Wednesday, April 15, 2015

To: (hidden for the purpose of privacy)

Proposal to set up solar water pumping systems for a 2000 Acres Farm/ Field to Irrigate Grass growing in the

As per information provided by Mr.(hidden4 privacy)the Project proposes to irrigate 2000 Acres of Flat land near Lake Volta. The land starts from immediately beside the lake and extends up to 2km further from the lake. The land has different heights at different locations, with respect to the lake surface, which is at some places minimum of 3 feet and maximum of 50 feet at Maximum.

Lake Volta

Lake Volta is a reservoir in Ghana, with following data.

Surface Elevation: 85 m

Area: 8,502 Km^2

Catchment Area: 385,180Km^2

Mean Depth: 19m

Outflow Location: Volta River

Lat: 6.5000° N

Lon : 0.0000°W

Proposed Objective of the Project

Proposed objective for the project is to irrigate the field of 2000 Acres for the purpose of growing grass to feed the cattle. The Water Requirements for irrigation as per www.fao.org is given below.

www.fao.org

Table 4 indicates the average daily water needs of this reference grass crop. The daily water needs of the grass depend on the climatic zone (rainfall regime) and daily temperatures.

Table 3 - EFFECT OF MAJOR CLIMATIC FACTORS ON CROP WATER NEEDS

Climatic factor	Crop water need	
	High	Low
Sunshine	sunny (no clouds)	cloudy (no sun)
Temperature	hot	cool
Humidity	low (dry)	high (humid)
Wind speed	windy	little wind

Table 4 - AVERAGE DAILY WATER NEED OF STANDARD GRASS DURING IRRIGATION SEASON (mm)

Climatic zone	Mean daily temperature		
	low (< 15°C)	medium (15-25°C)	high (> 25°C)
Desert/arid	4-6	7-8	9-10
Semi-arid	4-5	6-7	8-9

For the various field crops it is possible to determine how much water they need

Water Requirements Calculation

For the purpose of this calculation, we have following values/ data given.

Location Type: Semi-Arid, Tropical Climate

Temperatures: average 21°C to 28°C, with high up to 32°C.

Based on this information and FAO , Grass Irrigation Table.

Average Daily irrigation water need: 8mm

For sake of scaling up on the later stages,

we take the first pilot Project area of 500×505 meters or 60 Acres

Total Water need is = ET × plant factor × Area × 0.62 / irrigation efficiency

= 8mm × 1.0(PF =1.0 for grass) 505×500 × 0.62/ 0.75

= 1670 Cubic Meters

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Solar Radiation, near Lake Volta, Ghana: Annual 1850KWh /sq.m

That is : 1850 KWh per sq.m. / 365 days => 5,06KWh/sq.m. Per day.

That means we get 5.06 full sun hours. Hence total hourly pumping requirements

= 1670÷5.06 hours / day = ~ 330 Cubic Meter / hour

Solar Data of Area near Lake Volta

www.gaisma.com

Accra, Ghana - Solar energy and surface meteorology

Variable	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Insolation, kWh/m²/day	5.85	6.08	5.96	5.75	5.31	4.73	4.55	4.46	4.62	5.10	5.33	5.54
Clearness, 0 - 1	0.63	0.62	0.58	0.55	0.52	0.48	0.46	0.44	0.45	0.51	0.57	0.61
Temperature, °C	26.54	26.65	26.39	26.19	25.98	25.08	24.16	24.18	24.61	25.03	25.55	26.04
Wind speed, m/s	3.41	3.49	3.76	3.28	3.07	2.85	3.90	4.10	4.09	3.26	3.68	2.93
Precipitation, mm	13	33	68	102	140	202	70	36	69	88	45	24
Wet days, d	4.7	7.1	10.4	11.3	15.8	20.6	13.1	11.7	13.4	14.0	8.9	7.4

