South Tapanuli Agropolitan Smart Regency: A Proposed Model

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Abstract. The smart city is a city model widely developed around the world, despite its various definitions and concepts. Towards the best city quality of life, smart cities force various aspects of life to be managed in an integrated manner to solve complex urban problems, so that a large number of smart city models are born. In Indonesia, the smart city model is also applied to regencies known as a smart regency. This paper proposes a model for developing a smart regency with agropolitan characteristics in South Tapanuli using the Garuda Smart City Framework (GSCF), a smart city development framework. The proposed smart agropolitan model has been aligned with the masterplan of regional development (RPJMD), ICT development (RIPTIK/Renduk SPBE), tourism development (RIPKD/RIPPDA), and spatial governance (RTRW). The model was presented in the form of an architecture view which consists of three layers: the resource layer, the enabler layer, and the service layer. In addition to mapping modalities into enablers, this study also reveals several enablers that need to be presented and proposes several service clusters and items. Furthermore, this paper also proposes the Batang Toru – Sipirok area as a living lab for agropolitan smart regency continual improvement.

Keywords: smart city, smart city framework, smart regency, smart agropolitan, living lab.

1 Introduction

The rapid development of information technology has initiated the birth of smart cities around the world [1]. The concept of a smart city was originally represented with a very technological-centric designation, such as intelligence city, ubiquitous city, or digital city [2], [3]. The smart city then develops by involving human, environmental, cultural, economic, social, and political aspects in its concept [4]. With this more holistic paradigm, the concepts and definitions of smart cities are increasingly diverse [5].

Each smart city may have its specific competitive advantage, but the characteristics that are always found in every city considered a smart city are continual improvement of the city [6].

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A city can be an agropolitan, an area commonly with an agriculture competitive advantage. This type of city usually starts to grow in rural areas. Rural areas also generally have relatively higher agricultural potential, greater income from the agriculture sector, and a larger number of workers in agriculture than urban areas. [7]. Rural areas build relationships with urban areas in a long chain of agribusiness activities from upstream to downstream, thus forming an agropolitan [8]. However, the pattern of the economy and community activities in an agropolitan is not limited to agricultural activities [9], [10], other activities [11] need support because this urban development model is aimed at reducing the differences between rural and urban areas [12]. Thus, any economic style that develops in rural areas to reduce the gap with the surrounding urban areas needs to be considered in the application of the smart city concept, so that the carrying capacity provided can be maximized. The applied holistic concept of a smart city in agropolitan areas will shape the city's technology, people, and enabling environment that maintains its continual improvement. A city like this can be called a smart agropolitan.

This smart agropolitan concept is very suitable to be applied in Indonesia. With an agrarian and maritime style, the Indonesian government does have an agropolitan development program throughout the country [10]. On the other hand, the Indonesian government is also promoting smart regency and smart village development programs targeting rural areas [13], [14]. Considering that agropolitan cannot be seen as a rural area with agricultural potential that stands alone, but is connected to the surrounding urban area to run the chain of agribusiness activities from upstream to downstream [8], smart regency [15] is very well utilized for the development of smart agropolitan. In the Indonesian government's smart regency policy, this program is applied to regencies [16], [17], areas that are generally larger than municipalities with a combination of rural and urban areas within them.

This paper proposes a model for developing a smart regency with agropolitan characteristics in South Tapanuli. This regency has the potential and support needed to develop a smart agropolitan. The resulting model will contribute to the study of smart cities and developments related to rural-urban relations because combining smart city and agropolitan is rarely discussed in today's research.

2 Method

Referring to the basis of the emergence of an agropolitan development model that focuses more on resolving rural-urban disparities rather than what economic style is the driver of regional development, this study will conduct a literature review on development policy documents, regional spatial planning, and ICT development in South Tapanuli without limiting local potential on agricultural potential only. However, the potential for agriculture remains a prominent local potential considering that the district's competitive advantage lies in its agricultural potential. Other potentials will also be mapped and managed in the smart regency concept, especially to maintain the sustainability and continual improvement of the South Tapanuli Regency as an agropolitan.

After mapping all these potentials, the South Tapanuli Smart Regency modeling was carried out using Garuda Smart City Framework (GSCF) in architecture view format. This format will place the findings of the local potential of South Tapanuli in the resource, enabler, and service

layers, both something that already exists and the potential that can be developed. To fully support the continual improvement of the agropolitan smart regency that will be developed, the study proposes a certain area in the smart regency as a living lab, taking into account the selection both spatially and sectorally.

