Model Scheme on
Solar Photovoltaic Pumping System
(for farmers without pumpsets)

National Bank for Agriculture and Rural Development
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Index

MODELS ON SOLAR PHIOTO VOLTAIC PUMPING SYSTEM FOR SMALL IRRIGATON PROJECTS

1. INTRODUCTION

Energy is a key resource for the overall development of an economy. India has been endowed with abundant renewable solar energy resource and in this large country where the rate of electrification has not kept pace with the expanding population, urbanization and industrialisation which have resulted huge gap between demand and supply of electricity. People not served by the power grid have to rely on fossil fuels like kerosene and diesel to meet their energy needs. This may also lead to incur more and more recurring expenditure by the poor people in rural areas. The rural areas which have been brought under power grid, the supply would be erratic and unreliable especially during the critical farming period. India receives a solar energy equivalent of 5000 Trillion kWh/year with a daily average solar energy incidence of 4-7 kWh/m^2. This is considerably more than the total energy consumption of the country. Further, most parts of the country experiences 250-300 sunny days in a year, which makes solar energy a viable option in these areas. The solar energy is best suited for the remote areas where power grid is not in place. This may ensure high performance in the longer duration. Decentralised renewable energy systems, which rely on locally available resources, could be the solution to the rural energy problem, particularly in remote areas where power grid is not a viable proposition

Solar energy, with its virtually infinite potential and freely abundant availability, represents a non-polluting and inexhaustible energy source which can be developed to meet the energy requirements of mankind in a major way. The high cost of electricity, fast depleting fossil fuels and the public concern about the eco-friendly power generation have led to a surge of interest for utilization of solar energy. To evaluate the energy potential at a particular place, detailed information on its availability is essential. These include data on solar intensity, spectrum, incident angle and cloudiness as a function of time.

2. USE OF SOLAR ENERGY

Solar energy can be utilised in two ways:

Solar Thermal (ST) technology where the heat produced is used to operate devices for heating, cooling, drying, water purification and power generation. The devices suitable for use by village communities include solar hot water heaters, solar cookers and solar driers.

Solar Photovoltaic (SPV) systems which convert sunlight into electricity for use applications such as lighting, pumping, communication and refrigeration.

The Solar Energy Programme is prominent among the technology-based renewable energy programmes of the Ministry of Non-conventional Energy Sources (MNES). Areas covered under this programme include solar thermal technology (hot water systems, cookers, dryers, solar passive architecture etc.), solar photovoltaic technology (lanterns, fixed systems, pumpsets) as well as information dissemination, marketing, standardisation of products and R&D. The support to the programme is mainly in the form of subsidies and technical support.

Currently the MNES is promoting solar PV (and other) devices through (a) State nodal agencies of the MNES, (b) NGOs/CBOs, (c) authorised outlets of the MNES and (d) through local entrepreneurs.

3. SOLAR ENERGY FOR AGRICULTURE

The demand for electrical energy is far outstripping supply, especially in the agricultural sector. It is also becoming increasingly difficult to meet the exponential growth in demand of Agricultural productivity which is closely associated to direct and indirect energy inputs. Necessary policies are required to consolidate this relationship for the benefit of farmers. If any development in rural areas is to be achieved, proper energy inputs must be made available. This may require special efforts in the country as a whole to develop and utilize renewable energy sources particularly the solar energy.

Rural electrification has eluded the most far flung rural areas of the country. It is cost-prohibitive for the Government to extend grid power to remote areas especially to meet agriculture loads. An integrated approach for irrigation and water conservation with scientific agricultural practices, the system of solar energy water pumping assume relevance for optimum exploitation of the ground water resource for the benefit of small/marginal farmers. Inter-sectoral cooperation is necessary and it should include Government, Financial Institutions, Banks, NGOs and the Private sector. It would appear that there is a strong case for the design of institutional mechanisms for encouraging closer cooperation and collaboration between the agricultural and energy sectors.

