Identification of potential local wisdom of senamat ulu village (electrical independent village) as a source of science learning

F R Basuki, Jufrida* and K Suryanti
Faculty of Teacher Training and Education, Universitas Jambi, Indonesia

*jufrida_66@yahoo.com

Abstract. The purpose of this research explored and identified the potential of local wisdom of electrical independent village as a source of science learning and mapped the basic competency of science in junior high school integrated with local wisdom. This research was a qualitative descriptive. The subject of this research ware community and traditional figure of Senamat Ulu Village and science education expert. The object of this research is Micro Hydro Power Plant of Senamat Ulu village. Data collection instruments used observation sheets, interview guides and documentation. Data were analyzed descriptively qualitative with Miles and Huberman model consisting of data collection, data reduction, data display and conclusion. The data credibility test was done by triangulation technique (observation, interview and documentation) on the same object. The results of this study indicate that the object of local wisdom of electrical independent village has a concept of science. The concept of science such as environmental conservation, environmentally friendly technology, electrical energy sources, the concept of energy changes, and how the generator works. Basic competency of science in junior high school mapped with local wisdom in IX class are basic competency 3.5 (Applying the concept of electrical circuit, energy and electric power, source of electrical energy including alternative energy source, and various efforts to save electric energy) and basic competency 3.10 (Understand the process and product of environmentally friendly technology for the sustainability of life).

1. Introduction
Local wisdom is a system of values and norms that are organized, held, understood and applied by local communities based on their understanding and experience in interacting with the environment [1]. Local wisdom is obtained from within and outside the local community that lives in balance with the nature and culture of the community into local wisdom in a community [14]. Each region has a local wisdom that comes from various understanding of the concept of society that behave wisely to nature related to culture. Based on the results of the experience of certain communities and inherited from generation to generation, the culture in each region has different characteristics. Every society also has social resources that are useful for development, such as traditional knowledge, wisdom and environmental ethics. In the past, the local Indonesian community strongly supported and practiced traditional wisdom devoted to preserving and preserving nature and the environment. That wisdom passed down from generation to generation. Local wisdom is often very detailed and accurately guides people in developing their lives. Local wisdom has proven to be very effective in protecting the environment and ensuring community and environmental compatibility [7]. Local wisdom is an
intelligence possessed by a particular society derived through the experiences of society that is not obtained by other communities.

One area that has local wisdom in protecting the environment is Senamat Ulu village. Senamat Ulu is located in District Batin III Ulu, Muaro Bungo, Jambi, Indonesia. The community in Senamat Ulu Village and several villages in District Batin III Ulu have wisdom in keeping the forest village. Forest village in the District Batin III Ulu has an area of 1661 hectare. The existence of this village forest provides many benefits for the community. The availability of water in the village is still maintained. The existing river in the village is managed and utilized in agriculture as irrigation of rice fields and in the field of electricity as Micro Hydro Power Plant.

Micro Hydro Power Plant is a form of environmentally friendly technology that is built because of the wise behavior of the community of Senamat Ulu Village against the environment. With the existence of this environmentally friendly technology these villagers can independently meet the electricity needs in their village. Because of that village is called Electricity Independent Village. MHP in this village consumed about 190 houses. One house consumes a maximum of 250 watts. MHP is used Monday to Thursday and Saturday every night at 17:00-07:00 WIB and Friday and Sunday that live 24 Hours full.

The existence of Micro Hydro Power Plant in Senamat Ulu village can not be separated from the wisdom of society in protecting the environment. Local wisdom is an important part in the development strategy as it affects environmental sustainability. Culture provides a clear illustration of how to maintain nature continuously. The environmental wisdom can be used as a handbook for communities to implement sustainable development [7]. By maintaining the availability of river water in the village is still maintained so that it is used as Micro Hydro Power Plant. Micro Hydro Power Plant has science content that can be used as a source of learning. Based on preliminary studies that have been done, it was express that data about local wisdom of Senamat Ulu Village has not been well documented in the form of pictures, data from the relevant agencies as well as information about the object of local wisdom. So that there is need for identification and deep exploration of the object of local wisdom.

