FMIPA
Universitas Padjadjaran

ROADMAP

Research and Community Service Roadmap

2021 -2025

RESEARCH AND COMMUNITY SERVICE ROADMAP

FACULTY OF MATHEMATICS AND NATURAL SCIENCES

UNIVERSITAS PADJADJARAN

2021 – 2025

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FOREWORD

Praise and gratitude are offered to the Almighty for the issuance of the Research and Community Service Roadmap (PPM) of the Faculty of Mathematics and Natural Sciences (FMIPA) of Universitas Padjadjaran (Unpad) for the years 2021 - 2025 (FMIPA Research and PPM Roadmap). This document is prepared and developed based on the Unpad Research Master Plan 2021-2025 and the Universitas Padjadjaran Community Service Master Plan (RIPM) 2021-2025, as well as a comprehensive review and development of the FMIPA Research Roadmap in the previous period. The FMIPA Research and PPM Roadmap for 2021-2025 is designed to respond to various internal and external changes that have occurred at Unpad in general and at FMIPA in particular. There are five objectives to be achieved in FMIPA's research activities, namely: (1) Academic publications both nationally and internationally, (2) Intellectual property, (3) Research acquisition, (4) Faculty citations, (5) International collaborations. The Community Service Roadmap (PkM) refers to RIPM Unpad, where community service activities conducted at FMIPA are integrated with research. We hope this document proves beneficial to all members of the academic community, including researchers, reviewers, and administrators of Research and Community Service activities at FMIPA. The faculty leaders extend its utmost appreciation and heartfelt thanks to all parties who have contributed to the preparation of this Research and Community Service Roadmap.

Jatinangor, May 2021

Dean

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CHAPTER 1
INTRODUCTION

The Research and Community Service Roadmap (PPM) is a roadmap for research activities that can span from 5 to 20 years. This research and PPM roadmap can be conducted in a monodisciplinary or multidisciplinary (intra/interdisciplinary) manner. The presence of a research roadmap serves as an instrument to oversee research activities while understanding their characteristics. Furthermore, this research roadmap can be used as a unifying tool for all research activities within a university or faculty.

The Faculty Research Roadmap is an implementation of the university-level roadmap outlined in the University Research Master Plan (RIR) and contains flagship research areas. Therefore, the development of the faculty research roadmap will not be detached from the university RIR, which serves as the primary reference.

The Faculty PPM Roadmap is an implementation of the university-level PPM roadmap outlined in the University Community Service Master Plan (RIPM) Unpad 2021-2025. The PPM roadmap is integrated with the research conducted. The main reference for the development of the Faculty Community Service Roadmap is the RIPM Unpad.

The University RIR has been prepared to meet the National Research Standards set forth in the Regulation of the Minister of Education and Culture of the Republic of Indonesia No. 3 of 2020. In its preparation, the University RIR began by examining global, regional, and national policy issues in the field of research, considering external factors (opportunities and challenges), and internal conditions (strengths and weaknesses). These were then mapped through a TOWS analysis to produce a strategic research plan. The strategic research plan includes strategies, policies, programs, activity plans, financing plans, and key performance indicators (KPIs) aligned with the Unpad Strategic Plan 2020-2024. The reference for the preparation of the FMIPA research roadmap is the University RIR for the year 2021-2025. The FMIPA research

roadmap for 2021-2025 is based on the University RIR for 2021-2025, which has been developed based on the Unpad Strategic Plan 2020-2024, guided by the Basic Scientific Pattern and National Research Priority (PRN) 2020-2024. Based on the University Research Master Plan (RIR) of Unpad, the research focus areas that are considered flagship research pillars are as follows:

1. Law, Policy, Culture, and Information
2. Environment
3. Food
4. Energy
5. Health
6. Transportation
7. Defense and Security
8. Maritime Affairs
9. Engineering Sciences

In the implementation of these nine research pillars, Unpad is supported by 6 (six) Centers of Excellence, of which 3 (three) have already become Centers of Excellence in Higher Education for Technology and Science (PUI-PT), and 15 (fifteen) Research Centers currently exist at Unpad.

Centers of Excellence:

1. SDGs Center
2. Academic Health System
3. Sundanese Culture Digitalization
4. Center of Excellence in Higher Education for Pharmaceutical Care Innovation
5. PUI-PT Center for Environment and Sustainable Studies
6. Functional Nano Powder University Center of Excellence, FiNder U-CoE

These PUI-PT are Centers of Excellence and Research Centers that have gained recognition as leading and reference centers in specific fields of knowledge at the national level.

Research Centers:

1. Appropriate Technology
2. Sustainable Food
3. Molecular Biotechnology and Bioinformatics
4. Gender and Children
5. Water Resources and Energy
6. Disaster Management
7. Health Technology Assessment
8. Archipelagic Regional Resources
9. Citarum
10. Development Dynamics
11. Research Center for Care and Control of Infectious Diseases
12. Padjadjaran Halal Research Center
13. Center for Translational Biomarker Research
14. Village Development and Empowerment
15. Artificial Intelligence and Big Data

Each of Unpad's flagship research areas has its own roadmap, which is created by defining research topics that can address local and national strategic issues while aligning with the academic competencies of Unpad's researchers. In this regard, the FMIPA roadmap is also created by taking into account the strategic issues mentioned above in order to generate research topics that match the academic expertise of researchers within the FMIPA community.

Research contributors within the faculty encompass all human resources within the various departments of the faculty, engaging in diverse research topics distributed not only within the university's Centers of Excellence but also within the faculty's Study Centers. The faculty roadmap is developed by considering the diversity and synergy among different disciplines that, collectively, can address local and national challenges effectively.

The FMIPA research roadmap is structured as follows:

1. Explanation of the research development foundation at FMIPA.
2. FMIPA Research Focus.
3. Compilation of research topics at FMIPA.
4. Development of the roadmap

CHAPTER 2
BASIS FOR THE DEVELOPMENT OF FMIPA ROADMAP

The FMIPA Research Roadmap is designed with the following foundation:

2.1 Vision and Mission of FMIPA

Vision of FMIPA:

FMIPA Unpad aims to be an excellent faculty in education and research that is internationally recognized and has an impact on society.

Mission of FMIPA:

1. Conduct research-based education to produce graduates who can quickly adapt and innovate in facing international scientific and technological developments.
2. Conduct basic and applied research, particularly in the management of natural resources, energy, and the environment, for the benefit of society's well-being.
3. Build partnerships with government agencies and industries to support the quality and relevance of internationally recognized teaching and research activities.
4. Implement adaptive, accountable, and transparent governance that meets international standards in managing the tri-dharma of higher education.
5. Develop human resources according to their competencies and cultivate a culture of responsibility, excellence, scientific rigor, professionalism, encouragement, creativity, and trust (RESPECT).

2.2 Research Potential of FMIPA

2.2.1 Resource Potential

The resource potential at the Faculty of Mathematics and Natural Sciences (FMIPA Unpad) to support research and community service activities includes the potential of departments/programs, study centers, laboratories, and human resources.

Potential of Departments/Programs and Laboratories

The Faculty of Mathematics and Natural Sciences (FMIPA Unpad) consists of 8 departments and 17 programs, including 9 undergraduate programs, 1 applied undergraduate program, 5 master's programs, and 2 doctoral programs. In addition, FMIPA has 4 study centers that support research activities.

Study Centers Potential

These study centers are:

1. Modeling and Computational Study Center
2. Bioprospecting of Natural Fiber and Biological Resources Study Center
3. Natural Product and Synthesis Study Center
4. Material and Earth Engineering Study Center

Laboratory Potential

FMIPA has two ISO 17025-certified laboratories and one ISO 9001-certified management unit. The laboratories at FMIPA include:

- **Applied Mathematics Laboratory**
- **Pure Mathematics Laboratory**
- **Physical and Inorganic Chemistry Laboratory**
  Analytical and Separation Chemistry Laboratory
  Natural Substance and Synthesis Chemistry Laboratory
  Applied Chemistry and Services Laboratory
- **Basic Science Laboratory**
  Physics and Material Laboratory

Energy Physics Laboratory
Instrumentation Physics Laboratory
Environmental Biology Laboratory
Microbiology Laboratory

- **Environmental Biology Laboratory**
- **Microbiology Laboratory**

  Biosystems Laboratory
  Taxonomy Laboratory
  Molecular Biology Laboratory
- **Statistical Computing Laboratory**
- **Geophysics Laboratory**

  Computational and Geophysical Instrumentation Laboratory
- **Management Information Systems and Multimedia Laboratory**

  Robotics, Artificial,
  Intelligence, and Digital Imaging Laboratory
- **Laboratory of Electrical Engineering, Electrical Power, and Communication Technology**

Human Resources Potential

In terms of human resources (HR), specifically academic staff, FMIPA Unpad had 199 academic staff members at the beginning of 2020, consisting of 190 civil servants (PNS) and 9 non-civil servants (NON PNS), with qualifications as follows: Bachelor's degree (S1) 0%, Master's degree (S2) 42.71%, and Doctoral degree (S3) 57.29%. The composition of academic staff based on academic positions at the beginning of 2020 is as follows: 4 without academic positions, 16 assistant lecturers, 104 lecturers, 49 senior lecturers, and 22 professors. Currently, 96% of academic staff members have passed lecturer certification. FMIPA Unpad academic staff members are responsible for providing academic services in departments and related programs, with a lecturer-to-student ratio of 1:9 for undergraduate programs. Additionally, FMIPA Unpad academic staff members provide basic sciences courses to approximately 1,400

students from various natural science faculties at Unpad, coordinated by the Basic Science Service Center (PPBS).

Regarding Administrative Staff, FMIPA has 147 administrative staff members, consisting of 96 civil servants (PNS) and 51 non-civil servants (NON PNS), to support the implementation of the three pillars of higher education distributed among general sub-divisions, education sub-divisions, student affairs sub-divisions, personnel sub-divisions, and finance sub-divisions. The educational qualifications of administrative staff members include: Elementary School (SD) 6.12%, Junior High School (SLTP) 0.68%, High School (SMU) 54.42%, Diploma 1 (D1) 0.68%, Diploma 3 (D3) 12.24%, Bachelor's degree (S1) 23.81%, and Master's degree (S2) 2.04%.

2.2.2 Research and Community Service Results

a) Research

The research activities at FMIPA Unpad are directed in accordance with the FMIPA research umbrella titled "The Development of Science and Its Utilization in Studying Natural Resources and the Environment for the Welfare of Society." Under this research umbrella, FMIPA ranks highest in terms of research funding acquisition at the university level, both from government and private institutions, as well as from national and international sources. National research funding is obtained from the Unpad Research Grant Program (HRU) and the Ministry of Research and Technology/National Research and Innovation Agency (Kemenristek-BRIN), as well as research programs from the Ministry of Finance (KemenKeu) LPDP. Figure 2.1 shows the acquisition of research funding by FMIPA faculty members from 2016 to early 2021, where research funding comes from HRU and Kemenristek-BRIN. It can be seen that research funding acquisition has significantly increased each year. Additionally, research funding from private and international sources, including ITSF, Loreal-Unesco, TWAS, H2020, VLIR - UOS, and JSPS, has also been obtained. Besides funding from these sources, research can also be conducted using self-funding.