4. SOLAR ENERGY BASED WATER LIFTING AND PUMPING SYSTEMS FOR SMALL IRRIGATION PROJECTS

Under non-conventional energy source, power generation can be made through Bio-mass, windmill, small Hydro Electric, Solar Photovoltaic and Solar Thermal systems. Among solar technologies useful in irrigation sector are pumping and water lifting. Water pumping by solar power is a concept which has won widespread interest since the early seventies. Solar energy can be utilized to operate pumps, utilizing either the thermal or light part of solar radiation. With a solar pump, energy is not available on demand. The daily variation in solar power generation necessitates the surplus of water pumped on sunny days and shortage on cloudy days. In view of the fluctuating water demand of any irrigation scheme, solar energy needs to be reserved in the form of either electricity in batteries or lifted water in a storage tank. The suitability of solar power for lifting water to irrigate plants is undeniable because of the complementarities between solar irradiance and water requirements of crops. The more intensively the sun is shining the higher is the power to supply irrigation water while on the other hand on rainy days irrigation is neither possible nor needed.

Small scale irrigation is one of the most potential applications of solar power. The main advantage is that solar radiation is intense when the need for irrigation is high. Further, solar power is available at the point of use, making the farmer independent of fuel supplies or electrical transmission lines. The solar pumps have the potential to revolutionize small scale irrigation in the developing countries in the near future. The technical feasibility of solar (photo voltaic) pumps has been established. The major limiting factor has been the high cost and the lack of familiarity of the technology which require concerted effort in training of technicians and large scale introduction in a region with adequate technical

support. However with the incentives and initiatives undertaken by MNES, Government of India and State Government, the scheme may be propagated in rural areas for small irrigation system in far-flung rural areas where electrification is a costly proposition.

The model scheme is to introduce solar water pumping and support irrigation schemes to provide a sustainable economic activity to farmers in non-electrified or under electrified rural areas. Various agencies and financial institutions are in place to assist the credit scheme targeted for non-electrified rural areas.

5. PHOTOVOLTAIC POWER GENERATION

Photovoltaic cells frequently referred to as solar cells, convert the light part of the solar spectrum (Sunlight) into electricity. They are the most rapidly expanding energy sources in the world. Large scale manufacture of photovoltaic cells, coupled with continued research and development is expected to further make photovoltaic with in the economic framework of rural areas in developing countries.

6. SOLAR CELLS

The solar cell operates on the principle of the photovoltaic effect - the creation of charge carrier with in a material by the absorption of energy from the incident solar radiation. The efficiency of solar cells in converting incident solar energy into electrical energy depends on the illumination spectrum intensity, materials of construction and design of the cell, atmospheric temperature and clearness of the sky. Solar cells used in running DC electric motors have efficiencies ranging from 10 to 12 percent.

Silicon is the most commonly used material for making solar cells. Other materials include cadmium sulfide and gallium arsenate. The fabrication of the solar cell involves a large number of processes. Wafer form followed by junction formation, contact fabrication and anti reflection coating on the active surface of the cell. The outer surface of the panel is protected by a special tempered glass which provides high transmittance of sunlight.

7. SOLAR ARRAY

A solar cell behaves like a low voltage battery whose charge is continuously replenished at a rate proportional to the incident solar radiation. Connecting such cells into series of parallel configuration resulting in photovoltaic modules or solar arrays with high current and voltages. The power developed by a solar array ranges from 80 to 120 watts per square metre of the panel. The photovoltaic power can be utilized to operate conventional electrical appliances, including DC electric motors. The solar array is mounted on a simple frame which has provision for adjusting the array manually against the position of the sun.

8. POSSIBLE WATER SOURCES

The SPV based pumpsets are low head high discharge and may be productively used at sites where water is available at relatively moderate level. The possible water sources for the SPV systems are pits, pen dug wells, medium tubewells, doggies, tanks, farm ponds and surface water from canals and rivers.