Learning based on local wisdom can essentially facilitate students in learning, because students can directly see for themselves where the source of learning is located. Local wisdom has the potential that can be used as a source of learning. Local cultural wisdom besides having positive values can help to improve the competence of writing diaries and changing the negative character of students to be positive. Students' writing competence increases due to sources of inspiration derived from local cultural wisdom more easily understood and recognized by previous students [9]. Implementation of local wisdom in learning is also considered to increase the knowledge and skills of students in the learning process. Local wisdom can help students in connecting science and develop a positive cultural identity so that learning become more meaningful [5]. Through the integration of STEAM and local wisdom in learning, students find it easier to understand the content of the material and students feel more excited and motivated in learning activities as well as in utilizing the local potential of an area [6]. Implementation of science learning based on the local wisdom not only improving the positive characters of the elementary students, but also increasing their learning achievement [13]. The use of local wisdom in learning also ascertains that learning science does not merely understand the concepts, but also strengthen Indonesia’s identity with its various cultures [10].

The purpose of this research is to explore and identify the local wisdom of electricity independent village which has the potential as a source of science learning and to mapped out basic competency in science lesson of junior high school which is integrated in local wisdom. To achieve that goal requires an appropriate approach in learning. Based on the above description, learning that can integrate between science and local wisdom one of them can use SETS approach. SETS (Science Environment Technology Society) Approach is a unity in the concept of education that has the implementation so that students have high-order thinking skills [8].

2. Method
This research is a qualitative descriptive research with descriptive explorative type. The subjects of this research are the people of Senamat Ulu Village, traditional leaders and science education experts. Objects of local wisdom that is identified the independent Electricity Village or Micro Hydro Power Plant. The data used in this study are primary and secondary data. Instrument of data collection used form of observation sheet, interview and documentation. The research procedure consists of four stages: initial observation, interviews with community and customary leaders, further observation and interviews with science education specialists. The data were analyzed descriptively qualitatively using Miles and Huberman analysis model in the form of data collection, reduction, presentation and conclusion. Test data validity is done by triangulation technique that is collecting data through observation, interview and documentation.

3. Results and Discussion

Senamat Ulu Village is located in Batin III Ulu District, Muaro Bungo, Jambi, Indonesia. In this village, tradition, culture and religion are the foundation for everyday life, so that people still appreciate things that are related to culture and traditions. Generally, residents make a living as farmers. There are also those who trade daily needs. Senamat Ulu is the Other Reserved Area (APL), Production Forest, Customary Forest and Protected Forest Area. Forest of the village of Senamat Ulu is part of the Bukit Panjang Protection Forest - Rantau Bayur covering an area of 1,661 ha based on the Forestry Ministerial Decree number 360 / Menhut-II / 2011 [15]. In addition to village forests, the community also manages customary forests that have been established through the Regent's Decree number 48/2009 Hutbun covering an area of 224 ha [15]. The customary forests namely Bukit Bajang Forests. The community has local wisdom in utilizing its forests which are based on conservation and sustainability. They really understand the benefits of the forest and also the impacts that will arise from forest management, so that the community protects its forests with the Customary Forest scheme [15]. This customary forest can only be used for the benefit of the village and regulated customarily through traditional meetings. Before getting to know customary forests and village forests, they are used to maintaining forests because they depend on forest products such as wood, rattan, resin, rubber, bamboo etc. Wood in customary forests may be taken on condition that there are 10 trees replanted for every 1 tree that is cut.

Figure 1. Bukit Bajang Forests of Senamat Ulu (warsi.or.id)

The existence of village forests and customary forests has an important role in the presence of water in the Batang Senamat River. The community is aware of the importance of keeping the Batang Senamat water flow still present, not dry or flooded. The condition of the forest in the upper reaches of the Batang Senamat river has begun to be alarming. Because, there are several companies that open forests for oil palm plantations. The existence of this Batang Senamat river is also widely used by the
community for agricultural irrigation, micro hydro power plants and ecotourism managed by local youth.

This village is considered successful because it is able to overcome the problems that exist in the environment. One is to meet demand for electricity in the village. Local wisdom of the village, among others, is the community wisely to maintain the forest and the conservation of fish in the prohibition of the rest of the river is not polluted. River that flows in the village is utilized by the surrounding community as irrigation agriculture Micro Hydro Power Plant. There is evidence that by preserving the forests, the availability of water is maintained so that electricity continues to flow in the village, the community will play a role in the effort to preserve the remaining forest area in the village. They also have the principle "Forest lost, electricity goes out" [4].

![Batang Senamat River](warsi.or.id)

Prior to the existence of Micro Hydro Power Plant, the community formed a small group of 5-8 heads of household to build a hydroelectric plant. But people can only use less than 150 watts of electricity per house. This is because the power generated by the Power Plant is quite small. In the year 2014 people switch from Hydro Power Station to Micro Hydro Power Plant. It is used by two villages of Senamat Ulu village and Aur Cino village consisting of 190 houses. Each house can use up to 250 watts of power.