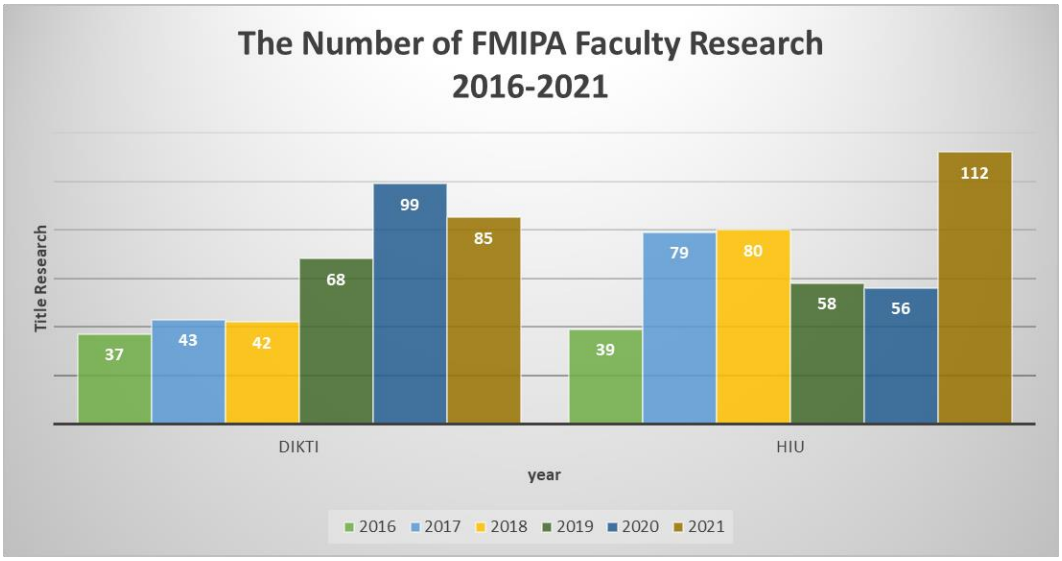


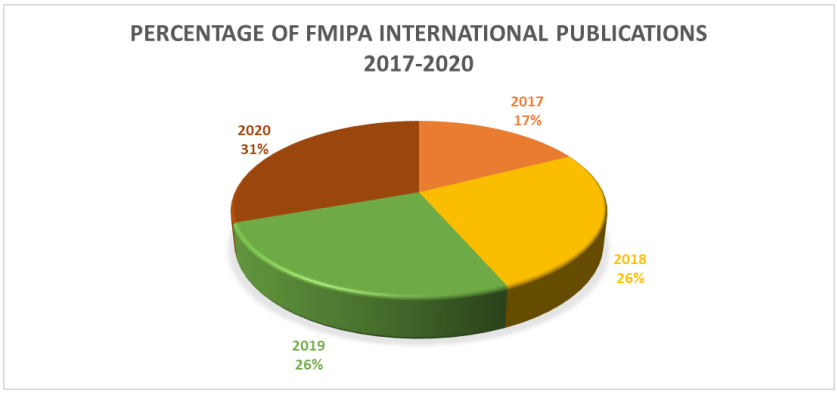
Figure 2.1. Graph of the Number of FMIPA Faculty Research from 2016-2021

FMIPA researchers have also achieved significant milestones in their research activities, including being awarded as the best presenters at national seminars, receiving the Loreal-Unesco award in the field of material science, and receiving the XL Indonesia Berprestasi Award in 2019. More FMIPA researchers have been trusted to serve as peer reviewers for accredited national journals and reputable international journals. International recognition for FMIPA faculty members has been received through the International RISE H2020 Grant and research funding from Belgium in collaboration between FMIPA Unpad and Virlous Belgium. Additionally, there has been an annual increase in the acquisition of World Class Professor (WCP) Grants from the Kemenristek BRIN.

The achievements and research contributions of FMIPA have played a crucial role in enhancing the faculty's reputation both nationally and internationally. FMIPA researchers have made significant contributions to the quantity of research output at Universitas Padjadjaran. In 2020, the number of international publications indexed in Scopus from FMIPA amounted to 222, with 177 publications falling within Quartiles 1 to 4 and 45 proceedings indexed in Scopus. This number exceeded the faculty's publication target (IKK) and significantly contributed to Unpad's total international publications. Figure 2.2 shows the number of FMIPA Faculty publications in Scopus-indexed international journals. To provide more opportunities for researcher faculty members to publish

their research results, the Faculty of Mathematics and Natural Sciences organizes national and international seminars on a regular basis. For international seminars held, the contributions of seminar participants are compiled in proceedings indexed in SCOPUS, which directly impacts the university's ranking and reputation.

With the increasing number of publications by FMIPA faculty members, the citation of faculty members has also increased. Figure 2.3 shows the number of citations of FMIPA faculty members from 2016 to 2019.



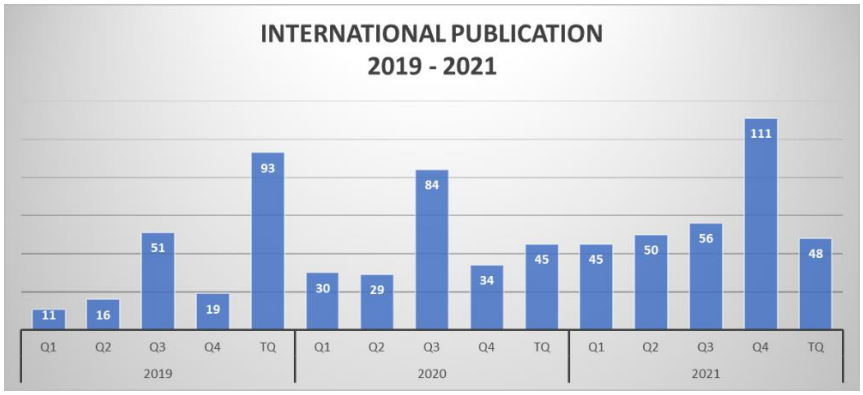


Figure 2.2. Graph of Publications in International Journals by FMIPA Faculty from 2017-2021

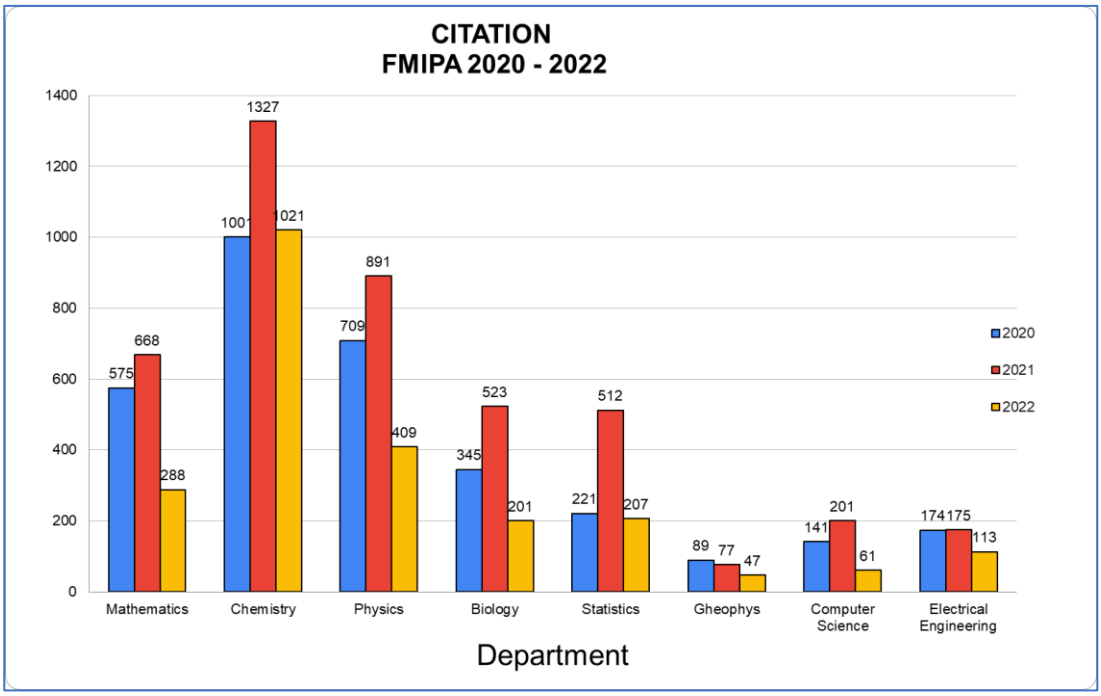


Figure 2.3. Graph of the Number of Citations of FMIPA's lecturer from 2016-2019

FMIPA faculty research programs, in addition to producing publications in national and international journals, are also aimed at generating innovative products. One of the efforts to protect the innovations created by the academic community of Unpad is by registering these products to obtain patents, trademarks, or copyrights. The process of registering Intellectual Property Rights (HaKI) is carried out through the Directorate of Innovation. As an effort to commercialize research results, Universitas Padjadjaran facilitates this process through the Directorate of Cooperation and Academic Corporate. Until 2019, FMIPA had filed 34 draft patent applications.

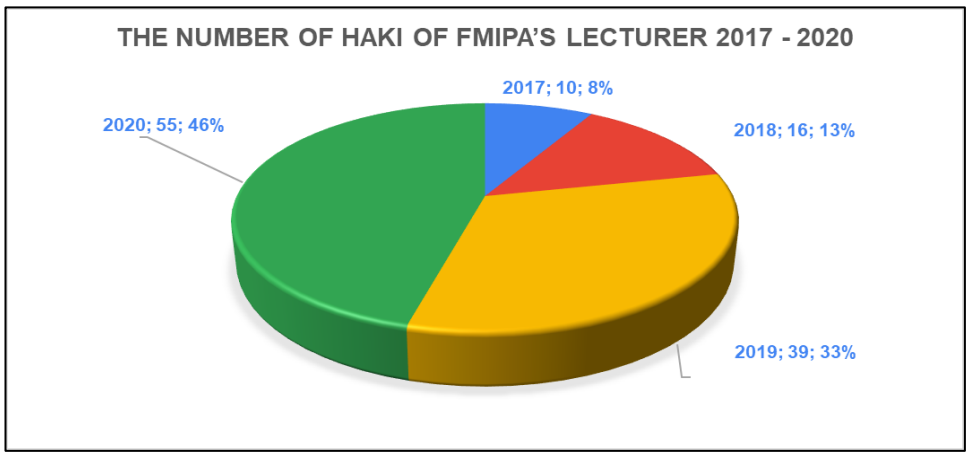


Figure 2.4. Graph of the Number of HaKi of FMIPA's lecturer from 2017 to 2020

b) Community Service (PPM)

Community Service (PPM) is part of the Tridharma activities aimed at implementing faculty research products to provide real benefits to society. PPM is an activity that brings universities to the community, which is concrete and directly benefits the community. The PPM activities conducted at FMIPA are funded by Unpad, external sources, and international funding. Additionally, the PPM activities are also conducted as independent PPM projects. PPM is carried out with active student participation. The PPM activities conducted by faculty members at the Faculty of Mathematics and Natural Sciences are a follow-up to research results that are applied in the community.