9. PUMPSETS FOR PHOTO VOLTAIC POWER

The solar pump unit consists essentially of a solar array, a direct-current electric motor and a pumping unit. The other components are the electrical control and some mechanism for tracking the array against the sun. Many types of pumping sets are used with photovoltaic systems such as a vertical centrifugal pump coupled to a submersible DC electric motor or an ordinary volute centrifugal pump close-coupled to a horizontal DC electric motor. However, the submersible pump unit is most suitable for the photovoltaic system. The arrangement eliminates the suction pipe and foot valve and results in a higher efficiency of the pumping unit. The submersible pump is made leak-proof by a silicon carbide mechanical seal. In case of volute pump, care is taken to limit the pump suction within about 5m to maintain a high level of pump efficiency.

The output of the solar array varies with the intensity of the incoming radiation and other factors. Hence, it is necessary to match a variable-speed DC motor with the panel output. At least one make of photovoltaic powered pumping sets utilizes a maximum power-control unit as an integral part of the system, in order to match the load on the pump to the varying power output of the panel.

There is considerable commercial interest in manufacturing photovoltaic powered pumping sets. The power output of the system is directly proportional to the number of solar cells and the surface area of the panel exposed to the sun. The discharge of a solar pump with array area of 2-4m varies from 6-8 lits/s at a head of15- 50 m. This could irrigate about 1.5 - 4 ha of land with crops having moderate irrigation requirements or may provide protective irrigation to even a larger command.

10. SYSTEM COMPONENTS

Solar Photo Voltaic Pumping system for 1800, 2200, 3000 and 5000 Watt peak DC surface system

Sr. No.	Description
1	SPV Module
2	Array tracking structure
3	Pumpset
4	Mounting Structure
5	Cable & Wire
6	Controller
7	Suction & Delivery Pipes

A user manual shall also be provided by the authorised dealer along with the system. MNRE/State Renewable Energy Agencies authorise the dealers of Solar Photo Voltaic Pumping systems.

11. COST DETAILS

a) The component and corresponding cost details are indicated in Annexure - I

The plant after installation is inspected by an officer from RREC after its satisfactory commissioning. It may be ensured that the SPV pump shall be supplied strictly as per technical specifications approved by MNRE/IREDA.

b) Margin

Bank may provide finance taking a margin of 10% on the cost to be paid by beneficiary.

c) Quantum of Refinance from NABARD

NABARD shall provide refinance upto 100 % on the bank loan

12. INCENTIVES FROM CENTRAL/STATE GOVERNMENT

The Ministry of New and Renewable Energy under JNNSM programme provides subsidy for off grid solar applications (solar water pumping) @ 30% of capital cost. Additional could be provided by State Govt.

13. MAINTENANCE OF SPV SYSTEM

The supplier provides annual maintenance contract to the beneficiary after initial guarantee period of 5 years. The solar panel is expected to provide about 20 years of satisfactory service under normal conditions, even though the cell itself may last much longer. The only maintenance requirement is occasional washing of the surface to maintain maximum optical transmission through the glass. The panel has to be protected from breakage by external agencies. Some manufacturers cover the cell/array with unbreakable glass. The motor and the pump require the usual periodic maintenance like cleaning, lubrication and replacement of worn parts.

14. ADVANTAGES OF SPV PUMPING SYSTEM

Cost effective: The life cycle and the cost to ultimate beneficiary make the SPV systems cost effective as compared to conventional systems. In addition, the farmer is saved from the capital investment for drawing lines from the grid to his field/farms. The government may save huge resources which otherwise may be uneconomical to network every agriculture field under the state electricity grid.

Reliable : The SPV is more reliable, consistent and predictable power option as compared to conventional power system in rural areas.

Free fuel: Sunlight, the fuel source of SPV system is a widely available, inexhaustible, reliable and free energy source. Hence the SPV system has no monthly fuel bills.

Low maintenance: The system operates on little servicing and no refuelling, making them popular for remote rural areas, hence the operation and maintenance is very low. The suppliers provide maintenance at a very low annual maintenance contract rates.

Local generation of power: The SPV system makes use of local resource-sunlight. This provides greater energy security and control of access to energy.

Easy transportation: As SPV systems are modular in nature they can easily be transported in pieces/components and are easily expandable to enhance the capacity

Energy Conservation: Solar energy is clearly one of the most effective energy conservation programs and provides a means for decentrailized PV-generated power in rural areas. Solar pump is energy efficient and a decentralized system avoids any unnecessary expenditure.