3.1. The concept of science in Micro Hydro Power Plant in Senamat Ulu Village

Micro Hydro power plant is a small-scale power plant that utilizes streams or irrigation channels. In principle, MHP utilizes the height difference and the amount of water discharge per second in the irrigation water flow, river or waterfall. This water flow will rotate the turbine shaft to produce mechanical energy. This energy then drives the generator and generates electrical energy.

![How MHP work](image)
The river flow is dammed to get the water discharge (Q) and the height of water falls (H), then the water produced is channeled through the conduit to the sedating pond, the sedative pond is connected to the pipe, and the water turbine is installed at the bottom. The water turbine will rotate after getting water pressure (P), and the turbine rotation is used to rotate the generator. After getting a constant rotation, the generator will generate electricity voltage, which is sent to consumers via a distribution cable channel (JTM or JTR) [12].

The main components of Micro Hydro Power Plant are water, turbines and generators. Other supporting components that can be seen in figure 4.

![Figure 4. The Component of Micro Hydro Power Plat](image)

Based on Figure 4, there are several components that support the construction of a plant. These components are divided into two main components and civil components. The main components of micro hydro power plant consist of water, turbine and generator, while for civil component consist of power house, forebay, tailrace, weir, and penstock.

3.1.1. The main components

![Figure 5. The main comonent of MHP, (a) Water, (b) Turbin, (c) Generator](image)

3.1.2. The civil components

The civil component serves to channel water to mechanical components. Furthermore, mechanical-electrical components convert the mechanical energy of water into electrical energy [11]. The civil component can be seen in figure 6.
Figure 6. The civil components: (a) Dams, (b) Intakes, (c) Channels, (d) Penstocks, (e) Calming Gardens, (f) Power Houses

According to [11], based on the location configuration criteria, PLTMH is divided into three namely the Run-Off-River Scheme, storage, and integration. The scheme used in PLTMH in this village is a type of run-off-river scheme. This scheme can be seen in figure 5.

Figure 7. The Scheme *Run-of-river*

Figure 8. Concepts of energy change

A Micro Hydro Power Plant should pay attention to the generated mechanical energy. The greater the discharge (the volume of water flowing every second) the greater the mechanical energy produced
3. The working principle of MHP to convert the potential energy of water into kinetic or mechanical energy. In this case kinetic energy can be obtained if the water is dammed, then flowed or piped through. In this system the mechanical energy of water is converted into electrical energy with turbines and generators. The concept of change of mechanical energy into electrical energy can be seen in figure 8.

The amount of potential energy of water at a certain height that will be used as a source of energy in MHP can be calculated through equation 1.

\[ E_{\text{potential}} = mgh \]  

Water is then streamed through a pipe (penstock) so that water can flow at high speed so that the energy changes from potential energy to kinetic energy. The flow of water flowing in the pipe can be written by the equation 2.

\[ Q = Av \]

Water that flows in the penstock will be passed on turbine. Turbine serves to convert potential energy into mechanical energy. Water will hit the blades of the turbine so that the turbine spins. The turbine rotation has an energy called rotational kinetic energy. This rotational kinetic energy is owned by an object that performs rotational motion. This can be written in equations 3.

\[ E_{K_{\text{rotation}}} = \frac{1}{2}I\omega^2 \]

This turbine rotation is connected to a generator with a mechanical energy transmission system using a belt or pulley, a serrated wheel or directly connected to its axis. Constant rotation of a generator in MHP will produce GGL induction. Images of a generator can be seen in the following figure 7.

\[ \varepsilon = N\frac{d\phi}{dt} \quad \text{atau} \quad \varepsilon = -N\frac{d\phi}{dt} \]  

3.2. Basic Competency Mapping integrated with Local Wisdom of MHP

Based on the analysis of the concept of science that is identified on the object of local wisdom of the village senamat ulu, then there are some concepts of science in accordance with learning at Junior High School. The concept of science such as electrical energy sources, environmentally friendly
technology, the concept of energy changes, and discharge. The basic competencies that can be mapped are in accordance with the National Curriculum in Indonesia for junior high school shown in table 1.