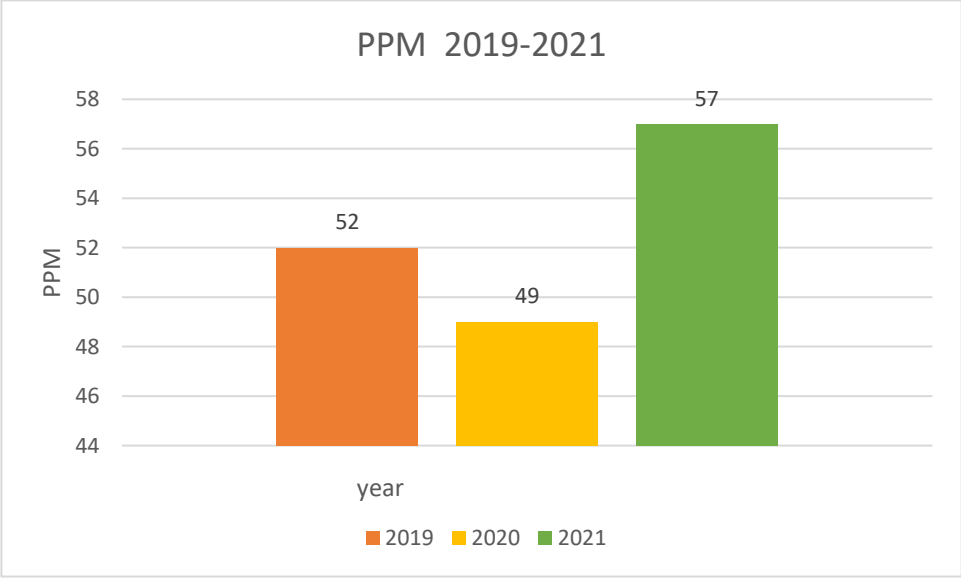


Figure 2.5. Number of PKM by FMIPA from 2019 to 2021

Based on Figure 2.5, it can be seen that FMIPA Unpad has shown a consistent increase in the number of PKM programs each year. All of these PKM activities involve students as team members.

CHAPTER 3

FOCUS OF RESEARCH AT FMIPA UNPAD

The determination of the focus of FMIPA's flagship research is based on the track record of researchers and the historical and philosophical facts of the faculty's establishment. FMIPA has played a significant role in environmental management, and research in this field must continue.

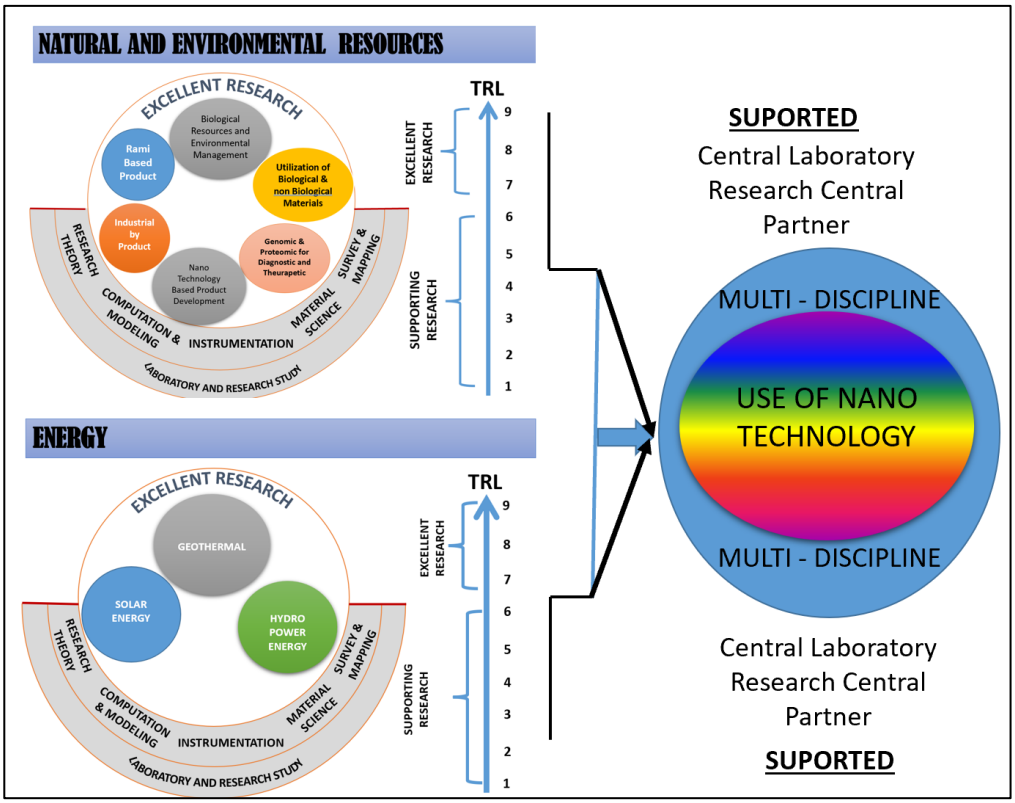
In anticipation of national strategic issues, it is deemed necessary to conduct research and development related to energy management and conservation. Therefore, supported by the roadmap and the track record of all researchers in the FMIPA environment, the focus of FMIPA's flagship research is determined as follows:

1. Environment and Natural Resources

This research focus includes activities related to environmental management, conservation, and the utilization of natural resources for the benefit of the nation.

2. Innovation and Energy Conservation

This research focus consists of activities related to energy utilization, energy transmission, as well as the exploration of new and renewable energy sources.



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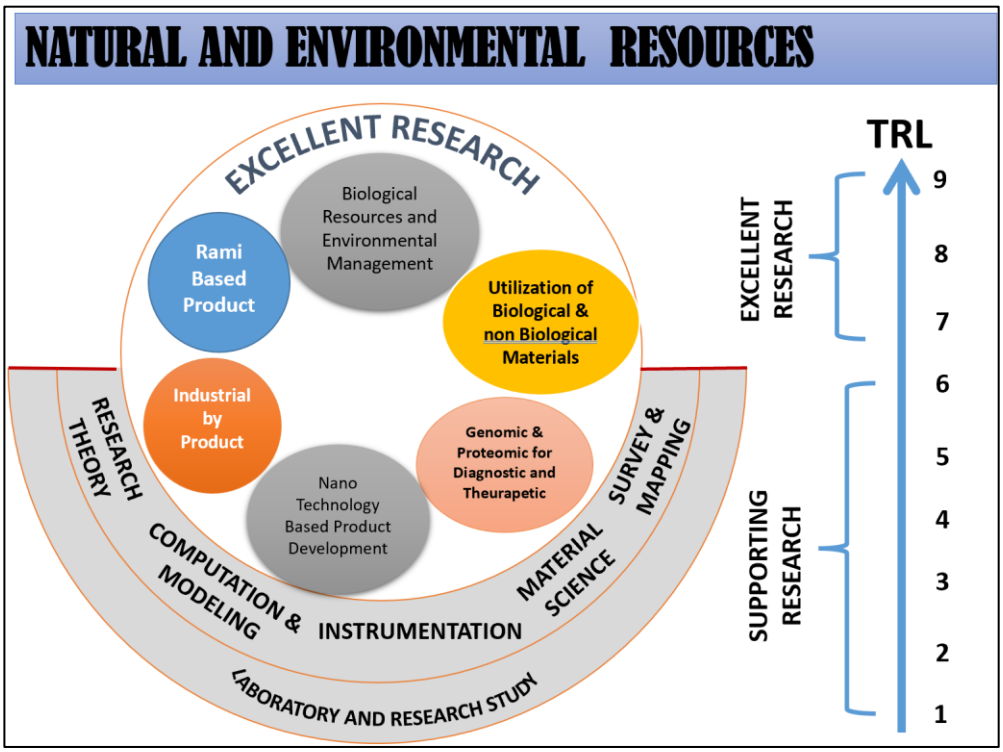
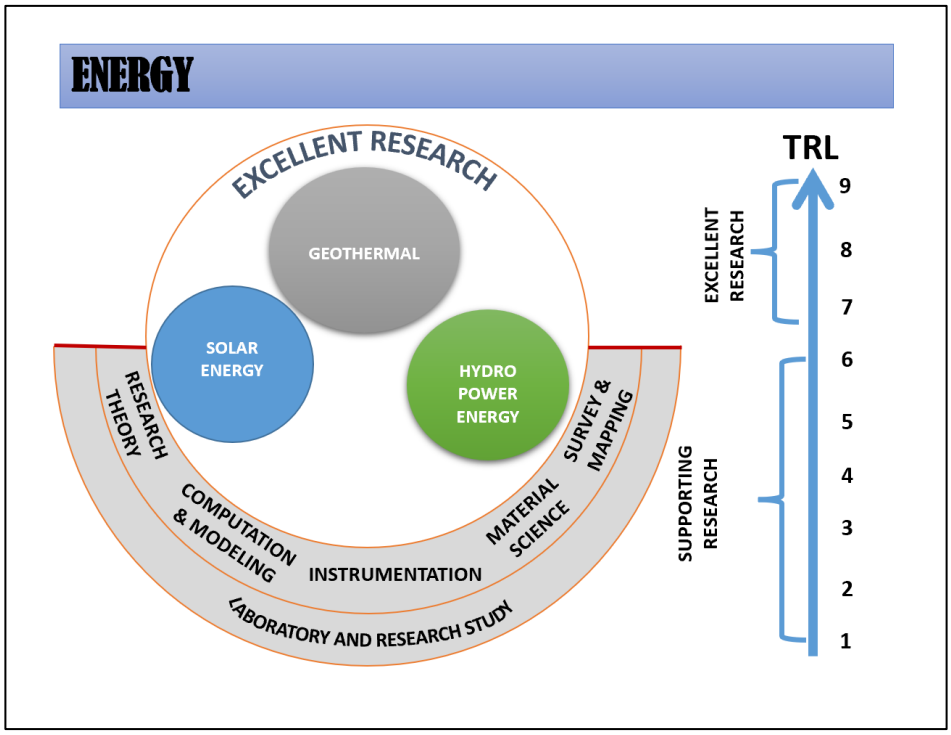
(a) Focus of Unpad Research



(b)



(c)

Figure 3.1 Focus of Excellent Research FMIPA Unpad

Figure 3.1 (a), Diagram of FMIPA's excellent research focus. The half-circle sectors represent support for excellent research activities. In red are research facility support, while in green are the basic research groups that serve as the foundation and hallmark of FMIPA Unpad's research.

Excellent research at FMIPA is depicted in the diagram shown in Figure 3.1. This diagram illustrates the strategy and mechanism of research activities to support the success of excellent research. A collection of research activities within the framework of FMIPA's excellent research is supported by fundamental research, which serves as the foundation and gives the "MIPA-ness" and distinctive character to the research outputs produced.