Water conservation: The SPV sets are highly economical when combined with water conservation techniques such as drip irrigation & night time distribution of (day time pumped & stored) water. The SPV system leads to optimum exploitation of scarce ground water.

Environmental friendly: The use of sunlight as a source of fuel leads to clean, eco-friendly and decentralised generation of energy which saves the fossil fuel, controls deforestation and prevents environmental pollution.

15. Financial viability

In order to know the economic viability of the SPV pumping systems, the Net Present Value (NPV) and the Internal Rate of Return (IRR) have been computed.

The cost and economics details are as under:

Sl. No	Models	Total Cost of system	Cost (net of subsidy) (Rs.)	Benefit (incremental incomel) (Rs.)	BCR	IRR (%)
1	Model – I (1800 Wp – 1.5 HP)	308320	184992	39587	1.00	15.04
2	Model – II (2200 Wp – 2 HP)	347200	208320	44833	1.00	15.20
3	Model – III (3000 Wp – 3 HP)	558400	335040	72019	1.00	15.14
4	Model – IV (5000 Wp – 4 HP)	767200	460320	98729	1.00	15.06

Assumptions

1. The capital cost taken is net of subsidy (Subsidy is assumed as 40%) for all the models for working out Economics.

2. Change in cropping pattern and increase in cropping intensity is considered after financing for the investment. However change in area under cultivation has not been considered while working out the model.

3. About 210 days (120 days during Rabi and 90 days during other two seasons) of sunny days is assumed. (This may, however, vary from State to State)

4. As the suppliers enter into annual maintenance contract with the beneficiary at fixed rate and no additional maintenance cost is assumed while working out economics for the first five years.

5. The Solar panel is expected to provide about 20 years of satisfactory service under normal conditions even though the cell itself may last much longer. Hence no replacement cost is included during the repayment period.

6. The life of pumpset is considered for ten years

7. The SPV based pumpsets are low to medium head (10 m to 50 m) discharge and may be productively used at sites where depth to water level at maximum of 50 m deep.

8. The possible water sources for the SPV systems are Open well, Borewells. Tubewells, tanks, farm ponds, diggies (Storage tanks), canals, rivers etc.,

9. The scheme is financially viable only with a minimum subsidy of 40%. The subsidy rate may have to be higher depending upon the cropping patterns and size of land holding.

10. As per the present interest rate , rate of interest of 12% is assumed for working out economics.

Details on model wise computation of economics are furnished in the Annexures I to V.

16. BENEFITS TO FARMERS

- No fuel costs & minimal maintenance costs.
- More economical than diesel pump sets in the long run.
- Enables cultivation of an extra crop,
- Helps in providing the critical protective irrigation in water scarce areas,
- Saves time and labour,
- Improves agriculture productivity,
- Improves general quality of life with higher levels of income,
- Incremental income enables easy repayment loan taken for installing system

17. EXTENSION SERVICES

Adequate extension services are to be made available by agencies/suppliers in the scheme area. The beneficiaries may adopt modern cultivation practices and adopt crop diversification with an emphasis on cash crop/high remuneration crops. The guidance may be availed from local agriculture extension departments of the state government.

18. SUPERVISION AND TECHNICAL GUIDANCE

The technical officer of the sponsoring bank/supplier would look after the supervision and implementation and also extend technical guidance wherever necessary. In addition the SPV pumpset installation may be supervised and inspected by concerned officials.

19. REPAYMENT PERIOD

The loan repayment period would be 10 years with one year grace period. The beneficiary may, if he so desires, repay the loan instalment with interest earlier than the period.

DISCLAIMER

The views expressed in this model project are advisory in nature. NABARD assume no financial liability to anyone using the report for any purpose. The actual cost and returns of projects will have to be taken on a case by case basis considering the specific requirement of projects

APPENDIX

SPECIAL TERMS AND CONDITIONS - MINOR IRRIGATION SCHEMES

A. SPV PUMPSET.

1. **Ground Water Development :** Bank shall ensure that the ground water development programmes are implemented in " Safe" and "Semi Critical" Blocks, and technical clearance from the State Government Department is obtained before extending the credit facility.