3 Results and Discussion

South Tapanuli has a lot of potentials, not only in agriculture. However, the most dominant potential in rural areas is agriculture, and the same thing happened in South Tapanuli. The agricultural sector contributes more than 40% of the district's GDP and is the only economic sector of the four district economic sectors with a double-digit GDP contribution percentage that has a positive growth in 2020. In 2020 many economic sectors experienced a slowdown as a result of the Covid-19 pandemic. But uniquely, the contribution of GDP of that magnitude does not make South Tapanuli included as part of the agropolitan area in the North Sumatra RPJPD 2005-2025 (Agropolitan Area of the Bukit Barisan Highlands). As far as literature searches have been carried out, no master plan document for agricultural development has been found, even though this district already has a development masterplan for ICT (RIPTIK) and tourism (RIPKD/RIPPDA).

However, to pursue the development gap, especially with the surrounding urban areas, non-agricultural potentials are also considered and managed in the smart agropolitan model that will be built. These potentials include the potential for natural wealth of minerals, energy, and the environment, plus rural non-farming economy (RNFE) activities carried out by the community.

These potentials are resources, objects, or commodities that are managed in such a way as to develop an agropolitan area. The management itself requires other potentials in the form of modalities that allow resources to be managed to achieve their goals. The potential in the form of this modality is infrastructure support such as transportation networks and ICT, as well as superstructures such as communities and organizations.

3.1 Resources

The potential in the form of resources owned by South Tapanuli Regency from the agriculture sector is agricultural products, production forests, and plantations. Agricultural development centers that have been designated as strategic areas based on the South Tapanuli Regional Spatial Governance Masterplan (RTRW) are the Sipirok area (Sipirok District), Sitinjak (West Angkola District), and Pintu Padang (Batang Angkola District). This district also has potential for freshwater and marine fisheries, especially marine fisheries, which has received attention with the establishment of an agromarine (minapolitan) area in Muara Upu (Muara Batang Toru District). Other potentials outside the agriculture sector are mining, construction, and trade, which are 3 out of 4 GDP contributors with a 2-digit percentage. The potential for mineral and rock mining is spread in almost all sub-districts, but certain potentials, such as geothermal, are special potentials that are determined by the mining area in Sipirok. One of the leading commodities of mineral mining is gold with a mining area in Batang Toru. The construction sector is driven by physical infrastructure development activities. Meanwhile, trade areas have been determined at the Batang Toru and Sipirok Local Activity Centers

(PKL), as well as the Promoted Local Activity Centers (PKLp) Pintu Padang (Batang Angkola District). Another potential that does not specifically become a separate business field, but provides a multiplier effect on many business fields is the tourism sector. The tourism sector is distinguished in cultural tourism and nature tourism, with areas spread throughout the district. However, the tourism area that is included as an economic strategic area is the Lake Siais tourist area (Angkola Sangkunur District).

To develop this regency as an Agropolitan area, the transportation and warehousing business field needs attention given its slowing growth to -3.06% in 2020. However, the Covid-19 pandemic also shows that this district has the opportunity to become a smart regency with the highest growth in the ICT sector compared to all other sectors (7.17%) even though its GDP contribution is still relatively small (0.54%).

3.2 Modalities

The potential in the form of modalities needed to support the management of these resources includes the availability of energy. This district has geothermal and water potential to operate PLTU, PLTP, PLTA, and PLTMH power plants. Energy availability is also supported by plans for the construction of substations (GI) at PKL and PKLp, as well as plans to develop 275KV SUTET and 150KV SUTET transmission networks. The government has also prepared plans for water resources management, raw and clean water supply, waste management, drainage, sanitation, waste, and mitigation facilities for five types of disasters (tsunami, flood, landslide, volcanic eruption, and earthquake). Thus, there is a great opportunity for the development of South Tapanuli as a smart agropolitan.

The development of agropolitan areas also requires the availability of processing facilities. This facility is represented by the presence of large, medium, small and micro industries. The PKL and PKLp areas that become industrial concentrations are Batang Toru (large, small, and micro industries), Sipirok (small and micro industries), and Batang Angkola (large industries). Small and micro businesses in Batang Toru and Sipirok carry out RNFE activities down to the household level.