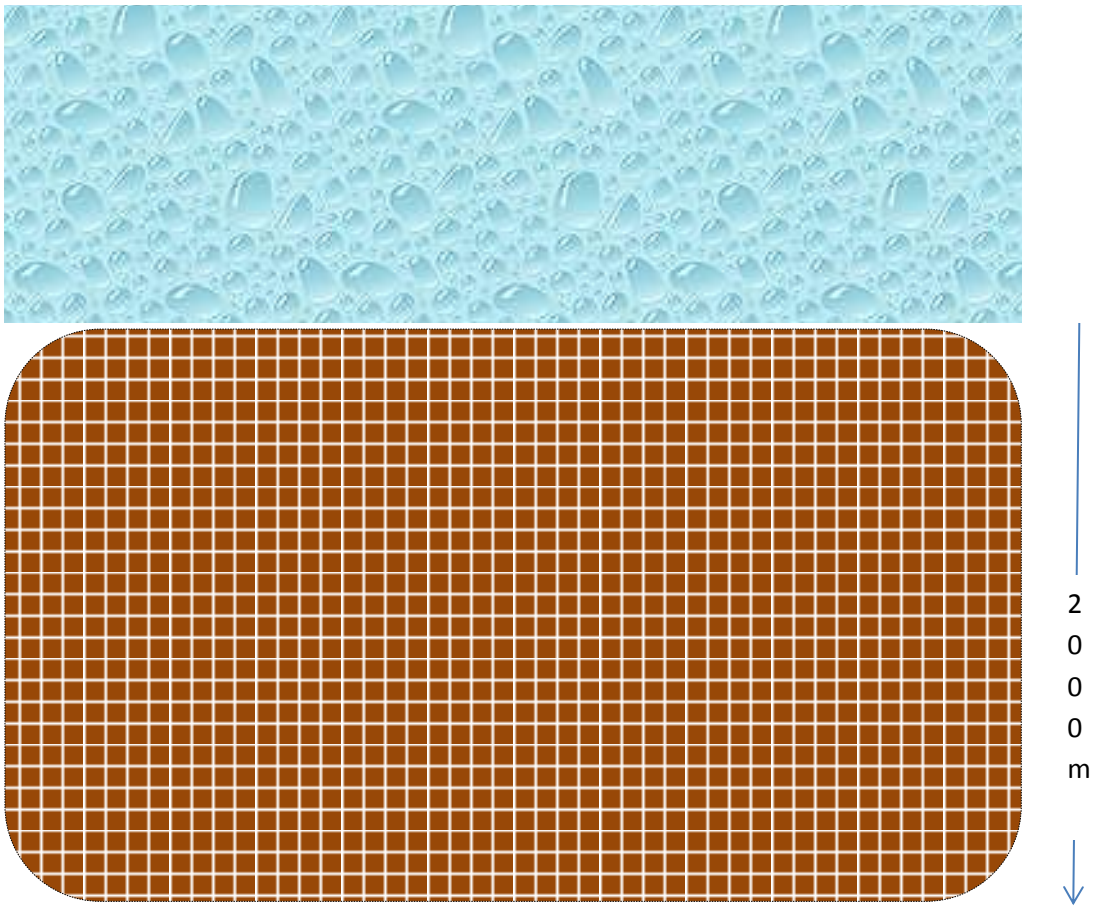
These data were obtained from the NASA Langley Research Center Atmospheric Science Data Center; New et al. 2002

Notes: Help. Change preferences.

