Journal of STI Policy and Management

Publication details, including instructions for authors and subscription information: http://www.stipmjournal.org/

Mechanism of Implementing Technology in The Community of Eastern Indonesia (Case Study in Belu Regency, Nusa Tenggara Timur Province)

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Version of record first published: 15 December 2020

To cite this article: Saparita, R. and Dyah S. (2020). Mechanism of Implementing Technology in the Community of Eastern Indonesia (Case Study in Belu Regency–Nusa Tenggara Timur Province). *Journal of STI Policy and Management,* 5(2), 121–136.

To link to this article: http://dx.doi.org/10.14203/STIPM.2020.183

ISSN 2540-9786 (Print); ISSN 2502-5996 (online)

Accreditation Number: 21/E/KPT/2018

JOURNAL OF SCIENCE, TECHNOLOGY AND INNOVATION POLICY AND MANAGEMENT (STIPM JOURNAL), Volume 05, Issue 02, December 2020

FOREWORD by EDITOR-in-CHIEF

We are pleased to present to the readers with the fifth issue of the Journal of Science, Technology and Innovation Policy and Management. In this issue, we continue to publish the results of interdisciplinary scientific researches in various aspects of STI Policy and Management. This issue, prior issues, and other resources are available at www.stipmjournal.org.

We thank the reviewers and editorial boards for taking their precious time to ensure the quality of the articles through the double-blind peer review process. The seven articles in this volume cover a wide range of topics in STI policy and R&D governance and management. In this issue, we introduce a special topic on *Original Concept Formation.* This is a new focus and scope of STI Policy and Management Journal. A concept formation in technology policy (TP) and management of technology (MOT), including proven soft technology concept based on rigorous data, cumulatively published references, and long experiences in the academic sphere. The original concept formation should deal with soft technology problems, policy context for problem-solving, concept formation, and its effective implementation.

M. Nawaz Sharif presents an original concept formation entitled *Technology for Development: Ten True Stories Revealing the Complexity of Replicating South Korean Success*. The essay comprises ten true stories presented to highlight personally observed problems encountered by Asian developing country leadership who tried to replicate South Korean success in fostering technology innovation induced sustainable economic growth strategy without paying robust attention to the crucial role of creating an "innovation climate/culture" as a necessary foundation for myriad development efforts.

The subsequent articles revealed research findings on the various issue of STI policy and R&D governance and management. First article is presented by Erwiza Erman entitled *Changing Stages of System Innovation at the Ombilin's Coal Mines of Sawahlunto: From Ghost Town to World Heritage.* This paper examines system innovation, a transition from one socio-technical system to another by transforming the historical and cultural area into a world heritage city. The objective of this study is to reconstruct the changing stages of system innovation in achieving the World Heritage status at the Ombilin coal mines site of Sawahlunto.

The second article is composed by Rachmini Saparita and Savitri Dyah, entitled *Mechanism of Implementing Technology in the Community of Eastern Indonesia (Case Study in Belu Regency, Nusa Tenggara Timur Province).* This paper focuses on the mechanism of technology implementation to increase society's welfare. The study also evaluated technology implementation activities in the period 2003 to 2019, using meta-synthesis. The analysis found that there are five types of technology transfer mechanisms carried out by researchers at LIPI.

The third article is composed by Budi Triyono, Ria Hardiyati, and Aditya Wisnu Pradana, entitled *Lack of Contribution of the Indonesian R&D Program to Economic Sector: Learning from the RPJMN Implementation*. Through a review of the National Medium-Term Development Plan (RPJMN) documents on the S&T Sector period of 2015–2019, this article attempts to analyze various obstacles related to the minimal contribution of Indonesian R&D Programs in supporting Indonesia's economic sector and national competitiveness.

Wati Hermawati presents an article entitled *Key Success Factors in Managing and Implementing Public Funded R&D Projects in Indonesia*. In this paper, she mentioned that the role of public-funded R&D institutions in supporting innovation and economic performance of MSMEs (micro, small and medium enterprises) is still very small. Therefore, the success factors in managing and implementing R&D projects at R&D institutions should be identified, particularly in providing solution for MSMEs' problems. Through the two case studies, this article provides key success factors and lessons learned to improve R&D project activities at PRCs.

The fifth article is presented by Trina Fizzanty, Kusnandar, Sigit Setiawan, Radot Manalu, and Dini Oktaviyanti, entitled *The International Research Collaboration, Learning and Promoting Innovation Capability in Indonesia Medical Sectors.* This article presents the case of eight international collaborative research projects in medical research in Indonesia. The research found that International research collaboration has opened the opportunity for Indonesian researchers to learn and upgrade their capability and contribute to the scientific arena. However, none of international research projects reached the commercialization stage yet, but some of which were at the beginning of clinical trial stage.

Finally, Budi Harsanto presents an article entitled *Eco-innovation Research in Indonesia: A Systematic Review and Future Directions*. The article analyzes the recent development of eco-innovation research in Indonesia and provides some potential avenues for future research. The analysis was carried out using Systematic Literature Review (SLR) techniques to synthesize knowledge development of a scientific field in a structured, transparent, and reliable manner.

The editor of STIPM Journal are dedicated to working with scholars in existing and emerging STI issues and produce high-quality papers to expand knowledge in the field of STI Policy and R&D Governance and Management. We believe that all the papers published in this issue will greatly influence on the STI Policy and Management for Sustainable Development.

The STIPM Journal is indexed by Google Scholar, ISJD, IPI, DOAJ, BASE, SINTA, and OCLC World Cat. This makes the journal dissemination wider.

The editor-in-chief acknowledge and are very grateful to the authors, the editorial board, the section editors, the designer, the staff of the LIPI Press Publishing Office, and everyone who has contributed to the publication of the STIPM journal. We are also very grateful to our future readers. By inviting the readers to publish your research results articles in this journal, we believe in the meaningfulness and future collaboration as well as to provide a higher scientific platform for the authors and the readers, with a comprehensive overview of the most recent STI Policy and Management research and development at the national, regional, and international level.

Happy New Year 2021 to all of you!