These three locations have been connected to the Sumatran crossing (west crossing) through the city of Padangsidimpuan. Although located outside the regency, the city of Padangsidimpuan which is surrounded by agricultural and industrial centers is also a market for South Tapanuli commodities. Apart from being connected to the highway network, these three points are also connected in an ICT (cellular) network. This further supports the application of smart agropolitan. However, connectivity to the western region with agromarine (Muara Upu) and tourism potential (Muara Upu and lake Siais) still requires further development of road networks and ICTs.

In addition to these modalities in the form of infrastructure, this regency also has support for superstructure modalities in the form of policies that support the development of agropolitan areas, namely the regional development masterplan (RPJMD), spatial governance masterplan (RTRW), ICT development masterplan (RIPTIK) and tourism development masterplan (RIPKD/RIPPDA). However, with a GDP contribution of more than 40%, it is unfortunate that this district does not yet have a strategic plan for developing its agriculture sector. Currently, the development of the agriculture sector is only part of other masterplans such as the RPJMD (as one of the economic sectors) and the RTRW (related to area allocation policy).

In the two masterplans, the strategic planning for South Tapanuli agriculture development is still inadequate. In the RPJMD document, priority support for the agriculture sector is mentioned in the second mission (people's economy and emphasize agriculture) but the strategy set is still limited to managing agricultural areas (in RTRW a strategic agricultural area is set), namely through extensification and intensification. The involvement of agricultural technology has not been emphasized in the strategy. Another strategic plan that needs to be specially prepared is how the government will condition the public-private partnership because in the smart city concept adapted in this smart agropolitan, public-private partnership is one of the important pillars[18]. This must be achieved by increasing the government's leadership in improving its services, especially in G2C and G2B relations in e-Government. Likewise with the superstructure of society. Adequate facilitation is not yet available for the development of agropolitan communities in the RPJMD and RIPTIK. As a comparison, RIPKD/RIPPDA already has a community development strategy and tourism organization/community, even though this sector is not a separate business field in the contribution of GDP and together with other services only contribute to 0.04% of GDP. Nevertheless, human development on the ICT side has been prepared in RIPTIK through the fourth stage of the RIPTIK Roadmap, namely six programs for developing a data culture and information society. On the government side, RIPTIK has also determined an apparatus development strategy in the ICT sector with four government ICT HR development programs (the third stage of the RIPTIK Roadmap).

3.3 Proposed Model in Architecture View

Modeling with the GSCF architecture view will describe the development of the South Tapanuli Agropolitan Smart Regency in three layers. The potential in the form of resources is placed at the lowest layer (resource layer), and the potential in the form of modalities will be mapped to the three corresponding enablers, namely smart governance, smart people, and smart technology (technology-infrastructure-environment), while the form of services resulting from management activities resources by the enabler will be formulated at the service layer. The GSCF architecture view is shown in Fig. 1.

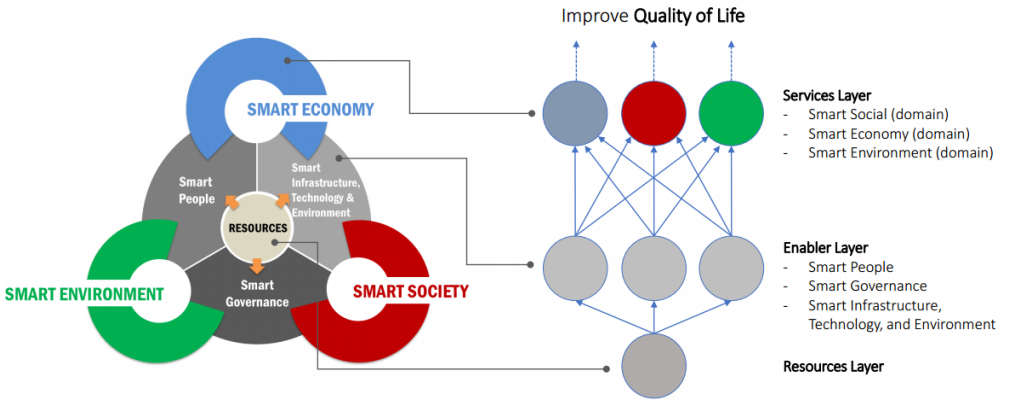

Fig. 1. Architecture view based on GSCF model[19].

