

STI Performance in Indonesia: Policies, Indicators, Current Achievements, and Recommendations for 2045

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ABSTRACT

The national (Indonesia) long-term development plan 2005-2025 has approached its final step. Currently, the Ministry of National Development Planning is preparing a technical text for the policy, including in the fields of science and technology. Referring to this notion, we have compiled this paper aiming at providing recommendations towards the applied indicators to measure efforts to achieve Indonesia's 2045 target. This paper is divided into four discussions, which consist of: STI Indicator Comparison, Achievements of the STI Indicator, Notes for STI Indicators in the RPJPN, dan Author's reflections/ insights.

Keywords: STI indicator, Indonesia 2045, STI Policy, STI Performance.

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Received: 03-06-2022

Revised: 26-07-2022

Accepted: 13-08-2022

DOI: 10.5530/jsires.11.2.29

INTRODUCTION

Prior studies have identified several indicators to measure the performance of a country's STI, including: Government S&T expenditure,^[1-2] R&D investment,^[3-4] Tax incentives for R&D expenditure by private firms,^[1] Number of Research Institutes,^[2] Full-time Researchers in R&D Per 1 Million People,^[2,4-5] Scientific Publications,^[2-4,6] and patents.^[3,6] In most cases, such indicators are stipulated as benchmarks for the progress of the science and technology sector and innovation,^[7] including in Indonesia.

Indonesia since 2018 has implemented a measure to navigate the development of STI, as outlined in the Presidential Regulation of the Republic of Indonesia Number 38 of 2018 concerning the National Research Master Plan for 2017-2045.^[8] In the 2017-2045 National Research Master Plan, achievement targets for each indicator are set, which are evaluated in each five-year timeline until 2045. In addition, the Indonesian government has reaffirmed the achievement targets in the STI sectors through Presidential Regulation of the Republic of Indonesia Number 18 of 2020, concerning the National Medium-Term Development Plan of 2020-

2024.^[9] Prior to the enactment of these two regulations, the Indonesian government in the era of President Susilo Bambang Yudhoyono's administration had additionally provided a number of achievement indicators as a measure of innovation performance. The STI indicators and targets are set through Presidential Regulation Number 32 of 2011 concerning Master Plan for the Acceleration and Expansion of Indonesia's Economic Development for 2011-2025.^[10]

Based on these three regulations, the indicators and targets of STI in Indonesia are compared. Further, the discussion is progressed with depicting the achievements of the STI indicators, as well as providing the recommendations for indicators which are implemented as reference in the future.

STI Indicator Comparison

Table 1 provides an overview of how the STI indicators compared from the three existing policies in Indonesia, depicting the various consistency of indicators from one policy to the others under different duration of the policy. However, the policies of Master Plan for the Acceleration and Expansion of Indonesian Economic Development (MP3EI) and the National Medium-Term Development Plan (RPJMN) denote a final policy period of up to 2024/2025, including for the National Research Master Plan policies (RIRN) in 2025 generating an intermediate target (achievement). Referring to such discourse, this paper utilizes several selected

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Table 1: Comparison of Indicators from STI Policy in Indonesia.

Policy	Presidential Regulation Number 32 of 2011	Presidential Regulation of the Republic of Indonesia Number 38 of 2018	Presidential Regulation of the Republic of Indonesia Number 18 of 2020
Title of Regulation	Master Plan for the Acceleration and Expansion of Indonesia's Economic Development 2011-2025 (MP3EI)	National Research Master Plan 2017-2045 (RIRN)	National Medium-Term Development Plan 2020-2024 (RPJMN)
Setting Duration	2011-2025 (15 Years)	2017-2045 (29 Years)	2020-2024 (5 Years)
Government Era	President Susilo Bambang Yudhoyono	President Joko Widodo	President Joko Widodo
Policy Initiator	Coordinating Ministry for Economic Affairs, and Ministry of National Development Planning/National Development Planning Agency	Ministry of Research, Technology and Higher Education	Ministry of National Development Planning/National Development Planning Agency
STI Indicator (Target)	R&D budget (1% of GDP/year) Addition of 7,000-10,000 Ph.D. in science and technology Formation of Regional Innovation Cluster Procurement of international standard laboratories International cooperation Revitalization of PUSPIPTEK as an S&T park, and development of an Agro-industrial Innovation area, in North Gresik, East Java Province, an industrial area for innovation for downstream palm oil, cocoa, and fishery products, and an Energy Innovation Area based on non-renewable and renewable energy in East Kalimantan Province.	Number of Science and Technology Human Resources per million population (8,600 - 2045) – for 2025 (3,200) Ratio of candidates for Science and Technology Human Resources (100% - 2045) – for 2025 (40%) Budget allocation for research by the central government and local governments, as well as the private sector to gross domestic product (5.04% - 2024) – for 2025 (1.69%) Productivity of science and technology human resources - reputable international publication per 100 science and technology human resources (22 - 2045) – for 2025 (8) Multifactor Productivity (70% - 2045) – for 2025 (30)	Number of scientific publications and citations in international journals a. Number of International Publications (Articles) (31,159 - 2024) b. Number of Citations in International Journals (59,770 - 2024) Number of Prototypes from Universities (304 - 2024) Number of Intellectual Property registered from the results of Research and Development of Higher Education (1,812 - 2024) Number of innovation products from tenants of Technology-Based Start-ups (PPBT) fostered (700 - 2024) Number of innovation products used by industry/business entities (210 - 2024) Number of Patent Applications that Qualify for Intellectual Property Administration Formalities - Domestic (3,000 - 2024) Number of granting of patents - Domestic (1,000 - 2024) Percentage of Doctoral Graduates in Qualified Science and Technology HR (20% - 2024) Number of Center of Excellence in Science and Technology (138 - 2024) Number of accredited - active R&D institutions (75 - 2024) Number of strategic science and technology infrastructure developed (10 - 2024) Number of strategic science technology parks (STPs) developed to fully operational: a. Higher Education Based (5 STP) b. Non-University Based (3 STP) National Research Priority research products and innovations produced (40 products - 2024) Application of technology to support sustainable development: a. Application of technology for sustainable use of natural resources (24 technologies - 2024) b. Application of technology for post-disaster prevention and mitigation (35 technologies - 2024) Percentage of R&D budget to GDP (0.42% - 2024)

