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Community Empowerment and Utilization of Renewable Energy: Entrepreneurial Perspective for Community Resilience Based on Sustainable Management of Slum Settlements in Makassar City, Indonesia

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Abstract: The acceleration of metropolitan city development toward economic growth has an impact on over-urbanization, energy scarcity, slum settlements, and environmental degradation. Slum settlements that are predominantly inhabited by the urban poor will require an increase in the productivity of economic enterprises through the empowerment process. This study aims to analyze (1) community empowerment functions as determinants of the use of renewable energy in handling slum settlement and (2) the effects of community empowerment, utilization of renewable energy, strengthening of institutional capacity, and productivity of economic enterprises on improving the quality of the slum settlement environment. The study approach used is a combination of qualitative–quantitative research. Data was obtained through observation, in-depth interviews, surveys, and documentation. The results of the study show that community empowerment, coupled with the use of renewable energy, strengthening institutional capacity, and community participation, contributes positively to increasing the productivity of economic enterprises and improving environmental quality toward sustainable management of slum settlements. The effect of economic empowerment, strengthening institutional capacity, and the use of renewable energy to improve environmental quality with a coefficient of determination of 78.5%. This study recommends socio-economic empowerment based on the use of renewable energy in the implementation of the Makasssar City toward environmental, economic sustainability and the creation of social cohesion.

Keywords: community empowerment; renewable energy; slum settlement; sustainable development

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1. Introduction

The development of large and metropolitan cities that tend toward industrialization and trade centers is the driving force for urbanization and an increase in population. Urbanization is a process related to economic growth, population growth, and expansion of the core city [1]. Excess urbanization and uncontrolled urban development have an impact on the spatial and socio-economic problems of urban communities, among others: crime, poverty, unemployment, and slums. Community poverty, which tends to increase in line with the increase in population, is positively associated with an increase in the crime

rate [2]. Thus, the population that tends to increase in urban areas causes social interaction and community social control to become weak [3]. Furthermore, urbanization and high population growth have had an impact on the conversion of productive agricultural land to meet housing and settlement needs [4]. The dynamics of changes in spatial use, followed by the intensity of urban development, have contributed positively to social change and differentiation of society toward socio-economic diversity. Social differentiation has a relationship with the level of income economically, social status, lifestyle, consumption patterns, and living conditions of people in geographic space [5,6]. Thus, the spatial dynamics of cities tend to change from time to time, and the triggering factors are urbanization and an increase in population. This condition is characterized by rural–urban migration and its impact on changes in land use, population mobility, and increased urban socio-economic activities. Furthermore, the impact of urbanization and rural–urban migration that can be observed is the existence of slum settlements, which are predominantly inhabited by poor people, inadequate housing facilities, inadequate infrastructure, and disproportionate socio-economic facilities located on illegal land [7]. Thus, land use change is directly related to economic growth, climate change, and demographic change [8].

The distribution of urban population in Indonesia is categorized as the second highest in Southeast Asia, with a rate of 54.7%. Malaysia is ranked first at 75.4%. Thailand is in third position, with a population distribution of urban areas of 49.2%. The Philippines and Vietnam follow in fourth and fifth, at 46.7% and 35.2%, respectively. Furthermore, as many as 154 million people inhabit urban areas in Indonesia in 2019, out of a total population of 267 million people [9]. Compared to the Asia–Pacific's average annual growth of 2.7% in the 1990s, Southeast Asia's urban population grew at 3.6% annually during the same period. While urban demographic expansion slowed after 2000, average annual growth in the past decade was still 2.6%. Estimates show that Southeast Asia will reach 50% urbanization by 2020, when 36 million additional inhabitants will bring its urban population to 330 million [10]. It is very important to understand the characteristics and forms of cities in the formulation of urban planning in Asia in relation to urbanization [11]. Excess urbanization, in the case of urban areas in Indonesia, has contributed positively to the differentiation of community jobs, high land prices, increased unemployment, poverty, and slum settlements. Social inequality, social disorganization, crime, and slum settlements are part of urban characteristics [12]. The existence of poor communities, which predominantly occupy urban slum settlement locations, will require empowerment support that is oriented toward community independence to develop economic enterprises and increase business productivity toward improving community welfare.

Empowerment is an effort made to change the condition of society due to a situation of poverty. This means that community empowerment efforts are aimed at making people able to solve various problems independently toward increasing welfare. Furthermore, program mechanisms and inclusive land management initiatives, followed by strengthening community capacity through empowerment mechanisms, contribute positively to the creation of social cohesion and the sustainability of community economic enterprises [13–15]. Community empowerment is the government's effort to reduce the gap between community groups toward solving socio-economic problems in a sustainable manner. Thus, the way the city government manages informal settlements and slum settlements that is oriented toward strengthening institutional capacity, developing economic enterprises, and improving the quality of the environment will have an impact on improving the welfare of people living in urban slum areas [16–18].

There were 103 slum settlements that developed in Makassar City in 2017, which increased by 127 locations in 2019. These slum settlements are spread across 15 subdistricts, occupy an area of 729 hectares, and are inhabited by 21,373 households. Slum settlements that tend to increase give an idea that urbanization in Makassar City has not been matched by the preparation of adequate employment opportunities and adequate housing facilities for the community. Furthermore, the developing slum settlements are inhabited by the poor, at 7% of the total population of Makassar City of 1,526,677 people. Thus, commu-

nities located in these slum areas have the potential to be empowered towards the use of renewable energy in a sustainable manner. This transition has profound bearing on human productive capabilities, adaptability, creativity and values, the organization of economy, public policy, social awareness, and lifestyles that determine sustainability [19,20].

Utilization of renewable energy through empowerment, followed by strengthening the capacity of the community in slum settlements in Makassar City, will not only encourage increased community economic productivity but also have an impact on improving environmental quality. The consumption of renewable energy has a positive impact on socio-economic development toward improving economic, institutional performance and minimizing the threat of environmental damage, both in the short- and long term [21,22]. Furthermore, community economic management through the use of renewable energy, which is carried out with an empowerment-based approach and community participation, is aimed at building ownership, in the sense of optimizing the use of renewable energy, such as solar power, water, wind, and biomass energy, and will have an impact on economic growth and increase in income, as well as the sustainability of community economic enterprises. Utilization of the main renewable energy sources—solar, wind, and biomass energy, which is integrated, will have an impact on meeting local energy needs [23].

The optimization of conventional to nonconventional energy sources has undergone a shift toward efficiency and effectiveness in the utilization of energy resources [24,25]. Furthermore, the negative environmental effects of conventional energy use, and the limited yields of conventional energy sources, are one of the bases and one of the factors that cause the use of renewable energy sources (RES) to be urgent [26,27]. Furthermore, the use of renewable energy through an empowerment approach and community participation is very important to be synergized with community social capital. Community energy storage (CES) is expected to contribute positively toward energy transition, while accommodating the needs and expectations of citizens and local communities [28]. Thus, optimizing the use of renewable energy based on community empowerment will accelerate poverty reduction toward increasing welfare, self-sufficiency in community economic enterprises, creating social cohesion, and sustainable management of slum settlements.

Community empowerment based on the use of renewable energy in handling slum areas is part of the implementation of the Makassar City development policy to achieve the fulfillment of sustainable development goals (SDGs), including the following: (1) The first objective is to alleviate all forms of poverty. (2) The sixth goal primarily ensures access to clean water and sanitation. (3) The seventh goal is concerned with access to affordable, reliable, and sustainable energy. (4) The eleventh goal is to ensure that cities are inclusive, safe, strong, and sustainable. Thus, the focus of this study is aimed at answering the research questions, (1) "How does community empowerment work as a determinant of the use of renewable energy in handling slum settlements?" and, (2) "How do community empowerment, use of renewable energy, strengthening institutional capacity, and productivity of economic enterprises affect the improvement of the quality of the slum settlement environment?"

2. Conceptual Framework

The management of slum settlements based on community empowerment that is carried out is aimed at improving environmental quality, fulfilling infrastructure, increasing economic productivity, and creating social cohesion. Economic inclusiveness will reduce inequality toward increasing the productivity of community businesses and create social justice [29,30]. Furthermore, slum settlements are understood as a condition of a residential environment that is not suitable for habitation, characterized by building irregularities, high levels of building density, and quality of buildings that are not suitable for habitation, as well as inadequate facilities and infrastructure as a unit of residential environment. Urban slums are the result of informal, illegal, and unplanned urban growth [31].

Community empowerment refers to three basic principles, among others: (1) enabling, namely creating a situation that allows the potential for the community to develop; (2) em-

powering, namely strengthening the potential or power of the community by increasing their capacity; and (3) protecting, namely building a protection system for the community. These three things are expected to be able to increase the productivity of economic enterprises and build social solidarity, together with the use of social capital that has been built in society. Thus, community social entrepreneurs create resilient businesses that contribute to maintaining healthy ecosystems and promoting social justice [32,33].

Community empowerment will be successful if it is implemented through four basic principles, among others: (1) building equality, namely the equal position between the community and the institutions that carry out community socio-economic empowerment programs; (2) community participation, namely programs that are implemented will be able to stimulate community independence; (3) building independence, namely respecting and prioritizing community capabilities rather than assistance from other parties; and (4) sustainable, namely the socio-economic empowerment program will provide a dominant role for the community to build sustainable independence. Thus, the role of government is oriented toward building community organizations independently and voluntarily toward sustainable community development [34,35].

Theresia et al. [36] states that community socio-economic empowerment requires four important aspects that need to be considered, among others: (1) institutional improvement, in the sense that activities or actions taken in socio-economic empowerment will improve the institutional conditions of the community; (2) business improvement, through educational support or enthusiasm for learning, improving accessibility, or affordability toward increasing the productivity of the business being developed; (3) revenue improvement, in this case, the improvement of a business or business developed to increase community income; and (4) environmental improvement, in this case, business productivity and increased income will encourage environmental quality improvement. Employees who are involved in sustainable activities and adopt sustainable development principles become sustainable human resources [37,38]. The challenge is how to apply new technologies, acquire new e-skills, and combine them with communication channels [39,40].

Community empowerment based on the use of renewable energy, in addition to increasing the economic productivity of the community, will also improve the quality of the slum environment inhabited by the urban poor. The higher level of plan implementation will ensure more sustainable slum upgrading [41,42] and energy; will be a prime enabler in achieving sustainable development goals (SDGs); and should be affordable, reliable, sustainable, and modern [43,44]. Thus, socio-economic empowerment, followed by the role of community participation, will become a driving force for increasing economic productivity and conserving natural resources in a sustainable manner. Conservation of natural resources is realized through stimulation of activities, namely environmental interpretation, and education [45,46].

Utilization of renewable energy in economic enterprises developed by the community in slum settlement locations will have a multiplier effect on increased income and community welfare. Energy systems using renewable energy technology will have an impact on structural change [47,48] and the use of renewable energy, in addition to increasing community income, and also facilitates sustainable development [49,50]. Thus, it is necessary to innovate and utilize technology to address the fulfillment of energy needs in developing economic enterprises at the community level. Factors of household size, distance, climate, and topography affect and grow in energy demand [51,52]. Furthermore, the use of renewable energy will be able to create community independence and increase the productivity of economic enterprises in a sustainable manner. Thus, the community will play a role in regulating energy supply, determining tariffs for energy transportation, and decentralization of energy supply [53,54]. Community empowerment in slum settlements, based on the use of renewable energy, will encourage increased effectiveness and efficiency in the use of natural resources toward sustainable urban development. That is, low-income households are faced with the challenge of meeting energy sufficiency [55].

2.1. Economic Enterprises and Community Social Capital

Economic activity is the action that involves the production, distribution, and consumption of goods and services at all levels in society. Economic enterprises developed by the community are expected to boost economic growth by creating new business and job opportunities, saving material costs, reducing price volatility, and increasing supply security, while reducing environmental pressure and impacts [56]. Three categories of community economic enterprises, among others, include (1) production in relation to activities that produce goods and services, (2) distribution, namely activities that distribute goods from producers to users or consumers, and (3) consumption, namely activities that utilize goods and services. These three things are closely related to the productivity of the community's economic enterprises in relation to the use of renewable energy. Therefore, a supporting policy and regulatory framework is needed to accelerate the use of renewable energy and the efficient use of natural resources to support economic enterprises developed by the community [57].

Furthermore, the productivity of community economic enterprises is influenced by several factors, including (1) natural resources, in this case, related to the availability and potential of energy sources that can be utilized; (2) human resources, related to the effectiveness and efficiency of economic enterprise production; (3) business capital, related to reproducible physical production factors; (4) manpower and organizations, related to the use of factors of production in various economic activities; (5) technology, related to the ability to use environmental technology; and (6) noneconomic aspects, including socio-cultural aspects and political factors. These six factors are determinants of economic business development toward business stability and improvement of community welfare in a sustainable manner. Sustainable entrepreneurship, based on the principles of sustainable development, also includes social sustainability, expressed in personnel policy, which includes management and care for all employees [58]. Thus, the economic enterprises developed by the community in slum settlements in Makassar City will require guidance through a process of empowerment, strengthening institutional capacity, and the use of renewable energy integrated with social capital owned by the community. Strengthening capacity and community empowerment plays an important role in transferring knowledge and technology, building innovative financing models, and shaping policies based on social capital owned by local communities [59].