Spacing :

The minimum spacing norms specified by the concerned department of State Government are to be maintained between two wells.

2. **Minimum acreage and sale of water**

It is necessary that the beneficiary have the following minimum area of land to be brought under irrigation to ensure viability of investments and repayment of loans in the prescribed period.

Type of Structure	Benefitting Area (ha.)
(a) Dugwell with SPV	1.0
(b) Borewell with SPV	1.6
(c) Shallow Tube wells with SPV	2.0

If the beneficiary's own irrigated area is less than the area which can be irrigated by well / borewell, the beneficiary can sell surplus water to the neighbouring farms. The income from sale of water, if guaranteed, may also be reckoned for the purpose of viability of investments upto a maximum of 50% of loan repayment instalment.

3. **Selection and Installation of Pumpsets**

(a) The bank shall ensure that the SPV financed under the scheme are supplied by the reputed dealers.
(b) In case of second hand pumpsets financed under the scheme, if any, the bank shall obtain a certificate from its technical officer that the useful balance serviceable life of the second hand pumpset is adequate to cover the repayment period of the loan for pumpset.
(c) Wherever loan is advanced for replacement of existing pumpset by new pumpset, the bank shall ensure that there is no change in the HP of the pumpset.
(d) Bank shall ensure that the spacing criteria as stipulated in 2 above are adhered to while financing for pumpsets as well.

4. After Sales Service

Bank shall ensure that adequate after sales services and repair facilities are provided by the manufacturers / dealers installing the SPV pumpset on beneficiary's well and that such service is provided free of charge during the first five years of installation.

5. (i) Wherever subsidy is available under any programme of the State / Central Government or any other subsidy scheme, the bank shall avail refinance net of subsidy.

6. While claiming refinance from NABARD, the bank may furnish block-wise details of different units financed.

ANNEXURE – I

MODEL SCHEME ON SOLAR PHOTOVOLTAIC PUMPSET – COMPONENTS

Sl.	Particulars	MODEL-1- 1800 Wp		MODEL-2- 2200Wp		MODEL-3- 3000Wp		MODEL-4- 5000Wp	
No.		No	Cost	No	Cost	No	Cost	No	Cost
A	**Components**								
1	SPV Module	8	107600	10	132000	14	180000	24	300000
2	Pumpset	1.5 HP	65000	2.0 HP	65000	3.0 HP	146000	4.0 HP	180000
3	Mounting Structure		35000		40000		65000		85000
4	Cable & Wires		9000		12000		18000		18000
5	Controller		20000		20000		36000		36000
6	Suction & Delivery Pipes		12000		12000		12000		12000
7	Installation & Civil Work @ 7.5%		18645		21075		34275		47325
8	Maintenance - 5 Years @ 2.5% per year		31075		35125		57125		78875
9	Misc. (Lumpsum)		10000		10000		10000		10000
	Total (Rs.)		**308320**		**347200**		**558400**		**767200**
B	**Annual Maintenance from 5th year onwards @ 2.5% per year**		**6215**		**7025**		**11425**		**15775**
C	**Incremetal Benefit by change in cropping pattern and increase in cropping intensity**		**39587**		**44833**		**72019**		**98729**
	Area of Cultivation Required (min)		**0.83**		**0.94**		**1.51**		**2.07**

MODEL - I (1800 Wp with 1.5 HP SPV pumpset)

Annexure - II

ECONOMICS

Particulars	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
OUTFLOW											
(i) Capital Cost	184992										
(ii) Recurring cost		0	0	0	0	6215	6215	6215	6215	6215	6215
Total Cash Outflow	184992	0	0	0	0	6215	6215	6215	6215	6215	6215
INFLOW											
Incremental Benefit	0	39587	39587	39587	39587	39587	39587	39587	39587	39587	39587
Net Benefit	-184992	39587	39587	39587	39587	33372	33372	33372	33372	33372	33372
NPWB	172763										
NPWC	172556										
NPV @15%DF	207										
BCR @15%DF	**1.00**										
IRR @15%DF	**15.04%**										