indicators from the three policies as a basis in determining the achievements of each selected indicator, derived from similar indicators between one policy and the others, containing:

- a) The allocation of research budgets from the central government and local governments, as well as the private sector to gross domestic product. In this indicator, the targets in 2024/2025 vary from one policy to another, which are 1% per GDP for MP3EI, 1.69% per GDP for RIRN, and 0.42% per GDP for RPJMN.

Efforts made by the government are actualized by enacting Super Tax Deduction, granted by the government to industries that are involved in research and development activities to generate innovation. This tax deduction is regulated in Government Regulation no. 45 of 2019. In Article 29C paragraph 1, the Government gives the appreciation to domestic companies conducting research and development activities in Indonesia. The appreciation is in the form of a reduction in gross income of a maximum of 300% (three hundred percent) of the total costs incurred for certain R&D in Indonesia which are charged within a certain period of time.

- b) The percentage of Qualified Science and Technology Human Resources holding Ph.D. level. The target in MP3EI is to add 7,000-10,000 Ph.D. graduates in the field of science and technology by 2024, and 20% of Science and Technology human resources with Ph.D. graduates based on the RPJMN. The Indonesian government, through the education endowment fund, provides scholarships for thousands of Indonesian scholars. As a result, until December 31, 2020, it was recorded that 9,849 domestic/overseas masters and 1,049 domestic/overseas doctorates were achieved. In addition, there are currently 7,988 Indonesian scholars who are undertaking the scholarship program.^[11]
- c) The reputable international publication. RIRN targets 8 (eight) reputable international publications per 100 science and technology human resources in 2025, and RPJMN targets 31,159 articles in international publications by 2024. Efforts are undertaken to increase the number of publications, including research collaborations between study programs, faculties or between universities, academic writing, formation of a higher education trainer team tasked with providing technical clinical services for international journal writing, coaching clinics, article workshops, and organizing international conference funded or subsidized by the university either as an organizing committee or as a partner.^[12]
- d) The development of the STP area. MP3EI targets 6 STPs with potential based on natural wealth and technology, while RPJMN targets STPs based on Higher Education

(5 STPs), and non-university-based STPs developed by ministries/government agencies (3 STPs). Efforts to develop STPs in Indonesia are embodied in Presidential Regulation Number 106 of 2017 concerning Science and Technology Areas. STP development programs in Indonesia are generally conducted in collaboration between universities and national research institutions, development of start-up incubators, and development of dissemination of research results.^[13]

- e) The development of strategic science and technology infrastructure facilities. RPJMN targets to establish the 10 facilities by 2024, while MP3EI has not stated the targeted plan. Efforts have been made by the Indonesian government by allocating a budget sourced from State *Sukuk* to finance 19 strategic infrastructure projects in the field of research and innovation in Indonesia since 2018-2021.^[14]

Achievements of the STI Indicator

For the duration of 2020 and 2021, Indonesia has recorded several achievements from the STI indicators as illustrated in Table 2. Indonesia R&D investment utilizes the data from global R&D forecasts.^[15] Meanwhile, data regarding the percentage of science and technology human resources with doctoral qualifications, reputable international publications, development of STP areas, and construction of strategic science and technology infrastructure facilities are obtained from official data submitted by President Joko Widodo in the Speech of the President of the Republic of Indonesia at the Annual Session in the Context of the 76th Anniversary of the Proclamation of Independence.