Social capital is a resource that is owned by society in the form of norms or values that facilitate building cooperation through a harmonious and conducive network of interactions and communication that relies on cultural roots [60]. Social capital is the collective energy of society to solve common problems and is a source of motivation to achieve economic progress for society [61]. Thus, social capital creates relationships, which are based on norms that shape the quality and quantity of social relations in society and serve as social glue. The characteristics of social capital include the capacity to emerge as an explanatory variable in the production function, accumulation over time, ability to increase economic performance, investment with expected future returns, convertibility, and maintenance requirements [62]. Furthermore, social capital is a person's ability to work together in a group. This means that reciprocal relationships between individuals in community groups are carried out, because of a strong belief to build a harmonious network of interactions and communication. Social relations in society are two-way to obtain information, and the relationships that are built are mutually beneficial [63]. Thus, the social capital owned by the community is very important to maximize its function in the community empowerment process for the use of renewable energy toward increasing the productivity of economic enterprises and the sustainability of handling slums. This means that improving the quality of life and equal distribution of opportunities economically and socially will result in a more dynamic and equitable city toward the sustainable management of slum settlements [64].

2.2. Economic Business Development and Strengthening Community Capacity

The main problems in developing community economic enterprises include first limited public access to funding, information, and markets; second, the relatively low capacity of human resources (HR) and community business institutions; and third, the low productivity of community businesses. Tambunan, T. [65] mentions the four steps needed to increase the productivity of the community's economic enterprises, namely (1) carry out training programs regularly and at all economic business centers that focus on online marketing, entrepreneurship, management, and improvement of product quality and business efficiency; (2) provide alternative funding facilities with low interest rates and nonburdensome terms; (3) provide technical assistance (e.g., production, machine maintenance) and nontechnical assistance (e.g., marketing, promotion, distribution) directly at the production site for new entrepreneurs within the first one to two years of doing business; and (4) ensure availability of the raw materials most needed at stable prices.

The development of community economic enterprises toward increasing productivity requires support from government policies, namely first, increasing community access; this process is carried out through the following efforts: (1) facilitating funding for community economic enterprises; (2) facilitating information distribution in the context of developing community economic enterprises; (3) business intermediation of community economic enterprises; and (4) facilitating the development of product databases and market information. Second, community capacity is built through efforts, such as the following, among others: (1) facilitating human resource capacity building in managing and improving the performance of community economic enterprises and (2) facilitating capacity building in mastery of technology and skills. Third, the productivity of community businesses is increased through the following measures: (1) facilitating micro business development and (2) facilitating various efforts to increase the productivity of community economic enterprises.

Basically, community economic grouping and organizing is aimed at gaining access to capital in existing financial institutions to develop economic enterprises. Facilitation and support for business capital through microcredit packages, including savings, insurance and other financial services, will encourage the development of economic enterprises by the poor [66]. Furthermore, the development of the scale of community economic enterprises will be related to the functions and roles of institutions. This means that community institutions have a strategic function, in relation to the business scale of the type of business, the market for goods, and the market for production inputs. The ability to manage knowledge in business and strengthen community capacity will encourage the creation of creative and innovative business products in response to market needs and according to consumer needs [67,68]. Thus, the development of economic enterprises, coupled with the strengthening of community capacity, and the use of renewable energy will have an impact on increasing the economic productivity of the community toward sustainable management of slum settlements in Makassar City.

2.3. Sustainable Slum Settlement Development

Handling of slum settlements in relation to sustainable development includes several things, namely (1) optimization of land use; (2) poverty reduction; (3) job creation and social integration; (4) improvement of housing quality; (5) management and control of the impact of environmental pollution; (6) access to adequate and healthy housing; (7) use of renewable energy; (8) increase of community economic productivity; and (9) prevention of disasters, mitigation, preparedness, and post-disaster rehabilitation capabilities. Sustainability is a concept that needs to be applied to all human activities and efforts to integrate economic, social, and environmental goals into the future [69]. Furthermore, the failure to handle slum settlements, which has been implemented so far, is more influenced by the dominant perspective and settlement procedures, which are still focused on the spatial arrangement of slum settlements. This process tends to ignore the right to basic community needs. Furthermore, the handling of urban slum settlements can be initiated by transforming slum areas into productive areas and creating an environment that is oriented toward

added economic value for the poor, environmental preservation, and integration of socio-economic and environmental systems toward sustainable cities. Urban development can be defined as a contribution to the improvement of conditions, material and subjective, of life in cities [70]. Hence, it is necessary to reduce social inequalities and guarantee social, environmental, and economic sustainability [71,72].

Sustainable development is defined as an effort to meet the needs of the present without reducing the ability of future generations to meet their needs. The four principles that become references in the sustainability of slum settlement management are (1) equality, which means that all people have the same opportunity to gain access to housing, infrastructure, and resources; (2) siding with the poor (pro-poor), which is a means to improve the quality of life of the community; (3) sustainability, namely achieving social, economic and environmental goals; and (4) the empowerment approach, namely community involvement in all series of processes. The United Nations Sustainable Development Goals (SDGs) is seen as a "global blueprint for dignity, peace and prosperity for humanity today and in the future" [73,74].

The results of research that support this study include the following: (1) Study conducted by Garrido, S., et al. [75]: the focus of the study examines the relationship between renewable energy and sustainability by considering three dimensions of sustainability: economic, social, and environmental. The study results show that wind and solar energy are the dominant energy potentials that contribute to environmental sustainability toward the use of clean energy. (2) Study by Khair, N.K.M., et al., [76]: the focus of this study is to examine sustainable cities and community empowerment. The results of the study indicate that community-based monitoring is designed to be an instrument in dealing with environmental issues based on public participation and decision-making for urban planning and development. Furthermore, the participation of urban communities determines an inclusive, safe, resilient, and sustainable urban environment. (3) Study by De Luca, E., et al. [77]: the focus of this study is to assess the procedural and financial participation of citizens and local stakeholders in wind energy projects. The results of the study show that concrete avenues for social acceptance of wind energy are fostered through appropriate institutional spaces for public engagement. In addition, missed opportunities for active and passive financial participation can have strong negative consequences for public acceptance. The results of the three studies indicate that the use of renewable energy through participation and strengthening the institutional capacity of the community will promote environmental quality improvement toward an inclusive, safe, resilient, and sustainable direction. Furthermore, the focus of this study is oriented toward community empowerment based on the use of renewable energy toward increasing economic productivity and improving the environmental quality of urban slum settlements. Thus, the hypothesis built in this study is as follows: There is a relationship or influence of community empowerment, use of renewable energy, strengthening institutional capacity, and productivity of economic enterprises on improving the quality of the slum settlement environment. The study conceptual framework is presented in Figure 1 below.

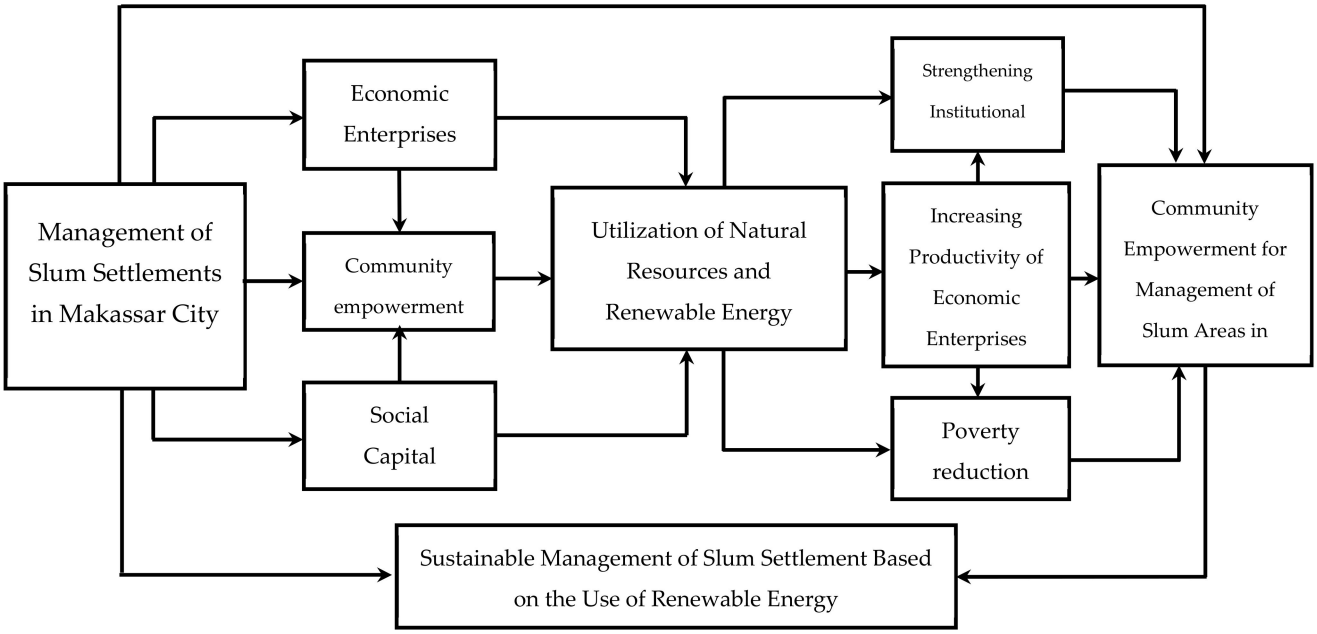


Figure 1. Conceptual framework for community empowerment and utilization of renewable energy based on handling slum settlements.

3. Material and Method

3.1. Research Design

Departing from the focus and purpose of this study, it provides an illustration that the slum settlements in Makassar City tend to increase, due to urbanization. Thus, the research approach chosen in this study is a combination of quantitative and qualitative approaches, namely research that prioritizes the quality of data carried out through the identification process of social situations related to the cases studied, namely community empowerment, based on the use of renewable energy in handling slum areas. This study was aimed at examining and analyzing (1) community empowerment works as a determinant of the use of renewable energy in slum management and (2) the effect of community empowerment, utilization of renewable energy, strengthening of institutional capacity, and productivity of economic enterprises on improving environmental quality. These two things will be studied in depth, in detail, and holistically. Furthermore, a case study was selected in this study, with the following considerations: (1) The slum settlements that have developed in Makassar City are specific and complex due to urbanization; (2) the context of the slum settlements in Makassar City has a prominent consistency and sequence; and (3) the nature of the case is intended to understand and describe the mechanism for implementing community empowerment based on the use of renewable energy in handling slum areas.

3.2. Study Area

This study was conducted in Makassar City in slum settlement locations that are spread across 15 subdistricts and 127 villages and occupy an area of 729 hectares. Slum settlements that have developed are divided into two categories: (1) the dominant typology is lowland slum, and (2) the dominant slum level is moderate slum. These characteristics and typologies are directly related to the work orientation of the community, the potential threat of flooding, poverty, helplessness, and the potential threat of fire. In the formulation of the development policy of Makassar City, several strategies for handling slum settlements are stipulated, among others: (1) increased public access to habitable settlements; (2) arrangement of slum settlements in suburban areas and in island areas; (3) construction and development of rental apartments for low-income people; and (4) rejuvenation, restoration, and resettlement of poor communities located on illegal lands.

Makassar City is one of the metropolitan cities designated as a National Strategic Area (NSA) in Indonesia. Excess urbanization in the development dynamics of Makassar City has an impact on the development of slum settlements, which are predominantly inhabited by the poor. In the majority of developing countries, slums are a defining part of the urban scape [78,79]. The urban spatial pattern that has been built has a tendency toward very basic differences, in terms of ownership of housing facilities, wealth, and community welfare. Furthermore, the typology of luxurious to very luxurious housing is predominantly inhabited by capital-intensive groups, which are facilitated through collaboration between government policies and the developer [80], whereas the dominant slum settlements are inhabited by the poor, and the provision of housing facilities is predominantly undertaken by the community, independently, characterized by high population and building density, poor sanitation, and inadequate infrastructure services. The number of places to live in slums, characterized by a lack of sanitation and public services, inadequate construction conditions, and irregular land ownership, also grows at a very high level [81,82].

The concept of handling the slum settlements of Makassar City is basically aimed at meeting the SDGs targets, namely (1) ending and reducing the poverty rate, (2) reducing economic inequality, and (3) protecting the environment. The evolution of the concept of poverty shows that the environment has a proportion of increasing poverty awareness [83]. Furthermore, the factors that influence the development of slum settlements include (1) excess urbanization, (2) limited access to economic resources due to socio-economic imbalances, (3) inability to fulfill basic needs due to poverty, (4) disparities in infrastructure services, and (5) community behavior in relation to environmental quality degradation. Slums are defined as a built environment based on access to primary basic services: (1) water, (2) electricity, (3) sanitation facilities, and (4) type and quality of housing [84]. Slum settlements that have developed in Makassar City are presented in Table 1 below.

Table 1. Slum settlements by district in Makassar City.

Districts	Number of Villages	Slum Area (Hectare)	Total Population (Person)	Typology of Slum Settlements
Makassar	13	35.57	85,515	Lowland and Water Edge
Mariso	9	35.87	60,499	Lowland, Water Edge, and Above Water
Tamalate	10	177.91	205,541	Lowland and Water Edge
Panakukang	10	68.95	149,664	Lowland and Waterbanks
Tallo	14	119.1	140,330	Lowland, Above Water, and Water Edge
Bontoala	8	16.48	57,197	Lowland and Waterbanks
Ujung Tanah	8	19.73	35,354	Lowland and Waterbanks
Sangkarrang Islands	3	26.49	14,531	Lowland and Waterbanks
Mamajang	9	5.97	61,452	Lowland and Waterbanks
Rappocini	9	59.74	170,121	Lowland and Waterbanks
UjungPandang	7	19.71	29,054	Lowland and Waterbanks
Wajo	8	32.37	31,453	Lowland
Manggala	6	21.77	149,487	Lowland
Biringkanaya	7	43.13	220,456	Lowland and Waterbanks
Tamalanrea	6	46.21	115,843	Lowland

Source: Makassar City Statistics Agency, 2019 [85].