Table 1. Mapping of Basic Competency on the object of local wisdom of electricity independent Village

| Subject matter                        | Basic competency                                                                 | Grade          |
|---------------------------------------|----------------------------------------------------------------------------------|----------------|
| Electricity independent village       | 1. Electrical energy source                                                      |                |
|                                       | 2. Environmentally friendly technology                                            |                |
|                                       | 3.5 Applying the concept of electrical circuits, energy and electrical power, sources of electrical energy including alternative sources of electrical energy, as well as various efforts to save electrical energy |                |
|                                       | 3.10 Understand the process and products of environmentally friendly technology for sustainability of life |                |

The local wisdom of electricity independent village can be integrated with science learning especially in class IX on the concept of electrical energy source and environment friendly technology. One suitable lecture is used to integrate local wisdom in science learning is Science, environment, technology, and society (SETS) approach. The relationship between SETS elements shows that each element influences each other in its development process. SETS approach will make students more familiar with the environment and the potential of existing natural resources and more concerned with local wisdom that is around. The inclusion of local wisdom in learning can make it easier for students to understand science concepts and make students closer to their environment, making it easier to understand problems and find answers to problems that exist in the environment [2].

Figure 10. Science, Environment, Technology and Society (SETS) Approach

4. Conclusions

Based on the results of research that has been done in the Senamat Ulu Village, it can be concluded that by behaving wisely to the environment the community get such great benefits in the field of technology that is as a source of renewable electricity. With the flow of water is maintained, people around the Senamat Ulu Village can meet their own electricity so called Independent Village of Electricity. The concepts of science that integrated on the object of Local Wisdom of Independent Village of Electricity among the components of micro hydro power, micro hydro power scheme, energy change concept including potential energy, kinetic energy and mechanical energy, and how to
work micro hydro power. Basic of competency mapping resulting from the concept of science on Local Wisdom identified on class IX are basic competency 3.5 and 3.10. Local wisdom can be a context in science learning to learn the concept of science. One approach that can integrate the concept of science and local wisdom is the SETS approach.

Acknowledgments
Authors would like to thank the Jambi University for the support of research and publication fund in fiscal year 2018. Authors also thank the research team that has helped complete the research.

References
[1] Agung, L 2015 The development of local wisdom-based social science learning model with bengawan solo as the learning source American International Journal of Social Science 4(2015)04
[2] Ardan, A 2016 The development of biology teaching material based on the local wisdom of timorese to improve students knowledge and attitude of environment in caring the perseverance of environment International Journal Of Higher Education 5(2016)03
[3] Artawan, P 2014 Fisika Dasar (Yogyakarta: Graha Ilmu)
[4] Ayat, A and Tarigan, T 2014 Kiprah Agroforestri (Jambi: World Agroforestry Centre)
[5] Azizahwati and Yasin, R M 2017 Pengembangan lembar kerja siswa berbasis kearifan lokal Jurnal Geliga Sains 5(2017)01
[6] Bahri, S., Kusumawati, L., and Nuraini, L 2017 STEAM education based on local wisdom of coffee plantation in jember to improve the competitiveness at 21st century Pancaran Pendidikan Fkip Universitas Jember 6(2017)03
[7] Hasbiah, A.2015 Analysis of local wisdom as an environmental conservation strategy in indonesia. Sampurasun E-Journal 1(2015)01
[8] Hidayah, F F 2014 Karakteristik panduan praktikum kimia fisika bervisi-sets untuk meningkatkan keterampilan proses sains Jurnal Pendidikan Sains Universitas Muhammadiyah Semarang 2(2014)01
[9] Mulyani, M 2011 Model pembelajaran menulis berbasis kearifan lokal yang berorientasi pendidikan karakter studi kuasi eksperimen pada siswa smpn 2 kelas vii, windusari, magelang Jurnal PENA 1(2011)01
[10] Parmin, Sajidan, Ashadi, and Sutikno 2015 Skill of prospective teacher in integrating the concept of science with local wisdom model Jurnal Pendidikan IPA Indonesia (JPII) 4(2015)02
[11] Rohman, A 2009 Studi Perumusan Alternatif Skema Pembangkit Listrik Tenaga Mikrohidro (PLTMH) Untuk Optimalisasi Potensi Energi Dan Potensi Wisata Curug Cimahi (Bandung : ITB)
[12] Sukamta, S and Kusmantoro, A 2013 Perencanaan pembangkit listrik tenaga mikro hidro (PLTMH) Jantur Tabalas Kalimantan Timur Jurnal Teknik Elektro.5(2013)02
[13] Subali, B, Sopyan, A and Ellianawati 2015 Developing local wisdom based science learning design to establish positive character in elementary school Jurnal Pendidikan Fisika Indonesia 11(2015)01
[14] Ubol, A R 2016. Enhancing local wisdom through lifelong learning in Thailand Culture, Biography & Lifelong Learning 2(2016)02
[15] Komunitas konservasi Indonesia WARSI (https://www.warsi.or.id)