

FPI ONLINE ACADEMY

PRACTICAL WORKSHEET SERIES

IRRIGATION BUDGETING

Estimate water, test pumping assumptions and build a complete irrigation cash budget.

OBSERVE	DESIGN	BUDGET	VERIFY
Site and water	Duty and storage	Setup and running	Capacity and cash

LEARN / COMPLETE / APPLY

Practical reading, worked examples and reusable worksheets for farmers, youth enterprises, cluster teams and agricultural professionals.

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Printable and digitally fillable PDF + editable Word edition. This is a planning and learning resource, not an approved site design or a guarantee of financial results.

START HERE

Use the worksheets with the calculator

This pack supports an early irrigation planning and budgeting decision. It helps assemble the evidence an irrigation designer, supplier and project manager need. It does not produce a final hydraulic design, select a motor, size a solar array or prove a borehole yield.

Work sequence	Pages	Spreadsheet connection
Site, crop and water-demand inputs	3-5	Inputs / Demand
System layout, pumping and storage	6-7	Pump / Checks
Capital, quotes, operations and cash	8-11	Capex / Opex / Cashflow
Risk, example, commissioning and sources	12-15	Scenarios / Dashboard / Sources

How the digital files work

Use the pale PDF response cells and save a new copy; expand tables in Word. Only the Excel companion calculates automatically. Blue spreadsheet cells are editable assumptions, green cells link to another sheet, and review flags remain visible. No macros are used.

Project / location / crop / planning period / preparer and reviewer

Default scenario: a hypothetical 2 ha electrically pumped scheme, 180 crop days and constant teaching inputs. The crop coefficient is NOT a moringa recommendation. Prices, yield of the source, tax, climate and finance are unverified. All costs are USD.

IR-01 | SITE AND SOURCE RECORD

Collect evidence before choosing equipment

Input or approval	Value, unit and evidence
Cropped area, field blocks and intended crop stages	
Soil texture, rooting depth, drainage and infiltration	
Weather source, reference period and representative peak	
Source type, pumping test, sustainable flow and dry-season level	
Water quality: lab, date, sample point and interpretation	
Land / water access and required local approvals	
Distance, elevation, electricity and available operating hours	

Water analysis commonly includes pH, electrical conductivity, sodium-related measures and crop-relevant ions; the required panel and interpretation depend on source, crop, soil and intended use. Use a competent laboratory and adviser. [16]

Unverified inputs, tests required, responsible person and due date

A water source is not "adequate" because it once pumped at a high rate. Separate sustainable supply, permitted use, seasonal reliability, water quality and the pumping duty point.

IR-02 | CROP WATER CALCULATION

Convert millimetres into cubic metres

For the basic crop-coefficient approach, crop evapotranspiration $ET_c = ETo \times Kc$. ETo is reference evapotranspiration; Kc depends on crop and growth conditions. For this simplified budget, net irrigation = $\text{MAX}(0, ET_c - \text{effective rainfall})$, and gross irrigation = net / overall efficiency. [11-13]

Step	Teaching calculation	Result
Crop water demand	5.5 mm/day x 0.85	4.675 mm/day
Net irrigation depth	4.675 - 0.500	4.175 mm/day
Gross irrigation depth	4.175 / 0.85	4.9118 mm/day
Gross water volume	4.9118 x 2 ha x 10	98.2353 m3/day
180-day seasonal volume	98.2353 x 180	17,682.35 m3
Separate 10% peak sizing allowance	98.2353 x 1.10	108.0588 m3/day

Unit check: 1 mm over 1 ha = 10 m³ = 10,000 litres. Overall efficiency must be greater than zero and no more than 100%; enter 85% as 0.85 in a decimal calculation. Do not add the same loss twice.

Your input / result	Value and unit	Evidence source
ETo / Kc / effective rainfall		
Area / efficiency / crop days		
Net depth / gross depth / daily volume		
Seasonal volume / peak sizing allowance		

This daily screen excludes soil-storage changes, capillary rise, salinity leaching and detailed event scheduling. Effective rainfall is not total rainfall. Do not use annual-average weather to claim peak design capacity.