The research activities of FMIPA Unpad in 2017-2020 were directed according to the FMIPA research umbrella with the theme "Development of science and its utilization in studying natural resources and the environment for the welfare of society." In 2016, the number of international publications from FMIPA amounted to 45, which is a significant number among Unpad's

international publications. In addition to generating publications in national and international journals, the research programs of FMIPA are also directed towards producing innovative products. To protect the innovations created by the academic community of Unpad, these products must be registered to obtain patents, trademarks, or copyrights. Until 2019, FMIPA had established ten Study Centers to facilitate directed research. These Study Centers include:

1. Rare Earth Elements
2. Natural Products
3. Science and Engineering of Materials
4. Ethnoscience
5. Geophysics of Natural Resources and the Environment
6. Development and Learning of Basic Science
7. Statistics and Actuarial Science
8. Bioprospecting of Natural Resources
9. Mathematical Modeling and Simulation
10. Energy Technology, Electronics, Communication, and Computing

In order to support FMIPA Unpad's vision of becoming an excellent Faculty of Mathematics and Natural Sciences at the regional ASEAN level and recognized internationally by 2026, FMIPA Unpad has missions that include conducting research-based learning to produce highly competitive graduates and conducting basic science and its application research, especially in the management of natural resources and the environment for the welfare of society. For this purpose, FMIPA Unpad has a research roadmap until 2020, as seen in the image above. As for the focus on natural resources and the environment, the excellent research conducted includes Ramie-based products, natural resources and environmental management, utilization of biotic and abiotic natural resources, genomics and proteomics for diagnostics and therapeutics, development of nano-based products, and industrial by-products. The initial focus of excellent research at FMIPA Unpad was on solar energy, geothermal, hydropower energy, and the development of nano-technology-based products.

The supporting research includes theoretical research, computation and modeling, instrumentation, materials science, surveys, and mapping.

As part of efforts to improve research quality, a research flow rescheduling was carried out. The research focus carried out by FMIPA for 2021-2025 includes the use of mathematical models for various problems, cultural and technological studies for various issues, diversity of raw materials for drugs and their production through biology and chemistry, herbal materials for drugs and phytopharmaceuticals, advanced materials for various fields, genetic material engineering/technology, food, plant breeding, and more, optimization, control systems, data science, and big data, hardware and software design, cultural and technological studies for various issues, production of drug materials, excipients, and medical devices, in vitro, in vivo, and in silico studies, management and protection of natural resources, the environment, and energy, mapping and analysis of zoning of biological resources, natural resources, and the environment, development of marine technology, energy, batteries, sensors, and environmentally friendly vehicles. The goal of all of this is technological progress and culture, as well as added value for natural resources, the environment, culture, and industry.

CHAPTER 4
RESEARCH TOPICS AND ROADMAP FOR RESEARCH AT FMIPA

4.1 Research Topics at FMIPA to Address Strategic Issues (Source: RIR Unpad 2021-2025)

Based on the RIR Unpad 2020-2024, the research topics at FMIPA are spread across nine research pillars of Unpad, including environment, food, energy, health, transportation, defense and security, and maritime, which are expected to address strategic national issues. The distribution of FMIPA research topics in the RIR Unpad 2021-2025 can be seen in Table 4.1.

Table 4.1 FMIPA Research Topics to Address Strategic Issues (Source: RIR Unpad 2021-2025)

No	Strategic Issues	Conceptualization	Problem Solving	Research Topic Needs	Scientific Competency
Top Research of Environment Topic					
1	Local, national, and global issues related to the environment and its changes: pollution, floods, forest fires, climate change, ecosystem changes, and the decline of biodiversity	The balance and efficiency of the relationship between natural resource utilization and environmental protection and conservation	Basic and applied research that is multi- and interdisciplinary in the field of natural resource and environmental protection and management	1 Ecosystem services and biodiversity • Mapping and documentation of local wisdom, ecosystems, and biodiversity • Environmental pollution, environmental toxicology, and the management of geological, meteorological, biological, and human-induced disasters	Biology

				• Human adaptation to environmental changes	
2	Eco-development in national development	Conflict of interest between ecology, economy, and society, as well as various groups and geographical regions	• Environmental education • Regulation of pro-environment policies	2. Rural-urban ecology • Aquatic ecology and water resources management • Environmental risk communication • Regulation and implementation of environmental education into school curricular	Biology
3	Green economy for sustainable development	• Clean and efficient production, distribution, and consumption • An economy that considers the sustainability of supplies	• Ecological footprint calculation • Eco-efficiency: between benefits and drawbacks	3. Ecosystem rehabilitation Regulation and implementation of production, distribution, and consumption practices for goods.	Biology
4	Indonesia's commitment to global environmental management agreements formulated at the international level (e.g., Agenda 21, CBD, REDD+).	Environmental Literacy	Application of research results in the field of natural resources and environmental protection	4. Regulations and the implementation of pro-environmental principles in human daily life • Sustainable natural resource management models	Biology
5	Recreation, environmental economics, and eco-psychology	Balance between entertainment and lifestyle with environmental interests	Pro-environment lifestyle	5. Ecotourism development • Strengthening environmental awareness movements	Biology

6	The increasing population growth combined with environmentally unfriendly urban planning results in transportation system issues; waste and flooding problems; noise, air, water, and soil pollution; industrial waste management; and water availability issues.	The use of science and technology (IPTek) to conduct studies in order to obtain models/systems for monitoring, controlling, and managing environmental impacts, including social, economic, and public health aspects	The determination of studies that utilize a knowledge, culture, and technology approach to address issues and related problems	6. Studies of culture and technology in flood and waste issues • Cultural and technological studies of pollution monitoring and management (air, water, and soil) • Cultural and technological studies of information for green and smart urban planning • Cultural and technological studies for waste planning, management, and monitoring, including recycling technologies	Information Technology
Top Research of Food Science Topic					
1	Indonesia, as a mega-biodiversity country, has a variety of plant species, fish, and livestock, but the economic-scale utilization of local food is still low.	• Reorienting food policy from a global/national/local approach to a global, national, and local approach • Food diversity supports the health and economy of communities • Reducing imports and increasing exports	• Promotion of the advantages and comparative benefits of local food • Basic and applied research in the field of plant/animal/fish biodiversity as a source of carbohydrates, fats, proteins, vitamins, and minerals.	1. Biodiversity of genetic resources for food crops, fruits, horticulture, plantations, livestock, fish, and crustaceans as potential food sources	Biology, Physics, Chemistry, Geological Engineering
2	• Local culture in *food* fulfillment	• Re-orientation of some	• Increased understanding of the	2. Community food culture	Biology, Physics,

	(*food habit*) has been eroded by global culture • Regeneration of positive values of local food culture threatened • Development of "*triangle smart technology"* (biotech, nanotech, digitaltech) in the agricultural sector • The existence of the application *smartphone* • IoT in food product marketing	carbohydrate and protein source foods based on local wisdom approach t o reduce imported foods • Strengthening family and community-based food culture	fulfillment of local food-based family nutrition • Identification and inventory of local food culture • Family and community food education • Implementation of "*triangle smart technology*" along the agricultural supply chain	3. Social engineering for the implementation of "*triangle smart technology*" along the agricultural supply chain	Chemistry, Geological Engineering
3	• The threat of climate change phenomena and environmental degradation on productivity and food quality and safety • Consumers want food	Improved genetic quality of crops/livestock /fish *Food waste hierarchy*	• Plant, livestock, fish breeding: feed engineering for livestock and fish; and environmental engineering in line with climate change and consumer demands • Post-harvest	*4.* Improvement of food quality through breeding of superior food crops, fruits, horticulture, plantations, livestock, *fish/crustaceans* *5.* Market-oriented post-harvest handling engineering *6.* Governance of agricultural logistics systems *7. Cold chain system*	Biology, Physics, Chemistry, Geological Engineering

	with ASUH quality • High yield loss along the agricultural supply chain		handling, refrigerated logistics system • Circular economy system		
4	• Productivity and quality of food yields are less stable • Production of superior local seeds of crops, livestock and fish is still low • Presence of biodiversity local food • threatened	• Location- and commodity-specific precision agriculture • Area-specific approach in the production of superior local crop/fish/livestock seeds	• Industry-oriented production optimization: input-process-output • Local and region-specific superior plant/livestock/fish seed production technology	**8.** Technological engineering of cultivation and production of plant seeds/ as well as superior local livestock/fish seeds oriented to output and precision	Biology, Physics, Chemistry, Geological Engineering
5	Chemical and mineral-based agricultural/farming/ fishing external inputs increase production costs and potentially degrade land/environmental quality	Some external inputs can be replaced by local (internal) renewable inputs	Utilization of microbes and local plants/livestock/fish for agricultural/livestock/fishery inputs	9. Agricultural input production technology (fertilizers, pesticides, probiotics, prebiotics, feed, bioremediators, *flocs*) based on local resources, renewable friendly	Biology, Physics, Chemistry, Geological Engineering
6	Instability and low quality of *raw*	• Commodity- and location-specific	Improving the quality and shelf life of	10. Post-harvest and value-added of agricultural, fishery and	Biology, Physics,

	materials and food products are among the obstacles to the competitiveness of the food economy	post-harvest can ensure product quality market-oriented agriculture/farming/ fisheries • Processing of economically oriented agricultural / livestock / fishery products to fulfill nutrition, taste and aesthetics • Food processing for disaste needs	agricultural, fishery and livestock products; as well as the nutritional value and aesthetics of processed foods	livestock products 11. *Precision food processing* 12. Promotion and marketing with IoT concept Countermeasures for *ready to eat* food for disaster needs	Chemistry, Geological Engineering
7	• Free market era: flood of food products/types into the domestic market • Value-added and profits are not fairly distributed among agricultural/farmi ng/fishing actors	• Upstream-downstream integration of agriculture/livestoc k/fisheries • *Agriculture Fair Trade Food Economy* • Inter-regional trade of agricultural products	Strengthening institutions, management, markets and food technology to improve the quality of local food products according to market demand	13. Engineering and institutional strengthening to improve local food competitiveness in the national market 14. Agricultural supply chain governance or coordination	Biology, Physics, Chemistry, Geological Engineering
8	Land quality degradation due to pollution, threat-	Improved land quality based on land	• Delineation of degraded land based on physical	15. Rehabilitation of agricultural/livestock land 16. Remediation of contaminated	Biology, Physics, Chemistry,

	based mining can improve land productivity and fisheries	characteristics and increased land productivity production and water availability fisheries	contamination/damage • Land rehabilitation modeling	agricultural land	Geological Engineering
Top Research of Energy Topic					
1	• Declining national fossil energy production • Availability of alternative energy to replace fossil energy • Global warming due to greenhouse gas emissions from fossil energy use	• Domination usage - fossil energy • Potential use of fossil replacement energy and its mix that big enough • Not yet optimal implementation of the use of alternative energy to replace fossils that are environmentally friendly	• Search and development of environmentally friendly renewable energy sources. • Optimizing the use of renewable energy • Fulfillment of community needs and increase in economic activities in areas producing EBT sources	1. Identification and mapping of potential EBT sources 2. Renewable energy production technology 3. Techno-economic assessment of renewable energy, economic and social aspects for sustainability 4. Information and communication to *stakeholders*. National energy policy	FMIPA
2	• Remote areas not yet electrified • Energy generation sources are located in city area (Java)	• Technology needs to support efficient energy generation • Community understandin g towards the use of renewable energy and supporting	• Creation of an *off grid* that suits the potential of the region • *Smart grid* design • Increased community understanding	5. *Smart grid* design according to the energy potential of the region 6. Techno-economic assessment of *smart grid*, economic and social aspects for sustainability 7. Dissemination of information to stakeholder.	FMIPA

		technologies is still less			
3	• Inefficient use of energy • Energy use mix	The concept of energy conservation	Energy use efficiency Energy use mix	8. Energy bar 9. *Smart building* for energy conservation 10. Techno-economic assessment, economic and social aspects for sustainability	FMIPA
Top Research of Health Topic					
1	• High epidemic of various diseases in Indonesia • Pandemics e.g. SARS- CoV2	Preventive, promotive, detection, and management of diseases using the latest science and technology can improve the quality and level of public health	1. Basic and applied research that is useful in preventive, promotive, detection, and comprehensive and effective disease management efforts 2. Use of the latest science and technology	1. Comprehensive disease prevention, diagnosis and management 2. Development of technology and biotechnology in disease detection	FMIPA
2	There is still a lack of knowledge about risk factors and mechanisms of disease occurrence, so that prevention and treatment is not optimal	In-depth exploration and identification that can explain risk factors and mechanisms of disease occurrence	Basic and applied research that explores and identifies in depth that can explain risk factors and mechanisms of disease occurrence in an attempt to improving the health of the community	3. Deepening the mechanism of disease onset (pathophysiology) for more effective prevention 4. Communication patterns and community psychology in health aspects	FMIPA