Table 1 shows the developing slum settlements in Makassar City. The typology and characteristics of slum settlements show differences, based on the level of slum and the pattern of spatial use built. Furthermore, the characteristics and differentiation of developing community jobs require empowerment support and the relocation of community settlements on illegal land. The composition of the environment and access to employment imply that the relocation program must be carefully designed if it is to improve

welfare [86]. Community empowerment in handling slum settlements in Makassar City is oriented toward increasing the productivity of economic enterprises based on the use of renewable energy sources, followed by increasing institutional capacity toward improving environmental quality. The research locations are presented in Figure 2, and the typology of slum settlements is presented in Figure 3.

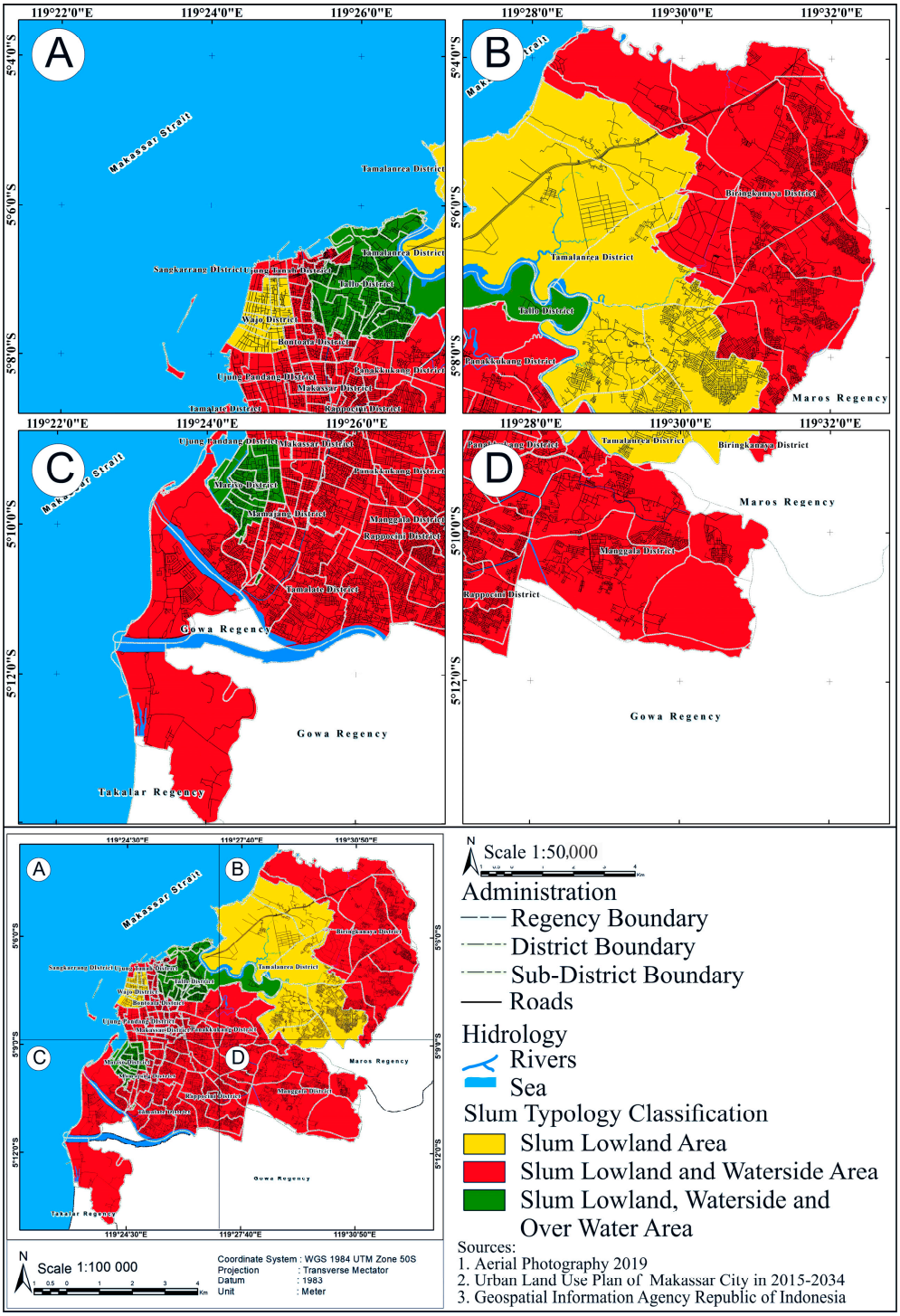


Figure 2. The locations of the slum settlements in Makassar City as the research object. (**A**) Slum in the city center; (**B**) Slums in an industrial area; (**C**) Slum in the center of business activities; (**D**) Slum settlements in suburban.

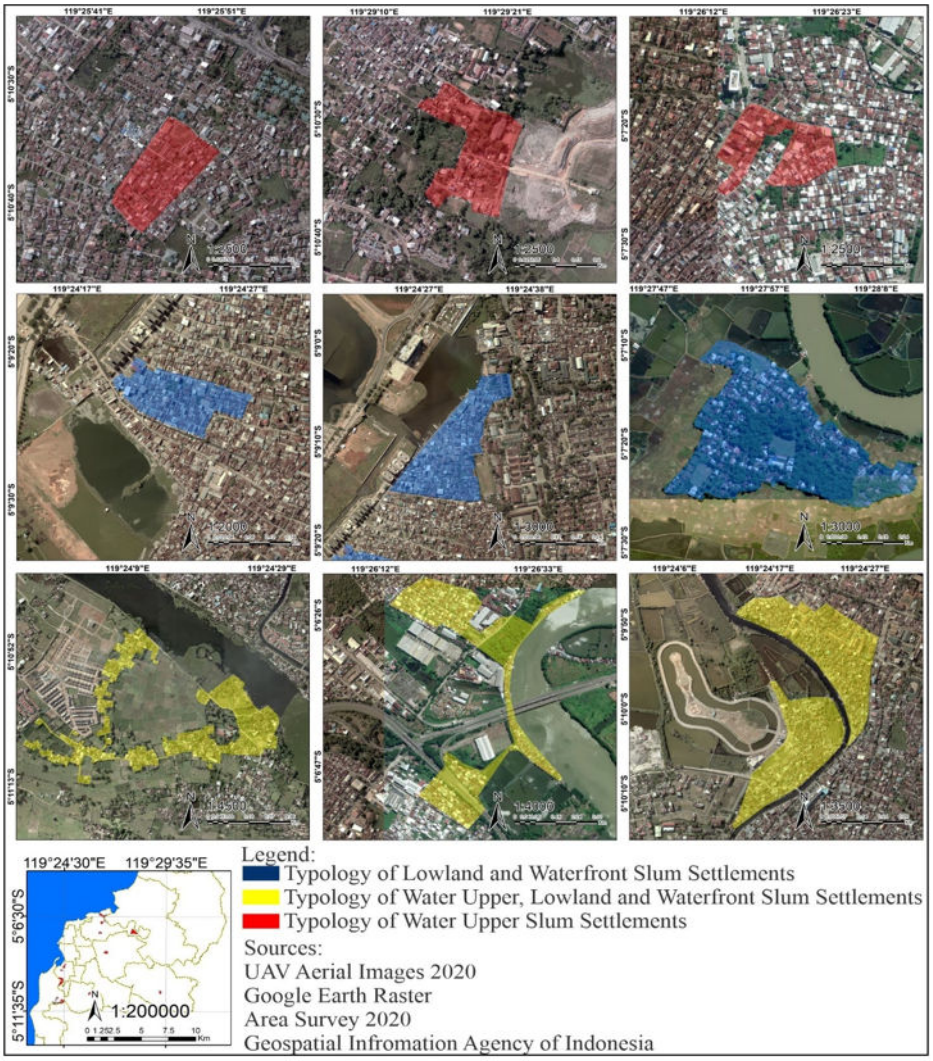


Figure 3. Example of typology of slum settlements in Makassar City.

3.3. Method of Collecting Data

In this study, the types of data are divided into two categories, namely primary data and secondary data. Primary data is data obtained through observation, surveys, and in-depth interviews. Meanwhile, secondary data is obtained through documentation. Furthermore, according to the focus and objectives to be achieved in this study, the data collection results obtained were divided into two categories, namely qualitative data and quantitative data. Qualitative data were obtained through observation, in-depth interviews, and documentation. These data are used by researchers to provide an overview of the mechanisms and procedures for implementing community empowerment in relation to the use of renewable energy in handling slum areas in Makassar City. The data are then presented in the form of descriptions, categorizations, and qualitative descriptions. Quantitative data were obtained through a survey using a questionnaire instrument. These data are used to describe the condition and social situation of the community in responding to the implementation of community empowerment in relation to the use of renewable energy in handling slum areas. The data obtained are then presented in tables and diagrams.

In accordance with the chosen approach, the case study, the data analysis process in the study used a quantitative–qualitative approach with the following considerations: (1) triangulation logic, where, in this case, the qualitative research results are checked back on quantitative studies, and vice-versa, thanks to the responses to the validity of the findings; (2) the quantitative approach is used to reveal the structural features of large-scale

social life, while the qualitative approach tends to monitor small-scale behavior, so that, when researchers try to reveal the second level, they jointly use quantitative and qualitative guidelines; and (3) to getting data from two different realities, it is necessary to combine two approaches (quantitative and qualitative). The combination of qualitative and quantitative research in this study is presented in Figure 4, below.

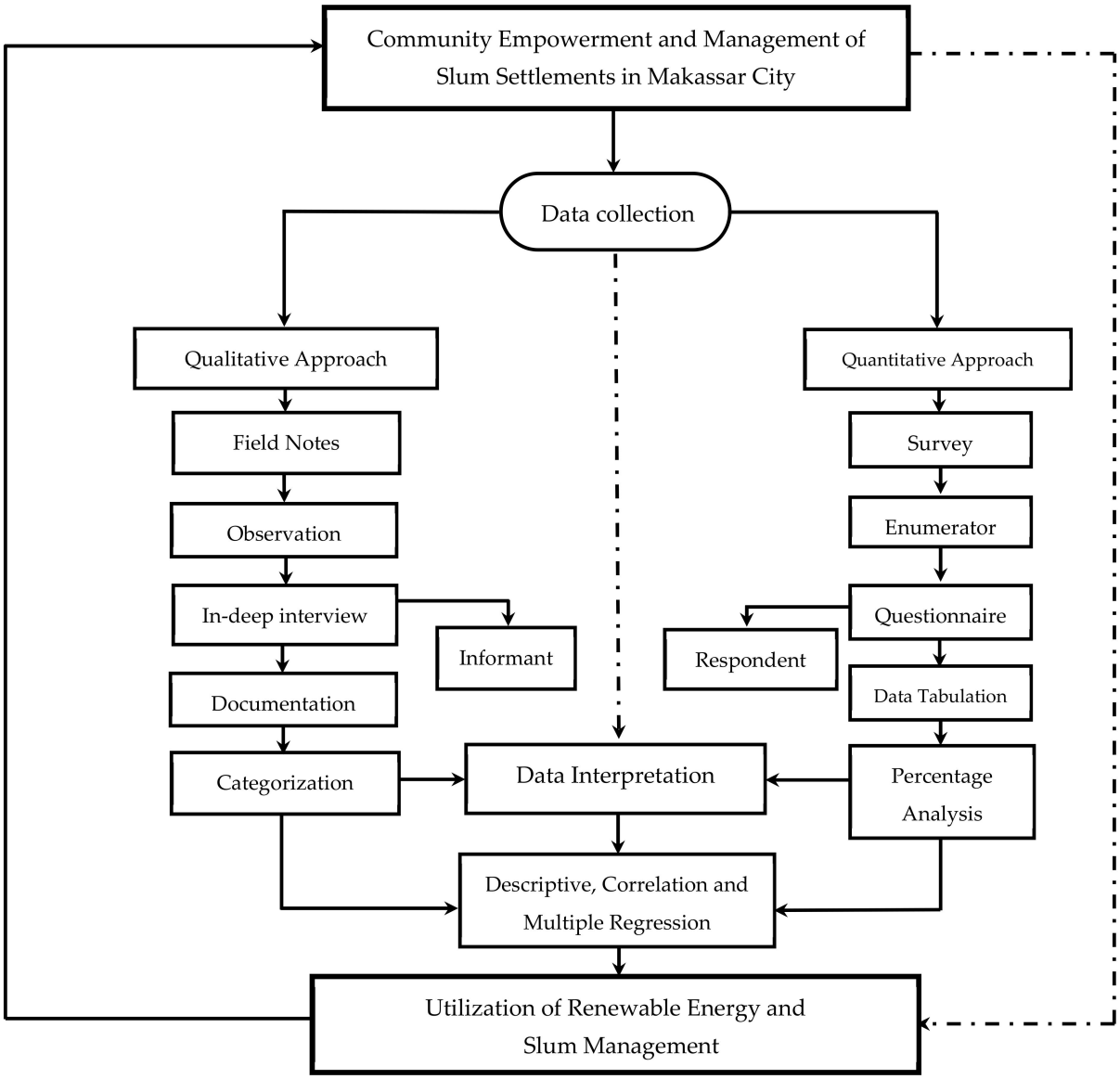


Figure 4. Research process implementation flow. Source: Author elaborator.

3.3.1. Observation

Observations in this study are used to observe the community empowerment process in relation to the use of renewable energy to support increased economic productivity of the community in the slum areas of Makassar City. Furthermore, the instruments used in the implementation of field observations are field notes, cameras, base maps of slum settlement locations, and data checklists. The aim is to understand the situation and describe the socio-economic characteristics of the community, the role of the community in the empowerment process, and efforts to develop economic business potential, as well as the use of community social capital, which enables them to be optimized in the empowerment process, and use of renewable energy, toward improving the quality of the slum environment. The results of the data obtained through observation were used to provide a

comprehensive picture of the mechanisms and procedures for community empowerment and orientation for the use of renewable energy to support economic enterprises and the role of the community in improving the quality of the slum environment in Makassar City. Thus, the observations in this study were used to trace data, including: (1) empowerment mechanisms and procedures implemented, (2) slum land use patterns, (3) economic enterprises developed by the community, (4) capacity building community institutions, (5) community involvement in the implementation of empowerment, (6) typology and characteristics of slum settlements, and (7) types of renewable energy used. The results of the data obtained through observations by researchers were then categorized and associated with the theories and assumptions used in this study.