IR-03 | SOIL-WATER SCHEDULING

Do not mistake a budget for a watering schedule

A field schedule also needs rooting depth, soil-water holding capacity, acceptable depletion, current moisture, rainfall and irrigation uniformity. Total available water and readily available water support root-zone scheduling, but inputs require local calibration. [15]

Screening relationships: TAW = 1,000 x (volumetric water content at field capacity - at wilting point) x root depth in metres. RAW = depletion fraction x TAW. TAW and RAW are in mm. These are not instructions to apply the entire depth at once.

Scheduling input	Measured / justified value	Source / date
Field capacity / wilting-point water content		
Effective root depth and depletion fraction		
Current root-zone moisture and recent rainfall		
Infiltration limit, system uniformity and zone size		

Date / block	Moisture or deficit	Irrigation / rainfall	Observation / action

Who sets and checks the field schedule? What triggers a change?

In the spreadsheet, crop days mean every day of crop demand within the budget period, not only the days the pump starts. Budgeting fewer pump-start days must not erase crop water use on intervening days.

IR-04 | LAYOUT AND HYDRAULIC BRIEF

Describe the system the designer must check

SOURCE -> PUMP / PROTECTION -> METER -> FILTER / BACKFLOW CONTROL -> MAIN -> ZONE VALVE -> SUBMAIN -> LATERALS / EMITTERS -> FLUSH POINT

Storage, additional pumps and treatment depend on the real site. This sequence is conceptual and not an installation drawing.

Design element	Location / quantity / evidence	Question for designer
Source and pump station		
Storage and pressure / elevation difference		
Main and submain routes		
Field zones and simultaneous operation		
Emitters, spacing, pressure and filtration		
Drainage, flushing, air and isolation points		

Sketch reference: lengths, elevations, pipe-rating constraints and future expansion

Commissioning criteria to include in the design and supplier scope

Keep flow rate, pressure/head and energy distinct. Pipe diameters, friction losses, surge, backflow protection and safe electrical works require a competent design and installation process. [14]

IR-05 | PUMP, ENERGY AND STORAGE

Test the proposed duty point

Total dynamic head combines required lift, outlet pressure head and hydraulic losses. Electrical input depends on flow, head and overall wire-to-water efficiency. A catalogue maximum flow is not the actual duty point. [14]

Teaching screen	Calculation / result
Minimum discharge over 10 available hours	$108.0588 / 10 = 10.8059 \text{ m}^3/\text{hour}$
Selected duty flow / head / efficiency	12 m ³ /hour; 50 m head; 60% overall efficiency
Electrical input power	$1,000 \times 9.81 \times (12 / 3,600) \times 50 / (0.60 \times 1,000) = 2.725 \text{ kW}$
Actual / design peak runtime	$98.2353 / 12 = 8.1863 \text{ h}$; $108.0588 / 12 = 9.0049 \text{ h}$
Annual energy and usage charge	$4,015.37 \text{ kWh} \times \text{USD } 0.18/\text{kWh} = \text{USD } 722.77$
Usable one-day storage target	98.2353 m ³ ; this is not a tank specification

Your duty / storage input	Value and unit	Verification
Flow / total dynamic head / efficiency		
Available pumping hours / tested source flow		
Runtime / energy tariff / fixed charges		
Usable storage / autonomy / source headroom		

This calculator assumes one powered pumping stage and constant head/efficiency. Multiple lift stages, solar pumping, changing groundwater levels or storage-decoupled flows need a revised design and energy model. Storage cannot remedy a long-term water shortage.

IR-06 | CAPITAL WORKSHEET

Budget the installed system, not only the pump

Record delivered, installed and commissioned scope. State what is excluded. Replace every example price in Excel with an actual quotation or an explicitly identified allowance before procurement.

Item / scope	Qty / unit	Unit USD	Total USD	Quote / gap
Survey, design and laboratory tests				
Source development / borehole works				
Pump, controls and power connection				
Storage, foundations and protection				
Filtration and backflow / fertigation				
Mains, submains and fittings				
Laterals, emitters and zone valves				
Meters, gauges and monitoring				
Trenching, installation and reinstatement				
Training, tests and critical spares				
Freight, permits and nonrecoverable tax				
Contingency / total capital cash				

Excluded items, evidence of an existing source and capital payment schedule

In the example workbook, new drilling and solar equipment have zero quantities and are excluded. Zero tax is unverified. Do not assume any of these costs are genuinely zero for your project.