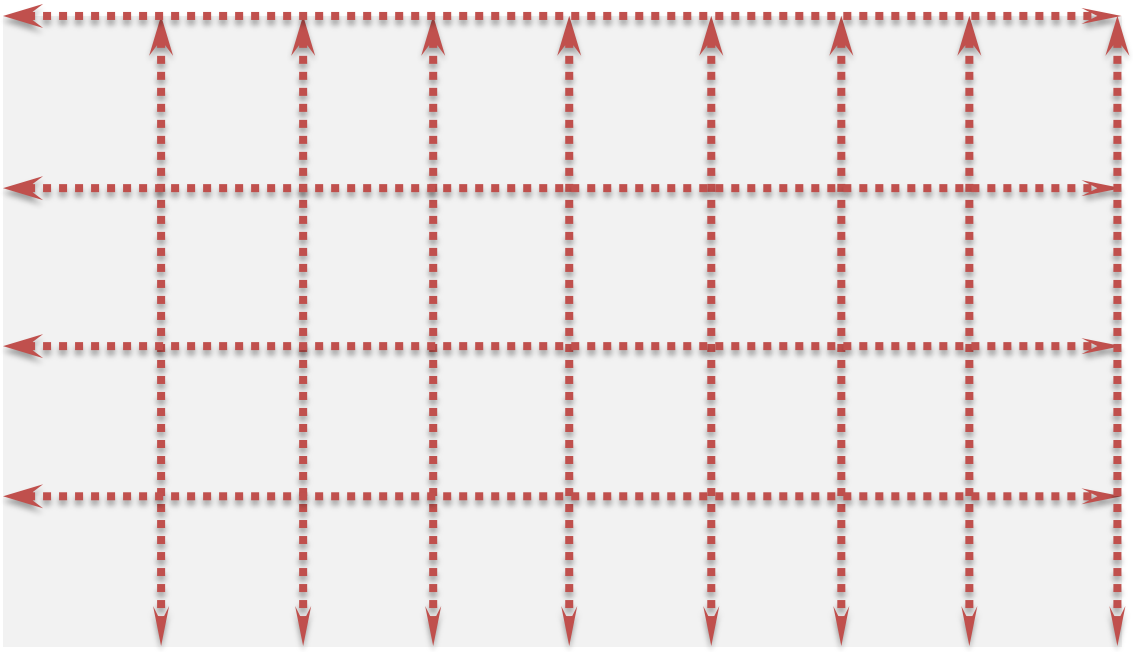
Proposed Solutions 1 : Tanks at different locations at farm.

Given Farm Size : 2000 Acres ; 1 Acre = 4046 Square meter, ;Given farthest distances from lake is : 2000m or 2 Km

Hence



Now for the sake of simplification, let's say we have a tank built horizontally on the filed at 500m, 100m and 1500 meter, with each having capacity to have enough water for one day.



