WIND ENERGY AS AN ALTERNATIVE ENERGY SOURCE
(Study Case at South Coastal of Yogyakarta Special Province, Indonesia)

By:
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Abstract

The need of larger quantity of energy to fulfill the demand of energy, especially the fossil fuel, forced the government of almost all nation try to find the new kind of energy or known as alternative energy resources. Fossil fuel as non-renewable energy resources would be decreased by the time if the using of it not under controlled. This kind of energy resources used to handle almost all the people need of energy, such as for domestic uses, industrial, tourism, etc. The used of fossil fuel for that purposed mostly for generated the electricity power (by built the power plant). Many natural energy resources can used to generate electricity power plant, but there always be some advantages and bad impact, especially for the environments. One of environmental friendly alternative energy resources is exploiting the form of wind power.

Keyword: *alternative energy, wind energy, windmills farms, human well-being.*

Introduction

Wind is the motion of air measured relative to the rotating Earth. The atmosphere is coupled to the planet and rotates with it. Once every 24 hr, every point on the Earth's surface and in the atmosphere describes a circular path in space. The circumference of that path decreases with increasing latitude. Wind has both magnitude (speed) and direction; that is, wind is a vector quantity. A distinction is usually made between the horizontal (east-west and north-south) and the vertical (up-down) components of the wind. Except in small, intense weather system such as thunderstorms, the magnitude of vertical air motion is typically only 1% to 10% of the horizontal wind speed.

Harnessing the energy of the wind is a technology that was established as early as the twelfth century in portions of the Middle East where water power was not available. Today, scientist are employing modern aerodynamic principles and space-age materials in designing and constructing modern wind-driven turbines that convert some of the wind's kinetic energy into electricity. Theoretically, windmills blades can convert a maximum of 60% f the wind's energy into mechanical energy. In practice, however, wind generator extract only 25% of the wind's energy. Furthermore, average wind speeds must be at least 19 km (12 miles) per hour before most wind-powered electricity-generating systems can operate economically (Morgan & Morgan, 1997: 204).

At ordinary speed, wind is a relatively diffuse energy sources, comparable in magnitude of *insolation*. Hence, a wind turbine's power generation potential also depends on the area swept out by the windmills blades. Large windmills blades harvest more energy. Until recently, design and strength-of-materials problems limited the size of wind turbines. Today, use of stronger and lighter materials for blades are making possible larger wind turbines that generate as much as 0.5 megawatt of electricity (Morgan & Morgan, 1997: 204).

The most formidable obstacle to the development of wind power potential stems from the inherent variability of the wind. The electrical output of wind turbines varies as a consequence, and a wind power system must include a means of storing the energy generated during gusty periods for use when the wind is light and calm. A 3- to 5-kW wind turbines is needed t meet the total electrical requirements, including heating, of a typical household, but in this research areas, where its in equatorial, no needed for heating a house (Morgan & Morgan, 1997: 205).

Today, such systems are commercially available, but the cost of materials and constructions-including a tower, storage batteries, and generator. Economy of scale dictates that centralized arrays of many wind turbines, called windmills farm, are preferable to individual household wind turbines. Windmills farm consist of 50 or more super wind power generators, each capable of producing as much as 0.5 megawatt of electricity. In view of current technological and economic limitations, wind power has its greatest immediate potential in regions where average winds are relatively strong and consistent, such as in the coastal areas. Recent technological advances and tax incentives are beginning to make wind power more cost-competitive with conventional methods of energy generation.

Power equipment manufacturers see a rapidly expanding market for wind energy and are acquiring expertise in order to complete. Leading industrial users of energy have committed to more efficient processes that will result in the lower carbon emissions not only to reduce costs but also in appreciation of growing customer and societal concern.

The Environmental Issues Or Ecosystem Services Of Concern (Theory, Indicators)

Over the past 50 years, human have changed ecosystems more rapidly and extensively than in ant comparable period in human history, largely to meet fast-growing demands for food, fresh water, timber, fiber, and fuel. The changes we have made to the ecosystem have contributed to substantial net going in human well-being and economic development. However this gain have come at growing costs in the form of degradation of many ecosystem services, increased risk of abrupt and harmful changes in ecosystem, and harms to some groups of people. Changes being made to ecosystem are resulting in an increased likelihood of potentially high-impact and abrupt changes in physical and biological system.