3.3.2. In-Depth Interview

In-depth interviews in this study were used for two purposes: (1) a description of the location of the slum settlements in relation to socio-economic conditions and the potential for community economic enterprises, and (2) exploration, to describe the situation and conditions of slum settlements, as well as the role of the community in the empowerment process and utilization of renewable energy. Furthermore, in-depth interviews in this study were used to interpret the socio-economic conditions of the community, based on the reality that develops in the field. The instruments used in in-depth interviews were a tape recorder, pictures, and interview guides equipped with freelance notes and a checklist. Furthermore, in-depth interviews were used to collect data, including (1) community involvement in the implementation of empowerment, (2) the role of society in the use of renewable energy, (3) community participation in handling slum areas, and (4) community efforts and efforts to develop economic activities and use renewable energy. The results of in-depth interview data obtained from informants by researchers are then categorized for use in formulating research hypotheses.

3.3.3. Questionnaire

The questionnaire in this study was used for two functions: (1) descriptive, which describes the process of community empowerment related to the use of renewable energy in handling slum areas, and (2) measurement, which refers to the characteristics of the data, namely the data obtained from the data collection using a questionnaire. Furthermore, the measurement scales used for the data collection results through a questionnaire were ordinal and interval scales. The ordinal scale in this study was carried out by grouping objects, both individuals and groups, into categories based on the socio-economic conditions of the community and based on the economic efforts developed. The next step is to provide a specific code to facilitate the data interpretation process. The category was then given a number, namely number 5 for very active, number 4 for active, number 3 for moderately active, number 2 for less active, and number 1 for inactive. The ratio scale in this study was used for measurement results that can be distinguished, sorted, have a certain distance, and allow for comparison; in this case, it was used to measure the types of economic enterprises developed by the community. Furthermore, the measurement results of the two scales then produced quantitative data and became the basis for statistical analysis.

The questions posed to respondents using a questionnaire in this study are divided into two categories: structured and unstructured, which have been prepared previously. This questionnaire was used in tracing data, among others. (1) Community empowerment was measured using indicators, such as community capacity, independence, community awareness, and community participation. (2) Utilization of renewable energy was measured by the indicators of energy availability, type of energy, energy security, energy distribution and services, energy needs, energy infrastructure services, and public knowledge of renewable energy. (3) Strengthening the institutional capacity of the community was measured by the following indicators: the function and role of the institution, the ability to organize the community, and the involvement of community organizations. (4) The productivity of community economic enterprises was measured by indicators,

such as income level, job opportunities, business opportunities, business environment, economic business products, and product marketing. (5) The quality of the slum settlement environment was measured by indicators of land use, environmental carrying capacity, community behavior, availability of infrastructure, and control of environmental pollution.

Filling in the questionnaire in this study was not carried out independently by respondents but was guided by the researcher. Furthermore, the selection of respondents was carried out by field officers, who also served as enumerators. The enumerators selected were based on the following considerations: (1) local residents who have the ability to collect data, (2) those who understand the socio-economic situation of people living in slum areas, and (3) having closeness with people who live in slum areas. Furthermore, before carrying out their duties in the field, the enumerator was given directions and training in filling out the questionnaire, as well as techniques for conducting interviews with respondents.

The questionnaire was distributed to 127 slum settlement locations inhabited by the urban poor. The reason the researchers determined the location was based on the following considerations: (1) the dynamics of the rapid development of Makassar City, in line with the development of slum settlements due to urbanization and (2) economic enterprises developed by the community require support for the use of renewable energy. Furthermore, the criteria for filling out the questionnaire (respondents) in this study were (1) people living in slum areas, (2) having economic business activities, (3) being active in social institutions, (4) participating in the empowerment process, (5) being married and having a family, and (6) having been settled in the slum area for five years.

3.3.4. Documentation

This study uses various documents and study results related to slum settlements in Makassar City. The documents referred to include (1) data on the population located in the slum areas of Makassar City, (2) the socio-economic profile of the community, and (3) documents of development activities carried out by the Makassar City Government in relation to the handling of slum settlements, as well as other documents related to the research objectives. Documentation data in this study were obtained through the following measures: (1) the results of the study on slum settlement management were obtained through the Makassar City Regional Development Planning Agency; (2) data on the number of residents living in slum areas were obtained through the Makassar City Central Statistics Agency; and (3) the socio-economic profile of the community was obtained through the District Office and the Village Office. The three documents are used to support the data from in-depth interviews, observations, and research questionnaires.

3.3.5. Research Informants and Respondents

Informants in this study were used as sources of information in collecting qualitative data. Determination of informants was performed using the snowball sampling method. This means that the researcher determines who can be interviewed, based on information obtained from the village office and community leaders in the slum areas in Makassar City. Furthermore, key informants were selected from community leaders who were able to provide good information about the socio-economic conditions of the community, the role of the community in empowerment, and the use of renewable energy. The next step by the researcher is then to find out who other community leaders can be interviewed to ensure the consistency of the information obtained from the informants. In addition, the informants were also determined from several respondents who had been interviewed previously in order to explore some of the questions generated from the questionnaire that required a more detailed explanation. Informants are referred to by researchers as actors in the phenomenon being studied.

Referring to the snowball method used, the number of informants in this study was determined to be 18 people. Of these, 10 were from outside respondents and 8 were from respondents. The 10 informants from outside respondents were determined

based on information obtained from the Village Office. Furthermore, the information that was obtained from the Village Office was then determined as the basic informant. This basic informant was used as a basis for obtaining information to determine the next informant, until the number is fulfilled, as many as 10 people. This means that all informants who come from outside the respondent are determined by the snowball method. Furthermore, 8 informants were selected from the respondents with the following considerations: (1) having economic business activities, (2) having economic relations in a growing economic business, (3) able to provide good information about the development of the location of slum settlements and their neighborhoods, and (4) able to provide good information about the use of renewable energy. The snowball sampling method used in this study is presented in Figure 5, below.

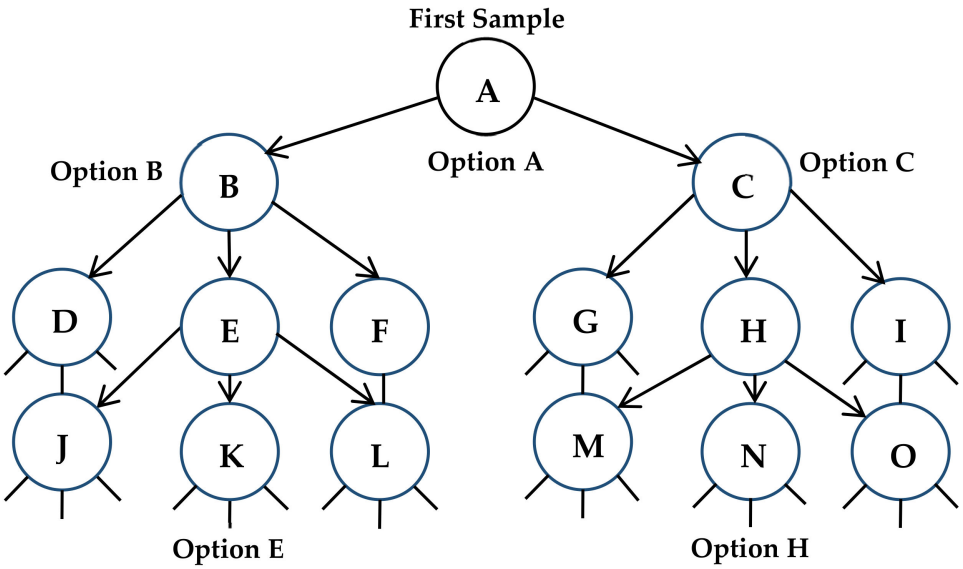


Figure 5. Schematic of the snowball sampling technique.

Furthermore, the research sample in this study was determined using purposive sampling based on the socio-economic conditions of the community, which the researchers determined based on certain characteristics: the sample must be residents located in slum areas, have a family, have lived in a slum area for five years, understand the process of implementing community empowerment, and understand the benefits of using renewable energy. The characteristics expressed are used by researchers in determining respondents. The results of filling out the questionnaire were then analyzed using percentage and statistical analysis. Withdrawal of samples refers to Cohran [87]. Determination of respondents used the following formulation:

$$n = N/Nd^2 + 1 \quad (1)$$

where n is the number of samples, N is the population, and d is the error rate (0.5) or 5% of the 95% confidence level. The number of research samples in this study was set at 500 samples. Furthermore, the number of respondents in this study is presented in Table 2 below.

Table 2. Number of research respondents.

Districts	Number of Villages	Total Population (Person)	Number of Respondents
Makassar	13	85,515	55
Mariso	9	60,499	35
Tamalate	10	205,541	40
Panakukang	10	149,664	40
Tallo	14	140,330	60
Bontoala	8	57,197	30
Ujung Tanah	8	35,354	30
Sangkarrang Islands	3	14,531	10
Mamajang	9	61,452	35
Rappocini	9	170,121	35
UjungPandang	7	29,054	29
Wajo	8	31,453	30
Manggala	6	149,487	21
Biringkanaya	7	220,456	29
Tamalanrea	6	115,843	21

Source: Author elaboration and Makassar City Statistics Agency, 2019 [85].

3.4. Data Analysis Method

Data analysis in this study is divided into two stages: first, qualitative data analysis, namely data collected through observation and in-depth interviews and then analyzed, and second, quantitative data analysis, in which researchers collected information from respondents using a questionnaire instrument and then analyzed using quantitative descriptive statistics and multiple regression. Furthermore, data analysis was carried out by combining qualitative and quantitative data. That is, the steps used for qualitative research were, at the same time, used in quantitative research. At the time of interpretation or analysis, reduction was then performed on each data set, namely categorization for qualitative data and statistical analysis for quantitative data. Then, a triangulation interpretation was carried out on the two data sets. This means that the data obtained using a questionnaire was explored again through two methods, namely qualitative and quantitative. This merger is more to strengthen the validity of the analysis results.

3.4.1. Qualitative Data Analysis

Qualitative analysis is used to answer the research question, "How does community empowerment work as a determinant of the use of renewable energy in handling slum areas?" In this study, qualitative analysis was used during data collection and after data collection was completed. Thus, the data analysis carried out is divided into three categories: data reduction, data display, and conclusion. Data reduction was used with the following considerations: (1) The data obtained in the field is quite a lot, complex and complicated, so data reduction and similar data grouping had to be done immediately for interpretation needs. (2) We selected and summarized the main things, focusing on the important things, themes and patterns, and then formulated the conclusions. (3) Reduced data were used to provide a clear picture based on the predefined focus and study objectives. (4) Data reduction was done by providing codes on certain aspects, according to the objectives to be achieved in this study.

After the data was reduced, the next step was to display the data. The following were the steps taken: (1) Quantitative data were presented in tables and graphs. Their purpose was to facilitate understanding and interpretation of data. (2) For data that were qualitative in nature, the data presentation was carried out in the form of a brief description, chart, and relationship between categories, with reference to the theory used. (3) Data was presented in text and narrative form for the purpose of facilitating understanding. (4) Data was displayed using letters and numbers arranged sequentially so that the structure could be understood for analysis needs. Furthermore, the data analysis stage was carried out by

combining qualitative and quantitative approaches, namely domain analysis, taxonomy, components, and cultural theme analysis.

Domain Analysis

Domain analysis, in this study, refers to the socio-economic characteristics of the community located in slum areas, namely place, actor, and activity (PAA). The domain in this research is community empowerment, working as a determinant of the use of renewable energy in handling slum areas. The domain analysis in this study was carried out in several stages: First, it described, in general, that community empowerment works as a determinant of the use of renewable energy. Second, categories were identified. The category referred to is the socio-economic empowerment of the community as a determining factor in the handling of slum settlements. Third, identify the research domain that is used as the basis, namely community empowerment and the use of renewable energy towards the sustainability of the community's economic efforts in handling slum areas.

Taxonomic Analysis

The domains that have been determined were then chosen by the researcher to be the focus of the research. The taxonomic analysis in this study is as follows: (1) The chosen domain is broken down into more detail, namely the community empowerment mechanism in relation to the use of renewable energy in handling slum areas. (2) The process is carried out through focused observation for the purpose of observing specific matters, namely on economic enterprises developed by the community, community institutions, and community participation.

Componential Analysis

Componential analysis is divided into three categories: (1) determining specific characteristics in the implementation of community empowerment in relation to the use of renewable energy and (2) contrasting each element, based on the conditions and socio-economic characteristics of the community. (3) Both processes are carried out through observation and selected interviews by asking questions that are contrasting to the socio-economic situation of the community. The aim is to provide an overview of community empowerment working as a determinant of the use of renewable energy in handling slum areas.

Analysis of Cultural Themes

Analysis of cultural themes is an effort to find a common thread by integrating across existing domains [88]. The steps that the researchers took were to (1) Determine the real domain by integrating it across domains; then (2) the results of the domain, taxonomic, and the component analysis is compiled into the construction of social situations that develop in the field. The construction of the social situation is directed at observing how community empowerment works as a determinant of the use of renewable energy in handling slum areas.

3.4.2. Quantitative Analysis

The quantitative analysis in this study is used to answer the research question, "How is the effect of community empowerment (X_1), renewable energy use (X_2), strengthening institutional capacity (X_3), and the productivity of economic enterprises (X_4) working toward improving the quality of the slum settlement environment (Y)?" The analysis method used to answer this question is the multiple regression analysis method. Multiple regression analysis, in this study, was used to determine how much influence the independent variable had on the dependent variable and to predict the value of the dependent variable when all the independent variables had known values. Thus, the multiple regression analysis method was used to answer the hypothesis that has been formulated through a qualitative approach. The multiple regression analysis model is presented in Figure 6 below.