Jakarta, 15 December 2020

Editor-In-Chief

JOURNAL OF STI POLICY AND MANAGEMENT

Volume 5, Number 2, December 2020

LIST OF CONTENTS

LIPI

STI POLICY AND MANAGEMENT

Journal homepage: http://www.stipmjournal.org

Mechanism of Implementing Technology in The Community of Eastern Indonesia (Case Study in Belu Regency, Nusa Tenggara Timur Province)

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ARTICLE INFO

Article History:
Received : 21 November 2019
Revised : 25 October 2020
Accepted : 21 November 2020
Available online : 15 December 2020

Authorship Contribution:
All authors have equal contribution as main contributors.

Keywords:
Technology implementation,
MSMEs,
Community

ABSTRACT

Indonesian Institute of Sciences (LIPI) is one of the R&D institutions that develops and implements technology for users (UKM and community). Researchers at LIPI conducted various technology implementation activities in Belu Regency based on their expertise. However, most of them only focus on the implementation of technology, not discuss the mechanism and maintenance of its use after implementation. How should technology be transferred so that it is used by the community continuously, or at least its failure implementation can be minimized? This paper establishes a pattern or mechanism of technology implementation that can be used to increase its use in society. First, this study evaluated technology implementation activities from 2003 to 2019 using meta-synthesis. The analysis showed that there are five types of technology transfer mechanisms carried out by researchers at LIPI with three important components, LIPI, Belu Regional Government, and MSME (community). But, the function of regional government is only as an intermediary for LIPI and MSME, so capacity building needs to be done at the Regional Government level. This research also proposed two additional components in building technology implementation mechanism in Belu Regency, i.e. Ministry of Villages, Disadvantaged Regions and Transmigration and markets creation from technology-based products. With a combination of greater resources and access to the market, technology implementation should produce optimal results.

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http://dx.doi.org/10.14203/STIPM.2020.183

I. INTRODUCTION

Belu Regency, East Nusa Tenggara Province, Indonesia, is one of the regions bordering the Democratic Republic of Timor-Leste and consists of 76 villages. Almost 90% (68 out of 76) of villages are poor and isolated (Ministry of Village, Development of Disadvantaged Regions and Transmigration, The Republic of Indonesia, 2018). Essentially, it still has adequate natural resources, especially in agriculture, including food crops, livestock, plantations, capture fisheries (BPS of Belu Regency, 2019). For daily needs, most people depend on the agricultural sector (Dyah et al., 2011). Inadequate infrastructure in many fields has become a barrier in economic development and forced them into subsistence positions (Saparita et al., 2015). With this condition, the community is unable to obtain the technology and innovation needed to improve their capacity and economic life, coupled with the lack of access to technology and innovation.

With the available resources, the community can actually use it to obtain a better life, but they need technological assistance. In Kenya, technology was important driver influencing performance in the manufacturing SMEs. There was a strong positive and significant relationship between technology and performance of an SME, manufacturing firms interested in (Kihara, Bwisa, Kihoro, 2016). From Kenya's case, communities in remote and isolated areas, similar to Eastern Indonesia, must have access to the technology needed. They must learn how to use technology so they can create innovations that benefit their lives and work.

Indonesian Institute of Sciences (LIPI) is one of the R&D institutions that develop and implements technology to users (micro-small-medium enterprises (MSMEs) and community). Researchers at LIPI carried out various technology implementation activities in Belu Regency based on their expertise. From 2003 to 2019, LIPI implemented technology through various programs, such as the competitive LIPI program Phase I (2003–2007) and Phase II (2008–2013), thematic program, the "Science and Technology for The Region" and national priority program (2018–2019). However, most of their researchers only focused on technology implementation, not discussing the mechanism and maintenance after implementation. So that after 17 years of ongoing activities, many of us are still running the same mechanism and do not pay attention to the pattern and what happens after the implementation, whether it affects the increase in technology use in the community or not.

We believe that the pattern or mechanism of technology implementation in the community is very important to know as we learn how technology must be transferred so that technology is used by the community or at least the failure of technology implementation can be minimized. Technology that has been successfully disseminated to the community is noticed by the use of technology and its improvement. It is adapted to the times and is used to increase productivity that drives community economic improvement and regional competitiveness. Therefore, this paper focuses on the construction of new technology implementation mechanisms (as a novelty) to improve their use in community.

First, the research evaluates technology implementation activities carried out by LIPI researchers in Belu Regency which have been going on from 2003 to 2019. The result of the evaluation brings to an understanding of the importance of technology transfer for communities and SMEs, to increase their capacity and productive activities and economy. We use the systematic method of synthesis (meta-synthesis) in building a technology transfer mechanism for community in eastern Indonesia.

II. ANALYTICAL FRAMEWORK

Mechanism of technology transfer in this study focused on the transfer from R&D (LIPI) to the community (MSMEs). Technology is defined as a way to complete a task mainly using technical processes, methods, or knowledge (Merriam-Webster, 2019). Technology is not only 'tools', but also knowledge. When technology 'products' are transferred or disseminated, knowledge about the use and application of these 'products' also must be conveyed or transferred. Because, without a knowledge base, 'technology' which is a 'physical entity' cannot be used (Sahal, 1981).

Park, Im, and Kim (2011) explained that for the success of knowledge or technology transfer collaboration between the parties is needed.

The main focus of technology transfer process are R&D institutions (as technology providers), MSMEs or communities (as technology users) and regional government (as policymakers that support technology transfer). This is known as the triple helix model. The use of technology is important in creating regional competitiveness (Bhavani, 2006). Collaboration of R&D institutions, business (MSMEs and markets) and regional government support can be the basis of developing a knowledge-based economy (Leydesdorff, 2012). While the liaison institution acts as an intermediary for R&D in transferring technology to MSMEs or users (World Bank, 2007). The analytical framework for the technology transfer mechanism in this study is shown in Fig.1.

As is shown in Fig. 1, the framework consists of five interconnected pieces, such as technology provider, intermediary users (MSMEs/ communities), regional government and markets. R&D produces technology that is transferred to MSMEs or communities. In the process of technology transfer, R&D requires intermediaries in assisting MSMEs or communities. The existence of intermediaries can be filled in by regional government staff who continue coaching technology transfer process so that the technology is used. Regional government and R&D work together and support each other in technology transfer activities.