Throughout the twentieth century and the current decade, energy supply has been dominated by plentiful fossil fuels, including coal, petroleum, and natural gas. Vast investments and facilities grown to facilitated the production, transportation, processing and use of these forms of energy. Despite the important role fossil fuel have played in economic

development, however, their use has taken and continues to take atoll on ecosystems and the services they provide to the people. This toll comes in the forms of impacts to ecosystem during extraction, and air pollution during transportation, and air pollution and greenhouse gas emissions during processing and use.

People everywhere rely on the ecosystems and the services they provide. Demand for these services increasing. However, many of the world's ecosystems are in serious decline, and the continuing supply of critical ecosystem is now in jeopardy. So does the availability of energy supply, especially the fossil fuel. The using of fossil fuel for many purposed create the negative impact for the environments, include the human life.

As demands for the services provided by the ecosystem grow and the ability of these system to meet these demand is eroded, increasingly difficult challenges must be confronted. In this case, how to get the expected increase in demands for energy with the critical problem, get the best solution for the most efficient and effective strategies to produce energy while also minimizing the impacts for air quality and the climate. That's the reason why it need to find the alternative energy resources that has a little impact for the environment and the people lived around it. Wind power was one of alternative energy source to answer that problem. Wind power has its greatest immediate potential in regions where average winds are relatively strong and consistent, such as in the coastal areas. Recent technological advances and tax incentives

Coastal area was a very unique ecosystem. Coastal environments are at the interface of the land and sea. They are about the most dynamic of natural environments. On one side, the coastal environments are connected with the sea, and are influenced by waves and tides, littoral drift, cliff erosion etc. On the other side, they are influenced by the land processes such as sub-aerial degradation of landform at the edge of the land, transfer of water and sediments through the river, etc. Distinct ecosystem (e.g. mangroves, coral reefs) are associated with coastal environments.

Coastal as one of ecosystem has some environments service and functions. They provide food, fiber, timber, etc. They also functioned as climate regulation, waste processing, nutrient cycling, storm and wave protection, recreation and ecotourism, and also had aesthetic values. The economic importance of coastal environments arises from the fact that the coast is the focus of the trade, recreational and tourism complexes, fish and shrimps farms, salt plans, coconut plantation, etc., allocated along the coast.

Scenario

Indonesia, a nation at South East Asia, as an archipelago, consisted by thousand of island, large and the small ones. It has more than 81.000 km of shoreline around its territorial. It is potential to develop the research for alternative energy. The way to get that aim was tried by the local government by doing the experimental research in specific area of South Coastal of Yogyakarta Special Province (DIY), Indonesia. This area has enough wind power to use as

power to generate the windmills to create electrical power. It can be used to fulfill the local demand of electric power.

Energy production and uses illustrate how threats to established ways of business from ecological stress (climate change) can turn into business opportunities and competitive advantages. Reliable and abundant forms of energy are essential for economic development and human well-being. One of environmental friendly alternative energy resources is exploiting the form of wind power. Indonesia representing archipelagic country (archipelago), owning very long coastline, reaching about 81.000 km, very potential for the development of energetic power station of wind. Wind power exploited by developed a built area which known as windmill farm, so that wind power catch by propeller of paddle wheel will more concentrated, then could moved more turbine rotor.

Some points that caused this research location (Parangtritis, Depok and Parangkusuma Coasts) have some potential resources to develop as experimental program to increase the wind power using the windmills are:

1. The average wind speed approximately consistent magnitude of 8 m/sec. This value of wind power hypothetically has potential to produce electricity and to tested many size of windmills.
2. Aesthetically, built the windmills in medium size will not influenced the landscape value in that location due to in some point there was communication transmission tower and the electrical pillar.
3. Can developed other tourism potency, a kind of tourism, a centre for alternative energy (eco-education and eco-tourism), and also despitefully, this area serve the purpose of complement of education medium for outside class study (outdoor learning)
4. Can improve the resident earnings because with the existence of amenity access to electrics facility and by expanding tourism activity, hence some type of home industry using electrics as source of power of activator of production machine earn more developed. Local resident fundamental living was fisherman. This profession not promised enough money for daily needs. There are some type of side job used to get the perquisite to sustain the everyday life like farming above sand dune (covered the dune by thin layers of fertile soils and compos), becoming labour to town in moment of *paceklik* season (high wind) and sell some tourism services by develop booth and simple lodging place