While resources can be directly placed into the model, this is not the case with modalities. Mapping of modalities into each smart enabler needs to identify which modality belongs to which type of enabler. Therefore, the differences between the three enablers need to be well understood. In the management process, resources are utilized in a manner that refers to the most suitable policy and procedure (smart governance), executed by the most competent HR (smart people), using the most reliable technology and in supportive conditions (Smart Technology, Infrastructure, and Environment). This layer shows that technology does not stand alone as a solution, but must be supported by the readiness of governance and the quality of human resources. In addition to displaying the results of the mapping of existing modalities, this layer should be able to identify some fundamental needs that are not yet available. Table 1 shows the condition of the enabler mapping results.

Table 1. Enabler of South Tapanuli Agropolitan Smart Regency

Dimension	Present	Unpresent
Smart Governance	Government Development Masterplan (RPJMD), Government Spatial Masterplan (RTRW); Tourism Development Masterplan (RIPKD/RIPPDA); ICT Development Masterplan (RIPTIK).	Agriculture Development Masterplan; External government collaboration strategy (public-private partnership) and service canvas development
Smart People	Stage III (4 programs of Building Government ICT Manpower) and Stage IV (6 programs of Development of Digital Culture and Nurturing the Information Society) of RIPTIK's Roadmap.	Agriculture society development strategy
Smart Technology-Infrastructure-Environment (TIE)	Energy infrastructure (power plants, substations, transmission lines); infrastructure for managing water resources, waste, sanitation, drainage, pollutants, and disaster mitigation facilities; large, medium, and small industrial centers; transportation and highway networks; telecommunication lines.	IoT sensors, integrated smart system (using ICT system for smart monitoring and smart maintenance, and even policy decisions)

The unpresent column in Table 1 shows some of the enablers needed but not yet available in the South Tapanuli regency. These enablers arise because of the existence of resources that require these enablers in their management. With the potential for agriculture that is large and dominant among other potential business fields, it is fitting for this resource to have its development master plan. The community in the South Tapanuli regency should also be prepared to become a smart agropolitan community through a development strategy. This strategy can be part of the agriculture development masterplan or be compiled in more detail in a separate strategic document with an emphasis on fulfilling the community's capacity as competitive human resources in agriculture, especially in agriculture center areas. External government collaboration strategy is an enabler needed for resource management by interested parties. In smart agropolitan, the spirit of public-private partnership is an important component not only to synergize the roles of government, private sector, and society in complementary roles in the development of smart agropolitan but also to increase the efficiency and effectiveness of its development. Furthermore, all enablers (both present and unpresent) and external government collaboration strategies are aligned and become a reference for service

needs at the service layer. Each service that involves HR and certain technologies is detailed in its implementation on a service canvas [19]. The development of the service canvas (also known as the business model canvas/BMC) is needed to ensure that each strategy is not only running and achieving the desired value but also sustainable [20].

The smart TIE layer is a layer containing enablers that become tools for smart people and smart governance to manage the environment in which services are produced. In addition to the availability of infrastructure such as energy, water, transportation, industry, and other infrastructure to support the development of agropolitan areas, ICT infrastructure is needed to make it a smart agropolitan. The most visible support for ICT infrastructure is the availability of telecommunication lines that enable the implementation of electronic services. However, to become an agropolitan with smart management, ICTs must be developed to a level where data transacted through services can intelligently help solve problems. A smart city has the characteristics of cognition, responsiveness, and intelligence [21]. At this point, it can be seen that South Tapanuli needs IoT devices and integrated systems as enablers that can fulfill these three characteristics to make the area a smart agropolitan. These enablers are unpresented yet. More complex smart technologies such as the implementation of big data and AI may be useful, but the availability of real-time data acquisition technology with South Tapanuli's current conditions is sufficient and will provide changes to policies taken in regional development.

Defined resources and enablers help organize the parts needed at the service layer. At the service layer, the services needed to achieve the basic value of an agropolitan and the added value of a smart agropolitan are defined. Referring to the GSCF, in this layer, there are at least three service domains (smart economy, smart environment, and smart society), each of which can be reduced to service clusters and service items. It is at the service item level that the service canvas is compiled which is mentioned in the smart governance enabler. Therefore, the proposed model for South Tapanuli Agropolitan Smart Regency shown is shown in Fig. 2. Current unpresent enablers are typed in red.