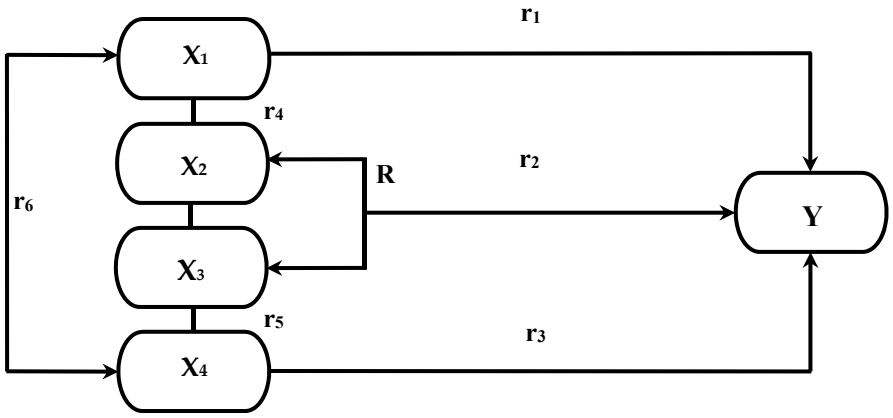


Figure 6. Model of multiple regression.

The multiple variable relationship model has four independent variables, X_1, X_2, X_3, and X_4, and one dependent variable, Y. To find the relationship between X1 and Y, X_2 with Y, X_3 with Y, and X_4 with Y, and X_1 with X_2, X_2 with X_3, X_3 with X_4, and X_1 with X_4, by using a simple correlation technique. To find the relationship from X_1, X_2, X_3, X_4 to Y, we used multiple regression. This model shows four independent variables (X_1, X_2, X_3, X_4) and one dependent (Y). The analytical formulations used are as follows.

$$Y = \beta o + \beta 1\, X1 + \beta 2\, X2 + \beta 3\, X3 + \beta 4\, X4 + \varepsilon \quad (2)$$

$$r_{xy} = \frac{N\sum X_i y_i - \sum X_i \sum y_i}{\sqrt{N\sum X^2{}_i - \left(\sum X^2{}_i\right)^2}\sqrt{N\sum y^2{}_i - \left(\sum y_i\right)^2}} \quad (3)$$

$$r_{y\cdot 12} = \sqrt{R^2 y\cdot 12} \quad (4)$$

$$R^2{}_{y\cdot 12} = 1 - JKG/(n-1)\, s^2 y \quad (5)$$

where Y is the dependent variable; X_1, X_2, X_3, X_4, . . . , Xn are independent variables; ε is random residues; and βo, β_1, β_2, β_3, and β_4 are population parameters whose values were unknown and had to be estimated from data. β_i reflects the effect of the independent variable Xi on the dependent variable Yi which reflects the effect of the independent variable Xi and the dependent variable Y. The r value ranges from (+1) to (−1). The value of r that is (+) is indicated by the value of b that is (+), and the value of r that is (−) is indicated by the value of b that is (−). If the value of r approaches +1 or r approaches −1, then X and Y have a high linear correlation. If r = +1 or r = −1, then X and Y have a perfect linear correlation. If r = 0, then X and Y do not have a linear relationship. $R^2y._{12}$ is the coefficient of determination for multiple linear regression, JKG is the sum of squares of errors, and s^2y is the sum of squares of y (corrected). In order to support optimal results, data analysis in this study was carried out by combining qualitative and quantitative approaches. The combination of these approaches is intended to strengthen the results of the analysis.

4. Result

4.1. Determinants of Community Empowerment and Use of Renewable Energy

Slum settlements that are developing in Makassar City are characterized by a high population density, poverty, inadequate housing conditions, and inadequate infrastructure support. Total population and spatial distribution in relation to the built environment are directly related to social, economic, and environmental issues in the formulation of urban development planning and policies [89]. Furthermore, community empowerment in handling slum settlements is an effort to increase public access to production factors to marketing the products produced. To improve living conditions and provide solutions to overcome slum areas, it is very important to understand the shape of the settlement and

its development and the production factors that the community cultivates [90,91]. Thus, community empowerment is directed at building the role of community participation in the implementation of development and encouraging increased productivity of economic enterprises. Productive efforts and inclusive economic policies are ways to increase community participation in accessing economic resources and social injustice [92].

The ability of the community to make decisions for the management of economic enterprises will encourage social cohesion, which is the optimal result of the empowerment process. Social justice is related to equitable distribution of resources, opportunities, and rights essential to achieving prosperity [93]. Thus, the development of socio-economic activities toward improving environmental quality will not succeed without the support of community participation. City resilience is an inclusive process that refers to the ability to manage unexpected risks; in this case, the community is able to adapt and face future challenges due to policy changes and urban spatial dynamics [94,95]. Community participation in the empowerment process is presented in Figure 7, below.

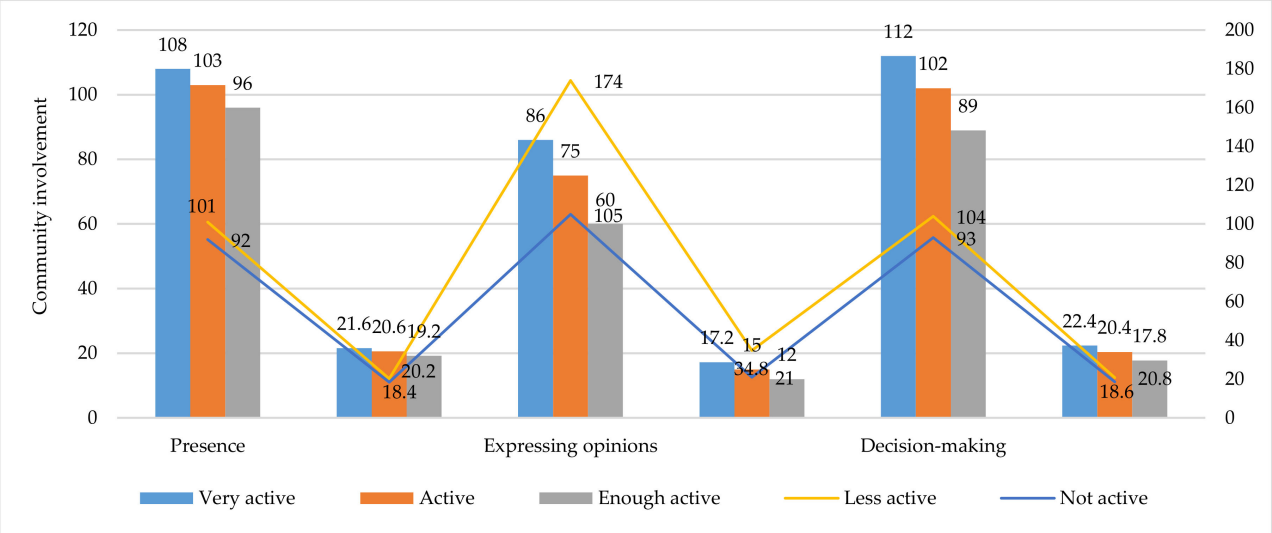


Figure 7. Community participation in social empowerment. Source: Primary data

Figure 7 shows community participation in the implementation of social empowerment in handling activities of slum settlements in Makassar City. Three interpretations that can be proposed regarding these results are, among others, (1) community involvement, in terms of attendance for each activity, which shows that 42.2% are in the active category, 19.2% are in the active category, and 38.6% are in the less active category; (2) involvement, in terms of conveying thoughts and opinions, which shows 32.2% in the active category, 12% in the moderately active category, and 55.8% in the less active category; and (3) community involvement, in terms of decision-making, which shows that 42.8% are in the active category, 17.8% are in the moderately active category, and 39.4% are in the less active category. These results confirm that the role of society in social empowerment is not optimal. The field facts found illustrate that the inadequate implementation of social empowerment in handling slum settlements is more due to the level of understanding and awareness of the community to participate in solving social problems faced. The community will participate in improving the quality of the environment if the status of land ownership, shelter, and social problems faced are facilitated by government policies [96]. Furthermore, community involvement in empowering economic enterprises is presented in Figure 8, below.

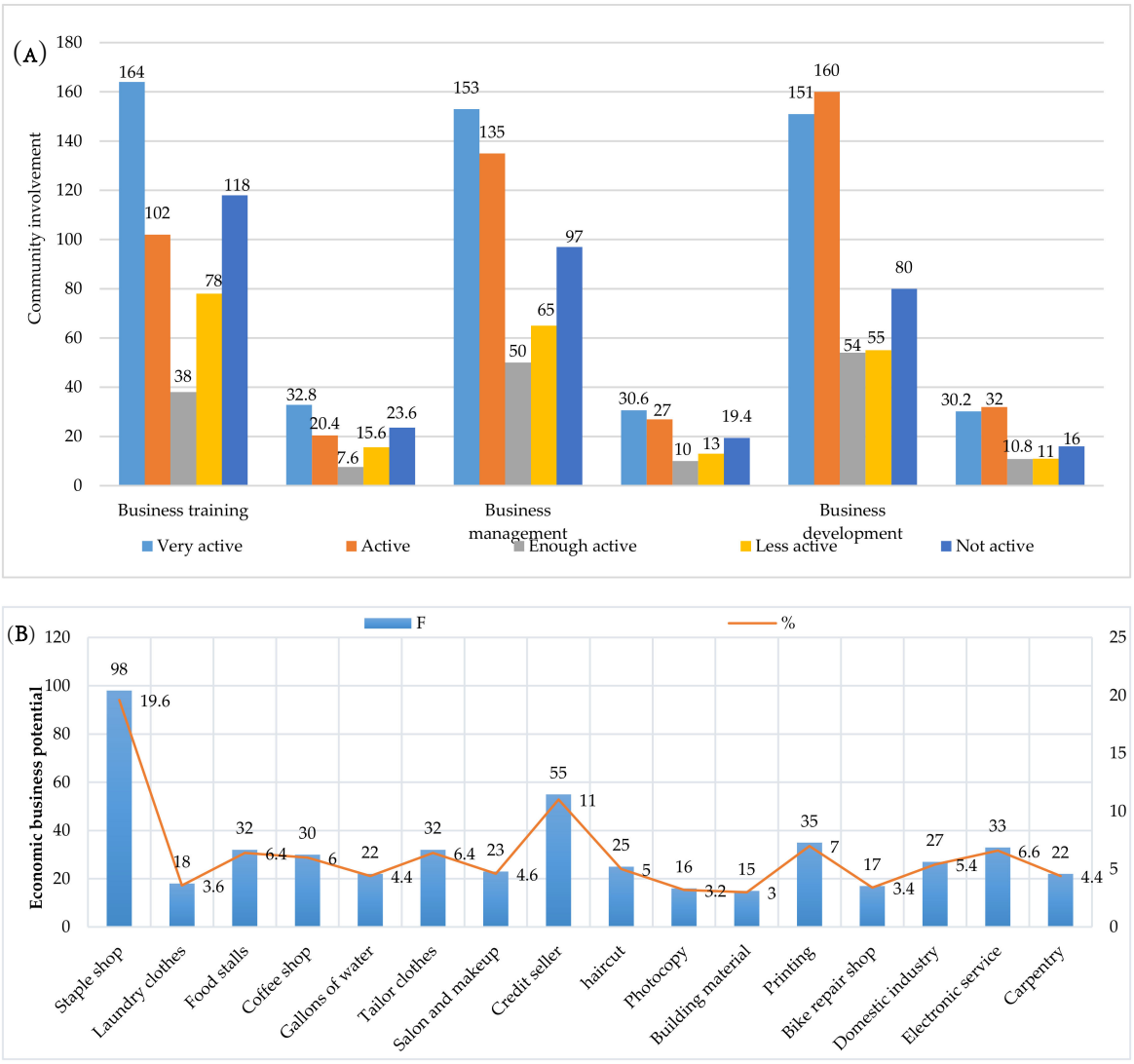


Figure 8. Community participation in slum empowerment. (**A**) Empowerment of economic enterprises. (**B**) Community economic enterprises. Source: Primary data.

Figure 8A shows community involvement in the implementation of economic empowerment. Three interpretations that can be put forward in relation to these results include (1) community involvement in the implementation of economic business training, which is 53.2% in the active category, 7.6% in the fairly active category, and 32.9% in the less active category; (2) community involvement in business management, which is 57.6% in the active category, 10% in the fairly active category, and 32.4% in the less active category; and (3) community involvement in the development of economic enterprises, which is 62.2% in active category, 10.8% in the quite active category, and 17% in the less active category. These results confirm that the public's interest in improving welfare through economic business development is quite positive. Thus, the potential for economic business that is developed by the community requires the support of government policies in the form of implementing strategic programs through the use of social capital built up in the community. That is, it is very important to understand social capital as the glue of social relations for the community and as the basis for the formulation of investment-based programs in community organizing [97]. The field facts we found illustrate that the economic business developed by the community is an effort to maintain its existence in the dynamics of urban development, so that it has the opportunity to be developed to reduce unemployment and poverty in Makassar City. The vital function of city governments is to

provide infrastructure and facilities that are easily accessible and enable communities to solve problems independently through strengthening capacity, increasing skills, building cooperative networks, and developing economic enterprises [98,99].