Some photograph taken to give basic understanding about the real condition at the research location. Here they are:

From some figure above, empty area without closing vegetation which closed alongside the coastline available in area which is last for performing of development a windmill farm. Original condition in field for the area without existence of vegetation covered is place region expand the sand dunes, but because this farm notching represent one of natural resources pertained by a rareness, hence is not suggested to built the installation of power station of wind power at place location expand the sand dune in this area. What suggested was built it in backside covey from sand dune, what generally represent the area with the more expanding ground was at the shares of back swamp or bog behind.

Place area expand by the sand dune, existing geology still in the form of loose material, especial fraction of soil in the form of sand. This matter is clear complicate the effort to make the foundation from a building structure because it will require the deepness of building foundation which enough, so that building can up-stand and sturdy. This matter non representing big problem because with the high enough technology use this time, development a building structure in area with the elementary material in the form of sand non representing barrier meaning.

The table below shows the characteristics of wind in the research location of Parangtritis, Depok and Parangkusuma Coasts at DIY. It consist of three parameter of wind, they are: average wind speed, maximal wind speed and average wind direction.

Table 1. Monthly Average Wind Speed, Year 1993-2004 (in m/sec)

No.	Month	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	mean averages
1.	January	3	6	2	3	3	3	4	4	3	2	3	3	3.25
2.	February	4	3	3	3	3	2	4	3	3	2	3	2	2.92
3.	March	2	3	3	3	3	2	3	4	2	2	4	3	2.83
4.	April	2	3	3	3	2	2	4	3	2	2	2	3	2.58
5.	May	2	2	2	2	2	3	3	3	2	2	3	2	2.33
6.	June	3	2	3	2	2	2	3	3	2	2	3	2	2.42
7.	July	2	3	3	3	2	3	3	3	2	2	2	3	2.58
8.	August	6	3	3	3	2	3	3	2	2	3	2	2	2.83
9.	September	4	3	3	4	3	3	4	4	3	3	3	4	3.42
10.	October	4	4	3	2	3	3	4	3	2	3	2	3	3
11.	November	3	3	3	4	3	3	4	3	2	3	2	3	3
12.	December	3	3	4	3	3	3	4	4	3	2	3	4	3.25

Source: field measurement and BMG

Table 2. Monthly Maximal Wind Speed, Year 1993-2004 (in m/sec)

No.	Month	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	mean averages
1.	January	12	11	11	12	12	11	15	14	11	10	11	12	11.83
2.	February	14	12	12	12	12	10	17	14	11	9	10	11	12.08
3.	March	11	12	11	13	12	10	15	15	10	9	10	12	11.67
4.	April	10	10	11	11	11	10	14	14	9	9	11	10	10.83
5.	May	10	10	10	10	9	11	12	13	9	8	10	9	10.08
6.	June	9	9	10	11	10	11	11	10	9	9	10	11	10
7.	July	10	10	11	10	10	10	11	10	9	9	10	11	10.08
8.	August	13	11	14	11	12	11	13	13	9	10	11	12	11.67
9.	September	13	12	11	11	11	12	16	13	10	10	9	10	11.5
10.	October	14	13	12	11	11	13	15	12	9	10	11	11	11.83
11.	November	12	12	11	10	11	14	15	11	9	10	12	10	11.42
12.	December	12	12	14	13	11	13	16	13	11	10	12	13	12.5

Source: field measurement and BMG

Table 3. Monthly Average Wind Direction Year 1993-2004 (N°E)

No.	Month	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	mean averages
1.	January	210	210	210	210	270	240	240	240	270	240	240	210	232.5
2.	February	210	210	210	230	240	210	240	240	270	240	210	240	229.17
3.	March	210	210	210	90	90	90	240	240	270	120	120	210	175
4.	April	2101	100	210	90	90	90	240	240	180	120	120	180	155.83
5.	May	120	120	120	180	220	90	180	180	180	240	210	210	170.83
6.	June	210	120	120	90	120	80	180	240	180	240	240	180	166.67
7.	July	130	210	120	180	180	180	180	210	180	200	200	180	179.17
8.	August	120	240	180	180	240	180	210	180	270	240	240	240	210
9.	September	130	210	180	210	240	180	210	210	180	240	210	210	200.83
10.	October	210	210	180	210	270	210	210	250	240	250	210	240	224.17
11.	November	210	120	210	240	270	240	240	270	240	240	210	210	225
12.	December	210	210	240	270	260	240	240	240	270	240	250	240	242.5