Repayment Schedule & Calculation of Interest Payment

Interest Rate 12% Repayment Period - 10 years incl. 1 year gestation period

(Amount in Rupees)

Year	**Disbursement**	**Subsidy**	**Outstanding**			**Repayment**		
			Principal	**Interest**	**Total**	**Principal**	**Interest**	**Total**
0	166493	0	166493	0	166493	0	0	0
1			166493	19979	186472	18499	19979	38478
2			147994	17759	165753	18499	17759	36258
3			129495	15539	145034	18499	15539	34038
4			110996	13320	124316	18499	13320	31819
5			92497	11100	103597	18499	11100	29599
6			73998	8880	82878	18499	8880	27379
7			55499	6660	62159	18499	6660	25159
8			37000	4440	41440	18499	4440	22939
9			18501	2220	20721	18501	2220	20721

MODEL - II (2200 Wp with 2 HP SPV pumpset)

Annexure - III

ECONOMICS

Particulars	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
OUTFLOW											
(i) Capital Cost	208320										
(ii) Recurring cost		0	0	0	0	7025	7025	7025	7025	7025	7025
Total Cash Outflow	208320	0	0	0	0	7025	7025	7025	7025	7025	7025
INFLOW											
Incremental Benefit	0	44833	44833	44833	44833	44833	44833	44833	44833	44833	44833
Net Benefit	-208320	44833	44833	44833	44833	37808	37808	37808	37808	37808	37808
NPWB	195658										
NPWC	194366										
NPV @15%DF	1292										
BCR @15%DF	**1.01**										
IRR @15%DF	**15.20%**										

Repayment Schedule & Calculation of Interest Payment

(Amount in Rupees)

Year	**Disbursem**	**Subsidy**	**Outstanding**			**Repayment**		
			Principal	**Interest**	**Total**	**Principal**	**Interest**	**Total**
0	187488	0	187488	0	187488	0	0	0
1			187488	22499	209987	20832	22499	43331
2			166656	19999	186655	20832	19999	40831
3			145824	17499	163323	20832	17499	38331
4			124992	14999	139991	20832	14999	35831
5			104160	12499	116659	20832	12499	33331
6			83328	9999	93327	20832	9999	30831
7			62496	7500	69996	20832	7500	28332
8			41664	5000	46664	20832	5000	25832
9			20832	2500	23332	20832	2500	23332

MODEL - III (3000 Wp with 3 HP SPV pumpset)

Annexure - IV

ECONOMICS

Particulars	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
OUTFLOW											
(i) Capital Cost	335040										
(ii) Recurring cost		0	0	0	0	11425	11425	11425	11425	11425	11425
Total Cash Outflow	335040	0	0	0	0	11425	11425	11425	11425	11425	11425
INFLOW											
Incremental Benefit	0	72019	72019	72019	72019	72019	72019	72019	72019	72019	72019
Net Benefit	-335040	72019	72019	72019	72019	60594	60594	60594	60594	60594	60594
NPWB	314301.5										
NPWC	312835.9										
NPV @15%DF	1465.56										
BCR @15%DF	1.004685										
IRR @15%DF	0.151381										

Repayment Schedule & Calculation of Interest Payment

(Amount in Rupees)

Year	Disburseme	Subsidy	Outstanding			Repayment		
			Principal	Interest	Total	Principal	Interest	Total
0	301536	0	301536	0	301536	0	0	0
1			301536	36184	337720	33504	36184	69688
2			268032	32164	300196	33504	32164	65668
3			234528	28143	262671	33504	28143	61647
4			201024	24123	225147	33504	24123	57627
5			167520	20102	187622	33504	20102	53606
6			134016	16082	150098	33504	16082	49586
7			100512	12061	112573	33504	12061	45565
8			67008	8041	75049	33504	8041	41545
9			33504	4020	37524	33504	4020	37524

MODEL - IV (5000 Wp with 4 HP SPV pumpset)