3	• Lack of efforts to develop and utilize biological / biological materials, and advanced materials • Lack of development of diagnostic tools/methods, analysis, drugs, drug excipients, dental materials, and vaccines	Optimizing the utilization of biological / biological materials, and advanced materials for the development of diagnostic tools / methods, analysis, drugs, drug excipients, dental materials, and vaccines	Basic and applied research for the utilization and development of biological / biological materials, and advanced materials for the development of diagnostic tools / methods, analysis, drugs, drug excipients, dental materials, and vaccines	5. Development of biological materials, and advanced materials for the needs of diagnostic tools, analysis, drugs, drug excipients, dental materials, and vaccines	FMIPA
4	• Indonesia is one of the most biodiverse countries in the world • Empirical use of herbal medicine in Indonesia for various diseases • Lack of scientific justification of herbal medicine • Side effects of dangerous synthetic drugs	• Obtain active compounds from herbal plants for therapy of infectious diseases (bacterial, viral, or fungal), cancer, metabolic syndrome diseases, catastrophic diseases, and dental materials • Development of herbal plants into standardized herbal medicines	Basic and applied research for the utilization and development of herbal medicines as therapy for infectious diseases (bacterial, viral, or fungal), cancer, metabolic syndrome diseases, catastrophic diseases, dental materials	6. Development of herbal medicines into rational alternative medicines for infections (bacterial, viral, or fungal), cancer, metabolic syndrome diseases, catastrophic diseases, nutraceuticals, and dental materials	FMIPA

		and phytopharmaceutic als through scientific • Safe medicine			
5	• Side effects of dangerous synthetic drugs • Lack of studies on factors affecting good patient quality of life	• Good patient quality of life is influenced by the accuracy of therapy which will improve the level of public health • Exploration and identification of factors affecting quality of life good patient	Research that can explore and identify factors that influence patients' quality of life through the accuracy of drug therapy	7. Improving quality of life through studies in public health, epidemiology, economics, development of intervention models, and other *outcome research*	FMIPA
6	Lack of supervision and optimization of policy implementation, management, and legal protection in the health sector	Provision of models or tools to facilitate supervision and optimization of policy implementation, management, and legal protection in the field of health	Applied research that is useful for facilitating ways to monitor and optimize the implementation of policies, management, and legal protection in the health sector	8. Health policy, management, and legal protection	FMIPA
Top Research of Transportation Topic					
1	Regulatory design on public transportation	The transportation system is supported by regulatory	There is a need for research to optimize the regulatory system supported by *realtime*	1. Optimization 2. Control system 3. Data science, big data analytics	Math

		techniques (traffic, vehicle queuing, and traffic control). passenger)	data study and analysis		
2	• Electric vehicle • Environmentally friendly vehicles	Prioritizing the development of environmentally friendly vehicles and electric vehicles from research level.	Emphasis on environmentally friendly fuels for transportation. Electric energy for vehicles	4. Green vehicle and electric vehicle prototypes 5. Refueling system	FMIPA
3	Local content in national automotive	Increased quantity and quality of TKDN	Support local industry of components and spare parts	6. Business strategy, production methods	FMIPA
Top Research of Defense and Security Topic					
1	• Defense Technology is lagging behind • Defense technology that is still a consumer product • other countries	Need to initiate basic and advanced research that contributes to Defense and Security technologies	Supporting research in the field of defense technology related to engineering and exact sciences.	1. Weaponry and supporting technologies (bulletproof, signaling, control) 2. Defense against biological weapons (viruses, bacteria etc.) 3. Defense against chemical weapons	FMIPA
2	• Cyber warfare • Reliable communication and data encryption system	Need for application of various fields of science related to new technologies on the issue	Supporting research in these fields to respond to the development of the revolution industry 4.0 and 5.0.	4. Research in data security, data science, telecommunication systems 5. Cyberattack countermeasures	Math, Electrical Engineering, Informatics, Physics

Top Research of Maritime Topic					
1	Effect of climate change on oceanographic conditions, maritime activities (transportation, economy), marine biota	• Understanding the effects of climate change is critical given its impact on the marine environment and marine biota. • Climate change impacts and risks.	Climate change impact study for impact prediction and Indonesia	1. Study of climate change and its impact on marine biota. 2. Oceanographic modeling and climate change prediction models.	Biology, Geophysics
2	Zoning mapping of marine resource potential and suitability of mariculture sites	• The potential of marine resources has not been well mapped and there is a need for recommendations on the suitability of locations for mariculture • Zoning mapping, preventing *overlapping* cultivation sites	Creation of zoning maps based on resources and characteristics of the marine environment	3. Mapping and spatial analysis of marine resource zoning. 4. Site suitability study for mariculture (fisheries and seaweed)	Biology

3	Marine instrumentation and oceanographic operations for strengthening the aspects of maritime	Development of instrument assemblies used in marine observations still minimal	Instrumentation development for operational marine aspects	5. Create or develop marine instruments 6. Instrument application & development in marine resource exploration.	Electrical Engineering, Informatics, Physics
Top Research of Engineering Topic					
1	Industry 4.0 and society 5.0 development	Research development for internet of things (IoT), *cloud* computing and artificial intelligence (AI)	Engineering technology related to IoT, cloud, AI according to technology needs	1. Hardware design 2. Software development 3. Smart phone app 4. Big data solutions 5. Sensor, instrumentation and control technology 6. Artificial intelligence	Electrical Engineering, Informatics, Physics
2	Abundant natural resources, but low in increased product added value	Perform pre-processing raw materials for material products advanced value-added quality and economy	Processing of natural materials and minerals in accordance with priorities research developed	7. Mapping Indonesia's potential energy and mineral resources 8. Natural material processing and Mineral processing	FMIPA
3	The amount of waste, residue or processed byproducts that are potential raw materials for certain	Conduct processing to increase added value	Engineering of waste, scraps or by-products for utilization in specific applications	9. Plastic recycling technology 10. Product processing and packaging 11. Environmentally friendly/biodegradable plastic technology 12. Organic waste recycling	FMIPA

	applications has not been utilized.			technology 13. E-waste recycling technology	
4	There is a need to characterize certain superior properties of materials for various applications: solar cells, *phosphor* materials for lights	Conduct research on advanced materials in these applications to add competitive value to industrial products	Engineering advanced materials for various application needs	14. Advanced materials for solar cells, phosphors, magnetic materials, battery materials, fuel- cell materials, bone/tooth replacement materials, medicinal materials and disease diagnostics	FMIPA

These FMIPA research topics are carried out and supported by 6 (six) Centers of Excellence/PUI-PT and 15 (fifteen) Research Centers. Some research topics that are currently not facilitated in centers of excellence and research centers have been helped by the presence of 4 (four) Study Centers in FMIPA, namely the Center for Modeling and Computing Studies, the Center for Bioprospection of Natural Fibers and Biological Resources, the Center for Natural Product and Synthesis Studies, and the Center for Materials and Earth Engineering Studies.

4.2 Research Topics in Study Centers in FMIPA

In carrying out research in FMIPA, Study Center (Pusdi) is one of the units in FMIPA that plays a role in managing research and community service in FMIPA. Currently there are four Pusdi in FMIPA, namely:

1. Center for Modeling and Computation Studies
2. Center for Bioprospection of Natural Fibers and Biological Resources
3. Center for Natural Product and Synthesis Studies
4. Center for Materials Engineering and Earth Studies

The research topics currently covered by Pusdi are as follows:

1. MODELING AND COMPUTING STUDY CENTER

The Center for Modeling and Computing Studies manages research and community service that is monodisciplinary and/or multidisciplinary in the scientific fields of mathematics, statistics, and computer science. Some of the topics studied in this Pusdi include theoretical studies of mathematics, mathematical and statistical models for various problems, studies of spatio models and their applications. Theoretical studies of mathematics and mathematical and statistical models are basic studies with TKT 1-3 levels that are done every year. This study then increases to TKT 5-6 for spatio model development studies, to TKT 7-9 and spin-offs for product development from this spatio model.

The Center for Modeling and Computation Studies in carrying out its activities has collaborated with the RISE_SMA International Consortium Team, Ambassador Committee Women for Mathematics International Mathematical Union (CWM IMU) for Indonesia and Asian Oceanian Women in Mathematics (AOWM), Uia Norway, LIACS Leiden University, KU Leuven and UHasselt Belgium.

