Improving Water Productivity in Agricultural Systems

(With emphasis on irrigated production systems)

05 – 23 November 2017

ICARDA, Amman, Jordan

Cost-Effectiveness Analysis of Water Saving-Irrigation Technologies

19 November 2017, Amman, Jordan

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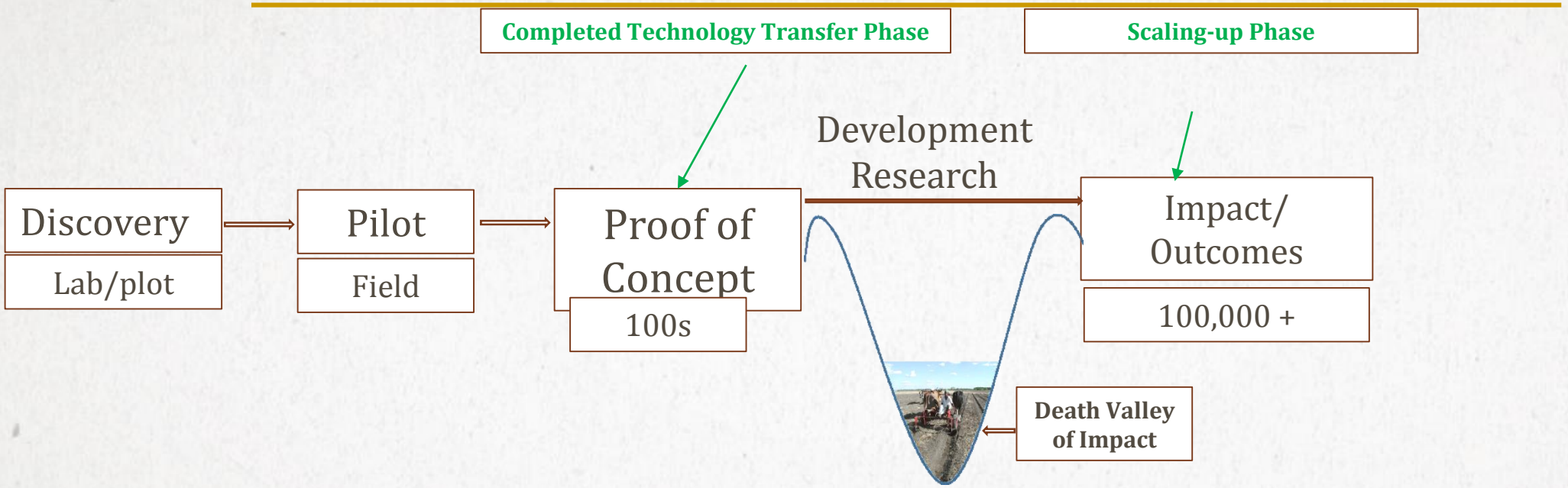
ICARDA – APRP TECHNOLOGIES: SETTING THE SCENE

Scaling-up framework

Food secure and prosperous small farmers in AP



- Changing external environment
- New Paradigm – R4D to transform lives

- **Agricultural technologies**
- **Subsurface drip irrigation**
- **……**

Economic Evaluation of Agricultural Technologies

Short Term - Partial Budget Analysis

TECHNOLOGY EVALUATION
Conceptual Framework

- Identify the technology (Proven and science-based technology)
- Describe the advantages/limitations
- Develop explicit and transparent budget to assess it economic feasibility
  - Collect data using PRA-RRA method – Rapid questionnaires
  - Face to face interviews
- Identify constraints/benefits to adoption
  - Quantitative methods
  - Qualitative tools/frameworks
- Estimate adoption rates (degree and intensity of adoption)

Benefit-cost analysis of technologies using Partial Budget Analysis - PBA

	Without Technology (Control)				With Technology Option			
1	**Costs**	**A**	**B**	**C**	**Costs**	**D**	**E**	**F**
2	**Inputs**	**Quantity**	**Unit price**	**Total**	**Inputs**	**Quantity**	**Unit price**	**Total**
3	Seeds				Seeds			
4	Fertilization				Fertilization			
5	Pesticides				Pesticides			
6	Labor				Labor			
7	Fuel/mechanization				Fuel/mechanization			
8	Water				Water			
9	**Total**	**XX**	**XX**	**XX**	**Total**	**XX**	**XX**	**XX**
10								
11	**Revenue**				**Revenue**			
12	Main product				Main product			
13	Secondary product				Secondary product			
14	**Total revenue**	**XX**	**XX**	**XX**	**Total revenue**	**XX**	**XX**	XX
15								
16	**Indicators**							
17	Net returns			**C14-C9**				**F14-F9**
18	% change in NR							**(F17-C17)/C17**
19	% change in TC							**(F9-C9)/C9**
20	IRR							**Change NT/Change in TC**
21	Benefit-cost Ratio			**C14/C9**				**F14/F9**

TECHNOLOGY EVALUATION

Key Features of the Partial Budget Form

* Simplicity (data collection at experimental, farm and community levels)

* Transparency- production, prices, etc.