Distance between two horizontal cross sections points: 505.75meters

Distance between two vertical cross sections: 500meters

Tank at each Intersection/cross section of horizontal and vertical lines

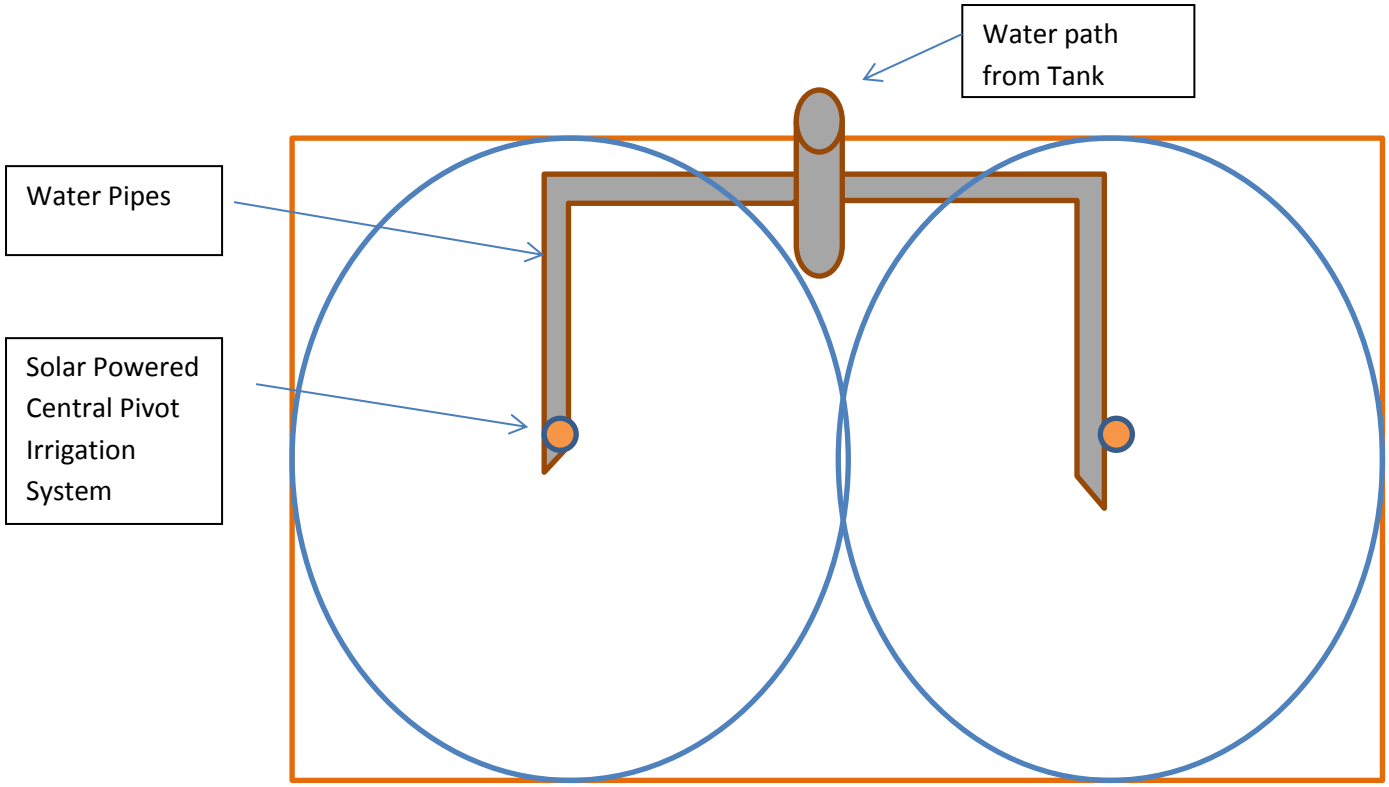
Tank bed/floor area: 60m × 10m, at one meter above ground.

Tank height from tank floor: 10 meter, tank capacity tank floor.

Tank Capacity = 3000 Cubic Meter. Total Tanks number = 32

Total Storage Capacity = 96000 Cubic Meters.

Let's take one Section of sides 505.75m × 500 meter



Water Pumping Head Calculation.

Maximum height of land above ground : 18meter

Tank Height Above Ground : 10meter,

Depth of pumping from the Lake : 2 meter

Total Dynamic Head, if we add the pressure loss due to friction,

TDH = (10 + 18 + 2)+ (10+18+5) ×0.1 = 30 + 3 = 33 meter

So Our Objective for water pumping:

We need water pumps to pump total 330 cubic. Meter per hour from TDH of 33 meter

Customized Smaller Pumps, Smaller Solar Array, And Smaller Maintenance.

a. 6 solar water pumping systems of 7.5 HP each , with Each providing about, 15 Liters Per Second of Water output , from the Total Dynamic Head of 35 Meter via a suction pipe of 100mm diameter clamped to a 400 mm diameter steel framed filter.