Capacity building of local staff (intermediaries) needs to be done so that they can accompany the process of technology transfer to the community until the technology is adopted by the user. Various policy supports are needed, including the provision of production infrastructure, markets, energy sources, roads, transportation, adequate water resources and other supporting production resources. When technology is adopted, MSMEs produce technology-based products (good quality), which can be sold to the market so they earn money for income and self-empowerment. The existence of markets encourages economic improvement, both for MSMEs or communities and regional governments.

III. METHODOLOGY

A qualitative evaluation approach was used in this research to study the technology implementation mechanism applied by researchers in the field. All activities during the 17-years period (2003–2019) were analyzed systematically using qualitative synthesis (meta-synthesis). Qualitative synthesis is a systematic approach in gathering, analyzing and interpreting results, examining experiences

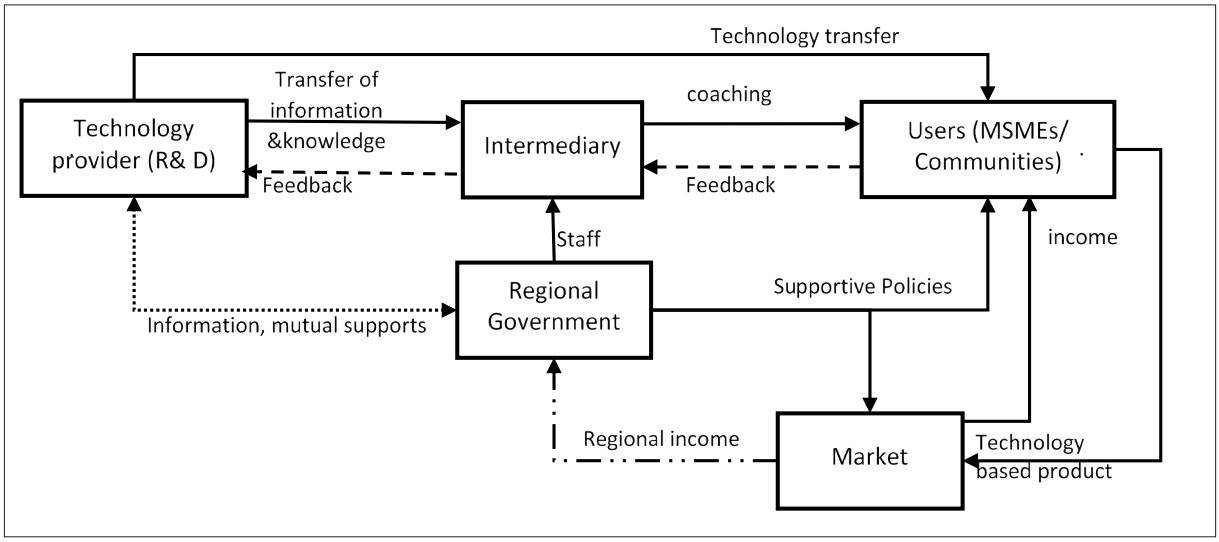

Figure 1 Analytical Framework Transfer Technology Mechanism from R&D to the User (MSMEs/Community) (framework was developed by authors)

and perspectives, and providing evidence for development, implementation, and evaluation (Barnett-Page & Thomas 2009; Lee et al., 2015). Data were collected from activity reports that use different methods, then systematically synthesized to interpret findings and then integrate those findings (Ring et al., 2011). Meta-synthesis method in qualitative synthesis was used because of its advantages which can synthesize systematically and integrate findings from qualitative studies (Lachal et al., 2017). This method is carried out in six steps, (1) determining research questions and inclusion criteria, (2) choosing a study, (3) assessing its quality, (4) extract and present formal data, (5) analyzing data and (6) express synthesis (Lachal et al., 2017).

To understand and interpret the findings correctly, it requires direct contact with the socio-economic and cultural environment where the activities took place (Tayabas, Leon, & Espino, 2014). For that reason, various methods to collect data and information in qualitative evaluation approach were used.

1) Studying and reviewing the technology implementation activities report of survey results (Saparita & Dyah, 2007; Saparita, 2007). The survey interviewed all components involved in technology implementation activities (such as related researchers, target communities and head of Regional offices and staff) for the period 2003 to 2007 in Belu Regency. The survey was conducted to gain people's response to whether the implemented technology was appropriate enough. From the survey also we derived information about the implementation process until the technology is used or is abandoned (Ponto, 2015). Survey could collect information from respondents through their responses to questions related to the implemented technology (Check & Schutt, 2012) and explored the behavior of the community who implemented technology (Singleton & Straits, 2009).
2) Various documents related to technology implementation activities in Belu Regency.
   a) Documents of competitive LIPI program
      1. Phase I (2003–2007): Dyah, Carolina and Hidajat (2008), Wawo (2008), Tappa et al. (2008), Sudaryanto and Abbas, (2008), Army (2008), Admono et al. (2008), Soedjatmiko, Arsadi and Widiyono (2008).
      2. Phase II (2008-2013): Widiyono (2010).
   b) Development Center for Appropriate Technology (2008–2013).
   c) Thematic program.
   d) The "Science and Technology for The Region" program (Development Center for Appropriate Technology (2008–2013).
   e) National priority program (2018–2019).
   f) Research Center for Appropriate Technology (2018–2019).
3) In-depth interviews conducted in 2011 and 2015 with the community who were still using the implemented technology. This was done because they provided more detailed information than what was available through surveys (Boyce & Neale, 2006). An action research was conducted in 2018 and 2019 for implementing a previous strategy that exhibited positive effects on local society.

IV. RESULTS AND DISCUSSION

This study was using a meta-analysis with six steps explained by (Lachal et al., 2017).

Step 1: Define the Research Questions and the Inclusion Criteria

Research questions accompany the framework (Fig. 1).

1) How do researchers transfer technology to the community?
2) How is the regional government involved in this activity?
3) How did intermediaries help transfer technology?
4) How was the technology implementation mechanism carried out?
5) Were any markets formed?

The participants of this study were researchers involved in technology implementation activi-

ties in Belu Regency, in the period 2003–2019, as mentioned in data collection. Because the case under study is a 17-years institutional activity case, we assumed that the synthesis method in building a technology transfer mechanism can produce a better, more relevant, more complete and clear.