To achieve the qualified science and technology human resources, capacity and capability improvement is executed by organizing the learning programs through research and scientific scholarships. Until 2020, these two programs have funded approximately 1,128 students. The number of participants from the program by research for two years reached 234 awardees, while the participants of the scientific scholarship for ten years reached 894 awardees.^[15]

The enforcement of strategic national science and technology infrastructure serves as one of the indicators in Indonesia's 7 future development agendas and 17 targets of Sustainable Development Goals (SDGs). In the 2020-2024 RPJMN, there are several strategic issues related to increasing productivity and competitiveness, one of which is the limited R&D infrastructure. The number of established research infrastructure, research, development, assessment and application in Indonesia throughout 2020 includes the two facilities, which are Cibinong Science and Technology Park (C-STP) Productive Infrastructure and Marine Bioindustry Laboratory in Mataram.

Table 2: Achievement of STI Indicators in Indonesia.

No.	Indicator	2024/2025 Targets	Achievements	
			2020	2021
1.	R&D Investment	0.42% - 1.69% per GDP	0.31% ^[15]	0.31% ^[15]
2.	Percentage of Doctoral Graduates in Qualified Science and Technology HR	20% of the total human resources in science and technology	14.14% ^[16]	14.55% ^[16]
3.	Reputable international publication	31,159 International publications	50,590 international publications ^[16]	42,444 international publications ^[17]
4.	STP area development	9 STP	4 STP ^[16]	4 STP ^[16]
5.	Development of strategic science and technology infrastructure facilities	10 facilities	2 facilities ^[16]	5 facilities ^[16]

Notes for STI Indicators in the RPJPN

The national long-term development plan (RPJPN) 2005 – 2025 in Indonesia has been approaching its final stage. The Ministry of National Development Planning/National Development Planning Agency, as the facilitator of the development planning process, requires the input and notes from all concerned parties for the preparation of the RPJPN 2026–2045 plan towards 100 years of “Independent Indonesia”. Hence this paper proposes a number of STI indicators included in the plan, grouping the STI indicators into 4 groups according to the pillars of Indonesia 2045 development, particularly from the pillars of Human Development and Mastery of Science and Technology, through the enhancement of contribution of science and technology in development.

In line with the aforementioned efforts, the four pillars which are used as guidelines in the proposed STI Indonesia 2045 indicator are in accordance with the globally applied indicators. The global indicators that are used as references include the indicators in strengthening the innovation ecosystem in The Global Competitiveness Index. The first pillar is Adoption and Application of Research and Innovation. The indicators in this pillar include: a) number and value of Licenses on research and innovation results, b) number and impact of research and innovation-based policy solutions, and c) addition of technology-based startups. The second pillar is Independence and Research and Innovation Ability. The indicators in this pillar include: a) number of science and technology human resources per million population, b) addition of science and technology human resources with doctoral qualification (100 doctors of strategic sciences every year, thereby adding 2,500 doctors in 2045), c) addition of 50 research professors annually, d) number of scientific publications and citations in international journals, e) revitalization and construction

of strategic research and innovation facilities (such as: space science facilities, longships for deep sea research), and f) number of registered intellectual property (not limited to Patents, but also multiply Industrial Designs, Trade Secrets, Plant Varieties, Integrated Circuits, Marks, and geographical indications).

The third pillar is related to Universities, Government and Private Partnerships, which includes: a) development and construction of STP based on local potentials and sectors in the territory of Indonesia, and b) mobility of Human Resources for Higher Education, Government and Private Institutions. The fourth pillar is Research and Innovation Funding, including a) contribution of the private sector to the share of the national R&D budget in Indonesia is 80% compared to 20% of the government sector budget, and b) development of an incentive scheme from the Research and Innovation Endowment Fund.

Author's reflections/ insights

The creation of an innovation ecosystem in Indonesia has been inseparable from the efforts and policies of the Indonesian state. The policy will be set out in the national long-term development plan of 2026–2045. In the field of research and innovation, we propose the 13 indicators as consideration for the Indonesian government in setting the STI Indonesia 2045 indicator. The indicators we propose are in accordance with The Global Competitiveness Index by regarding a number of policies in Indonesia. Indonesia's experience in implementing the achievement of targets based on Table 1 has always been inconsistent with one another, hindering the implementation of the target achievement program due to changes. Therefore, our recommendation through these 13 Indicators provides a solution dealing with the inconsistency problem to be implemented until 2045.

ACKNOWLEDGEMENT

This research is regarded as a partial fulfillment of “The doctoral program by research” from the Indonesian Institute of Sciences–Universitas Padjadjaran, with Memorandum of Understanding Number 059/KS/WAKA-LIPI/XI/2018, 745/UN6.WR3/PKS/2018.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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