Figure 8B shows the economic enterprises developed by the community in the slum areas of Makassar City. The dominant economic businesses are (1) food stalls, at 19.6%, (2) credit sales, at 11%, (3) printing businesses, at 7.4%, (4) 6.4% for the categories of food stalls and clothing tailors, and (5) 6.6% for the electronic service business category. The differentiation of developing economic enterprises shows that the capacity of business capital and the interests of community businesses vary considerably. The results of the field confirmation illustrate that the economic business developed by the community is still limited to maintaining the existence and ensuring the survival of the family, both individually and in groups as a community unit. Thus, it takes initiative and synergy between the city government and the community in the form of strategic steps to address the problem of slum settlements [100,101].

Slum settlements that tend to increase every year have a positive contribution to land use changes that are predominantly developing in river and coastal areas. Land use changes that tend to increase from time to time have a positive contribution to spatial dynamics and a decrease in environmental quality. Land use in the slum areas of Makassar City is presented in Table 3, below.

Table 3. Land use of Makassar City slum settlements.

Land Use	Slum Area Location					
	CBD Areas		Transition Areas		Peri-Urban Areas	
	Area Large (ha)	Percent (%)	Area Large (ha)	Percent (%)	Area Large (ha)	Percent (%)
Barren Land	0.06	0.01	315.88	2.57	222.46	3.63
Bush	14.44	1.85	507.15	4.13	137.28	2.24
Commercial and Services	101.92	13.04	306.29	2.49	25.67	0.42
Cropland	19.17	2.45	180.53	1.47	1711.87	27.92
Field	17.48	2.24	1394.67	11.35	82.16	1.34
Graveyard	2.62	0.33	39.51	0.32	4.77	0.08
Industrial	0.00	0.00	57.50	0.47	401.90	6.56
Lakes	0.00	0.00	219.87	1.79	0.00	0.00
Leas	0.00	0.00	84.95	0.69	110.54	1.80
Mangrove	1.44	0.18	409.38	3.33	60.86	0.99
Median	0.05	0.01	0.15	0.00	0.20	0.00
Mixed Farm	2.35	0.30	504.31	4.10	933.11	15.22
Office Buildings	5.77	0.74	0.04	0.00	0.00	0.00
Pond	58.39	7.47	1831.34	14.90	466.65	7.61
Port	23.80	3.05	1828.94	14.88	0.00	0.00
Residential	510.34	65.29	68.53	0.56	1889.74	30.82
Rivers	3.22	0.41	4252.45	34.59	31.15	0.51
Rural Parks	14.96	1.91	72.89	0.59	21.26	0.35
Sandy Areas	0.00	0.00	13.55	0.11	0.00	0.00
Schools and Others Education Services	5.63	0.72	152.90	1.24	24.36	0.40
Urban Forest	0.00	0.00	44.51	0.36	0.01	0.00
Waste Dumps	0.00	0.00	6.99	0.06	6.67	0.11

Source: Author elaboration and Google Map@ 2019.

Table 3 illustrates that the slum settlements in Makassar City are divided into three categories: (1) slum settlements that develop in the city center that are in direct contact with the center of trade and port activities, whose dominant work orientation consists of industrial workers, port workers, and urban informal economic activities; (2) slum

settlements that develop in the dominant transitional area develop on the riverbanks, namely the Tallo River and the Jenneberang River, whose work orientation is primarily fishermen, odd jobs, the urban informal sector, and garbage collectors; and (3) slum settlements that develop in suburban areas that are in direct contact with formal settlements built by developers, higher education centers, and industrial areas. These three things show the differentiation of community work in relation to the function of the developing urban space. The social differentiation that is built is directly related to the level of income economically, social status, lifestyle, consumption patterns, and the combination of social groups in geographic space [102,103], which signify the increasing socio-spatial differentiation of urban space [104,105]. This means that the socio-spatial structure of a city is closely related to political, physical, economic, and social transformations [106,107]. Furthermore, the developing slum settlements are also related to the existence of the community, which functions as a facilitator and driving force in handling slum settlements. The functions and roles of community institutions in relation to the implementation of socio-economic empowerment are presented in Figure 9, below.

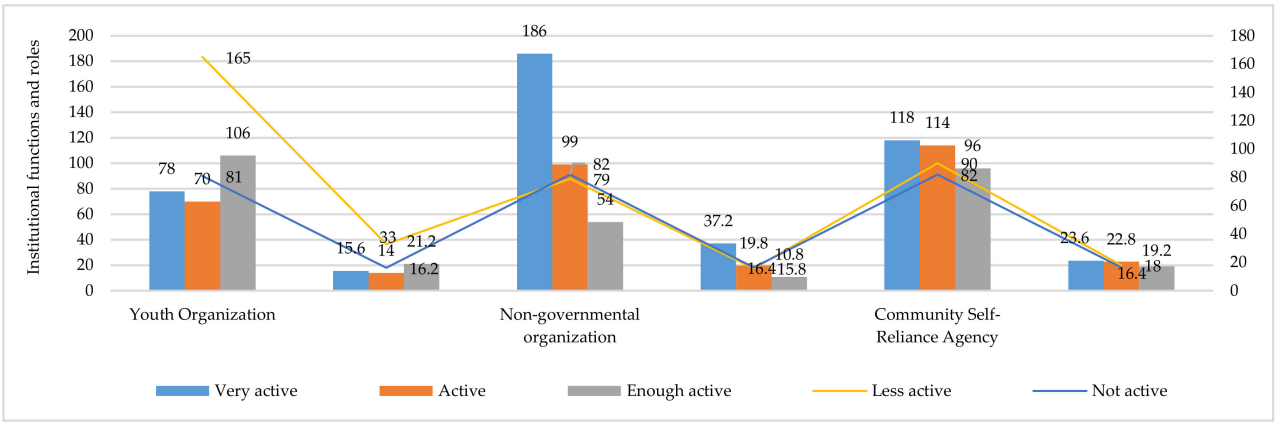


Figure 9. Functions and roles of institutions in the implementation of socio-economic empowerment. Source: Primary data.

Figure 9 shows the role of community institutions in the implementation of socio-economic empowerment in relation to the handling of slum settlements. Three interpretations that can be put forward in relation to these results include (1) the involvement of youth organizations in the implementation of socio-economic empowerment, which shows that 29.6% are in the active category, 21.2% are in the fairly active category, and 49.2% are in the less active category; (2) the involvement of nongovernmental organizations in the implementation of socio-economic empowerment, which shows that 57% are in the active category, 10.8% are in the fairly active category, and 32.2% are in the less active category; and (3) the involvement of community self-supporting bodies in the implementation of socio-economic empowerment, which shows that 46.4% are in the active category, 19.2% are in the fairly active category, and 34.4% are in the less active category. These results confirm that the functions and roles of community institutions in the implementation of socio-economic empowerment in handling slum areas are not optimal. The role of community institutions is to assist government officials and formulate policies to solve slum settlement problems, maintain development, and participate in urban planning. [108,109]. Furthermore, public understanding and knowledge related to the use of renewable energy in the implementation of socio-economic empowerment is presented in Figure 10, below.

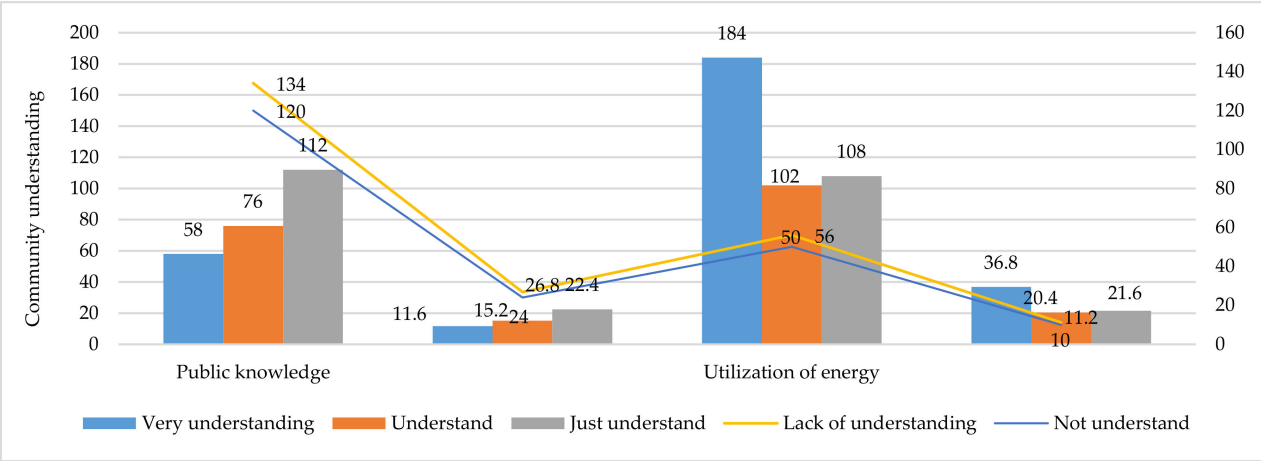


Figure 10. Public understanding of renewable energy. Source: Primary data.

Figure 10 shows people's understanding of the use of renewable energy. Interpretations that can be submitted regarding these results include (1) public knowledge regarding the use of renewable energy indicates the population is split, with 26.8% in the very understanding category, 22.4% in the sufficiently understanding category, and 50.8% with the category of lack of understanding; and (2) the use of renewable energy in relation to the increase in productivity of economic enterprises shows that 57.2% are in the very understanding category, 21.6% are in the quite understanding category, and 21.2% are in the category of not understanding enough. The results of the field confirmation illustrate that the public's knowledge of the use of renewable energy is quite low, due to the lack of optimal socialization. Population growth and an increase in the workforce have a positive correlation with an increase in energy consumption, so the use of renewable energy is urgently needed [110]. Thus, optimizing the use of renewable energy toward the use of clean energy as a process will require optimal socialization support at the community level [111].

The field facts found illustrate the potential for renewable energy, which allows it to be used to support increased productivity of community economic enterprises in handling slum settlements, including (1) water energy, through the utilization of potential watersheds, namely the Jenneberang river and the Tallo river; (2) wind energy, by changing the rotation of the turbine blades into electric current using an electric generator to rotate mechanical equipment; (3) solar energy, through the use of solar panels made of metal to be converted into environmentally friendly electrical energy; (4) biomass energy, sourced from palm oil to produce biodiesel for engine combustion efficiency, including the use of motorized vehicles; and (5) biofuel energy, in the form of solid, liquid, and gas biofuel produced from organic materials sourced from plants and industrial, commercial, and domestic waste. The five energy sources require optimal use of them through the use of local labor. This means that the use of renewable energy will promote the effectiveness and efficiency of economic enterprises developed by the community toward sustainable business stability. Excessive use of gas and fossil fuels in economic activities causes the emission of large amounts of CO2 (carbon dioxide) into the air and has an impact on the greenhouse effect [112]. Therefore, it is necessary to make decisions regarding the use of renewable energy for business transformation, technological innovation, and community entrepreneurship development toward efficient energy use [113].

4.2. Productivity of Economic Enterprises and Improvement of Environmental Quality

The productivity of society will increase if it is followed by business innovation, capital support, and economic business development. Local economic development plays an important role in job creation, poverty alleviation, and economic growth [114]. Furthermore, community economic enterprises require increased competitiveness, strengthening human

resource capacity, and business innovation toward sustainable economic business stability [115]. Policies needed to boost the productivity of community economic enterprises include (1) entrepreneurship training based on strengthening human resource competencies, (2) business capital support, (3) business diversification through the use of renewable energy, (4) increasing the competitiveness of economic enterprises toward, and (5) access to information technology-based potential markets. The development of work skills toward the flexibility of economic enterprises will boost the adaptability of the community toward increased economic productivity [116].

Furthermore, entrepreneurship training will be successful if the community plays an active role and is integrated with strategic programs from the government. To foster entrepreneurship at the community level, it will require optimal community participation and support from government policies [117]. Furthermore, to support increased productivity of economic enterprises, the orientation is to increase income, business opportunities, job opportunities, and protect economic enterprises. Government decision-making in favor of the community will encourage economic transformation, innovation, and entrepreneurship toward increasing welfare [118,119]. Income levels, employment opportunities, business opportunities, and marketing of community economic business products are presented in Figure 11 below.

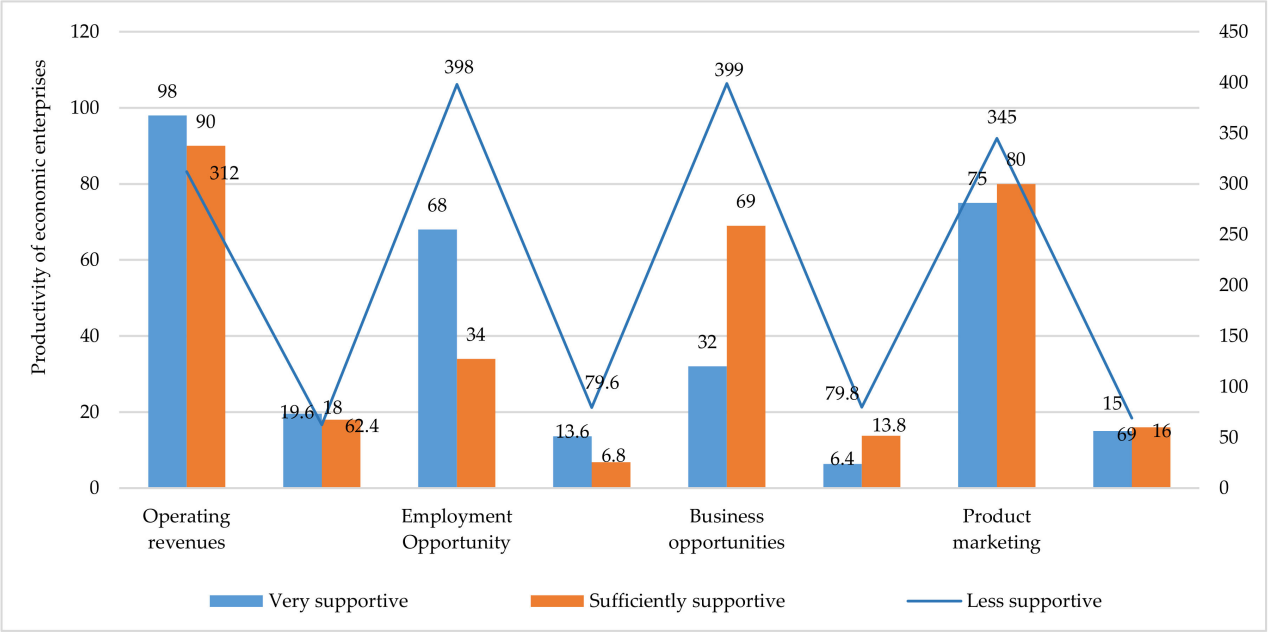


Figure 11. Level of income, job opportunities, business opportunities, and marketing of community economic business products. Source: Primary data.