Source: field measurement and BMG

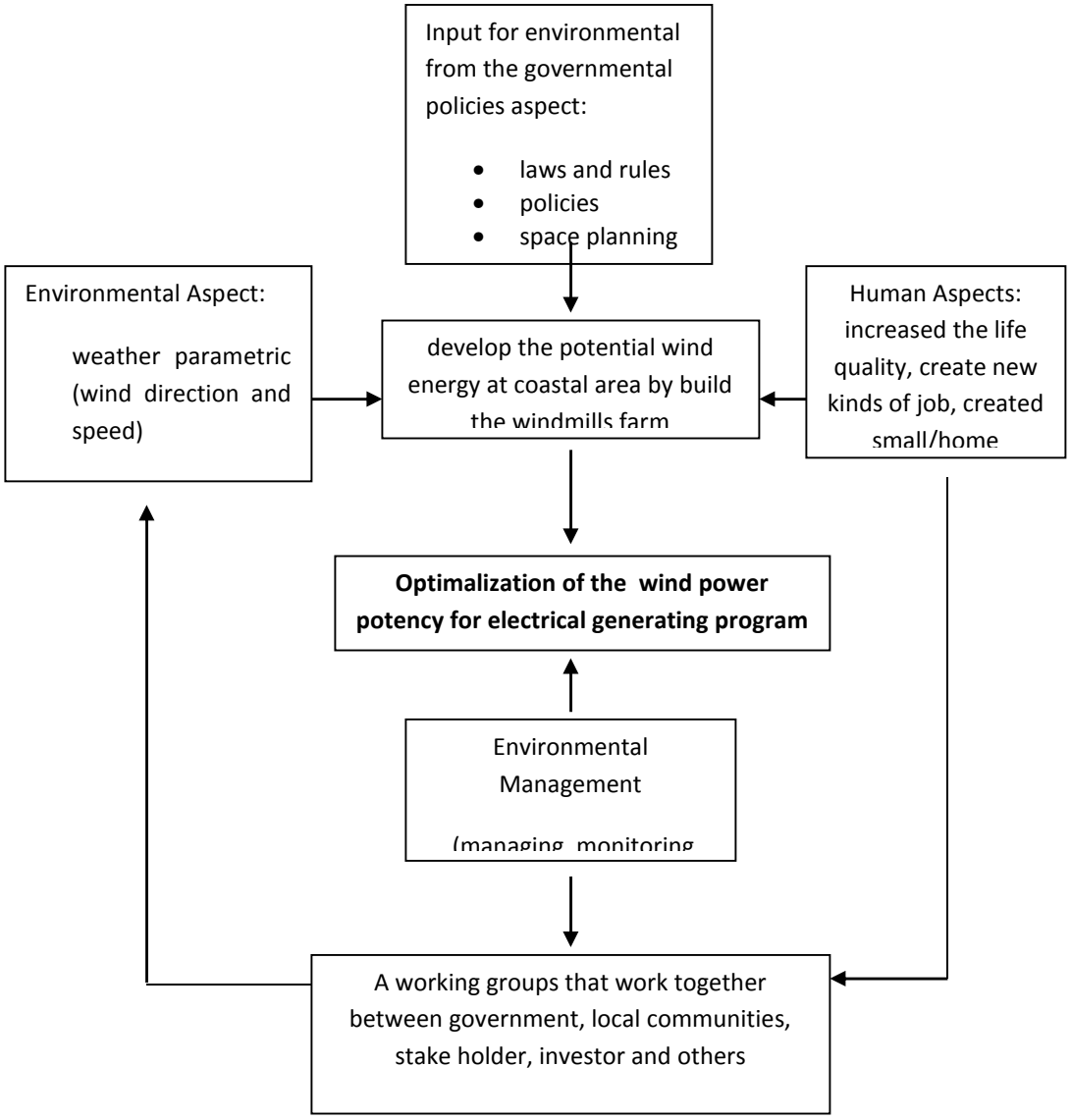


Figure 1. Scheme for Wind Energy Development in Coastal Area Based on Human Aspect of Well-Being