The service cluster of smart agriculture, smart markets, and smart financing can be built in the service domain of the smart economy. Under this cluster, service items can be built in the form of applications for monitoring the availability and prices of commodities at production points, as well as a marketplace for agricultural products, for selling seeds, crops, and also agricultural industrial products with added value. Service items in the form of upstream-downstream agribusiness distribution chain information can also be provided and will be very helpful for public and private users. One of these domain service items that are currently available is the Poken Tapsel marketplace application. Although the products marketed are varied, the provision of an agriculture marketplace application can imitate or even directly use this application. However, Poken Tapsel still needs development in terms of availability, completeness, and service updates. This service domain also has the potential to accommodate service clusters and service items that contain a variety of public information about business units and the agriculture industry at various scales, including locations, main products, market networks, and even finance (for example, smart financing clusters reduce service items in the form of smart services for banking, capital, insurance, and financial transactions). Considering the potential for agriculture-based tourism which is also quite high in South Tapanuli, it is also necessary to prepare service clusters and service items which are non-farm activities, especially tourism. The services needed include location information, transportation and

accommodation, as well as the advantages of the attractions offered. Smart tourism service clusters can also be developed by adding service items that focus on regional branding as an agropolitan area. In this domain, the implementation of smart technology is expected to increase the ease of interaction between users and applications (UI/UX), so that the desired value from the smart economy service domain will be optimal because users tend to easily access the services provided. However, other support from smart technology also needs to be considered.

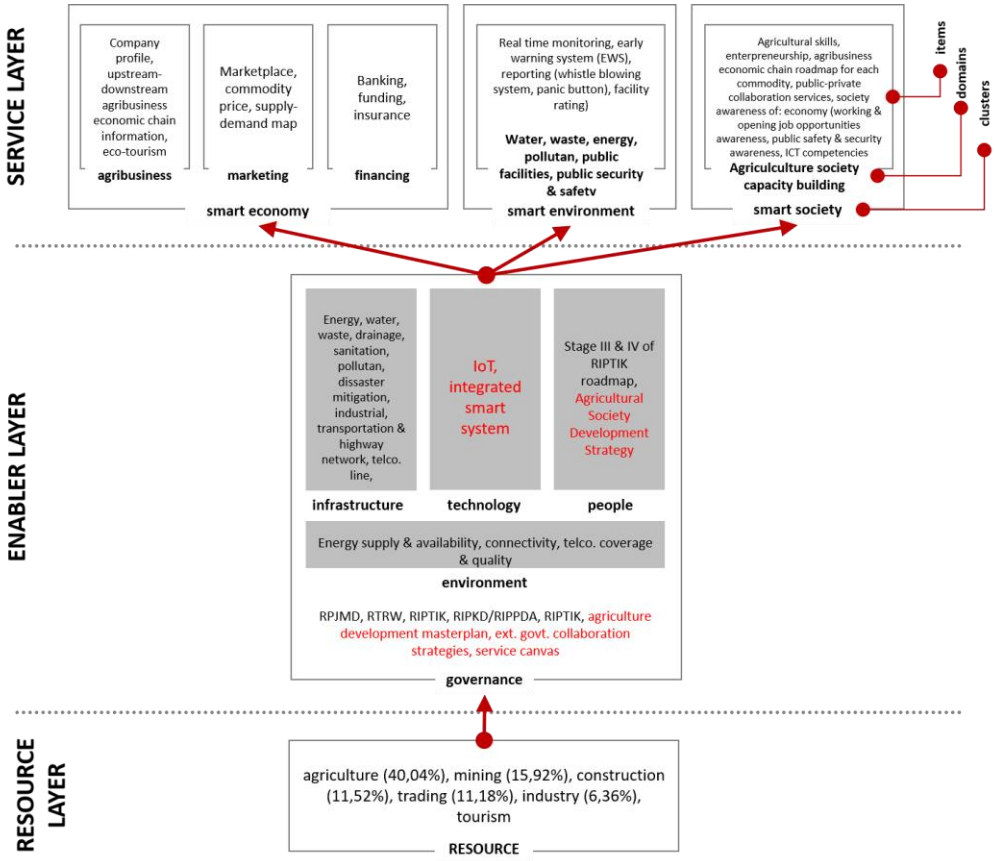

Fig. 2. The proposed model of South Tapanuli Agropolitan Smart Regency.