Step 2: Driving the Selection of Study

Belu Regency, East Nusa Tenggara Province, was selected for the case study, because its strategic area as a border region, a window for foreign countries. Unfortunately, this region is very poor (Ministry of Village, Development of Disadvantaged Regions and Transmigration, The Republic of Indonesia, 2017) despite having valuable resources (BPS Belu Regency, 2019). On the other hand, the lack of understanding of the use of technology in community was also a consideration (Dyah et al., 2011). Technology must be disseminated and utilized by the community to manage and process the valuable natural resources. Various efforts must be managed to improve the competitiveness of Belu Regency.

The review was undertaken from technology dissemination activities by LIPI research functions to formulate a new pattern or mechanism of technology transfer that should be implemented in order to encourage its utilization in the community and is expected to improve the economy and regional competitiveness.

Step 3: Quality Assessment

When viewed from the results of technology, we considered all selected studies had good quality because researchers had passed various requirements before the research program was implemented. So, if it refers to the assessment criteria recommended, such as research objectives, appropriateness of methodology, strategies for research purposes; data collected in a way that addresses research issues, ethical issues, and research value; all research criteria were completely met (Higgins et al. 2019; Lachal et al. 2017). The problem was not in terms of technology, but in terms of its implementation in society.

Step 4: Extracting and Presenting the Formal Data

In this step, Lachal et al. (2017) recommended to identify and summarize the results of the object of study. There were twelve selected research activities during the period 2003–2019 to analyze showed in the analysis and synthesis (Step 5).

Step 5: Analyzing the Data

There were three steps of this stage. The first step was to read carefully and repeatedly for each study, so that we could assess, identify, extract, record, organize, compare, map, and verify it (Thomas & Harden, 2008; Lachal et al., 2017). The second step was coding and the third step were grouped and categorized.

There are twelve activities selected, which are clustered into five technology groups.

1) Technology for basic needs
   a) Building micro-hydro technology for electrification in Haikesak Hamlet, Tohe Village, Raihat District (Belu District) (2009).
   b) Well drilling for clean water supply in dry areas (2008–2009) (Development Center for Appropriate Technology, 2008–2013).
2) Technology for environmental conservation
   a) Sandalwood agroforestry activities (2005–2006) (Wawo, 2008).
   b) Conservation of land around the reservoir (2005–2006) (Widiyono 2009; 2010).
3) Engineering technology
   a) Installation of point-to-point digital radio equipment (2005–2006) (Army, 2008).
   b) Implementation of block ice machines for fishing communities (2005–2006) (Admono et al., 2008).
4) Technology in animal husbandry by improving the quality of generic beef cattle and forage farming (2005–2006) (Tappa, 2008).
5) Food processing technology and agro-based industry

a) Coffee and cashew processing (2003–2006).
b) Wood workshop processing equipment for coffee (upstream) and cashew crushing equipment (2004–2005) (Sudaryanto & Abbas, 2008).
c) Making banana peel grapes and instant herbal remedies from local plants (2005–2006) (Saparita & Dyah, 2007)
d) Producing shredded fish (2005–2006, 2018)
e) Making instant bose corn and liquid smoke from corncob waste (2019) (Research Center for Appropriate Technology, 2018–2019).

1. Technology Implementation for Basic Needs

Technology implementation for basic needs was stressed in bore wells for clean water and micro-hydro technology for electrification. The construction of bore wells, especially in coastal and remote areas where lack of water, was carried out in 2008. The well was still functioning until 2019.

The implementation of micro-hydro technology for electrification was built in Tohe Village in 2009. In early 2010, micro-hydro could only illuminate 50 houses, but it expanded to 150 houses in 2015. Training of micro-hydro operators and institutions establishment that manage payment of electricity use was formed and implemented. The mechanism is described in Fig. 2.

The technology implementation mechanism for basic needs involved regional governments from the beginning of the program. The technology, especially related to water and electricity, was highly used by the community. However, the sustainability of this program depends on the presence of regional governments that was represented by relevant officers. Changes in policy affect the use of technology. In the case of the implementation of micro-hydro technology for electricity, it was only monitored by the Mining and Energy Office until 2016. When government policies eliminated the existence of the office at the regional level in 2016, the activities of implementing technology (micro-hydro) was no longer supervised. This had an impact on the continued use of micro-hydro technology. When the turbine shaft was damaged in 2017 and the power went out, there were no more officers taking care of it. Fortunately, in 2019, electricity from National Electric Company had entered Tohe Village.

2. Technology Implementation for Environmental Conservation

Land conservation around small lakes (water storage) in Leosama Village was carried out in 2005–2006 (Widiyono, 2009). Many trees planted surrounding the lake were still growing. Conservation involves communities in three hamlets, but not involving Plantation and Agriculture Office (Saparita & Dyah, 2007). Nevertheless, the communities still maintain the lake as they feel the benefits as it provided water for irrigation for their crops.

Sandalwood forest conservation was carried out in Dirun Village, Lasiolat and Teun in 2005 (Wawo, 2008). This activity did not involve Forestry Office, only the community surround-

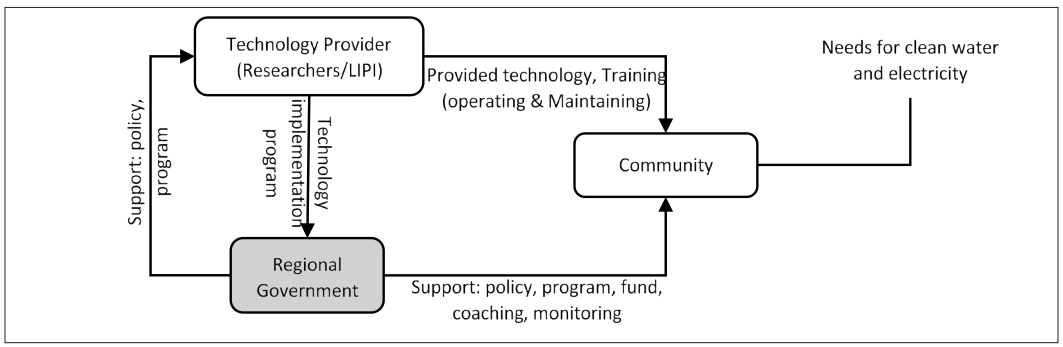

Figure 2. Technology Implementation Mechanism for Basic Needs

ing the area (Saparita & Dyah, 2007). Currently, the forest area at Dirun Village had become sandalwood forests. However, there was no information so far about technology transfer to the community regarding sandalwood nurseries, or anything else related to conservation technology for sandalwood tree. Technology implementation mechanism is very simple (Fig. 3). The lack of involvement of the regional government still allowed the implementation of technology because the benefits can be felt directly by the local community.

