Development of Solar Energy Technologies and Cost Estimating for Small Solar Water Pumping System in Rural Area of Sagaing Region

Aye Aye Khine[1], Myat Myat Thaw[2], Thant ZinOo[3]

Abstract

A solar photovoltaic water pump is a pump running on electricity generated by solar photovoltaic panel which converts solar energy into electrical energy. A solar photovoltaic water pump does not depend on grid electricity, diesel and other fuels. Solar photovoltaic panel is the main power supply of the water pumping system. In this paper, solar energy technologies, system components of solar water pumping system and estimated cost for small solar water pumping system in rural area of Sagaing region were described.

Introduction

There are various kinds of energy resources in nature. Most of the energy sources that we use rely on fossil fuels. These energy sources are not sustainable and cause a great deal of damage to the environment. However, solar power relies on the energy provided by the sun. Nowadays, solar energy is very popular and widely used in all over the world. Solar Energy is the radiation coming from the sun. It does not produce carbon dioxide and greenhouse gas emission, environmental sustainability. Solar energy can be converted into electricity using solar cells. In a solar water pumping system, solar panels are the main power resources of the solar water pumping system. The solar water pump is a pump running on electricity generated by solar photovoltaic panel which converts solar energy into electrical energy. A solar photovoltaic water pump does not depend on grid electricity, diesel and other fuels. The aim of this paper is "to develop solar energy technologies and to calculate estimated cost for small solar water pumping system in rural area of Sagaing region". At present, many places in Myanmar (mostly rural area and central dry zone) where no coverage of power grid depend on lakes and wells. They are facing the problem of shortage of water in summer and winter. Solar water pumping system is very beneficial for places where there has no electricity to get plenty of water for many purposes in the day time. Cost estimating for solar water pumping system is very important for villagers and donors who want to support funding.

Literature Review

N. Argaw and his partners (2003) introduced conventional and renewable energy sources for water pumping applications in rural villages by reviewing the technologies and illustrating typical applications.Yahia Bakelli and his partners (2011) stated that the photovoltaic water pumping system optimization sizing model, is developed based on the loss of power supply probability and the life cycle cost concepts. M. Benghanem and his partners (2013) stated that the widespread of the photovoltaic water pumping systems technique requires accurate information and experiences in such system sizing and installation. Harishankar, S.and his partners(2014) stated that solar powered smart irrigation systems in which solar powered water pump along with an automatic water flow control was constructed

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by using a moisture sensor. Many researchers from all over the world investigated solar PV water pumping system by various methods and estimated cost for solar PV water pumping system at their sites. In this paper, development of solar energy technologies and the estimated cost for small solar water pumping system in Rural Area of Sagaing Region were described.

Aim and objectives

The aim of the present work is "To develop solar energy technologies and to calculate estimated cost for small solar water pumping system in rural area of Sagaing region".

Objective 1:To raise the awareness of solar energy technologies forenvironmental conservation and sustainable development

Objective 2: To share the knowledge of solar water pumping system

Objective 3:To calculate estimated cost for small size solar water pumping system forvarious purposes

Solar Energy Technologies

Solar Energy

The Sun is 150 million kilometres away from the Earth and amazingly powerful. Just the tiny fraction of the Sun's energy that hits the Earth is enough to meet all our power needs. In fact, every minute, enough energy arrives at the Earth to meet our demands for a whole year.

Solar Energy is the largest source of energy received on Earth, but its intensity on the earth's surface is quite low. Solar energy is rapidly becoming the ultimate energy source because of its non-polluting character and its inexhaustible supply which are in stark contrast to such fossil fuel sources as coal, oil, and natural gas. The applications of solar energy are solar power generation, solar water heater, solar water pump, solar cooker, solar seawater desalination, solar cooking, solar building and solar drying.