In Depok Coast there is TPI (Place of Fish Auction). All fishermen in this area usually sell the other marine product and fish in TPI. The facilities in this TPI still inclusive of modestly. With the existence of plan of development of exploiting of energy electrics to be converted to become the electric power, its possibilities condition in this area will be able to more

expanding. With the primary factor of TPI existence hence expected will pop out the type of this effort dissimilar which can give the perquisite to all fishermen in this area. This matter perhaps can be existed if supported by availability of adequate electrics facility, which expected obtainable and developed through the existence of local resources in this location.

Policy and Decision Maker Setting

Coastal area in south shares from Yogyakarta Special Province (DIY) represent the place which big enough potency for development the types of alternative energy resources, in form of wind's energy. Wind speed with enough averages means owning economic value for the development of this alternative energy types. Target given high priority for the accomplishment of local resident requirement for electrics energy, so the scale of this power station system development only in level test-drive.

Based on the regional potential of the Yogyakarta Special Province or DIY, view from the capability of the Indonesian National Development Program (the policies), expected that these research program of develop wind energy as alternative energy resources has multi advantages, even for the tourism industrial and for the welfare of the local residents by technological development of alternatives energy resources can be realized. In DIY, there are big enough potency for the implementation system of generating alternative energy, start from waves energy, wind's power, solar energy, heating power (*ocean thermal electric convention* or OTEC), till volcanic energy, with the development and exploiting the heat energy from volcano. As for the exploiting of development and from some the source energy alternative, effort up at that still must be conducting some phase of exploration and study farther in the future its exploiting is ambulatory as optimal as possible.

Regional development cannot assume that there will be ample warning of the change in the availability to the key services or that communities past response change in will be successful in the future. Ecosystems often change in abrupt, unpredictable ways. Most ecosystems are being altered by human actions in unprecedented ways. Consequently, it is difficult to predict the future state of an ecosystem or the availability of the ecosystem services. These uncertainties mean that past successes in ecosystem management may not apply to current or the future condition. In this way, MA has to provide the benchmark to public policy, public awareness and the private sectors it will influenced the investments, the regulatory climate and public opinion.

First, related to the spirit of Area Autonomy, hence development energy in area require to not-stopped to be improved, especially by exploiting local source energy potency, supported with the self-supporting improvement effort of communities. Management program the incoming electrics of countryside continued and developed to push the economic activity and also improve the intelligent rate and also rural people prosperity by improving role and self-supporting of them-self. The Rural Electrics Levying Program, using local source energy, like micro water power, wind energy, solar energy, and biomass energy

never stopped to be developed in order to economizing fossil fuel and lessen the experienced environmental damage impact.

Second, area development have to be re-affirmed to increase level live and prosperity in area by passing good inwrought and directional development usher and also sector's development, going to reaching of independence of area and progress which flatten. The area development as integral part from national development instructed to more compatible and to developing growth rate of urban area and rural which its execution adapted by area priority, pursuant to area potency as optimal as possible.

The Millennium Ecosystem Assessment (MA) identified climate changes as one of the most important drivers of stress and degradation of ecosystems and ecosystem services. Climate change is directly linked to the buildup of carbon dioxide in the atmosphere from the use of fossil fuels. A critical challenge in the protection and restoration of ecosystem services is the transition to an energy future with lower carbon emission, less air pollution, and minimal risk from the extraction and transportation or distribution of fossil fuels.

Communication of the Result

Although there have some law product made by government concerning problem of energy, especially conservation and also the effort development of resources alternative energy, however overall of the product impress to have the characteristics theoretically. Law and regulation created have idealist characteristics and looks very good, but in reality there is not yet seriously applying, so that not yet earned to give the real implication in effort government secure and prosperous the society. It need the societal participatory and the good communication between community, governance, stake holders and participated of NGOs to work together. Socialization of the government's programs needs to be more active.

The MA has assessed many options for enhancing ecosystem services as well as addressing drivers of change. Several of these options hold promise and, if implemented, would yield benefits for ecosystem and human well-being, but, thing that should remember, not all the options could implemented, in every places. Less Develop Countries such Indonesia, has their own specific problem based on their people characteristics. It need increasing use of integrated responses to address the degradation of ecosystem across a number of system simultaneously, requiring the combination of a range of policies and strategies developed by actors from the government, civil society, and private sector, including increased coordination among multilateral environmental agreements.