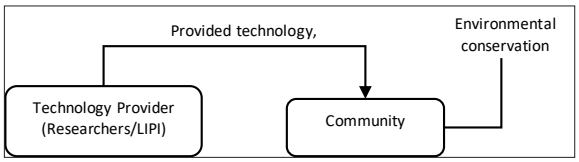

Figure 3. Technology Implementation Mechanism for Environmental Conservation

3. Technology Implementation of Engineering Field

LIPI, in collaboration with Marine and Fisheries Office, implemented the ice block manufacturing technology in 2005 for a small factory. The involvement of regional government was an effort to guarantee its sustainability (Fig. 4). The small factory was managed by staff from Marine and Fisheries Office, but only lasted a few months. LIPI researcher provided technical guidance to operate the factory and equipment installation. Nevertheless, when operating a machine, the operator was not following the operational procedures, i.e. the operator did not check the cleanliness of the water as the raw material. Therefore, when the water used contains small stones, the ice block-making machine broke directly. The operator could not repair it so the ice block factory no longer operates (Saparita & Dyah, 2007).

Actually, nowadays fishermen and traders at the fish auction location need ice blocks. However, because the ice factory was no longer in operation, the current need for ice block in coastal areas in Belu Regency obtained from household-scale refrigerator.

Communication technology was needed in remote and isolated areas in Belu Regency. The implementation of communication technology included the design of rural telephone radios and transmitter stations starting from 2004 to 2007 in collaboration with Information & Communication Office. The technical guidance provided by LIPI was limited to operate the telephone, equipment installation, and technician training who were responsible for the transmitter. At the time, local institutions to manage telephone booths were formed. Until December 2018, the transmitter stations became Belu-TV and has been collaborating with national TV station (SCTV) since 2009 for sustainable broadcasting. Unfortunately, in 2019 Belu TV was stopped due to no fund allocation from the Regional Government of Belu. Since 2009, while the telephone booth did not operate, cellular phones spread out to various parts of the country. Technology implementation of engineering field is described in Fig. 4.

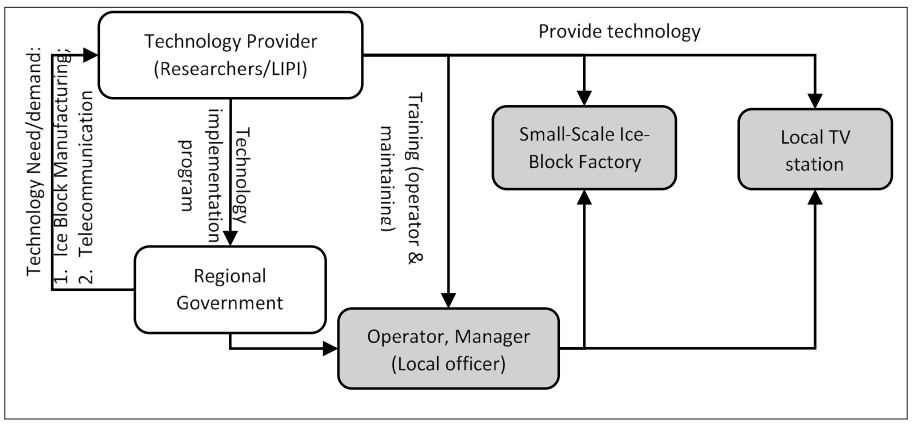

Figure 4. Technology Implementation Mechanism for Engineering Field

4. Technology Implementation of Animal Husbandry

In 2005, artificial insemination technology implemented to a number of cattle farmers in Belu Regency involving Livestock Office (Saparita & Dyah, 2007). This program only ran for two years. Artificial insemination applied for ten cows intended for cattle farmers (Tappa et al., 2008). Unfortunately, this program was not successful because sperm injection was done at the wrong time due to the limited time of the researchers in assisting the cattle farmers. Moreover, cattle farmers did not receive training on how to do artificial insemination. This happened because of the lack of supporting equipment for artificial insemination in the area (Belu Regency) (Saparita & Dyah, 2007). Technology implementation mechanism for animal husbandry is described in Fig. 5.

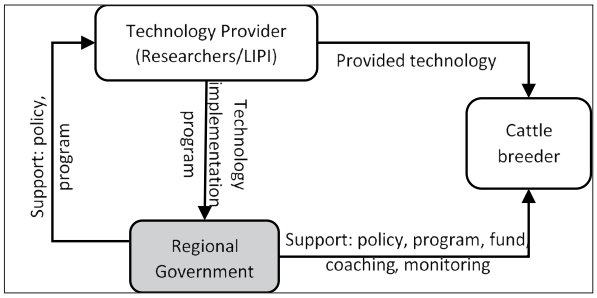

Figure 5. Technology Implementation Mechanism for Animal Husbandry

5. Implementation of Food Processing Technology & Agro-based Industry

Implementation of food processing technology is a way to optimize local resources in the community. The initial stage was to identify technological needs in the community. In 2003, one of the problems identified was about banana peel waste and polluting the environment. On the other hand, there was a need to fulfill wine in church activities. Therefore, the technique of making wine from banana peel was trained for selected communities (Saparita & Dyah, 2007). There was one household-scale business that run until 2015 (Development Center for Appropriate Technology, 2015), but it stopped running in 2019 because it was old. The mechanism was described in Fig. 6.

In 2004, training in processing instant herbal drinks and banana chips were held because of the abundant resources in the backyard. Many households in Belu use their backyard to grow various herbs and bananas.