IR-07 | SUPPLIER COMPARISON

Compare equivalent, complete quotations

Question	Supplier A	Supplier B	Supplier C
Quote reference / date / validity			
Duty flow and head guaranteed			
Water-quality / filtration assumptions			
Pipe rating and emitter performance			
Delivered installed price (USD)			
Taxes, freight and exclusions			
Payment milestones and delivery time			
Warranty, local spares and response time			
Acceptance test and operator training			

Preferred supplier and technical/commercial reasons; unresolved conditions

Lowest purchase price is not necessarily lowest installed or operating cost. Compare the same duty, area, water quality, installation scope and service obligations. Do not release payment solely because equipment has arrived.

IR-08 | OPERATING COST AND RESERVES

Plan the cost of keeping water moving

Annual operating item	Basis / quantity	Rate USD	Annual USD
Electricity usage: kWh x tariff			
Fixed power / demand charges			
Water charges and source fees			
Operator labour and supervision			
Maintenance service and repairs			
Filters, consumables and replacement parts			
Water tests and monitoring			
Insurance, security and communications			
Permits and administration			
Total operating cash cost			

Replacement reserve, useful lives, major repairs and who funds them

Payment timing, deposits and seasonal working-capital needs

Do not count the same maintenance work twice. A reserve is a planned cash set-aside, not automatically an operating expense. Loan principal and capital purchases belong in cash flow, not in operating-cost totals.

IR-09 | CASH FLOW AND FUNDING

Make the financing gap explicit

Complete the Excel Cashflow tab for full calculations. The table below summarises your plan. All financing in the example starts at zero, so the negative balance correctly identifies unfinanced irrigation costs; it is not a forecast accounting loss.

Period	Opening USD	Funding / recovery USD	Cash paid USD	Closing USD
Month 1				
Month 2				
Month 3				
Month 4				
Month 5				
Month 6				
Month 7				
Month 8				
Month 9				
Month 10				
Month 11				
Month 12				

Closing cash = opening cash + equity + grants + loan draws + cash recoveries - capital payments - operating payments - interest - principal - other cash costs - reserve set-asides. Revenue is not assumed merely because irrigation is installed.

Lowest cash balance / funding required / committed source / timing evidence

Funding received too late cannot pay an earlier invoice. The workbook minimum-balance funding gap assumes any extra top-up is available at the start; it is not a loan amortisation or investment-return model.

IR-10 | SENSITIVITY AND DECISION

Stress the assumptions before committing

Scenario	Water demand factor	Power-price factor	Action to consider
Lower demand	0.80x	1.00x	Check fixed costs and actual crop water need
Base teaching case	1.00x	1.00x	No field verification implied
Hotter / drier screen	1.20x	1.00x	Check source yield and available pumping time
Power-price rise	1.00x	1.25x	Recheck operating cash requirement
Combined stress	1.20x	1.25x	Check both capacity and cash

At 1.20x demand, the example design daily requirement becomes 129.67 m³, above the assumed source screen of 120 m³/day. The same example can therefore pass the base screen and fail the stress screen. These factors are learning scenarios, not climate forecasts.

Decision check	Evidence / unresolved condition
Source, water access and peak supply verified	
Duty point, uniformity and safe design reviewed	
Installed scope and operating costs complete	
Funding timing and stress response credible	

Decision: proceed to design / revise / hold; owner and next review date

WORKED EXAMPLE | ANSWER KEY

Reconcile the calculator outputs

The following values are from the supplied example workbook. They are teaching calculations with unverified field and price inputs, not a quotation or a recommendation for a specific farm.