Total Water output of single 7.5 HP system,
Average water output = 15 Liters per second
= 15 × 3600second/hour ÷ 1000liters per cu.m
= 54 Cubic Meter per Hour

Total Water Output of six systems = 54× 6 Cubic Meter per hour
=324 Cubic Meter Per hour.

b. System Components of a single 7.5 HP system

- **i.** Mono block End Suction pump 7.5 HP
- **ii.** Solar Modules = 210Wp × 54 = 11340 Watts
- **iii.** Solar Power Controller with Control panel = 10 KW
- **iv.** Mounting Structure based on site survey with seasonal manual tracking.
- **v.** Earthing
- **vi.** On off Switch built in the control panel.
- **vii.** Display of Voltage/ running status/ power/ ampere/ fault message inbuilt on control panel

MONO BLOCK END SUCTION PUMPS

FEATURES:

- The pumps have back pull design enabling to remove the motor without dismantling the pump
- Motors are of class – 2
- This pump can be driven by diesel set or DG set

APPLICATIONS:

The end suction pumps are especially suitable for water distribution in large scale irrigation systems

- Industrial pressure boosting
- Industrial liquid transfer
- HVAC
- Irrigation

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S. NO	MODEL	SUCTION PIPE SIZE (MM)	DELIVERY PIPE SIZE (MM)	RECOMMENDED DELIVERY PIPE SIZE	H.P.	DUTY		HEAD RANGE IN (M)	DISC RANGE (LPS)	LPS DISCHARGE			
						HEAD IN (M)	DISCH. IN (M)			2	3	5	6
										HEAD			
1	32-250/260-3	75	32	65	7.5+	77	5	61-81	6-3	82	81	77	60
2	32-160/177	50	32	75	7.5	45	10	36-47	11-5		48	47.8	47.6
3	32-200/204-7	75	32	65	7.5	37	10	30-39	13-9			48	46
4	32-200-206-6	65	32	65	7.5+	55	8	44-58	13-3				56.5
5	40-125/145	75	40	100	7.5	27	13	22-28	18-13				
6	50-160/136	75	50	100	7.5	26	13	21-27	20-9				
7	65-125/127	100	65	100	7.5	18	26	14-20	37-17				

S. NO	MODEL	LPS DISCHARGE																
		7	8	9	10	11	12	13	14	15	16	17	18	19	20	23	24	26
		HEAD																
1	32-250/260-3	32	21	12														
2	32-160/177	47.5	47	46	45	41	33	24										
3	32-200/204-7	44	43	40	37	35	32	28	23									
4	32-200-206-6	56	55	53	50	47	45	43	40	35	30							
5	40-125/145	31	30.4	30.2	30	29	28	27	26	25	24	23	22	19	18			
6	50-160/136	27.5		27		26.5		26		24.5		23	22	21.5		19	18	
7	65-125/127							21				20		19			18.5	18

c. Scope of Work

- **I.** Site visit and Site Survey
- **II.** Site Selection
- **III.** Study of past 20year site solar data and climate data
- **IV.** System design and installation on site.
- **V.** Commissioning after a week of successful performance
- **VI.** Practical on site, training for operation and maintenance to the staff of stakeholders.

d. Benefits of the proposed solution.

- **i.** Division of risk, smaller systems reduce the risk of failure of whole project at once.
- **ii.** Easier transportation to site
- **iii.** Easier repairs and maintenance

e. Cost of Complete System Turnkey Single System (1 × 7.5 HP)

i.	Basic Cost FOB, India	: US $ 22621
ii.	Export Taxes & duties	: Nil
iii.	Import Taxes	: Extra At Actual as applicable
iv.	Freight and Insurance	: Extra At Actual
v.	Lodging , Boarding and Travelling	: Extra at Actual

f. Cost of 6 systems (7% off)

i.	Basic Cost FOB, India	: US $ 126226
ii.	Export Taxes & Duties	: Nil
iii.	Import Taxes	: Extra at Actual
iv.	Freight and Insurance	: Extra At Actual
v.	Lodging Boarding and Travelling	: Extra At Actual

g. Cost for filling 32 tanks, with same as above systems (14% off)

i.	Basic Cost FOB, India	: US $ 3473740
ii.	Export Taxes & Duties	: Nil
iii.	Import Taxes	: Extra at Actual
iv.	Freight and Insurance	: Extra At Actual
v.	Lodging Boarding and Travelling	: Extra At Actual

h. Payment Terms

i.	First Payment	: Site Survey Expenses : USD 5000
ii.	Second payment	: 90% of the system cost after site survey
iii.	Third Payment	: 10% + All the Extra At Actual and Applicable, Within 48 hours of Commissioning.