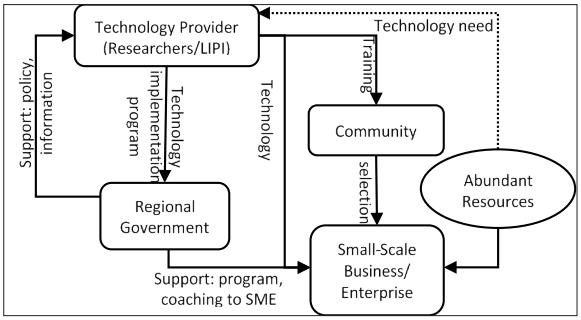

Figure 6. Technology Implementation Mechanism of Food Processing and Agro-based Industry (First Version)

In 2005, training in making shredded fish and fish crackers was conducted in the fishing village area to process excess fish products. Due to difficulties in finding small businesses that were willing to accept and use the technology that was introduced, a little change was made to the first implementation mechanism. Attention in running small-scale businesses was a factor in the selection of target communities. For some people who were interested in running a business, LIPI provided technology and also business management training. Since 2007, several small businesses (household-scale) have developed, some of them became food processing instructors. Village and Community Empowerment Office then continues coaching to motivate SMEs in implementing technology. This first improvement is described in Fig. 7.

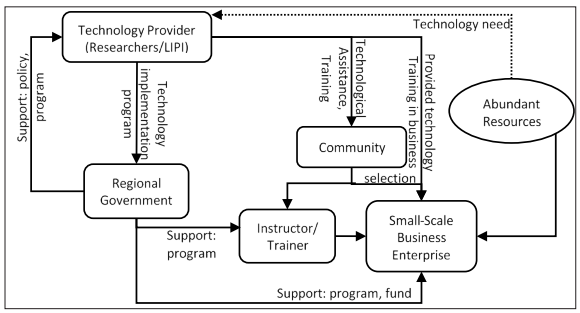

Figure 7. Technology Implementation Mechanism of Food Processing & Agro-based Industry (Second Version)

In 2009, technology implementation mechanism was emphasized on optimizing local resources to improve the community's economy. Regional Government gave access to markets. The 'new' mechanism (third version) was carried out after evaluating the results of second version. Improving the economy of community must consider the existence of the market (Fig. 8).

The technology implementation in 2009 was focused on fish processing in fish producing areas and post-harvest processing of plantation commodities (coffee, cashew, and candlenut) in each of the agricultural commodity-producing regions (Development Center for Appropriate Technology, 2008–2013). The training was focused on establishing micro-scale businesses commodity processing.

Three micro-scale fish processing businesses and one coffee processing business were established. They were also equipped with technological tools. Village and Community Empowerment Office coached and supported them through small programs and funds. In 2019, one SME in fish processing and one in coffee processing developed their business, while the others are in a stagnant condition.

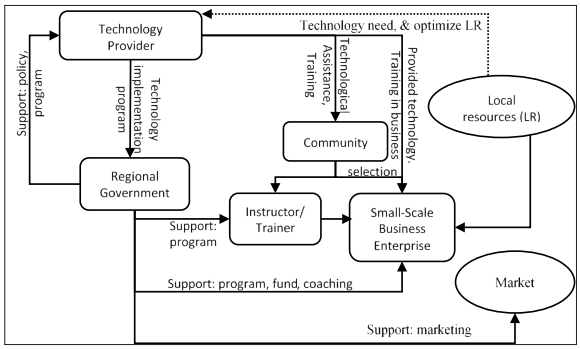

Figure 8. Technology Implementation Mechanism of Food Processing & Agro-based Industry (Third Version)

The implementation of food processing technology through training was conducted again in 2018 based on fish processing in fishing villages and coffee processing in coffee-producing villages. From the training results, two small shredded businesses grew with innovations in improving the quality and local taste of shredded product (Research Center for Appropriate Technology, 2018–2019). In addition, they were also capable and trusted to be instructors in food processing. Training for coffee processing conducted in collaboration with the Indonesian Coffee and Cocoa Research Institute (Saparita, Karsani, & Hidajat, 2019). The coffee small-scale business had already applied coffee processing technology (downstream), but the upstream coffee processing technology was not applied because at the beginning of this year (2019) it was not coffee harvesting time. Technology implementation mechanism (fourth version, Fig. 9) followed the third version with additional knowledge of good packaging to prolong the product shelf life also increase the quality of the product. In addition, collaboration with other research institutes were conducted to add more value especially for coffee commodity both in good cultivation practice, post-harvest and processing coffee beans.

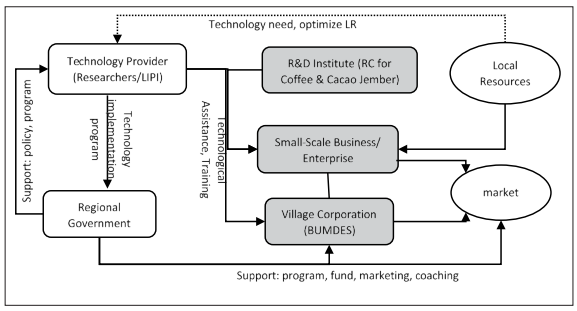

Figure 9. Technology Implementation Mechanism of Food Processing & Agro-based Industry (Forth version)

In general, food processing technology training was conducted for ten selected communities and five staff from the regional government. In 2019, a number of small-scale entrepreneurs developed from their involvement in the technology implementation program had managed to develop their business, whereas three local office staffs (from the Village Community Empowerment Office) were becoming food processing technology trainers at the local level. Working together with business actors (SMEs) for innovations could be one effective method in transferring technology (Knaggårda et al., 2019).

Step 6: Synthesis of Technology Implementation Mechanism in Belu Regency

From the analyses results, we found that there are five types of technology transfer mechanisms carried out by researchers at LIPI. The entire technology selection is preceded by a survey of the identification of technological needs conducted in 2003 by Dyah Carolina and Hidajat (2008). From the survey results, LIPI researchers then executed the implementation of technology by five types (mechanism showed in Fig. 10).

1) Type 1: technology selection - regional government collaboration - technology installation.
2) Type 2: technology selection - regional government collaboration - formation of small scale business enterprise (MSMEs/farmer groups) - technology installation.
3) Type 3: technology selection - regional government collaboration - formation of MSMEs/farmer groups - technology installation - technical guidance.
4) Type 4: technology selection - MSMEs/farmer groups - technology installation - technical guidance - other knowledge support.
5) Type 5: technology selection - regional government collaboration - MSMEs/farmer groups/pilot plant - installation - technical guidance - other knowledge support.

