

Questions and Answers for the live class 3

Q1 (Fassihath TOUKOUROU): what about hybrid pump and their integration

A1: Do you mean hybrid pump or hybrid SPIS?

A pump can be driven by either an AC motor or a DC motor. DC pumps can be powered directly from the solar panels or batteries (which generate DC power). However, AC pumps cannot be powered directly from the solar panels, an inverter (DC to AC converter) in this case is needed. There are some pumps that are able to run off either DC or AC electricity as an inverter is already integrated with the motor.

If a hybrid SPIS is to be considered (meaning a combination of power sources, such as solar + wind + diesel generator + grid), the pump will need to have a suitably DC motor or a suitably AC motor, depending on the configuration.

Q2 (Koffi Apedjagbo): Is sustainable to add the Diesel Gen to the system?

A2: it is better to avoid diesel generator as they require maintenance and the cost of fuel. However, depending on the needs, this option could be integrated in the SPIS configuration. For example, if power is needed at night for irrigation or other needs, a PV system (without batteries) cannot provide that power. In this case, the user reduces the full dependence on diesel and uses it only when the sun is not available.

Q3 (Abed Doughan): How do the solar panels turn on or allow the pump to work? Is it solar energy to mechanical energy? Or what is the mechanism?

A3: Using a PV system, sunlight is converted to electricity through what is called the “**photovoltaic effect**”, without any moving parts, without any chemical effect, without need for heat (heat will be generated as a byproduct, it’s a waste that happens in the conversion process). So, the process doesn’t require heat, nor chemistry, nor moving parts. That’s the reason PV panels have long life (there is no degradation).

A solar cell is made from silicon, a semi-conductor and not a full conductor (it is not metallic), which can conduct electricity only under certain conditions. When it absorbs light, it generates electrical charges, but the secret to have photovoltaic effect is to separate those charges by a built-in electrical field. Thus, the light generates charges positive and negative (heat). The separation of these charges that produces voltage.

Q4 (Nehad Ahmed): Is there is type of controller that convert DC to AC?

A4: Yes, to convert DC to AC power, you need to use an inverter. So if the power source is a PV system and it is needed to operate AC motors, an inverter is needed to convert power from DC to AC.

Q5 (Fassihath TOUKOUROU): Can I have an average value of efficiency?

A5: System efficiency relates to losses in the equipment’s operation (temperature, shading, dirt, cable losses...etc.). A good rule of thumb is that modules will operate at about 75% of their rated power, at most, due to losses.

Q6 (Julius A K): Can you convert any electrical pump to use solar power. bearing in mind the high start up current required by electrical pumps. secondly, can all electrical pump motors run on a VFD - variable frequency device.. please explain. Thanks

A6: Yes, as long as the motor of the pump is an electrical motor, it can be operated using solar energy, if it is a DC motor then an inverter is needed.

Sizing the PV system requires the consideration of the start-up current needed to start the pump motor. However, after the pump has started that current requirement decreases. This means that the PV system needs to be oversized. To overcome this, A maximum power point tracker (MPPT) can be installed between the PV panels and the pump to match the panels' output with the required current or voltage of the pump motor to be operated.

VFDs regulate the speed of AC motors by adjusting the frequency and voltage supplied to the motor. However, not all AC pump motors are compatible with a VFD. Because variable frequency drives convert energy into harmonics and resonant frequencies motor that can handle them is needed.

Q7 (Kushal Gautam): In river water pumping, pumps face a lot of debris that may damage the impellers. What kind of filtration systems would you suggest to improve the life of the pump?

A7: The best way to avoid debris at the inlet of the pump is to use strainers (pump suction strainers). Now there are some self-cleaning strainers available in the market. It is also advisable to not put the inlet end of the pipe in mud, you can create a small pond with gravel at the bottom as pre-filters before pumping the water.

Q8 (Maya Mhanna): If the efficiency of the solar panel decrease with the increase in temperature and at the same time crop water needs increase with the increase of temperature, how to deal with this?

A8: Yes, as the air temperature increases, irrigation demands increase. At the same time, the increase in air temperature may lead to an increase in the PV module temperature. The solution could be the selection of a type of PV modules that are less sensitive to temperature increase. For example: considering the use of Monocrystalline panels as they tend to be slightly less affected by high temperatures compared to polycrystalline panels. Also, considering floating solar panels or install solar panels over a water pond to reduce the air temperature of the panels as well as reduce the evaporation of water from the surface of the pond or water body.

Q9 (Santa AKANYO): I would like to know the service interval of surface and submersible pumps. is it restricted to a specified time period or service is done as required.

A9: Regular servicing and maintenance of pumps (either surface or submersible), is necessary to ensure that they performs as needed for their designed lifetime. Usually, the manufacturers provide the service interval for their pumps. Some pumps are designed for long operation and low maintenance and life cycle costs than others. Nevertheless, the pump owner/user must perform certain maintenance actions to ensure that it is working optimally. It is imperative to follow the guidelines provided by the manufacturers, which take into consideration the operating conditions of the pump.

Because surface pumps are placed on the “surface” (environmental conditions, weather, theft or vandalism ...etc.), they require more maintenance than the submersible ones. Surface pumps require priming, and more energy to operate since they first move water by suction. On the other hands, submersible pumps do not require manual priming, and since they are submerged in water, they are protected and do not need as much maintenance as surface pumps.