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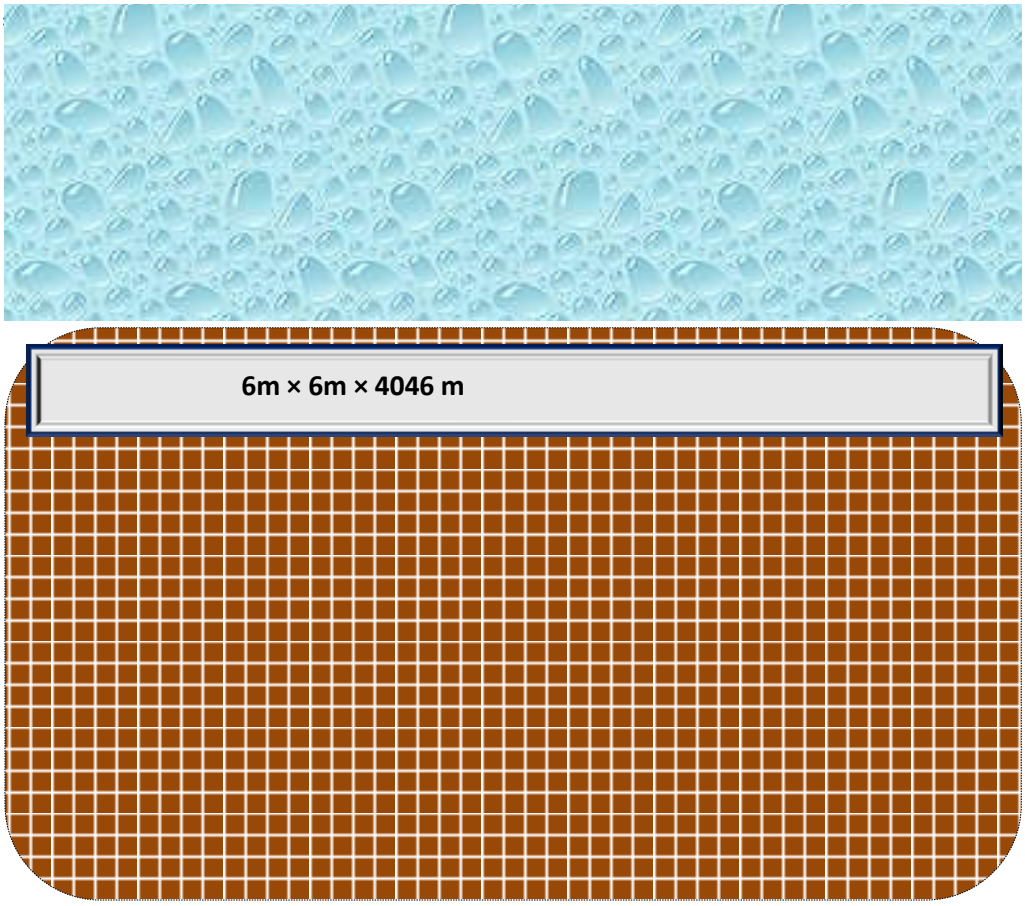
Proposed Solutions 2 : one long Canal type Tank Close to the lake.

Possible Benefits of this system: one huge wall, facing lake, will create a sophisticated barrier , against the lake waters to enter the field, stopping the erosion. This will also help as a security in any natural disaster like excess flooding… a wall can be designed through which water from the filed can be diverted to the lake, during excess rains, while also preventing the waters of lake to enter the field/ farm land.

This canal type long storage system running parallel to the lake, if kept up to 6 meter above the floor, with canal floor of 6meter × 4046 meter. Tank floor bed will be at 1 meter height from ground.