LIPI, Regional Government and MSME/community are important actors in the process of implementing technology. LIPI as a research institution was indeed required to produce technology and must be disseminated to the community. MSMEs as users are entitled to receive technology and use it for productive activities, especially in producing technology-based products. What is interesting in this study was the function of Regional Government, which was only an intermediary, which directed LIPI to disseminate technology to the public/community. This condition needs to be corrected. How can Regional Governments become stronger in carrying out their duties as the formation and implementation of policies conducive in increasing the use of technology so that innovation can lead to increased competitiveness in the regions? One of which is capacity building for leaders and staff.

Proposed Technology Implementation Mechanism in Eastern Indonesia for Optimal Utilization

From the mechanism that has been implemented (Fig. 2 to 8), almost all types of mechanisms involved Belu Regional Governments in the technology transfer process. Indeed, there was some researchers who did not involve regional government in their activities and the program worked because it greatly affects the lives of the people themselves, such as environmental conservation. Technology implementation program that was not felt directly by the wider community, but only by someone being targeted, some obstacles to the acceptance of technology occurred.

From information collected in the field of all the documents, the role of regional government was prominent in the role of its staff as intermediaries in technology implementation activities. regional governments did not produce many policies that support activities. One reason for the lack of Belu Regional Government policy support is because of poverty in Belu. Regional

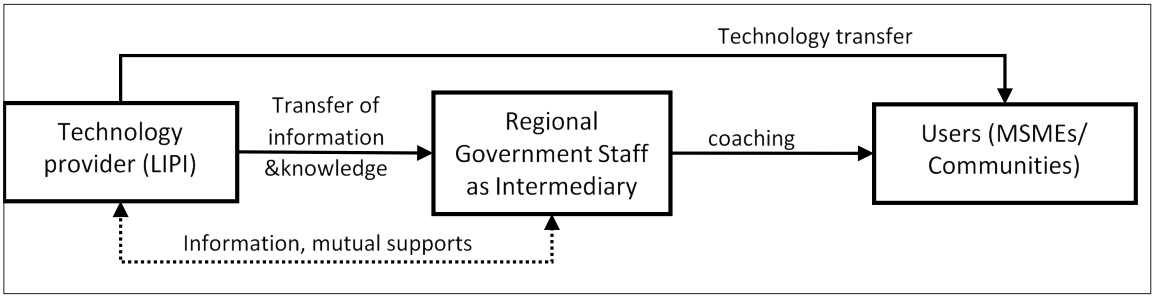

Figure 10. Current Technology Implementation Mechanism in the Eastern Indonesian Community

development in Belu is carried out by the Central Government of Indonesia. The construction of infrastructure for access roads to rural areas was carried out by the Ministry of Villages, the Development of Disadvantaged Regions and Transmigration (2018), while the construction of main roads by the Ministry of Public Works and Housing (2018). Besides LIPI, technology for rural areas is complemented by the Ministry of Villages, the Development of Disadvantaged Regions and Transmigration (Saparita et al., 2019). So, the role of the central government is very important in Belu Regional Development. Unfortunately, LIPI did not collaborate with the ministries whose carrying out development in Belu Regency, especially with the Ministry of Villages, the Development of Disadvantaged Regions and Transmigration. The technology implementation program carried out by LIPI and the ministry ran independently. If collaboration were established, the synergy of activities between stakeholders in regional development through technology implementation was expected to generate regional development significantly. Therefore, we propose the mechanism of technology implementation for Belu Regency and others (poor) regions in eastern Indonesia (Fig. 11).

1. Capacity Building: Technical Training and Continuous Coaching/Assistance

Most of technology implementations carried out by LIPI (Fig. 2 to 9) are accompanied by capacity building of local communities, so that they can develop their skill (Scott et al., 2014). Capacity building is complemented by technical training and ongoing training. Technical training is an appropriate strategy for rural communities with low education levels in increasing the level of technology adoption and their capacity in solving the problems they face. From experience in China, technical training increases the opportunities for technology adoption (Liu et al., 2019).

Many problems were faced in implementing technology in the community. Refer to Lebel and Reed (2010), those problems can be overcome by ongoing coaching, such as marketing problems, availability of raw materials, lack of understanding of technology, lack of supportive government regulation, how to produce good food, and many other aspects. They added that capacity building brings a multidimensional concept.

From experience in Belu, continuous coaching becomes an appropriate method that can be implemented for technology implementation strategy in rural areas, especially in remote and isolated areas as in Eastern Indonesia. As

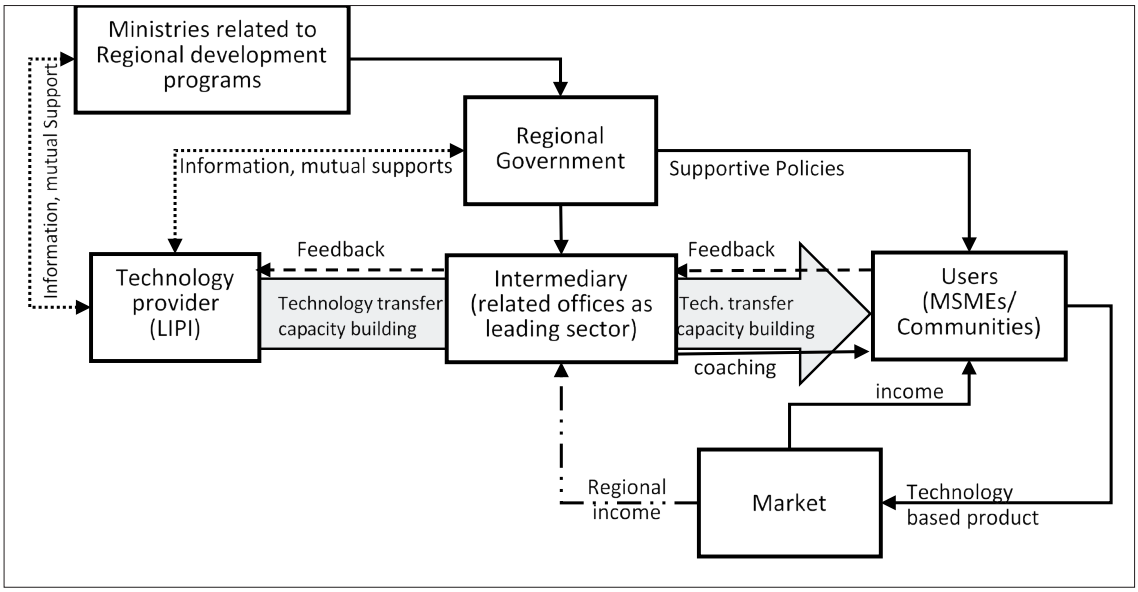

Figure 11. The Proposed Technology Implementation Mechanism in Eastern Indonesia for Optimal Utilization

explained by UN, capacity building (in this case through training and continuous coaching) is an effective way in responding to current global economic, environmental, and social development challenges, including achieving the SDGs (UN, 2018). From our experience, the problem of technology implementation is not only about technology, but also in many problems that have to be dealt with and must be solved. So continuous coaching could solve many problems faced in the community.