In the smart environment service domain, smart clusters and items can be developed in the form of services with business processes related to the management and handling of water and clean water, waste, energy, pollutants, public facilities, public safety and security, to disaster mitigation. Details of services that can be provided include monitoring of water quality, air, weather, distribution monitoring and detection of water and energy distribution disturbances, observation of potential disasters (wind speed and direction, water level, sea waves, earthquakes, etc.) for example with EWS, rating public services for public facilities,

prevention services (detection, detention, protection) and reporting (panic button and whistleblowing system) environmental security. Smart technology used in service domain smart environment applications emphasizes the accuracy and speed of recording, reporting, analysis, and decision making based on the data received. Therefore, to maximize the value to be achieved from the smart environment, IoT technology will be widely used in its services.

In the service domain of a smart society, service clusters and service items can be developed that are related to the capacity building of an agropolitan society. The services provided can be in the form of education related to agriculture skills, entrepreneurship, information on agribusiness chains for various commodities, and open community involvement in public-private partnership programs. No less important guidance is building economic awareness, an initiative to work and create jobs, social cohesion, political awareness, understanding of the urgency of public safety and security, and the ability to use information technology wisely, well, and correctly. Services in this domain will be dominated by e-learning, public opinion channels (online and offline), and thematic community development. The characteristics of smart technology that are most needed in the smart society domain are wide coverage, easy and fast access, simplicity, and responsiveness. The spread of cellular networks and mobile application technology will greatly assist the implementation of this service, of course with the support of good community ICT literacy.

3.4 Suggested Area for Living Lab

The proposed smart agropolitan model will continue to develop following the development of the problems faced and the innovations made to overcome them. Continual improvement that must run in a smart agropolitan requires a living lab as a development environment before the innovation is implemented in a wider area. The determination of the living lab needs to consider the supports available in an area so that innovations can be born and tested on a limited basis in that area.

Based on the RTRW, several regions have the best infrastructure support and can serve activities on the scale of regency or district. An area with this capability is the Local Activity Center (PKL) which consists of the urban areas of Batangtoru and Sipirok. This study suggests that these two urban areas become the living lab of the South Tapanuli Agropolitan Smart Regency. Apart from being street vendors, these two areas also have various supports. Fig. 3 shows some of those supports.

The right side of Fig.3 shows the strategic advantages of Batang Toru – Sipirok as an agropolitan area. The characteristics of an agropolitan area that focuses on the economy of agribusiness, both upstream and downstream activities, as well as a supportive environment such as urban-rural linkages, processing industries, and infrastructure support such as urban areas, can be fulfilled by this area. Batang Toru provides the infrastructure for urban basic needs, large processing industries, and potential financial and environmental conservation programs. With the support of an inter-district road, Batang Toru can also function as a hub for the distribution of fishery products from Muara Upu and access to the Lake Siais tourism site. Meanwhile, Sipirok provides urban infrastructure, government, agricultural commodity production, medium and small industries, SMEs, and trade. The Batang Toru – Sipirok area can also be an opening for marketing agricultural commodities to areas outside the district such as Padang Sidempuan, Central Tapanuli, and Sibolga. This is because these two areas are

located on the Sumatran Highway and inter-city road as infrastructure that supports economic growth in the western region of Sumatra.