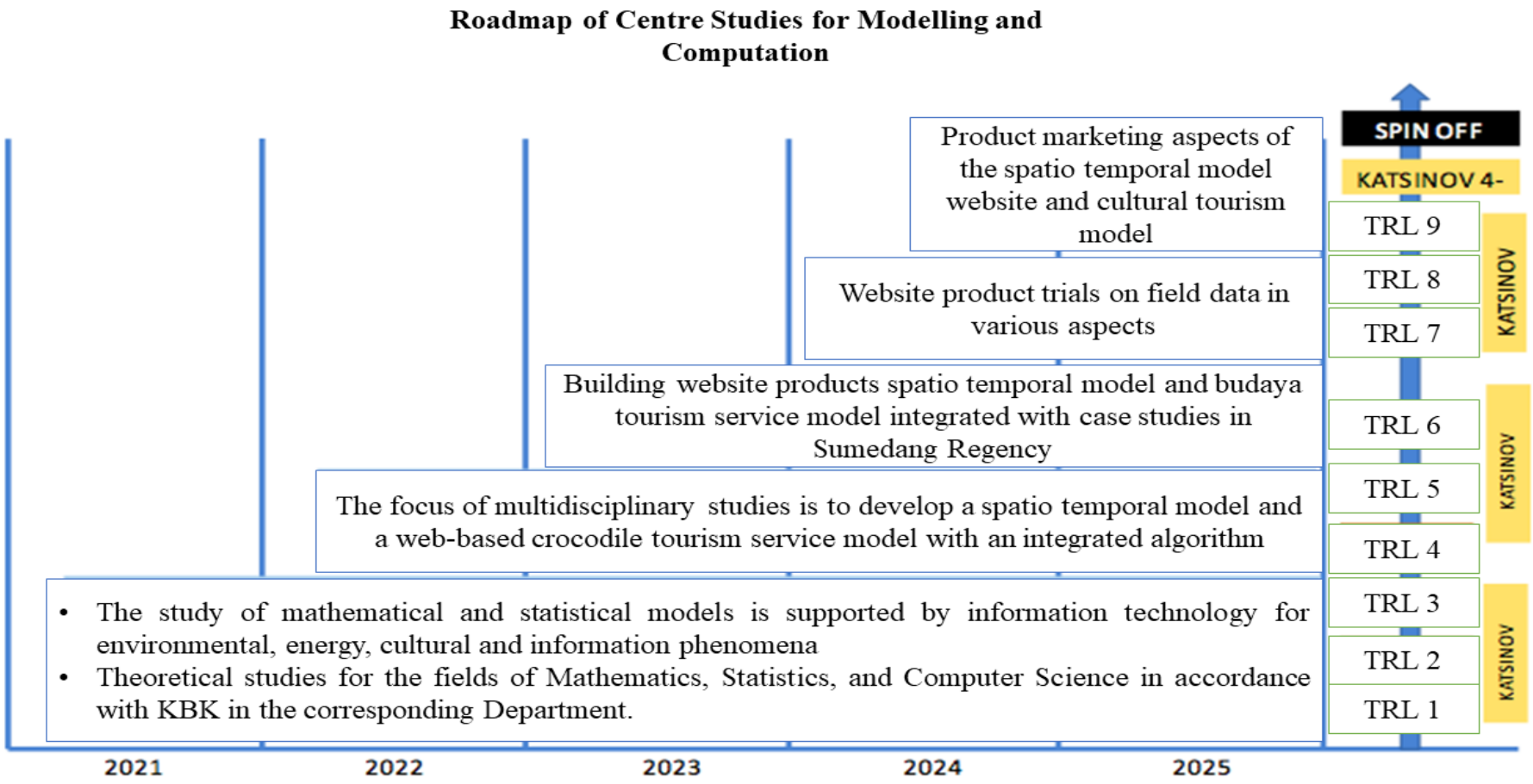


Figure 4.1 Roadmap of the Center for Modeling and Computing Studies

2. CENTER FOR NATURAL FIBER AND BIOLOGICAL RESOURCES BIOPROSPECTION STUDIES

The Center for Bioprospection of Natural Fibers and Biological Resources (BSA- SDH) manages research and scientific development activities related to natural fiber and biological resources objects; community and industrial service programs organized from the results of the utilization of research that has been developed; training programs as a form of service in improving analytical and production procedures, which can be held in the form of training or internships; national and international seminars, workshops, public lectures or integrated MBKM, and venture activities. The organizational structure of Pusdi BSA-SDH Unpad is divided into three main divisions: Division (1) Research and PPM Division includes the Sub Division of Natural Fiber Product Development and the Sub Division of Biological Resources Development; Division (2) Training; and Division (3) Publication and IPR; and added two supporting sections such as: General and Finance.

In carrying out these activities, Pusdi BSA-SDH, Unpad has established cooperation with various agencies related to the development of natural fibers and biodiversity, as well as universities both at home and abroad. In supporting activities in the Division of Research and Community Service, Training, Publications, currently has established cooperation with the Indonesian Ramie Consortium (KORI), the Indonesian Fiber Council (DSI), BRIN, and the University of Technology Malaysia, and several domestic universities, as well as industrial partners and business start- ups.

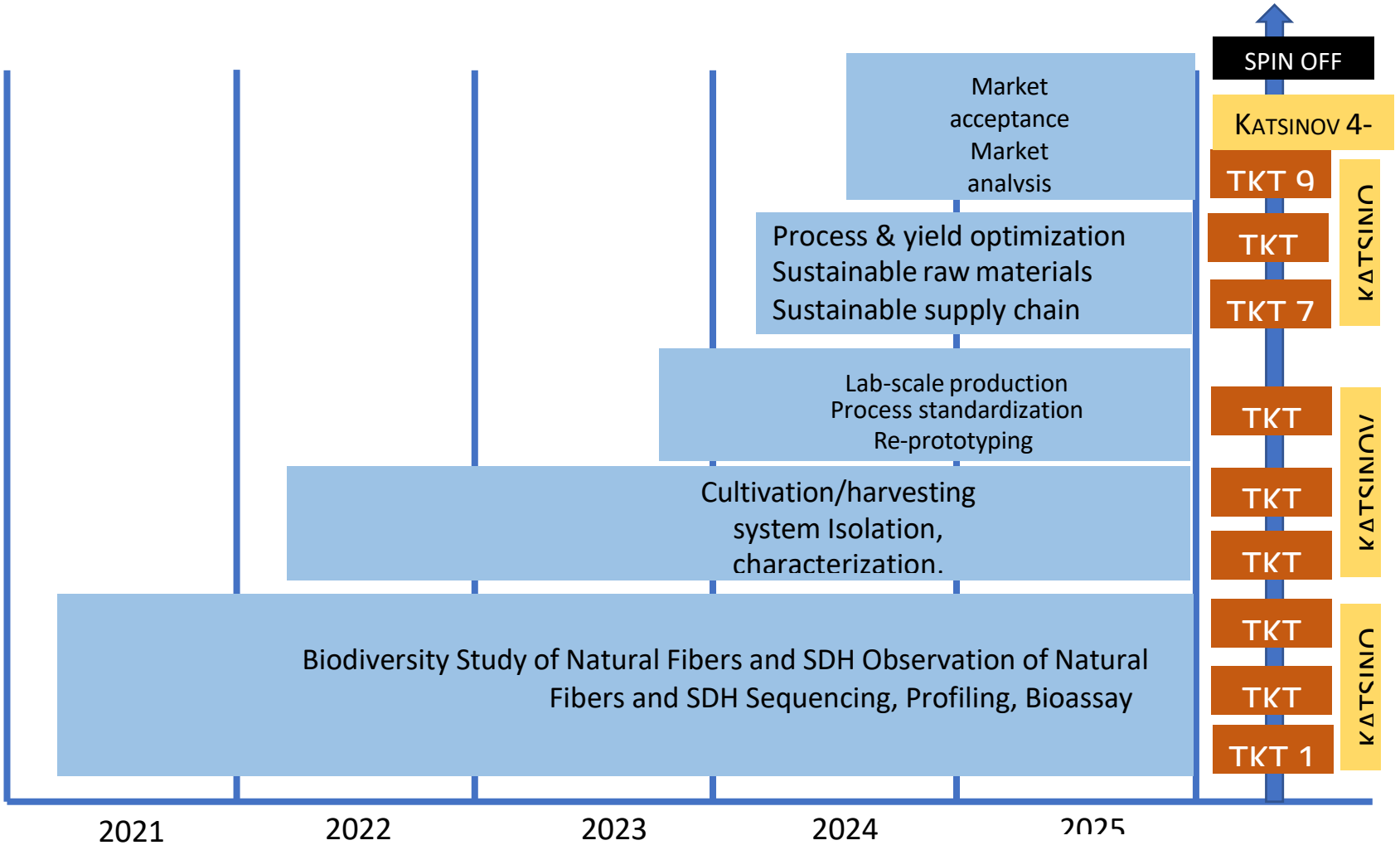


Figure 4.2. Roadmap of Bioprospection of Natural Fibers and Biological Resources Study Center

3. NATURAL PRODUCT AND SYNTHESIS STUDY CENTER

The Natural Product and Synthesis Study Center is a study center that has expertise in the field of natural material chemistry and synthesis which is tasked with carrying out research activities and community service as well as quality control of research activities and community service in this field. Activities in this Center include research activities, coordination, utilization of researchers, evaluation of the implementation of activities, training, scientific services, cooperation, development of researchers' professional abilities, and business consulting.

Members of the Natural Product and Synthesis Center work in TKT 1-3 research to isolate and determine the structure of bioactive secondary metabolite compounds from natural sources such as plants, microbes, or fungi, including studying the synthesis of bioactive compounds chemically. Advanced research includes testing bioactive compounds *in vivo* including studying the mechanism of action of bioactive compounds *in silico, in vitro* and *in vivo* (TKT 4-5). Formulation of extracts as herbal preparations (TKT 6) is a study that is also carried out in the Center for Natural Products and Synthesis.

Pusdi Natural Product and Synthesis has collaborated with many domestic and foreign institutions including Osaka University, Universiti Malaya, Universiti Sains Malaysia, Yamagata University, Chiba University, Melbourne University, La Trobe University, Kansas University, Walter and Eliza Hall Medical Institute, Royal Botanical Garden London, and BRIN.