Technical training generates technical instructor from the local community and local office staff. The presence of a number of instructors from household-scale entrepreneurs and regional government staff had shown that technology transfer had occurred and food-processing technology was implemented in the community.

2. Regional Government Support

Regional government support through direct involvement of staff in relevant local offices was a requirement in the success of technology implementation strategies in the community. This support gave a guarantee for the sustainability of technology implementation in the community. When the program from LIPI is finished, the regional governments can continue by assisting the community and when there are problems related with the technology, they can consult with LIPI researchers.

Various obstacles had to be faced to get support from the regional government. Convincing the regional government about the technology and innovation implementation program for the community should be carried out in various ways. Starting with dialogue between the heads of LIPI and Regent of Belu, followed by signing of the MoU (Memorandum of Understanding) between LIPI and Regent of Belu. The next step is signing MoA (Memorandum of Action) between Head of Research Center under LIPI with local offices under Belu Regency. What LIPI should do is inviting regional governments to assist SME by open access to markets, improving the transportation to the villages. All communications could be done with dialogues and discussions. LIPI also encouraged the regional governments to open consultation forums for community-related to the implemented technology.

Convincing and attracting the regional government involvement in the technology and innovation implementation program was not easy. Replacement and shifting of local officials are very influential in the support and sustainability of an activity. Networking, collaboration and intensive communication are powerful ways to get full support from the regional government for the sustainability of technology and innovation implementation.

3. The Success and Failure of Technology Implementation

Technology applied in the community depends very much on how much it benefits the community. From the evaluation, several technologies still applied by the community, such as technology for local food processing and technology that supports basic needs and for environmental conservation. The community continued to utilize these technologies because technology implemented were in accordance with the community's needs and location and had a direct effect on the community. Moreover, these technologies are quite easy to operate or practice by the community, as food-processing technology is a technology that is in line with people's daily activities (cooking).

Some of the reasons presented by household-scale entrepreneurs formed through technology implementation activities, especially food processing, are that technology simplified their work, generated income, and facilitated marketing. The use of technology implemented can increase production and hence income and attract labor force around production houses.

In the case of ice block manufacturing technology, implementation was unsuccessful due to imperfect technology transfer to the operators. From interviews with LIPI researchers in May 2007, it was noticed that operators were not skilled enough to operate the machines. On the other hand, in interviews in August 2007, the Head of the Marine and Fisheries Office stated that technology transfer was not done well to the operators. From these conditions, it can be seen that there was a miscommunication by researchers

as a technology provider, operators as technology recipient, and the Marine and Fisheries Office as a stakeholder. This was very unfortunate. Meanwhile, from an interview with the Head of the Jenilu Village Enterprises (April 2019), information was obtained that the fishermen still needed ice blocks to maintain the freshness of the fish they caught for several days to be sold with good quality and good prices.

In this case of ice block factory and telecommunication, there was a technology demand from the regional government, so the involvement of the regional government is a must. The involvement of the regional government assumingly will guarantee the sustainability of a program, but not for these two cases. The fact is they were still reluctant to support technology that was complicated and difficult to handle.

Similar cases also occur in the implementation of artificial insemination technology. The lack of supporting facilities in the area to store cow sperm to be injected and the incompetence of researchers to always be on location, also the absence of technology transfer had caused the failure of the implementation of this technology.

In improving technology implementation strategy, the level of technology needs must be in accordance with local and community resources and regional capacity. Although the capacity of the community can be increased, other factors must be considered, such as regional carrying capacity so that the technology and innovations applied can produce effective results. One alternative to improve technology implementation in society is the development of institutions that manage the existence of implemented technologies and innovations, as well as the utilization of the technology, the results of its utilization and problems that arise from the use of technology. The information is then distributed to all related elements.

V. CONCLUSION

From a systematic analysis, the results of the study propose technology implementation mechanism for the eastern Indonesian region. In addition to collaborate with the regional government, LIPI needs to collaborate with ministries that carry out regional development, specifically the Ministry of Villages, the Development of Disadvantaged Regions and Transmigration, so that LIPI can build better performance through combining resources. so the results can be optimized. Collaboration and synergy with ministries were difficult because it involves complex administrative problems. However, through a collaborative network that can be done, formally and informally, and solve the problem.

Regional government support in carrying out technology implementation activities is very important so that the community uses technology continuously. The support can be a way to solve problems faced by the community related to the use of technology.

In carrying out technology implementation, one of the things that are very important is capacity building. Capacity building can be done through technical training and ongoing coaching to ensure its sustainability. Technical training for local office staff (training for trainers) needs to be done so that the technology applied can be more widely spread in the community. Technology support needs to be given to the community that runs a business to generate income and increase work productivity.

From the success and failure of technology implementation in Belu Regency, lessons can be drawn that the technology implementation requires adequate initial information, starting from location condition, socio-economic of the community, supporting infrastructure, HR readiness, involvement and full support from the regional government.

From a long experience (17 years), the application of technology in Belu Regency can be a lesson for the implementation of similar activities for eastern Indonesia or other regions that have similarities in terms of community characteristics and similar natural conditions.

ACKNOWLEDGEMENT

The paper was presented at the 2nd South East Asia Conference on STI Policy & Management 2019 in Kuala Lumpur, Malaysia, (6–8 November 2019) which entitled “The Strategy

of Implementing Technology in The Community of Eastern Indonesia".

We would like to thank LIPI for providing research funding. Thank you to the Research Center for Appropriate Technology who gave opportunity to do this research. To the Head of Research Center of Policy and Management of Science, Technology and Innovation and all related staff, we also thank you for the opportunity to publish this paper.

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