Planning result	Example value	Boundary
Area and crop days	2 ha; 180 days	Six generic periods of 30 crop days
Peak gross daily water	98.24 m ³ /day	Before the 10% sizing allowance
Design daily water	108.06 m ³ /day	Includes the separate sizing allowance
Annual pumped volume	17,682.35 m ³	No flushing or salinity-leaching increment
Electrical consumption	4,015.37 kWh	Single-stage, constant head/efficiency
Electricity usage charge	USD 722.77	Excludes fixed power charges
Capital subtotal	USD 19,230.00	Before tax and contingency
Capital cash budget	USD 21,153.00	Zero tax; 10% contingency
Annual irrigation operating cash	USD 3,899.67	Includes fixed charges and other listed costs
Capital + first-year operating cash	USD 25,052.67	Before additional finance/tax/reserve items
Unfunded cash gap with zero inflows	USD 25,052.67	Financing is not assumed

Your recalculated result and explanation of differences from the example

Audit check: $\text{USD } 19,230 \times 1.10 = \text{USD } 21,153$; $\text{USD } 21,153 + \text{USD } 3,899.6662 = \text{USD } 25,052.67$ after rounding. Display rounding does not change the underlying spreadsheet calculation.

IR-11 | COMMISSIONING AND FOLLOW-UP

Verify performance after installation

Agree acceptance criteria before purchase, then record measured results with the installer and responsible reviewer. This worksheet does not specify universal acceptance thresholds; they must come from the approved design, equipment specification and applicable local requirements.

Test / record	Design requirement	Measured result	Pass / corrective action
Source level, discharge and runtime			
Pressure at representative zone points			
Filtration and backflow protection			
Emitter discharge / distribution uniformity			
Energy meter reading and pumped volume			
Leak, flushing and shutdown checks			
Electrical protection and guarding			
Operator training, drawings and spares			

Snags, responsible person, correction deadline and retest record

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Handover approval / installer / farm operator / reviewer / date

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Monitor kWh per m3, water per output unit, service interruptions and maintenance after handover. A signed handover must not conceal unresolved safety or supply problems.

REFERENCES AND BOUNDARIES

Technical reading and exclusions

[I1] FAO. Crop Evapotranspiration. Second edition, revised 2025. Irrigation and Drainage Paper 56 Rev.1.

<https://doi.org/10.4060/cd6621en>

[I2] FAO. Crop Evapotranspiration, Chapter 6: Single Crop Coefficient (Kc).

<https://www.fao.org/4/X0490E/x0490e0b.htm>

[I3] FAO. Annex I: Irrigation Efficiencies.

<https://www.fao.org/4/t7202e/t7202e08.htm>

[I4] USDA NRCS. National Engineering Handbook, Part 623, Chapter 8: Irrigation Pumping Plants. 2016.

<https://directives.nrcs.usda.gov/sites/default/files2/1720457430/Chapter%208%20-%20Irrigation%20Pumping%20Plants.pdf>

[I5] FAO. Crop Evapotranspiration, Chapter 8: Soil Water Stress Conditions.

<https://www.fao.org/4/x0490e/x0490e0e.htm>

[I6] FAO. Water Analysis, Chapter 5. Irrigation-water sampling and analysis.

<https://www.fao.org/4/i0131e/i0131e01.pdf>

Important scope boundaries

The calculator is an early single-stage irrigation cash budget. It does not automatically model solar yield, detailed pipe hydraulics, groundwater recharge, irrigation-event scheduling, leaching requirements, multiple lift stages, full crop economics, depreciation, tax recovery, debt amortisation or return on investment. Add verified specialist work where those items matter.

References checked 12 October 2026. Technical sources support principles; all example prices, crop-period inputs, efficiencies and source values are unverified teaching assumptions. Source citation does not imply approval or endorsement.

Turn learning into a working plan

An irrigation budget begins with reliable water evidence and ends with an operating and financing plan. This pack connects the crop-water calculation to the equipment brief, supplier scope and cash needed to keep the system working.

What you will produce

A documented site, source and crop-water requirement.

A pumping, storage, installed-cost and operating-cost screen.

A 12-month cash budget, sensitivity review and commissioning record.

Use within Agriculture Systems Integration

Connect the farm, the cluster and the water budget. Use all three worksheet packs together, but maintain separate evidence files, decisions and approvals for each project.

Farmers Pride International
RUAIPP: Rural and Urban Agriculture Innovative Production Program
ABC: Agriculture-Based Cluster
ASI: Agriculture Systems Integration

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