References

Aprilia, Aryani, 2003, Deflasi Pasir Pada Berbagai Tipe Gumuk Pasir di Parangtritis, *Skripsi*, Fakultas Geografi, Universitas Gadjah Mada, Yogyakarta.

Bush, Mark B., 2000, *Ecology of a Changing Planet*, 2nd Edition, Prentice Hall Inc., Upper Saddle River, New Jersey, USA.

Brown, R. Lester (Ed), 1992, *Tantangan Masalah Lingkungan Hidup: Bagaimana Membangun Masyarakat Manusia Berdasarkan Kesinambungan Lingkungan Hidup Yang Sehat* (Shea, P. Cynthia: *Memetik Hasil Dari Angin)*, Bab XII, halaman 190-200, Yayasan Obor Indonesia, Jakarta.

Cunningham, William P., Saigo, Barbara W., 1999, *Environmental Science: a global concern*, 5th Edition, McGraw-Hill Companies, Inc., USA

Dwandaru, W.S.P., 2002, Optimalisasi Pengelolaan Sumber Daya Alam Sebagai Sumber Energi Dengan Pemanfaatan Sains Dan Teknologi Untuk Mencegah Krisis Energi, *Majalah Energi (Teknologi Energi)*, No. 16 Juni – Agustus 2002, Pusat Studi Energi, Universitas Gadjah Mada, Yogyakarta.

Gipe, Paul, 1995, *Wind Energy Comes of Age*, Jhon Wiley and Sons, Inc., New York, USA

Hardjasoemantri, K., 2002, *Hukum Tata Lingkungan*, Gadjah Mada University Press, Yogyakarta.

Kellert, R. Stephen (Ed), 1997, *Macmillan Encyclopedia of The Environment*, Volume 6, page 70-72, Macmillan Library Reference USA, Simon & Schuster and Prentice-Hall International, New York, USA.

Kementerian Lingkungan Hidup, 2004, *Kesepakatan Nasional Dan Rencana Tindak Pembangunan Berkelanjutan*, Jakarta.

Krohn, Soren, 2002, *Wind Energy Policy in Denmark: 25 Years of Succes – What Now*?, Danish Wind Industry Association, Vester Voldgade 106, DK 1522 København V, Denmark (http://www.windpower.org)

Moran & Morgan, 1997, *Meteorology, The Atmosphere and The Science of Weather*, 5th Edition, Prentice-Hall, New Jersey, USA.

Myers, Norman (Ed), 1985, *The GAIA Atlas Planet of Management: for Today's Caretakers of Tomorrow's World*, Pan Books Ltd., Cavaye Palace, London, UK.

Notodisoerjo, E. Utomo, 2002, Kebijaksanaan Energi Dalam Era Keterbukaan, *Majalah Energi (Kebijakan Energi)*, No. 14 Desember 2001 – Februari 2002, Pusat Studi Energi, Universitas Gadjah Mada, Yogyakarta.

Partowidagdo, W., Arsegianto, Indriyanto, A., dan Hindarto, Dicky E., 2000, *Agenda 21 Sektoral: Agenda ENERGI untuk Pengembangan Kualitas Hidup Secara Berkelanjutan*, Kantor Menteri Negara Lingkungan Hidup & United Nations Developments Programme, Jakarta.