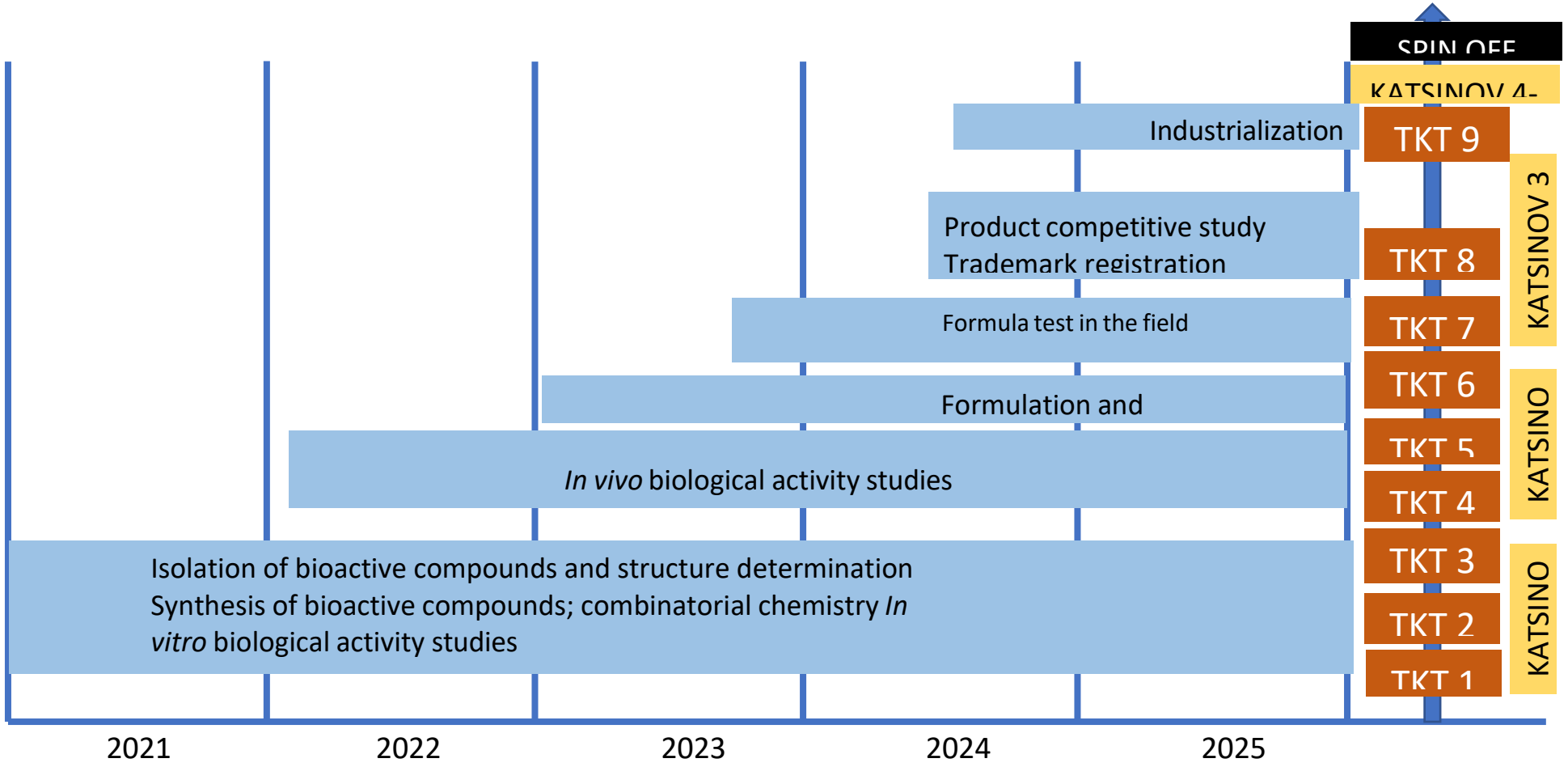
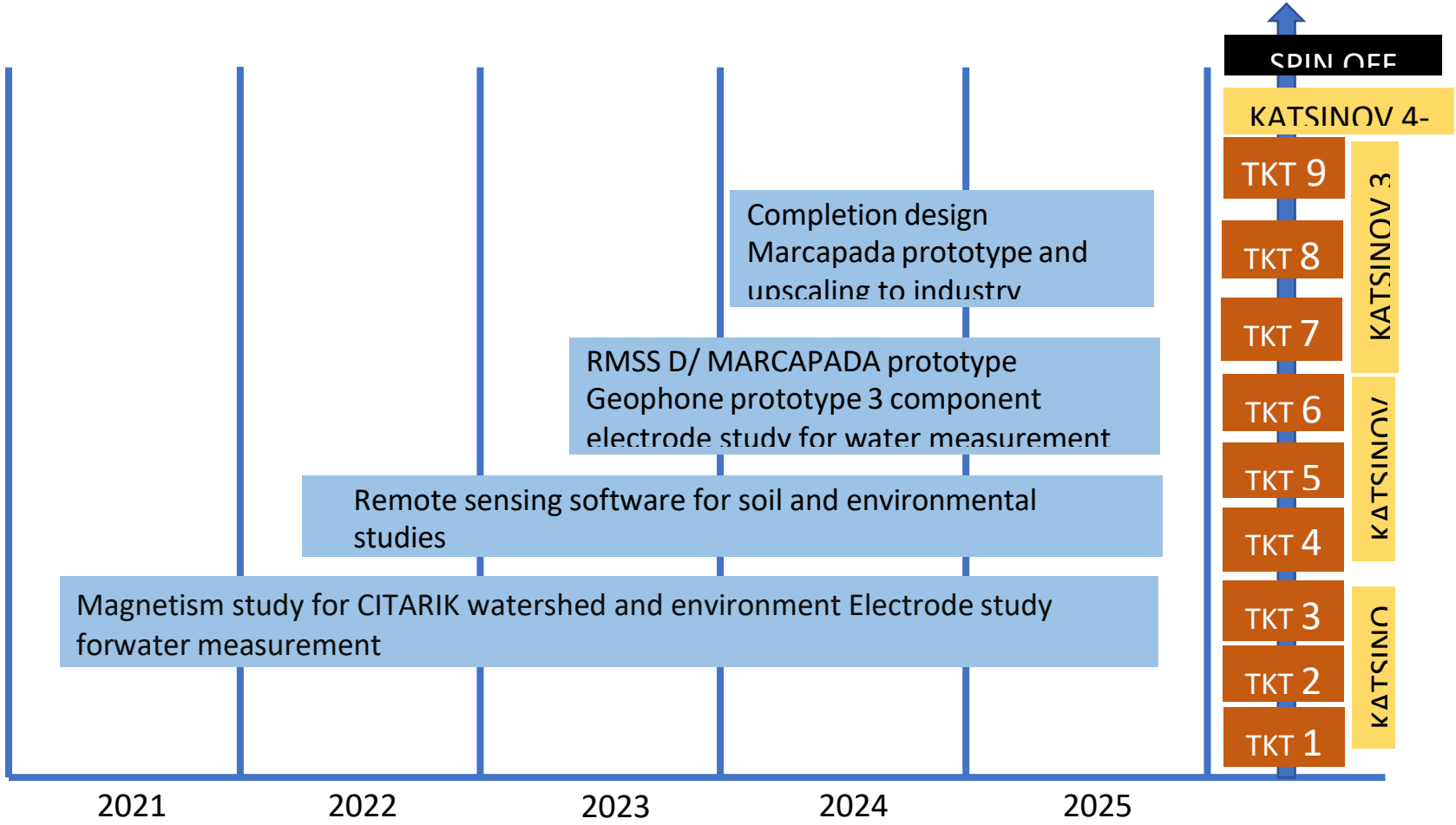


Figure 4.3. Roadmap of Natural Product and Synthesis Study Center

4. MATERIALS AND EARTH ENGINEERING STUDY CENTER

The Center for Materials and Earth Engineering Studies examines the engineering of various things in the field of materials and earth to be utilized for environmentally sound human welfare. The study will start from the discovery and collection of data, data processing, analysis and interpretation of the study data. The center studies and develops *hardware* and *software* that support material and earth studies to support the utilization and development of environmentally sound natural resources. PUSDI also serves cooperation with external parties in joint research schemes and for Pusdi's profit by paying the Faculty of Mathematics and Natural Sciences of Universitas Padjadjaran. Pusdi also carries out social activities, especially to develop the tridarma of Community Service.

The Center for Materials Engineering and Earth Studies in carrying out its activities has collaborated with many domestic and foreign institutions such as: PPGL, PSG, BRIN, Pertamina, PT Geostroom, PT ardhsys data, FACT, University of Brunai Darussalam, Hokkaido University, and University Kaiserslautern.



Gambar 4.4. Roadmap of Material and Earth Engineering Study Center

BAB 5
FMIPA ROAD MAP

5.1. FMIPA Research Roadmap

In previous years, FMIPA's research topics focused on environment, natural resources, innovation and energy conservation. Unpad's RIR 2020-2024 shows that to answer national strategic issues, FMIPA's research topics are spread across Unpad's research pillars, especially on the pillars of environment, food, energy, health, transportation, defense and security, and maritime affairs. Based on the research topics that have been formulated in Unpad's RIR and also collected in the study centers in FMIPA, FMIPA's research topics are combined in the following FMIPA *roadmap fishbone*. All of these research topics are expected to support FMIPA's research objectives, namely to advance technology and culture as well as added value to natural resources, biological resources, and independence in the fields of health, environment, culture, and industry. These research topics have been accommodated and supported by the presence of 6 (six) Centers of Excellence/PUI- PT, 15 (fifteen) Research Centers at universities and 4 (four) Study Centers in faculties.

FISHBONE OF FMIPA RESEARCH ROADMAP

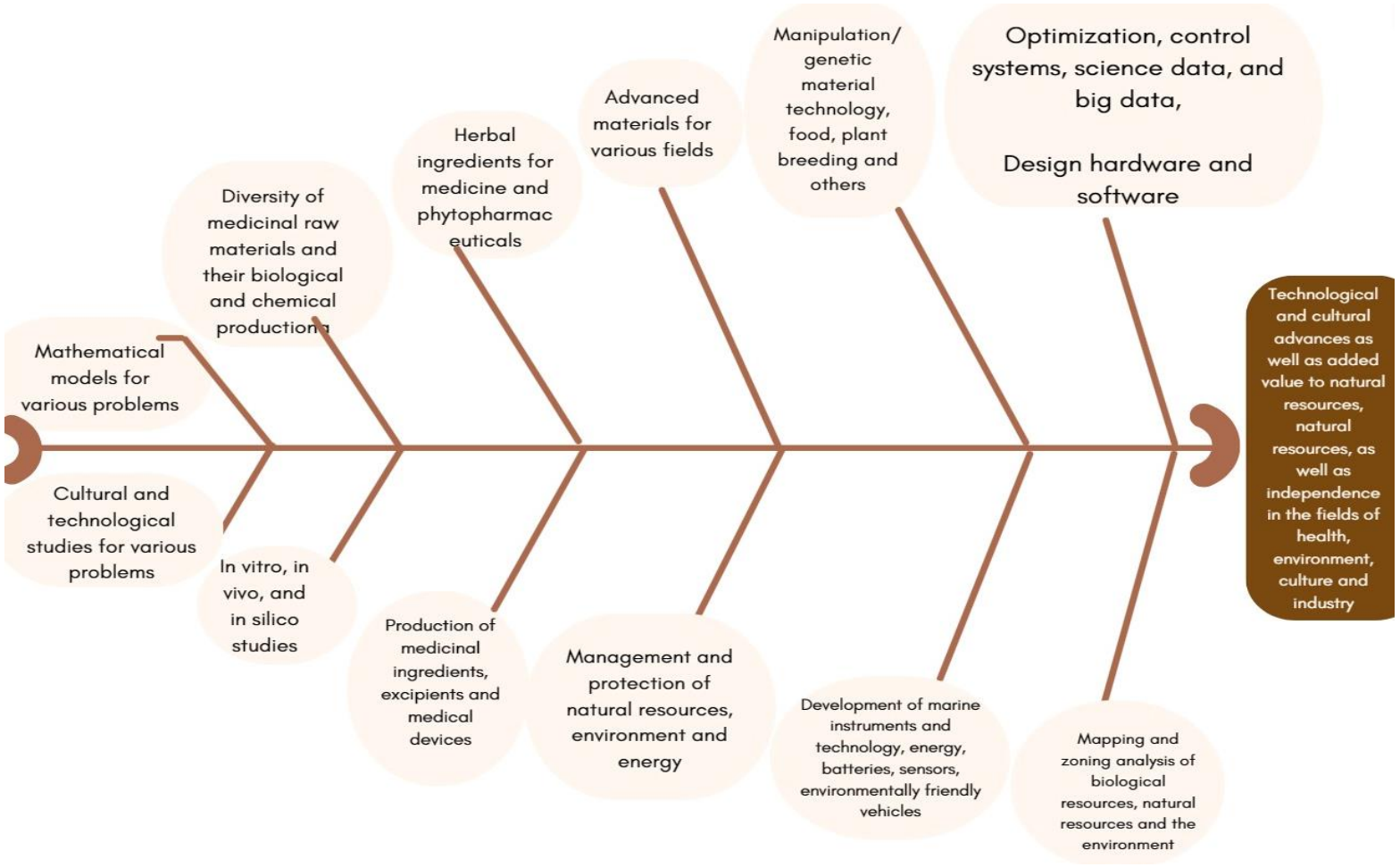


Figure 5.1. *Fishbone* Research *Roadmap* FMIPA Unpad

The road map was prepared based on various legal frameworks, current thoughts and challenges, phenomena that will be faced in the future (the development of science and technology in the industrial era 4.0 and the era of society 5.0, and the impact of the SARS-CoV2 pandemic), as well as the vision of internationalization of FMIPA. As time goes by, research in FMIPA is growing. Currently, FMIPA has four study centers, namely the Center for Modeling and Computation, the Center for Bioprospection of Natural Fibers and Biological Resources, the Center for Natural Products and Synthesis, and the Center for Material and Earth Engineering. Each Study Center in FMIPA has a research scope that is equipped with a research topic scheme and a research road map (road map). The FMIPA road map includes the Pusdi road map and Unpad Research Center with the aim of advancing technology and culture as well as increasing the added value of natural and biological resources and independence in the fields of health, environment, culture and industry. The interdisciplinary approach in determining FMIPA's leading research topics provides an opportunity for every research actor to actively participate in the implementation of each leading research topic. Thus, through the 2021-2025 FMIPA research road map, it is hoped that it will be able to answer various challenges in the 2024 National Long-Term Development Plan, namely realizing an independent, advanced, just and prosperous Indonesian society through accelerated development in various fields by emphasizing the building of a solid economic structure based on competitive advantage.