Power Generation of Solar Cells

When charged by the sun, the basic unit generates a dc photo voltage of 0.5 to 1 volt and, in short circuit, a photocurrent of some tens of milliamps per cm^2. Although the current is reasonable, the voltage is too small for most applications. To produce useful dc voltages, the cells are connected together in series and encapsulated into modules.

A module typically contains 28 to 36 cells in series, to generate a dc output voltage of 12V in standard illumination conditions. Generally, 36 cells are needed for 12 system voltage and 72 cells for 24 system voltage. The 12 V modules can be used singly, or connected in parallel and series into an array with a larger current and voltage output, according to the power demanded by the application. The array is also called a photovoltaic generator.

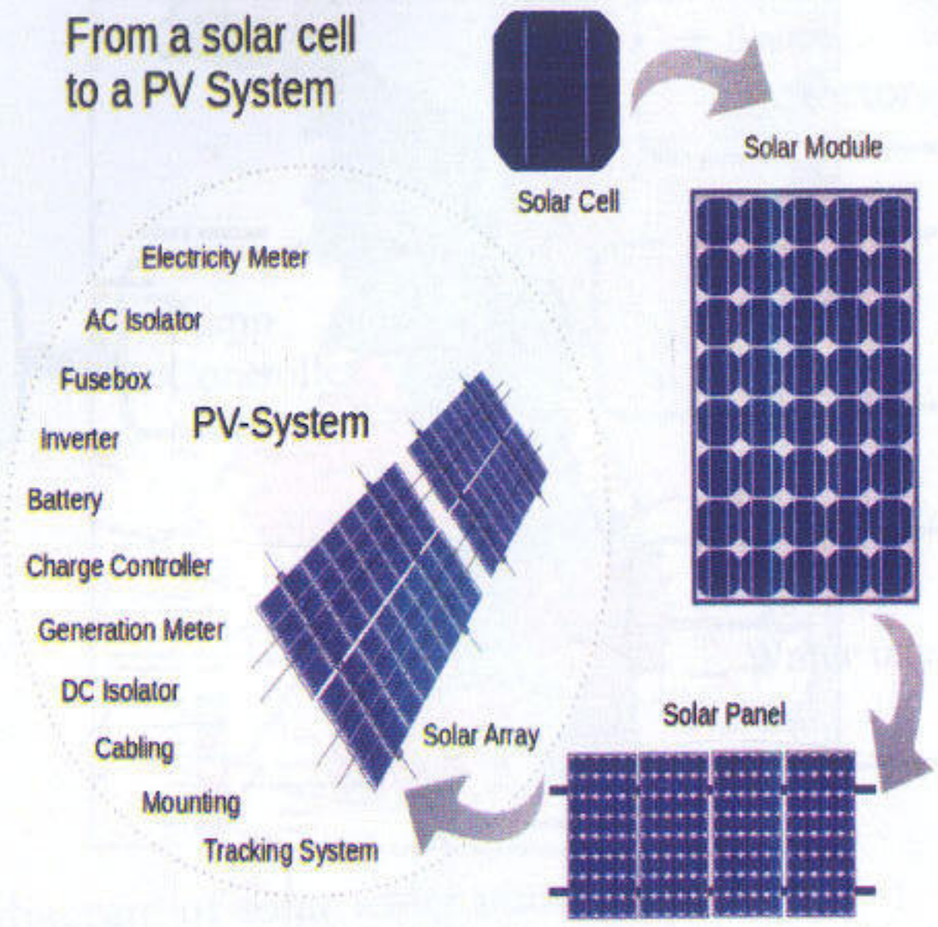

Figure .From a solar cell to a solar PV system

Size and Boundary of Sagaing Region

Sagaing Region is located in the north-western part of the country between latitude 21° 30′ north and longitude 94° 97′ east. It is bordered by India's Nagaland and Manipur States to the north: Kachine State,ShanState and Mandalay Region to the east, Mandalay Region and MagwayRegion to the south, China and India to the west.Sagaing Region consists of 198 wards Villages, 38 townships and eight districts. Sagaing township is a township in Sagaing district in the Sagaing region of Myanmar.