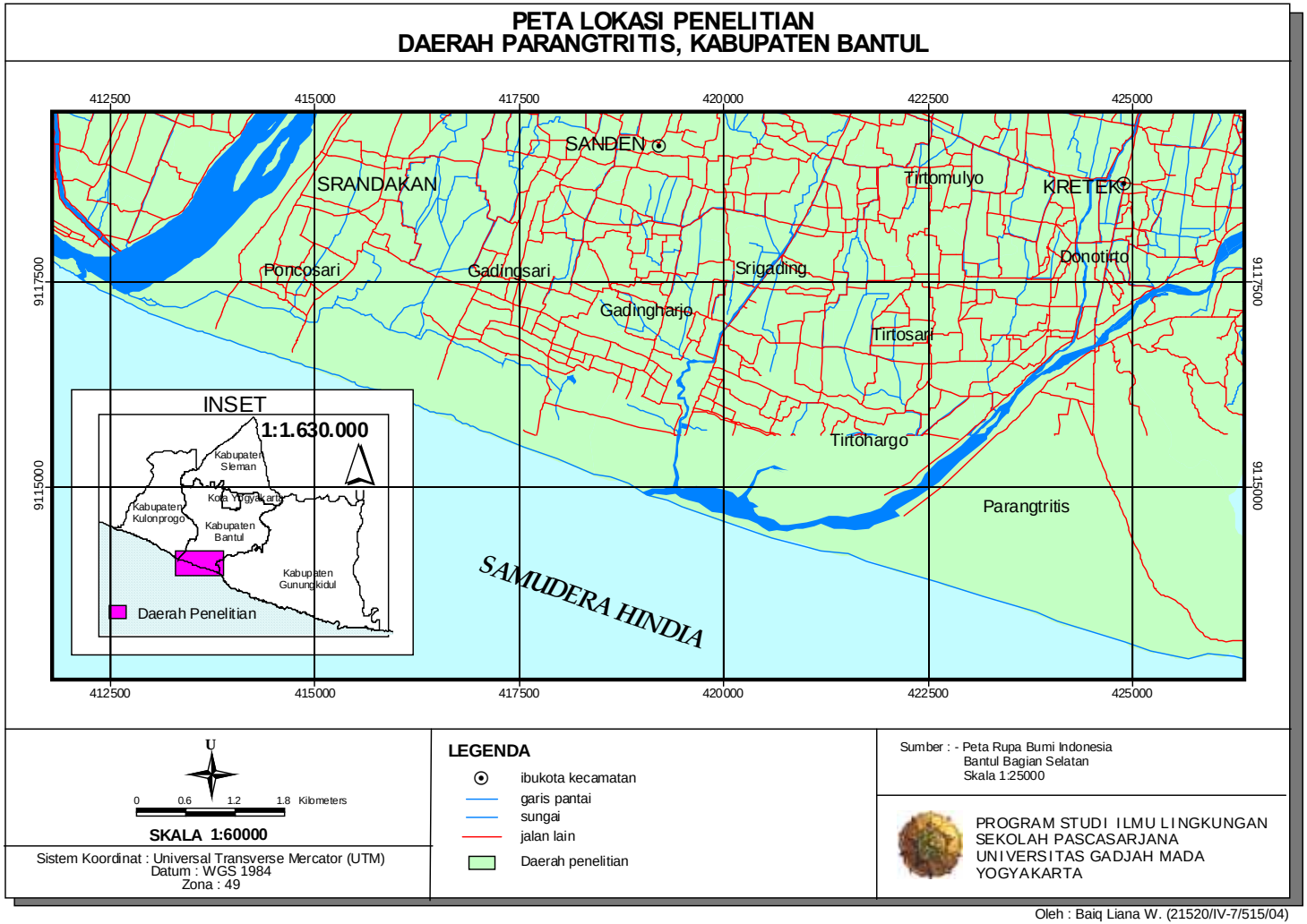
Pusat Studi Energi, 2002, Mengembangkan Pantai Baron: Sebagai Taman Wisata Energi Alternatif, *Majalah Energi (Liputan),* No. 16 Juni-Agustus 2002, Universitas Gadjah Mada, Yogyakarta.

Soemarwoto, Otto, 1995, Kependudukan Dan Lingkungan Hidup, *Warta Demografi*, Th 25, No.6, Halaman 35-36, Lembaga Demografi, Fakultas Ekonomi Universitas Indonesia, Jakarta.

Threwartha, T., 1954, *An Introduction to Climate*, 4th Edition, Mc Graw-Hill, Kogakusha, Ltd., Japan.

Tumiran, 2002, Kualitas Energi Listrik Menyongsong Pembahasan RUU Ketenagalistrikan, *Majalah Energi (Umum*), No. 16 Juni-Agustus 2002, Pusat Studi Energi, Universitas Gadjah Mada, Yogyakarta.

Turk, J., Wittes, T. Janet, Wittes, E. Robert, Turk, A., 1975, *Ecosystem, Energy*, *Population,* W.B. Saunders Company, Philadelphia, USA.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