the Asian Productivity Organization (APO) on Total Factor Productivity 2001/2002*, pp. 98-133.

Solow, R, M. (1956). A contribution to the theory of economic growth. *The quarterly journal of economics*, 70(1):65–94.

Solow, R, M. (1957). Technical Change and the Aggregate Production Function. *Review of Economics and Statistics*, 39(3), 312-320.

Swan, T, W. (1956). Economic growth and capital accumulation. *Economic record*, 32(2):334–361.

WIPO. (2020, May). What is intellectual property?. https://www.wipo.int/edocs/pubdocs/en/wipo_pub_450_2020.pdf

WIPO. (2022). *Global Innovation Index 2022: 15th Edition*. https://www.wipo.int/edocs/pubdocs/en/wipo-pub-2000-2022-en-main-report-global-innovation-index-2022-15th-edition.pdf

World Bank. (2024). *Charges for the use of intellectual property, receipts (BoP, current US$) – Indonesia*. https://data.worldbank.org/indicator/BX.GSR.ROYL.CD?locations=ID

Appendix 1. Explanation of the scope of HRST IIRI 2023 and IIRI 2024

SECTOR	COMPONENT	HRST NEEDS	IIRI OF 2023	IIRI OF 2024
Government	Central (BRIN)	Number of BRIN personnel in Research Deputy and Organization	Included in the calculation, under the following condition: **HRST Needs** are human resources who are conducting R&D at BRIN based on 11 (eleven) functional positions.	Included in the calculation, under the following condition: **HRST Needs** are human resources who are conduction R&D, including R&D services and its HD in Deputy and Research Organization.
	Local	Number of researchers in regional levels	Not yet calculated	Included in the calculation. Collected data includes the number of HR in 6 functional positions at BRIN
Higher Education	Full-time lecturers	Number of public, private, government, and religious HE institutions	Included in the calculation	Included in the calculation
	Non-lecturers	Number of non-lecturing workers/researchers in HE institutions	Not yet calculated because data is not yet available	Not yet calculated because data is not yet available
	Post-doc and visiting researchers	Number of foreigners enrolled in Post-Doc programs	Not yet calculated because data is not yet available	Not yet calculated because data is not yet available
	Enrolled Doctorate students	Number of students enrolled in public, private, government, and religious HE institutions	Not yet calculated	Included in the calculation
Business Enterprise / Industry	Private-owned companies and state-owned companies	Number of researchers in private and and state companies who are conducting R&D	Included in the calculation	Included in the calculation, using data from IIRI 2023
NGO	NGO	Number of researchers in NGOs who are conducting R&D	Not yet calculated because data is not yet available	Not yet calculated because data is not yet available

This book is one of BRIN's flagship reports published periodically, showcasing Indonesia's strengths in science, technology, research, and innovation. This book presents data and achievements of the main indicators of Indonesia's science and technology, R&D, and innovation in 2023. Various important indicators, including R&D budget and expenditure, HRST, R&D performance, and the contribution of science and technology to the national economy, are presented in a structured manner. This book can be used by various stakeholders, such as ministries/institutions, local governments, business owners, academics, and international institutions, as a reference for policy formulation, planning, and analysis in R&D.

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Jln. M.H. Thamrin No. 8,
Kota Jakarta Pusat 10340
E-mail: penerbit@brin.go.id
Website: penerbit.brin.go.id

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