Area and Population of Sagaing Region

The region has an area of 93,527km^2. In 1996, it had a population of over 5,300,000 while its population in 2012 was 6,600,000. The urban population in 2012 was 1,230,000 and rural population was 5,360,000. The population of Sagaing township is about 307,000(2014).

Electricity receive in Sagaing Region

There are over 1,500 villages receiving power from electric generators, over 1,400 villages, from a solar-powered system, over 1,500 villages from diesel-powered generators, over 140 villages from biomass/ husk power and over 190 villages from mini hydroelectric power.Over 4,000 villages out of over 6,000 villages receive the electricity in different ways in Sagaing region. According to the 2014 census, 75.8 percent in the region receive the electricity from private sources while only 24.2 percent receive electricity from the government power supply.

Figure. The Map of Sagaing Division

System Components of Solar Water Pumping System

Solar PV water pumping system mainly consists of solar panel system, supporting, solar water pump, pump controller, surge protector, water tank and pipes.

Solar PV panel system is the main power supply of the solar water pumping system. Supporting is needed to support solar panels. In the market, there are many types of solar panels, mainly monocrystalline, polycrystalline solar panels. Monocrystalline solar panels are saving space, the longest lifespan and the most expensive in currently on the market. Polycrystalline solar panels are offered as a cheaper alternative, but less efficient. Installation methods of solar panels are landform, on the roof, combine with the machine room and regular installation. Installation can be flexible with the landform.

There are basically two types of solar water pump, surface solar pump and submersible solar pump. Surface solar pumps are used to pump water from river, lake and shallow tube well. They are the best if the water supply is 20 feet or less than from the surface. Submersible solar pump can lift up to 650 feet and fit in a 4 inchesor larger well. They are used when the water supply is deeper than 20 feet from the surface. Submersible solar pumps can operate directly of solar panels, batteries or in some cases, an AC power source. Water is usually pumped during the day when the sun is shining and stored in the tank for used whenever used.

Pump controller control and regulate the system and convert the DC (direct current) generated by solar panels to AC (alternating current) to drive the pump. In addition to increasing the current output to allow for longer pumping days, a pump controller also have features like a connection for a float switch to turn the pump on or off based on water level, over current and over voltage protection.

Surge protector is used to protect the solar water pump. The tube well (inner diameter 4.5 inches) mustbe drilled by mechanical driller to fit with solar water pump which will pump out water to the water tankwith pipes.