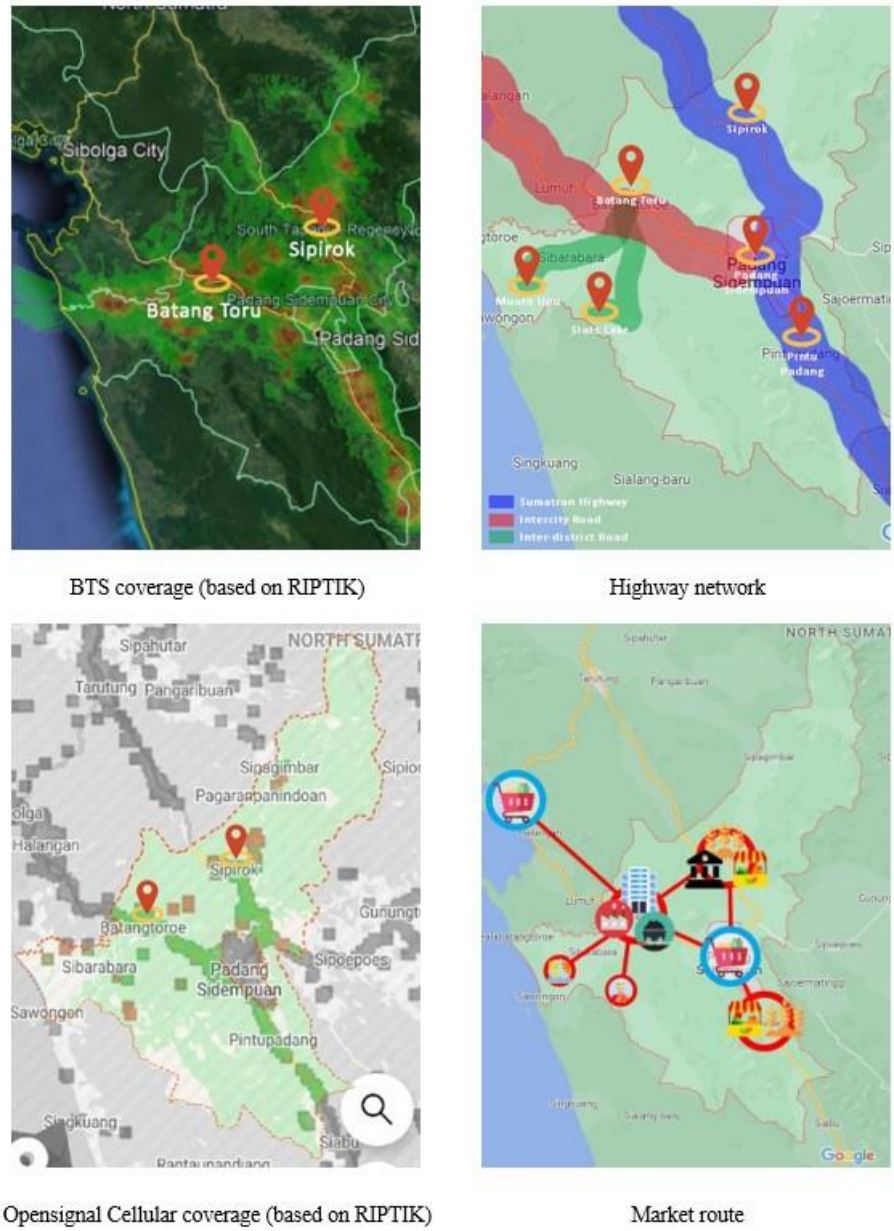

Fig. 3. Strategic advantage of Batang Toru – Sipirok as a living lab.

Meanwhile, the left side of Fig.3 also shows that the Batang Toru and Sipirok areas receive internet connectivity support evenly. Based on the RIPTIK document, Batang Toru is the path for the BTS network to the southeast to Central Tapanuli Regency and Sibolga City. Meanwhile, Sipirok is also a BTS network route to the north towards North Tapanuli. The two BTS lines meet in Padang Sidempuan City, which is surrounded by South Tapanuli Regency. Cellular coverage monitoring with Opensignal also shows that the Batang Toru and Sipirok areas are on the green cellular coverage line, which indicates that these two areas have relatively better cellular internet connection quality than other areas in South Tapanuli. This internet connectivity support is an important modality to develop South Tapanuli as a smart regency. In smart regency, internet availability and coverage are environmental support in smart TIE.

With these advantages that Batang Toru – Sipirok has for the development of agropolitan and smart regency, this area together has the potential to become the living lab of South Tapanuli Agropolitan Smart Regency. The existence of a processing industry and government center, local markets (internal districts) and connectivity with external markets (external districts), ICT infrastructure support, plus the position of one of the centers of agricultural commodity production allows this area to develop a research and development unit for continual improvement of smart agropolitan. The resulting innovations can be applied first in a special area in the Batang Toru – Sipirok living lab before being implemented in other areas.

4 Conclusion

The results of the study show that South Tapanuli has the potential to be developed as an agropolitan smart regency using the proposed model. To be able to manage all available resources, several enablers need to be prepared. The need for unpresent enabler development exists in all three dimensions of the enabler layer. By completing the required enablers, South Tapanuli Agropolitan Smart Regency will be able to run the proposed service items at the service layer. Continuous improvement for smart agropolitan can be developed in the living lab. By considering aspects of strategic advantage, the living lab can be built in the Batang Toru-Sipirok area, by adding a research and development unit of smart agropolitan.

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