Annexure - V

ECONOMICS

Particulars	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
OUTFLOW											
(i) Capital Cost	460320										
(ii) Recurring cost		0	0	0	0	15775	15775	15775	15775	15775	15775
Total Cash Outflow	460320	0	0	0	0	15775	15775	15775	15775	15775	15775
INFLOW											
Incremental Benefit	0	98729	98729	98729	98729	98729	98729	98729	98729	98729	98729
Net Benefit	-460320	98729	98729	98729	98729	82954	82954	82954	82954	82954	82954
NPWB	430867.8										
NPWC	429959.8										
NPV @15%DF	908.0141										
BCR @15%DF	1.002112										
IRR @15%DF	0.150623										

Repayment Schedule & Calculation of Interest Payment

(Amount in Rupees)

Year	Disburseme	Subsidy	Outstanding			Repayment		
			Principal	Interest	Total	Principal	Interest	Total
0	414288	0	414288	0	414288	0	0	0
1			414288	49715	464003	46032	49715	95747
2			368256	44191	412447	46032	44191	90223
3			322224	38667	360891	46032	38667	84699
4			276192	33143	309335	46032	33143	79175
5			230160	27619	257779	46032	27619	73651
6			184128	22095	206223	46032	22095	68127
7			138096	16572	154668	46032	16572	62604
8			92064	11048	103112	46032	11048	57080
9			46032	5524	51556	46032	5524	51556

Farm Model (1 ha) | **Annexure - VI**

A. Increase in farm income

Crops (per 1 ha.)	Yield (q/Ha)	Rate (Rs./q)	Yield of Byproduct (q/Ha)	Rate of Byproduct (Rs./q)	Total income (Rs.)	Cost of cultivation (Rs./Ha)	Surplus (Rs.)	Are under Crop (Ha)	Total Surplus (Rs.)
KHARIF (PRE-DEVELOPMENT)									
MAIZE	16.00	980.00	50.00	60.00	18680	7500	11180	0.02	224
Urd	5.00	3400.00	5.00	20.00	17100	9402	7698	0.07	539
Soyabeen	14.00	2100.00	15.00	25.00	29775	11000	18775	0.32	6008
Sorghum	12.00	980.00	50.00	60.00	14760	7500	7260	0.24	1742
Groundnut	18.00	2500.00	5.00	20.00	45100	10000	35100	0.05	1755
RABI (PRE-DEVELOPMENT)								**0.70**	**10268**
Mustard	8.50	2500.00	22.00	50.00	22350	8500	13850	0.20	2770
Gram	8.00	2700.00	5.00	20.00	21700	6700	15000	0.04	600
Coriander	5.50	4200.00	4.00	25.00	23200	3500	19700	0.05	985
Wheat	28.00	1120.00	30.00	100.00	34360	9850	24510	0.01	245
								0.30	**4600**
					Total Surplus in Pre-Development			**1.00**	**14868**
KHARIF (POST-DEVELOPMENT)									
MAIZE	24.00	980.00	55.00	60.00	26820	9000	17820	0.05	891
Urd	8.50	3400.00	5.00	20.00	29000	10000	19000	0.14	2660
Groundnut	20.00	2400.00	8.00	20.00	48160	11000	37160	0.04	1486
Soyabeen	22.00	2100.00	20.00	25.00	46700	11800	34900	0.65	22685
								0.88	**27722**
RABI (POST-DEVELOPMENT)									
Wheat	40.00	1120.00	70.00	100.00	51800	12000	39800	0.16	6368
Mustard	15.00	2500.00	25.00	50.00	38750	9500	29250	0.45	13163
Gram	18.00	2700.00	5.00	20.00	48700	8000	40700	0.10	4070
Coriander	10.00	4200.00	4.00	25.00	42100	4500	37600	0.15	5640
Orange	60.00	1000.00	0.00	0.00	60000	20000	40000	0.14	5600
								1.00	**34841**
					Total Surplus in Post-Development			**1.88**	**62563**

POST-DEVELOPMENT TOTAL SURPLUS	**62563**
PRE-DEVELOPMENT TOTAL SURPLUS	**14868**
NET SURPLUS	**47695**
NET SURPLUS RS IN LAKH	**0.477**