Total Capacity = 6 ×4046 × 6meter = 145656 cu.m.



Total Area To Irrigate = 2000 Acres,

Total Water Needed per day = 8/1000 × 1.0 × 2000 × 4046 × 0.62 ÷ 0.75 Cubic. meter

= 53515 cu.m. per day => 10576 cu.m. per hour

Tank Capacity = 145656 Cu.m.

Tank Backup = 145656cu.m ÷ 53515cu.m/day = 2, 72 days. Tank will hold up to 3 days of irrigation water as backup.

Water pumping Head = lake pumping depth + tank floor height+ tank height + Frictional losses

= 3m + 1m + 6m + (3+1+6) ×10%

= 10 + 1m = 11 meter

We need 54000 cubic meters per day from total head of 11meter.

(MONOBLOCK END SUCTION PUMPS) PERFORMANCE TABLE

S. NO	MODEL	SUCTION PIPE SIZE (MM)	DELIVERY PIPE SIZE (MM)	RECOMMENDED DELIVERY PIPE SIZE	H.P.	DUTY		HEAD RANGE IN (M)	DISC RANGE (LPS)	LPS DISCHARGE			
						HEAD IN (M)	DISCH. IN (M)			2	3	4	5
										HEAD			
1	32-200/206 -4	50	32	65	5.5	36	7	29-38	8-6	52	48	45	42
2	32-160/163	50	32	75	5.5	35	8	28-37	11-7		40.5	40	39
3	40-125/139	65	40	100	5.5	24	12	19-25	18-11				
4	50-125/130	65	50	75	5.5	18	15	14-20	18-10				
5	65-125/115	100	65	100	5.5	14	23	11-15	33-16				

S. NO	MODEL	LPS DISCHARGE																
		8	9	10	11	12	13	14	15	16	18	19	20	22	23	27	32	33
		HEAD																
1	32-200/206 -4	31	26	20	16													
2	32-160/163	35	34	31	28	25	22											
3	40-125/139	26.5		26	25	24	23	23.5	23	20	19							
4	50-125/130	21		20		19		18.2	18	17	15	14						
5	65-125/115		17		16.2		16			15		14.5			14	13	12	11

As per above given performance data file, a 5.5 HP Monoblock End suction pump can provide, 32 liters per second from the total operating head of 12 meters.

Hence, Hourly Water Pumped from 1 5.5 HP System = 32 lps × 3600 seconds/hr

= 115 cubic meter

To fulfill hourly water pumping requirement of 10576 Cubic meter,

We need , 10576÷ 115 = 92 systems of 5.5 HP each.

For safety we will suggest installation of 92 system and system components of 8 systems be kept as spares to assure immediate action in case of any failures. Hence for calculation we will take 100 systems.

a. System Components of a single 5.5 HP system

i. Mono block End Suction pump 5.5 HP
ii. Solar Modules = 210Wp × 36 = 7560 Watts
iii. Solar Power Controller with Control panel = 7.5 KW
iv. Mounting Structure based on site survey with seasonal manual tracking.
v. Earthing
vi. On off Switch built in the control panel.
vii. Display of Voltage/ running status/ power/ ampere/ fault message inbuilt on control panel

b. Scope of Work

i. Site visit and Site Survey , Site Selection
ii. Study of past 20year site solar data and climate data
iii. System design and installation on site.
iv. Commissioning after a week of successful performance
v. Practical on site, training for operation and maintenance to the staff of stakeholders.
vi. Civil works like construction of tanks, or base of solar mounting system is not included.

c. Benefits of the proposed solution.