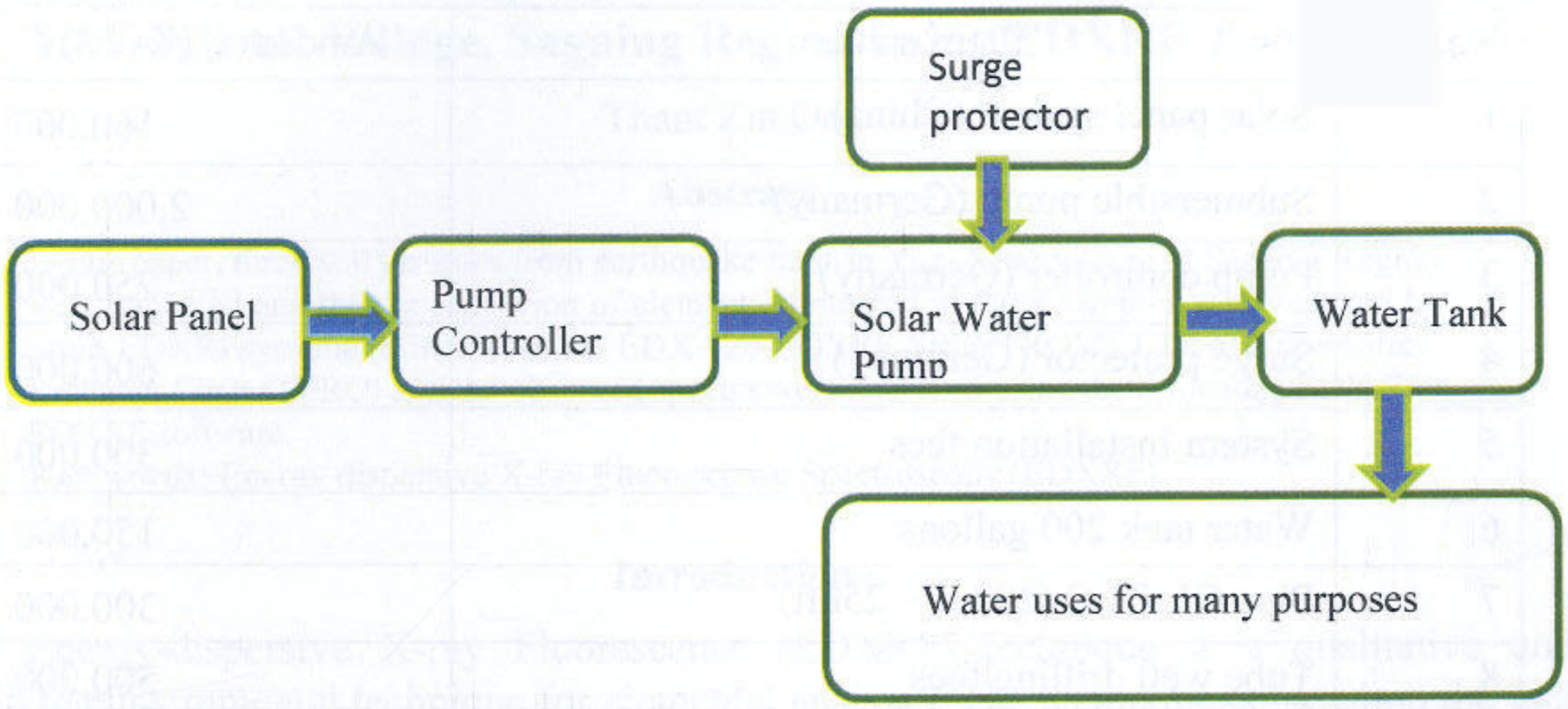

Figure. Block diagram of solar water pumping system

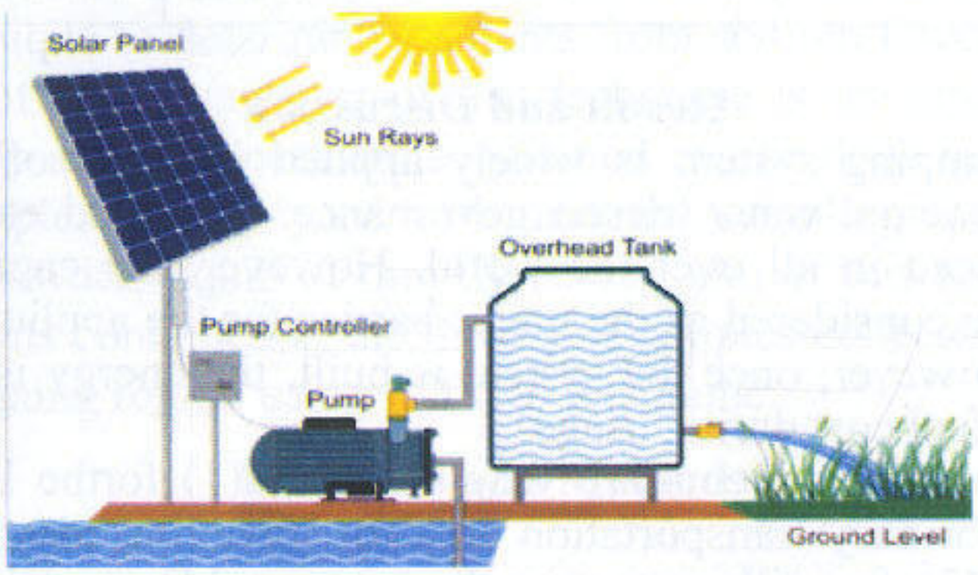

Figure.Sample of solar water pumping system with surface solar pump

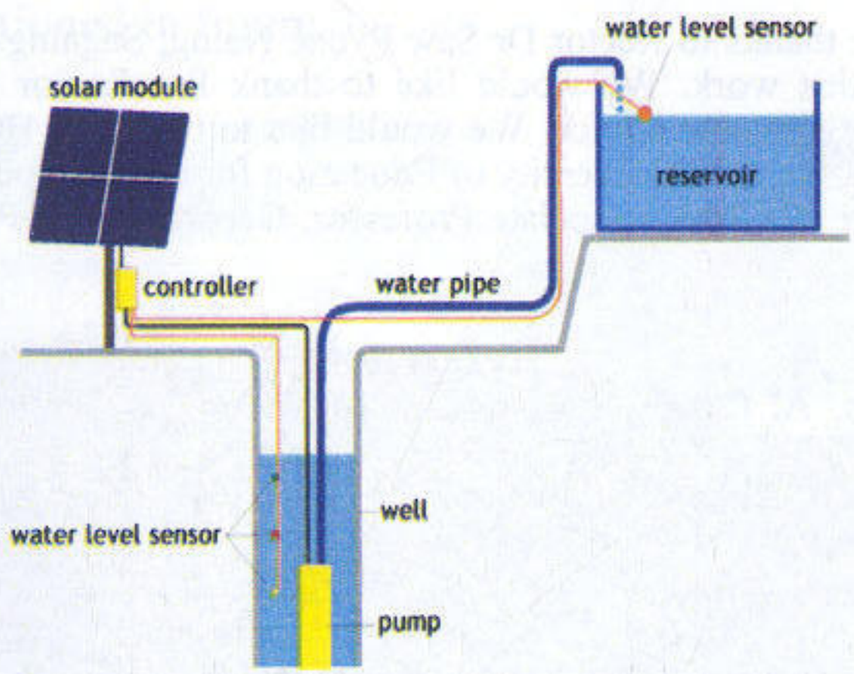

Figure. Sample of solar water pumping system with submersible solar pump

Estimated Cost for Small Size Solar Water Pumping System

Lift range : 200 ft
Daily water volume range : 200 gallons
Capacity of Solar array : 160 kW
Power of Water Pump: 0.5 kW
No battery storage system

Table. Estimated Cost for Small Size Solar Water Pumping System

No.	Item name	Amount (Kyats)
1	Solar panel system (China)	160,000
2	Submersible pump (Germany)	2,000,000
3	Pump controller (Germany)	250,000
4	Surge protector (Germany)	600,000
5	System Installation fees	300,000
6	Water tank 200 gallons	150,000
7	Pipe GI+PVC (200 ft + 250ft)	300,000
8	Tube well drilling fees	500,000
9	Spare parts, nut screw and others	150,000
	Total	4,410,000

Result and Discussion

Solar water pumping system is widely applied in areas of agricultural irrigation, forestry irrigation, municipal water, desert governance, grassland etc. Nowadays, the solar module costs are reduced in all over the world. However, the capital cost of solar water pumping system can be considered as the major barrier for the application of the system in a developing country. However, once the system is built, the energy is virtually free, with no electricity cost and no fuel cost during usage.

Solar water pumping systems are very beneficial(1) forthe location away from the national grid line, (2)for easy transportation area for travelling to construct the solar water pumping system and (3) for villagers strongly organized.Cost estimating for solar water pumping system is very important for villagers and donors who want to support funding.

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