Figure 11 shows the productivity of community economic enterprises in the slum areas of Makassar City. The interpretations that can be proposed for these results are as follows: (1) The economic enterprises developed by the community, in relation to the income, earned give a picture of 37.6% in the very supportive category and 62.4% in the less supportive category. (2) Economic business, in relation to job opportunities, gives an illustration of 20.4% in the supportive category and 79.6% in the less supportive category. (3) Economic enterprises developed by the community, in relation to business opportunities that can be achieved, give an illustration of 20.2% in the supportive category and 79.5% in the less supportive category. (4) Economic business, in relation to product marketing, gives an illustration of 31% in the supportive category and 69% in the less supportive category. These results confirm that the productivity of economic enterprises developed by the community has not been able to support increased welfare and is only used to fulfill the needs of daily life. Therefore, it is necessary to optimize the production factors (capital

and labor), knowledge, and economic productivity of the community in the direction of increasing economic growth [120].

Field facts that are found show that the community's economic business is not optimal, due to lack of guidance, limited business capital, underdeveloped business innovation, and mastery of technology. Furthermore, the economic business being developed is directly related to energy services, energy availability, and meeting energy needs. The use of renewable energy is presented in Figure 12, below.

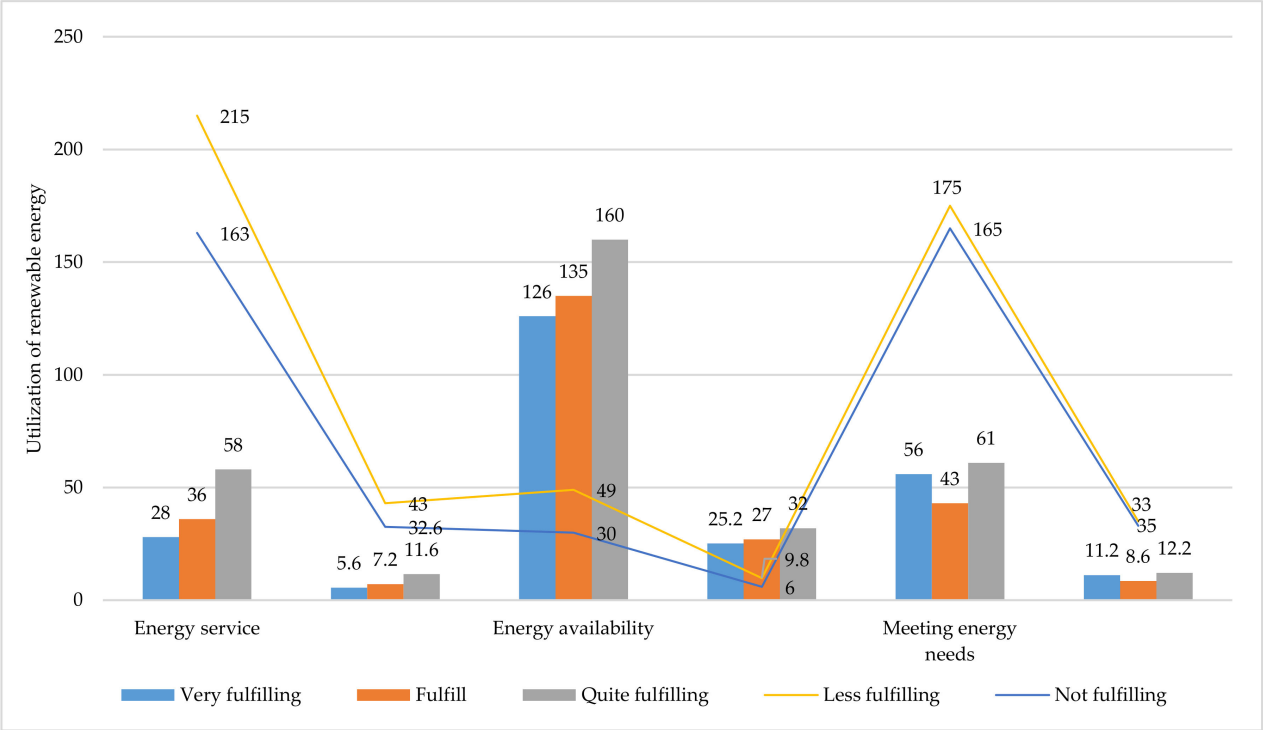


Figure 12. Utilization of renewable energy. Source: Primary data.

Figure 12 shows the use of renewable energy in relation to economic enterprises developed by the community. Interpretations that can be put forward in relation to these results include the following: (1) energy services, in relation to economic enterprises developed by the community in slum settlements, illustrate that 12.8% are in the fulfilling category, 7.2% are in the sufficiently fulfilling category, and 75.6% are in the nonfulfilling category; (2) the availability of energy, in relation to the developed economic business, shows that 52.2% are in the fulfill category, 32% are in the fulfilling category, and 15.8% are in the nonfulfilling category; and (3) fulfillment of energy needs, as related to economic enterprises developed by the community, give an illustration of 19.8% in the fulfilling category, 12.2% in the sufficiently fulfilling category, and 68% in the not fulfilling category. These results confirm that the distribution of energy services to support increased productivity of economic enterprises developed by the community is not optimal. The prime drivers of increasing urban energy consumption are multifaceted and complex [121]. This means that energy as the main driver for achieving the goals of sustainable development (SDGs) must be affordable, reliable, sustainable, and modern [122].

Field facts that are found indicate that the service of electricity and Liquefied Petroleum Gas (LPG), which is not optimal, is influenced by several factors: (1) the selling price of energy is quite high, which cannot be reached by the public; (2) the installed capacity for electrical energy services is very limited, due to the limited purchasing power of the community; and (3) the distribution of LPG gas energy services is still limited. These three factors contribute positively to the low productivity of community economic enterprises. Policies promoting LPG to the poor will have limited success if they are not supported by

adequate infrastructure [123]. Furthermore, infrastructure services, in relation to improving the quality of settlements and the productivity of community economic enterprises, are presented in Figure 13, below.

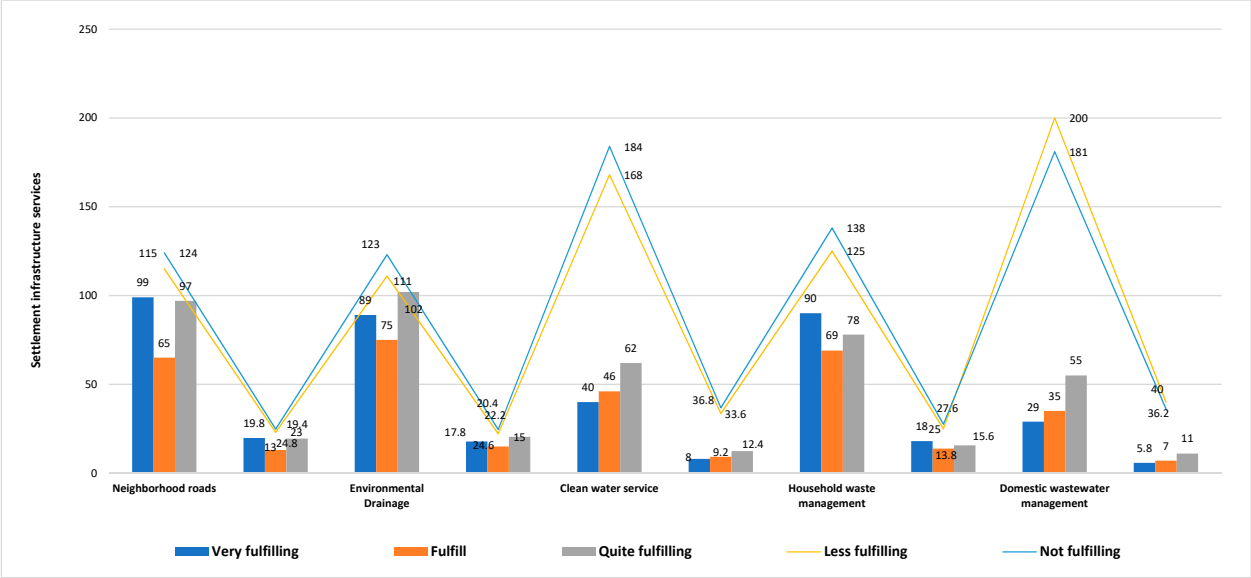


Figure 13. Slum settlement infrastructure services. Source: Primary data.

Figure 13 shows the infrastructure services for slum settlements in Makassar City. Interpretations that can be proposed in relation to these results include (1) support for environmental road infrastructure services provides an illustration of 32.8% in the fulfilling category, 19.4% in the sufficiently fulfilling category, and 47.8% in the under-fulfilling category; (2) support for environmental drainage services illustrates 32.8% in the fulfilling category, 20.4% in the sufficiently fulfilling category, and 46.8% in the inadequate category; (3) support for clean water services illustrates 17.2% in the fulfilling category, 12.4% in the adequate category, and 74.4% in the inadequate category; (4) the management of household waste provides an overview of 31.8% in the fulfilling category, 15.6% in the sufficiently fulfilling category, and 52.6% in the inadequate category; and (5) household waste management gives an illustration of 12.8% in the fulfilling category, 11% in the sufficiently fulfilling category, and 76.2% in the insufficient category. These results confirm that settlement infrastructure services to support increased community economic productivity are not yet optimal. Inconsistency in the development of settlement infrastructure and community poverty are factors that trigger environmental damage [124]. Furthermore, the carrying capacity of the slum neighborhoods in Makassar City is presented in Figure 14, below.

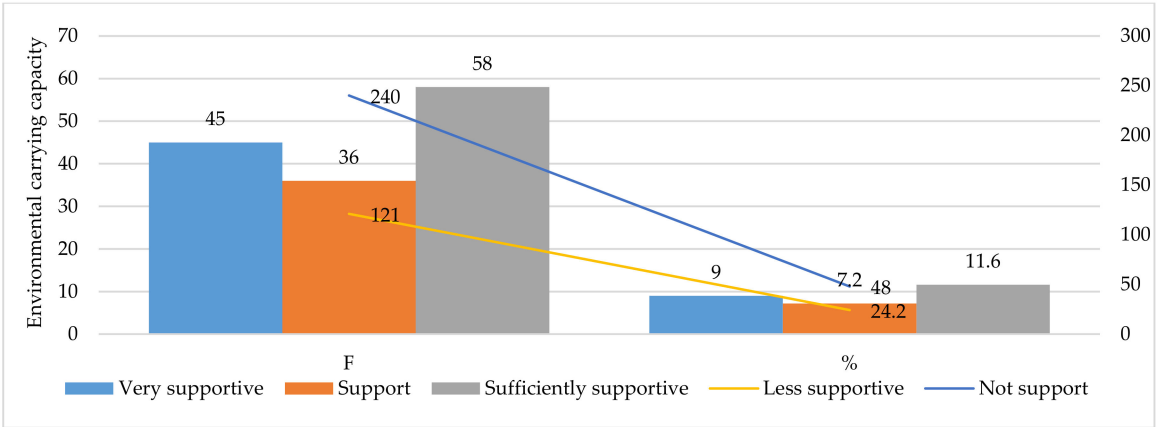


Figure 14. Carrying capacity of the slum area. Sources: Primary data.

Figure 14 shows the carrying capacity of the slum area of Makassar City. Interpretations that can be proposed for these results include (1) the carrying capacity of the environment in relation to development activities gives an overview of 16.2% in a supportive category, (2) 11.6% in a sufficiently supportive category, and (3) 72.2% in a less supportive category. These results confirm that the carrying capacity of the slum environment is categorized as very low. The facts found in the field show that the dominant slum settlements located on riverbanks and coastal areas are very vulnerable and have the potential to become areas prone to urban flooding. Urban flooding is not only related to rainfall but is also influenced by the built environment and the vulnerability of urban areas [125,126]. Thus, the built environment plays an important role in the environmental resilience of the community [127]. Furthermore, the effect of community empowerment, renewable energy utilization, strengthening institutional capacity, and productivity of economic enterprises on improving environmental quality is presented in Table 4, below.

Table 4. Summary of test results for the significance of the regression equation coefficient.