i. Division of risk, smaller systems reduce the risk of failure of whole project at once.
ii. Easier transportation to site
iii. Easier repairs and maintenance

d. Cost of Complete System Turnkey Single System (1 × 5.5 HP)

i.	Basic Cost FOB, India	: US $ 17717
ii.	Export Taxes & duties	: Nil
iii.	Import Taxes	: Extra At Actual as applicable
iv.	Freight and Insurance	: Extra At Actual
v.	Lodging , Boarding and Travelling	: Extra at Actual

e. Cost of 100 system (10% off)

i.	Basic Cost FOB, India	**: US $1594530**
ii.	Export Taxes & Duties	Nil
iii.	Import Taxes	: Extra at Actual
iv.	Freight and Insurance	: Extra At Actual
v.	Lodging Boarding and Travelling	: Extra At Actual

f. Payment Terms

i.	First Payment	: Site Survey Expenses $ 5000
ii.	Second payment	: 90% of the system cost after site survey
iii.	Third Payment	: 10% + All the Extra At Actual and Applicable, Within 48 hours of Commissioning.

Hence based on cost comparison, the second option to create one single wall like tank close to the lake is less costly and has more benefits compared to the previous option.

This was costing and two different project designs for water pumping and irrigation.

Cost of Irrigation System.

The construction of tank will ensure the water stored at a height and can be taken to the fields via Hot Dipped GI pipes, just by the help of water pressure and gravity.

Based on Site Survey and factoring in all pros and cons of various irrigation techniques, any of the following techniques can be implemented.

1. **Central Pivot Irrigation, Fully Powered by solar**
2. **Drip Irrigation System**
3. **Sprinkler System.**

Cost of Central Pivot Irrigation, Powered by Solar , will have cost of about US $ 400/ Acre, for 2000 Acres, purely for CPIS and solar systems will have additional cost of about US $ 300-400/Acre for 2000 Acres.

Drip Irrigation and Sprinkler System can have almost similar costs of about US $ 400-600 per Acre for total of 2000 Acres

These calculations and information are purely for reference and understanding purpose only. Final decision should be taken only post complete site survey of the project.

Other Aspects / components of the Project

- The Actual Design of the whole project will be prepared only after site survey
- The Project may very likely require storage tanks at the increasing distance of 500 meter from the lake, i.e. respectively at 500m, 1000m, 1500m,2000m
- To irrigate whole 2000Acres, the project may require the capacity of whole pumping unit, i.e. solar structure, Suction pipes, control units, pumping motor, **OR** just pumping unit without Solar Structure, to be mobile and hence with a special mobile structure that may run parallel to the shore of the lake and pump water further. This requirement will be studied during the site survey.
- The project may need booster pumps, at an interval of between 500m-1000m; this requirement can be partially studied during site survey and fully studied and observed after first installation.
- The Requirement of Sprinkler, Central pivot or drip irrigation will be studied and implemented in the whole project design during site survey.
- Other points such as slope of the land, possible positive / negative points to the projects will be studied and designed during the site survey.
- The cost outlined above, includes just the cost for Solar System, Pumping unit.
- The cost outlined above doesn't include the cost of Pumping Pipes, Cables more than 100meter per 5.5 HP systems, or any other system components as highlighted above, such as, tanks, booster pumps, any mobile structure, sprinkler, central pivot or drip irrigation system and components.

The Way Forward

Irrigating about 2000 Acres of land is a huge endeavor and requires timely planning and study of all related project components. To make this project a success we propose to start with visit to the project site by two experts from Bati Energy, one for Irrigation Technologies and one For Solar Systems, and study the project in all aspects, depths and design the project.

We propose to make this site survey visit that should last about a week spent on site. We propose to make this visit in the 2nd week of May, if the payment for the visit trip expenses, of approximately, US $ 5000/- is paid and visa assistance is provided for the engineers, w.r.t in advance.

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Our Bank Account Details:

Bati Energy Private Limited

Bank Name: IDBI Bank Ltd.

Bank Branch: Amreli, Gujarat, India. PIN 365601

Current Account Number: 0697102000006064

IFS Code: IBKL0000697

Company PAN: AAFCB9023N

Company Import Export Code: 2414012919

Thank You For The Opportunity To Serve !

Bhaveshkumar J. Bati

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