

A technical and economic evaluation of wind-pump-low pressure drip for vegetable irrigation in a coastal zone of Ghana

SGK Adiku^{1,2*} and D.B. Sarpong³ and J.W. Jones¹

1. Department of Agricultural and Biological Engineering, University of Florida
2. Department of Soil Science, University of Ghana, Legon , Accra, Ghana
3. Department of Agricultural Economy and Agri-Business, University of Ghana, Legon , Accra, Ghana

* Corresponding Author: s.adiku@ufl.edu or s_adiku@hotmail.com

Anloga represents a chain of small coastal villages in Ghana which are sandwiched between the Gulf of Guinea in the south and an inland lagoon (Keta Lagoon) in the north. These villages were famous for vegetable production, drawing water from shallow hand dug wells that reach a fresh water lens floating on the denser salt water from the sea and from the lagoon. The most common irrigation practice is “rope and bucket” and due to the low water holding capacity of the sandy soil, irrigation is repeated several times in a day. The traditional rope and bucket irrigation method is very labour intensive and entails much drudgery. Land holdings are small (< 0.030 ha) and labour productivity is low. An emerging irrigation is based on diesel pumps but these accounts for less than 3 % of the current irrigation practice. Given the drudgery and low labour productivity, young people are un-attracted to vegetable farming and migrate to the bigger cities.

We evaluated the wind pump and low pressure drip as alternative energy source and irrigation method for the vegetable production industry at Anloga. Preliminary data showed that wind speeds of 4 to 5 m/s are attainable for at least 6 hours a day at 4 m height along the coast of Anloga. This speed could drive a 1.72 m-diameter propeller-type wind pump system to deliver water volume of 10 m³/d through a height of 6 m into overhead storage tanks. Using gravity, water from the tanks were used to irrigate onions, okra, and tomatoes within a 0.50 ha field, about 18 times the average holding of a typical farmer. The wind-pump-low pressure drip technology completely removed all the drudgery associated with the rope and bucket method. Also, water extraction rate by the wind pump from the fresh water aquifer is small and prevents the mixing the fresh water with the saline water below. The irrigation rate by the drip system is slow, preventing excessive water application and leaching of chemicals beyond the root zone.

The socio-economic evaluation showed that though the initial installation cost of the windmill-drip irrigation system is very high relative to the other rope and bucket, financial worth indicators such as the internal rate of return (IRR), benefit-cost ratio (BCR) and the net present value (NPV) suggested indicated that the wind powered pump is potentially financially viable compared to the motor pump water lifting device in particular. The break even time is estimated to be 5 years from the initial installation. Compared with diesel, wind is a “free” renewable resource and its use is environmentally friendly. Our survey showed that about 88% of farmers would adopt and practice the wind-based irrigation given financial support to install wind pumps and drip irrigation system.