Correlated Variables		Coefficient Value	Error	t-count	t-table
Community empowerment toward improving environmental quality (rx_1y)		0.193	0.079	2.873	1.91
Utilization of renewable energy toward improving environmental quality (rx_2y)		0.138	0.062	2.853	1.91
Strengthening institutional capacity toward improving environmental quality (rx_3y)		0.254	0.042	2.648	1.91
Productivity of economic enterprises toward improving environmental quality (rx_4y)		0.406	0.097	4.182	1.91
Source variant	Sum of squares (JK)	Free Degrees (db)	Average of the sum of the squares (RJK)	F-count	F-table $\alpha = 0.05$
Regression	19,642	4	6.547	85,814	4.76
Residue	0.458	8	0.076		
Total	20.1	12	-	-	-
R	R^2	db1	db2	F-count	F-table
0.886	0.785	4	8	85,814	4.76

The interpretations that can be submitted to the results of Table 4 include (1) community empowerment has a positive effect on improving environmental quality by 0.193; (2) the use of renewable energy has a positive effect on improving environmental quality by 0.138; (3) strengthening the institutional capacity of the community has a positive effect on improving environmental quality by 0.254; and (4) the productivity of economic enterprises has a positive effect on environmental quality improvement by 0.406. The effect of community empowerment, renewable energy utilization, strengthening community institutional capacity, and productivity of economic enterprises has a significant effect on improving the quality of the slum environment with a coefficient of determination of 78.5%. Thus, community empowerment, coupled with the use of renewable energy and strengthening the institutional capacity of the community toward increasing the productivity of economic enterprises, will contribute positively to the sustainability of slum settlement and environmental quality improvement. Utilization of renewable energy and optimization of energy infrastructure services contributes positively to social, economic, and community welfare development toward improving environmental quality [128].

Furthermore, slum settlements in Makassar City, which are predominantly inhabited by the urban poor, will require policy support from the government that is integrated with optimizing the utilization of natural and environmental resource potentials, followed

by strengthening institutional capacity and community participation toward the use of renewable energy effectively and efficiently. Housing is very important for the quality of life of the poor, which requires adequate infrastructure and social and physical support in order to meet sustainable energy needs [129,130]. The implementation of development policies and urban governance requires the support of community and private sector involvement in the direction of sustainable development and improvement of community welfare at the local level [131,132].

5. Discussion

5.1. Utilization of Renewable Energy Based on Slum Management

Utilization of renewable energy, in relation to increasing the productivity of economic enterprises in handling slum settlements in Makassar City, will require action and implementation of strategic policies from the government, including (1) provision of energy to support community socio-economic activities, (2) support for the availability of electricity and fuel that is environmentally oriented and friendly, (3) building of public awareness for the use of new and renewable energy, (4) reducing the use of fossil energy, and (5) maintaining stability and security of supply for energy availability. These five policies will require effort to optimize the utilization of renewable energy resources toward improving the quality of the environment and increasing the productivity of community economic enterprises. Meeting the need for renewable energy to meet social and economic development will have an impact on improving the welfare and health of the environment [133,134].

Increasing the productivity of economic enterprises, in relation to the handling of slum settlements based on community empowerment, is oriented toward the implementation of (1) utilization of renewable energy sources based on the use of efficient and environmentally friendly energy technology, (2) distribution of energy services based on energy-saving culture, (3) optimizing the use of solar energy through the application of solar panels in support of increasing socio-economic activities and enhancing the aesthetics of slum settlements, (3) utilization of biofuel energy through a composting process from biomass, which is integrated with organic waste treatment, and (4) utilization of wind energy through the manufacture of windmills in a green open area that is synergized with a solar panel system. Sociotechnical transition is understood as an evolutionary process of transforming energy production, consumption, and governance through the development of new energy production and distribution technologies [135,136].

In order to ensure access to affordable, reliable, sustainable, and modern energy for the community in relation to the fulfillment of energy services, actions are needed, including (1) increasing energy supply and electricity by taking into account the guarantee of primary energy supply and energy mix, (2) control of energy utilization followed by energy conservation, (3) increasing the use of new and renewable energy and the energy mix to support increased productivity of economic enterprises, (4) increasing energy accessibility, and (5) increasing energy efficiency based on strengthening institutional capacity and community participation. Integration of renewable energy sources ensures a step forward toward reducing CO2 emissions and consumption of primary energy [137].

The application of new and renewable energy systems toward energy security in dealing with slum settlements is oriented toward increasing the productivity of community economic enterprises. This means that energy security is an effort to ensure the availability of energy and people's access to energy at affordable prices and with a long-term orientation. Thus, the potential for renewable energy, namely hydropower, wind, solar, and biomass, is an alternative to meet the energy needs of the community toward increasing the stability of economic enterprises and improving the quality of the slum environment. The use of renewable energy will create a dynamic balance between ecological, social, and economic dimensions [138].

5.2. Sustainable Slum Management

The sustainability of handling slum settlements is oriented toward three basic principles, namely economic, social, and environmental. Actions required to overcome and settle slum settlements in Makassar City include (1) control of spatial use in riverbank areas and coastal areas, (2) reducing the poverty rate by increasing the productivity of economic enterprises and opening up job opportunities, (3) creation of social cohesion toward social integration, (4) increasing the quality of community housing facilities, (5) utilization of new and renewable energy, (6) conservation and rehabilitation of benefit areas for rivers and coastal areas, and (6) disaster mitigation and climate change adaptation. These six things are developed toward strengthening institutional capacity and changing community behavior. Furthermore, the strategic actions required include (1) increasing public access to settlement infrastructure, (2) strengthening the capacity of local governments through collaboration with stakeholders, and (3) increasing community welfare through sustainable livelihood development. Regional autonomy initiatives to expand urban-based economic activities and supported by political interests play an important role in disaster management [139].

In order, to achieve the target of sustainable management of slum settlements in Makassar City, several strategic measures are needed: (1) equality, meaning that people have the same opportunity to access housing, infrastructure, and economic resources; (2) supporting the economy to the poor toward increasing welfare; and (3) social justice toward increased productivity of economic enterprises. Furthermore, the empowerment mechanisms that need to be followed up in the future include (1) build mutual concern for environmental conditions, (2) actively involving community leaders to build solidarity together, (3) changing people's behavior to live healthily, and (4) build public awareness in maintaining infrastructure that has been built as a form of belonging. The four things will create an increase in the quality of the settlement environment and equitable development in a sustainable manner. Improving the quality of infrastructure will encourage an increase in the quality of life and an increase in the quality of the environment toward sustainable urban development [140,141].

Furthermore, there are several things that need to be evaluated and improved in the future, in relation to the sustainability of the handling of slum settlements in Makassar City, including (1) saving and safety of the community's residential environment; (2) building solidarity, togetherness and mutual trust in society; (3) availability of facilities and effectiveness of financial aid support as an economic stimulus for the community; (4) increasing purchasing power based on increasing the productivity of community economic enterprises; (4) guarantee of land tenure status and occupancy status; (5) building community capacity based on mastery of technology and support for adequate educational services; and (6) addressing slum settlements according to typology and slum level of the settlement environment.

The achievement of slum settlement management targets in Makassar City is carried out through (1) creating a healthy residential environment, namely improving the quality of environmental sanitation (waste, drainage, and garbage); (2) supporting distribution of adequate and affordable drinking water services; (3) community participation in preventing environmental pollution; (4) utilization of renewable energy, including energy efficiency and use of alternative energy; (5) integrating land use with a community socio-economic activity system based on saving the environment; and (6) increasing the community's economy, including job creation, and integrating formal and informal economic activities. The sustainability of handling slums is presented in Figure 15, below.

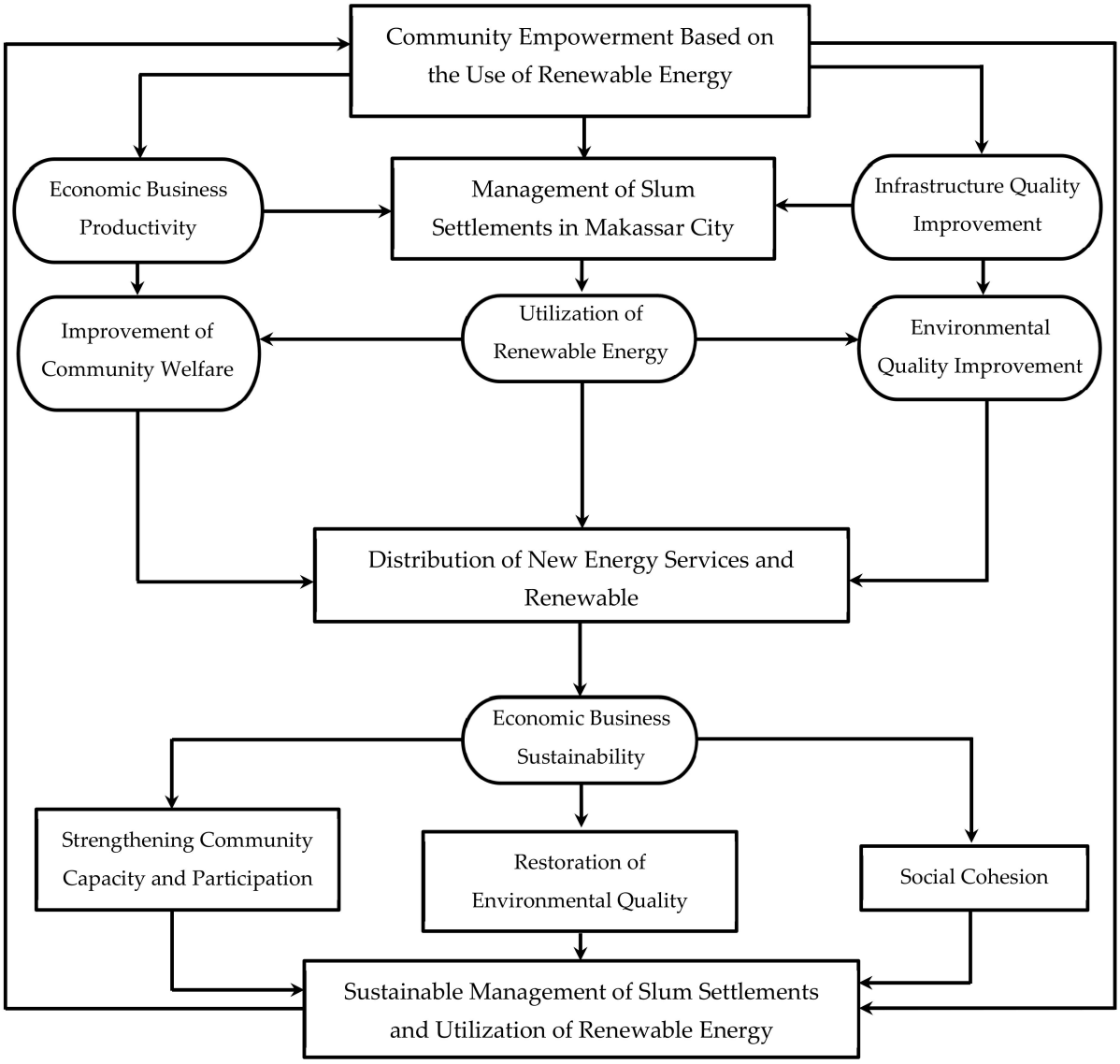


Figure 15. Sustainability of handling the slum settlements in Makassar City. **Source:** Author's elaboration.

6. Conclusions

The management of community empowerment-based slum settlements in Makassar City is aimed at building the independence of productive economic enterprises, which are integrated with strengthening institutional capacity and optimizing the use of renewable energy. Implementation of strategic policies is needed to support the productivity of community economic enterprises, including (1) provision and distribution of renewable energy, (2) availability of electricity that is environmentally friendly, (3) increase in public awareness for the use of new and renewable energy, (4) Reducing the use of fossil energy, and (5) ensuring the stability, security of supply and availability of energy. Optimizing the utilization of renewable energy is carried out through (1) the use of efficient and environmentally friendly technology, (2) energy services based on energy-saving culture, (3) utilization of solar energy based on solar panel systems, (3) utilization of biofuel energy through an integrated biomass composting process with organic waste treatment, and (4) utilization of wind energy through the manufacture of windmills in a green open area that is synergized with a solar panel system. Thus, community empowerment, coupled with the use of renewable energy and strengthening the institutional capacity of the community toward increasing the productivity of economic enterprises, will contribute positively to the sustainability of slum settlement and environmental quality improvement.

The lack of optimal economic business developed by the community in slum settlements is due to weak guidance, limited business capital, underdeveloped business innovation, and limited mastery of technology. The strategic rarities needed to achieve sustainable targets for handling slum settlements in Makassar City include (1) equality, meaning that people have the same opportunity to access housing, infrastructure, and economic resources; (2) supporting the economy for the poor; and (3) social justice toward increased productivity of economic enterprises. Furthermore, the empowerment mechanisms that need to be followed up in the future include (1) build mutual concern for environmental conditions, (2) actively involving community leaders to build solidarity together, (3) changing people's behavior to live healthily, and (4) build public awareness in maintaining the infrastructure that has been built. These four things will create equitable development and increase the welfare of the community toward environmental and economic sustainability and the creation of social cohesion.

Because this study was conducted in a limited scope and only focused on community empowerment and the use of renewable energy in relation to business development and increasing the productivity of economic enterprises toward community resilience based on urban slum management, it is recommended that further studies be carried out, namely a model of sustainability handling urban slums based on energy security and community participation. This study is intended to complement the results of the current study.

Author Contributions: B.S., conceptualization; B.S., S.S., and F.M., compiling the research; H.A., M.I., and E.S.R., establishing the study; B.S., S.S., and F.M., processing data; H.A., M.I., and H.R., contributing to materials/methods/analysis tools; B.S., F.M., and H.A., analyzing data; H.R. and M.I., contributing to data checking; B.S., S.S., F.M.; H.A., M.I., E.S.R., and H.R., writing and revising concepts. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The results of this study have received approval from the Institute for Research and Community Service at the University Bosowa Makassar as outlined in a Decree of Approval by the Head of the Center for Research and Community Service Number 72/LPPM/VIII/2020.

Informed Consent Statement: We fully support open scientific exchange through MDPI in sharing and archiving research data from this study. We fully comply with the provisions that have been set by referring to the established journal guidelines.

Data Availability Statement: We are grateful for the participation of stakeholders in contributing ideas for the implementation of this study. Thanks to the Ministry of Education and Culture of the Republic of Indonesia and the Bosowa Foundation for their support and financial assistance in carrying out this research.

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Conflicts of Interest: The authors declare no conflict of interest.

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