Q10 (MAYTHAM ALGHAFARI): what about the depth of the wells? will it take it into consideration in design?

A10: of course, depth of the well is an important parameter to consider when design a pump. The deeper the water table the more head is needed to lift water. This may entail a more powerful pumps with a higher cost.

Q11 (Eng.Mahmoud Ahmed): does the temperature affect the voltage or intensity or both of the pannels? how can we remediate to this loss in hot areas such as Djibouti?

A11: the temperature of the panels affects the voltage as the temperature increases, the voltage decreases. Thus, the output power of the panels decreases.

For the mitigation see **A8**

Q12 (Koffi Apedjagbo): what to do to reduce the temperature's impact on the modulle ?

A12: see **A8**

Q13 (James N.W): is there a posibility of Short circuit issues with the SPIS?..Especially during the rainy season

A13: Yes, since there is electricity, there is a risk of short circuit and fires. That’s why it is extremely important to well installed the system, i.e., insulate all wire and connection, make sure that all wires are high to avoid rodents from chowing on them. Make sure that all controller/other devide housing are insulated and closed.

Q14 (Laith Sarsour): What is it the maximum hp we can find in DC pumps, is there a DC Dynamic pumps?

A14:

Q15 (Koffi Apedjagbo): From how many ha the SPIS system is really profitable for the farmer

A15: Cannot have a straightforward answer to this, usually SPIS are profitable, but this is strongly related to the income of the farm and not it’s size. Because the smaller the farm the lower is the investment for the SPIS. The larger the farm, the higher is the investment but this may mean a higher income. So, it is important to perform a financial farm analysis (you can use the Farm Analysis Tool), then perform a Life Cycle Cost Analysis to assess the long term balance (investment-income-expenses), for this you can use the Payback Tool.

Q16 (khaled abdal-sattar): DC motors have many disadvantages such as lots of malfunctions and availability also limitations of its hp sizes ,,, Ac motors are more reliable used with inverters in spis

A16: AC pumps usually provide higher pressure than DC pumps. The latter are usually used in low power capacity systems up to 5 kW. DC SPIS consists of solar panels, controller, and the DC pump. There are some factors that need to consider when selecting pumps (advantages and disadvantages):

DC pumps are more efficient than AC pumps and required less solar panels to operate. However, they are more difficult to maintain, especially in remote areas as they need professional services. They are also more expensive than AC pumps.

DC pumps have longer lifespan as it uses motor coils manufactured from pure copper, while AC solar pump uses motor coils manufactured from aluminum/copper to achieve competitive price. In addition to that, Brushless DC pumps (BLDC) are less noisy, they are totally quiet because they use internal BLDC motor with high manufacturing technology while AC pump uses old motor technology.

Q17 (Farida Joumade): can we place the PV boards in different orientations to have a maximum of sunshine time?!, that can affect the amount of power?!

A17: Yes, the orientation and the tilt of the solar panels is very important to maximize the use of the solar energy. This can be done by installing single or dual-tracking systems (track the sun). However, installing trackers requires maintenance, hence, additional costs. Since the cost of the solar panels has dropped significantly, it may be more feasible to install a larger fixed PV system with an optimal orientation and tilt.

Q18 (Laith Sarsour): I suppose it is efficient to use DC pumps In small scale, which will not require an inverter!

A18: For small-scale systems, it is more efficient to use DC pumps. But the selection is not a straightforward decision, different factors have to be considered. (see **A16**).

Q19 (James N.W): I heard some pump switch off after pumping for some hours. What could be the cause?

A19: I am not aware of this. But it is always advisable (important) to use controllers between the PV system and the pumps to well control the switch-on and off of the pump.

Q20 (khaled abdal-sattar): may be Dc pumps suitable for minimal applications while in agriculture I think these applications is not exist a lot

Q20: actually, small-scale farming is widely spread, more than 60% of farmers in sub-Saharan Africa are small-scale holders.

Q21 (Abed Doughan): True cable checking! I have had problems in my experiment where cables were cut due to theft, tractors and mice! :(

khaled abdal-sattar : cables should be buried in earth to prevent mice and tractors

Abed Doughan: true thats what we did and we added colored flags for tractors to see it and fence for security

A21: cable should be well installed, if they have to be buried, it is recommended to use special conduit for that (strong to avoid being damaged by animals and farm activities) and well insulated from water.

Q22 (Farida Joumade): is this aquastat tool?!

A22: No, the toolbox has nothing to do with the FAO Aquastat, which is an online database. The Toolbox and its tools were developed specifically for SPIS

Q23: (BENBAASID Hicham): Thank you mr wahid for your great presentation .. i have a question please , In the case of several pumps, for example a submersible pump and a surface pump, is one solar pumping system can be use for them, or in this case a centralized solar system connected to the electrical network (ON GRID) must be designed

A23: This is an interesting question. The answer is that it all depends on the number and the size of the pumps, their location (from the water delivery point and from each other). If the pumps are far from each other, then two separate PV systems may be more suitable. If they are close to each other, a centralized PV system may be considered. However, designing and managing such a system is very complex and not an easy task. This decision requires detailed and careful study (technical feasibility, economic viability). If a reliable grid is available, maybe a PV system can be used to reduce the electricity cost than to operate a stand-alone PV system.

All options may be taking into consideration by optimizing the entire system: stand-alone (either separate or centralized PV system), hybrid system(s), grid systems. Assess all options with a comprehensive technical and financial analysis