5.2. FMIPA Service Roadmap

The FMIPA Community Service (PkM) road map is a direction of PkM FMIPA Universitas Padjadjaran for the period 2020 - 2025 towards a faculty that excels in science and technology research results devoted to the community, through the phasing of a series of research and PkM, Computer Science, Geophysics and Electrical Engineering in a structured sustainable manner. The PkM road map is a policy direction in the management of PkM in FMIPA in a five-year period. The PkM road map consists of an umbrella, the implementation of science and technology in each field of study. Departments and Study Programs spearhead the implementation of PkM which is supported by laboratories, and research interest groups. The PkM road map must be a guide for every researcher/lecturer in carrying out PkM by lecturers and lecturers with students, both momentary and sustainable integrative

PkM that can be carried out by study programs and between study programs. The PkM road map is a strategic part in supporting the achievement of the vision, mission and goals of FMIPA Unpad. The road map is prepared based on an analysis of the positioning between functions, resources and challenges from the developing community. For this reason, the road map must be understood by lecturers, students and education personnel. The PkM road map is used as a guide in planning and implementing PkM. The road map is able to create an academic atmosphere in PkM planning. through an integrative and integrated PkM system a good, mutually beneficial relationship is created between study programs / faculties with partners and the community

The PKM road map is adjusted to the lecturer's research road map, this is in line with Unpad's policy of integrating research with PKM. The PKM road map of FMIPA Unpad refers to the University PKM road map based on the Unpad Community Service Master Plan (RIPPM). RIPPM Unpad is one of the strategic plans in the development of higher education that is integrated with RIP (Research Master Plan) Unpad, learning system, regional development policies and national development policies, even international policies, one of which is related to the implementation of Sustainable Development Goals (SDGs) known as sustainable development goals. PKM management includes elements including having a road map, lecturers and students carry out PKM in accordance with the road map and use the evaluation results to improve the relevance of research and scientific development of study programs within FMIPA.

The road map is divided into four, namely the Individual PKM Road Map, the Faculty/Study Center/Department PKM Road Map, the Cluster PPM Road Map and finally the inter-Cluster PPM Road Map (University PPM) and inter-University PPM. The outline of the road map can be seen in Figure 5.2. The following is the PKM Unpad road map for the next five years from 2021-2025.

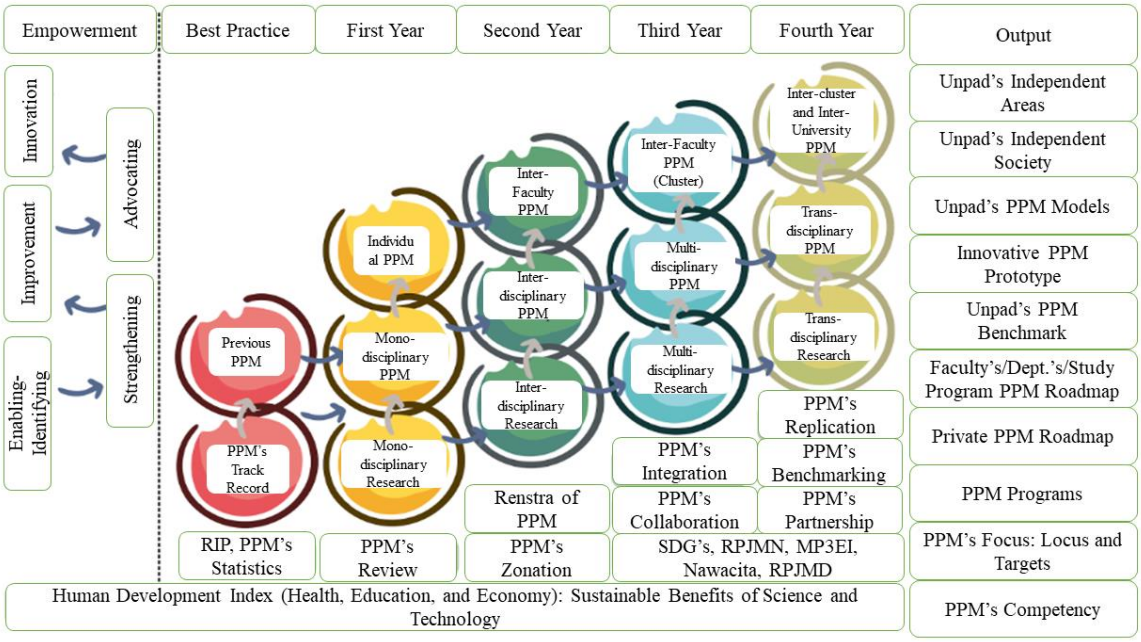


Figure 5.2 . Roadmap of PPM Unpad

Description:

- RIR (Research Master Plan),
- PPM (Community Service),
- RPJMN (National Medium-Term Development Plan),
- MP3EI (Master Plan for the Acceleration of Indonesian Economic Development).

PKM activities developed by FMIPA are the implementation of educational and research activities that prioritize 4 main principles, namely the principle of benefit, the principle of community development, the principle of thinking and the principle of sustainable development. The four principles are shown in the road map in Figure 5.3. The long-term goal of PPM activities is expected to achieve community development that supports sustainable development through counseling and empowerment activities, so as to create benefits in the scope of science and technology and social justice that elevate the identity and dignity of the nation.

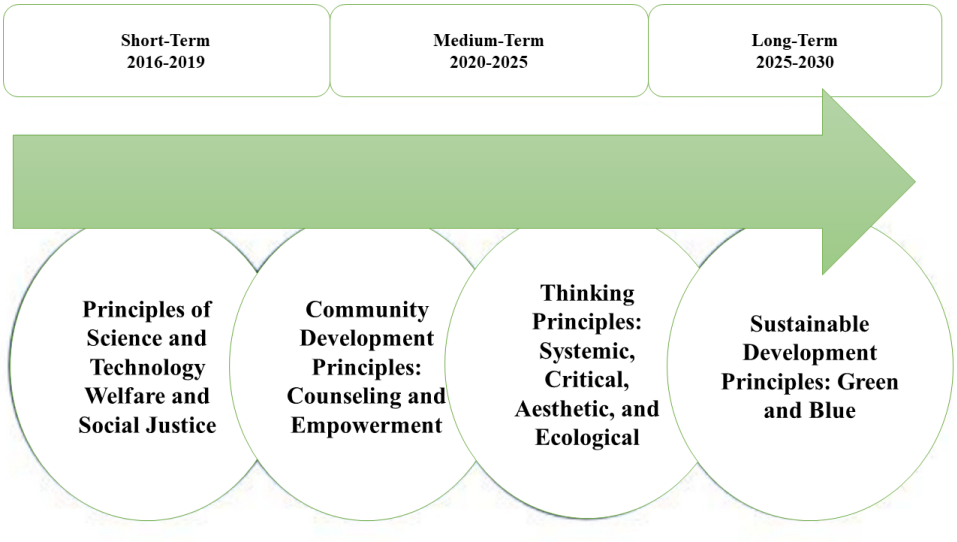


Figure 5.3. PKM activity roadmap

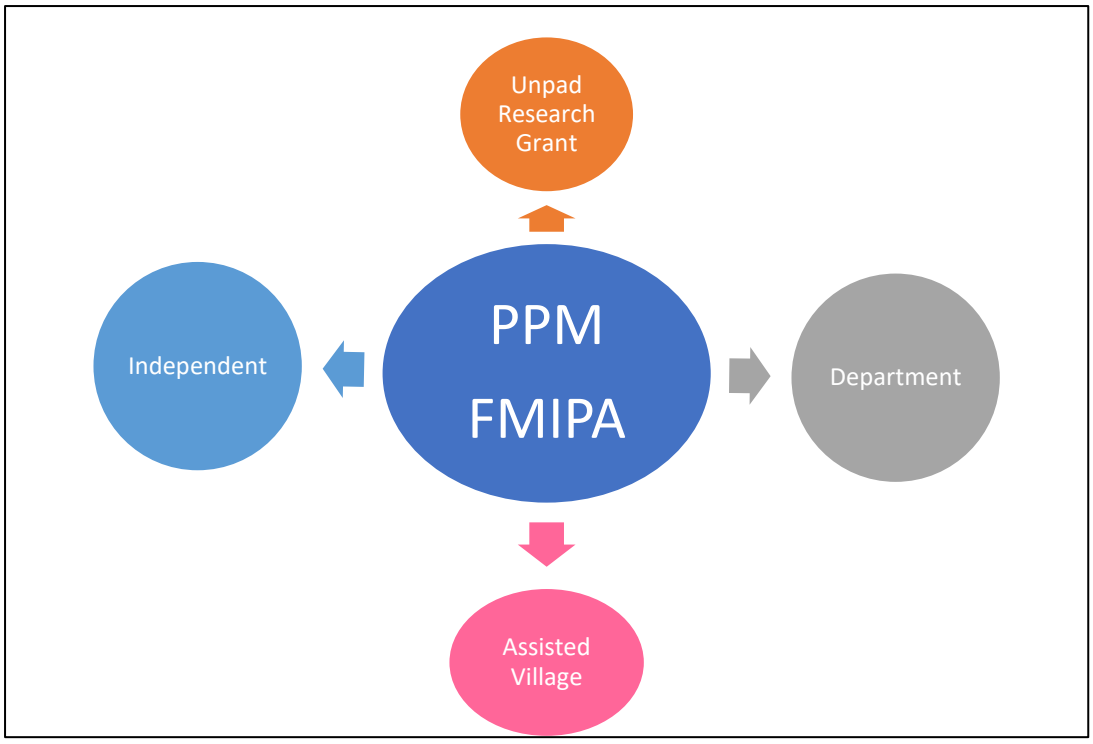


Figure 5.4 PPM activities at FMIPA

Community service activities carried out at FMIPA Unpad currently consist of PPM activities carried out by the Department, those carried out from the Unpad Internal PPM Grant, and those carried out independently. In the future, FMIPA will create a Faculty Assisted Village.

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Rencana Strategis Universitas Padjadjaran Tahun 2020-2024

Rencana Strategis FMIPA Universitas Padjadjaran Tahun 2020-2024

Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 3 Tahun 2020 Tentang Standar Nasional Perguruan Tinggi

PRIORITAS RISET NASIONAL 2020-2024 Kebijakan Untuk Mendorong Pengembangan dan Pemanfaatan Produksi Dalam Negeri, Direktorat Jenderal Penguatan RIset dan Pengembangan Kementerian RIset, Teknologi dan Pendidikan Tinggi