* Different professionals (agronomists, economists, farmers can scrutinize)

* Provides basic agronomic and economic indicators

* Forms the basis for more sophisticated analysis-such as optimal crop allocation and input use (farm models)

CASE STUDY - YEMEN

Economic evaluation of the improved technologies: Soilless vs Soil production system

	Without technology (Soil)					With technology option (Soilless)				
1	Costs (Including livestock)		A	B	C	Costs (Including livestock)		D	E	F
2	Inputs	Unit	Quantity	Unit price	Total	Inputs	Unit	Quantity	Unit price	Total
3	seeds	kg/ha			167.4	seeds	kg/ha			167.4
4	fert	kg/ha			232.6	fert	kg/ha			195.3
5	pesticides	l/ha			46.5	pesticides	l/ha			34.9
6	labor	man/day			162.8	labor	man/day			116.3
7	Irrigation	m3			223.3	Irrigation	m3			74.4
8	Transportation	USD/unit			69.8	Transportation	USD/unit			69.8
9	Packaging and ropes	USD/unit			27.9	Packaging and ropes	USD/unit			27.9
10	Depreciations	USD/unit			132.6	Depreciations	USD/unit			160.5
11	soil solarization	USD/unit			130.2	soil solarization	USD/unit			0.0
12	Zakat and tax	USD/unit			152.9	Zakat and tax	USD/unit			106.4
13	Others	USD/unit			30.2	Others				37.2
14	**Total Costs**				**1376.2**	**Total Costs**				**990.1**
15	Revenue					Revenue				
16	Main product	kg/ha	4050	0.47	1903.5	Main product	kg/ha	6128	0.47	2880.16
17	Secondary product	0	0	0	0	Secondary product	0	0	0	0
18	**Total revenue**				**1903.5**	**Total revenue**				**2880.16**
19	**Indicators**									
20	Net returns (US$)				527.34					1890.04
21	% change in NR								(1890.04-527.34)/527.34=**258.41%**	
22	% change in TC								(1376.2-990.1)/990.1=**38.99%**	
23	IRR							(258.41% / 38.99%)= **6.62%**		

Economic Valuation of Agricultural Technologies

Long Term – Business Plan/Feasability Study

KEY INDICATORS WHEN CREATING THE ECONOMIC STUDY

- ***Gross margin***: Gross margin is estimated for the purpose of making comparisons. The formula used to calculate the gross margins is as under:

Gross margin = Total revenue – Variable cost

- ***Net return***: Net Return is the difference between total revenue and total cost. The formula of the net return is as under:

Net return = Total revenue – Total cost

- ***Discounted capital budgeting techniques***: Three measures are often used in finding the present worth of the future values of a project:
  - Benefit Cost Ratio: BCR
  - Net Present Value: NPV
  - Return on Investment (ROI)
  - Internal Rate to Return: IRR

KEY INDICATORS WHEN CREATING THE ECONOMIC STUDY

- ***Benefit Cost Ration – BCR:*** Benefit Cost Ratio (BCR) is the ratio of present value of benefits to present value of costs, and may be given:

$$BCR = \sum \frac{B_t}{(1+r)^t} / \sum \frac{C_t}{(1+r)^t}$$

- Where, Bt = benefit in each year, Ct = cost in each year, r = interest (discount) rate, t = # of years (1, 2 …n,)
- **Note 1**: Money don't have the same value now and in the future, and even they have the same value, lending money have a risk and the lender ask for a rate.
- We call rate to: r = (Future/Present) = (110/100)=0.1 (in %: the 10%)
- **Note 2**: Project is viable and worth taking up when the BC ratio is more than 1

KEY INDICATORS WHEN CREATING THE ECONOMIC STUDY

- ***Net present value (NPV)*:** It is the difference between present value (PV) of benefits and (PV) of costs and denotes net worth of the project. It is representative of the dynamic investment appraisal and a discounted cash flow method. It may be given:

$$NPV = \sum \frac{B_t}{(1+r^*)^n} - \sum \frac{C_t}{(1+r^*)^n}$$

- ***Return on investment (ROI):*** The return on investment formula is calculated by subtracting the cost from the total income and dividing it by the total cost.

Return on Investment

$$ROI = \frac{\text{Investment Revenue - Investment Cost}}{\text{Investment Cost}}$$

- ***Internal rate of return (IRR)*:** The earlier two measures (BCR & NPV) are computed at a given rate of discount. In general, the implied discount rate is computed such that PV of benefits equals PV of costs and NPV becomes zero: Thus, IRR is the rate 'r*' that can make NPV zero.

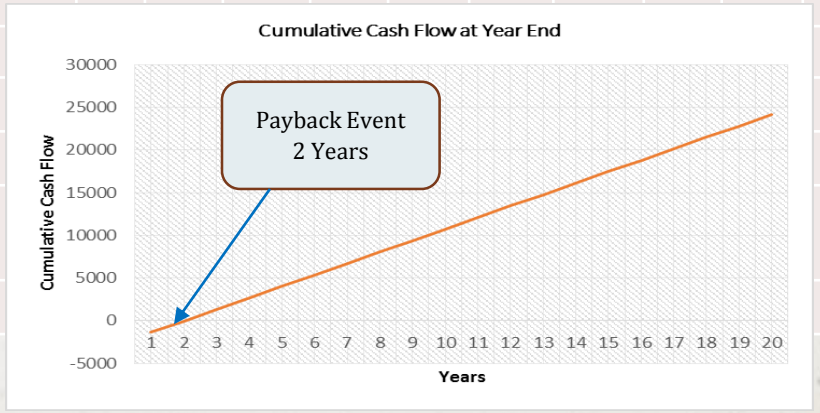
IRR = r* such that NPV= 0

Payback Period (PBP): It gives the investment's return period: Is the minimum length of time required for the investment to break even. The PBP helps to determine the acceptability of the project.

CASE STUDY - OMAN

Economic evaluation of an Irrigation system for an agricultural crop: Tomatoes

	Costs	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20
Capital cost (US$)	2700	2700	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Life of drier (Years)	20																				
Depreciation (US$/year)	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135
Cost of labor and maintenance (US$/year)	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300
Cost of electricity (US$/year)	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
Total Variable costs (US$/year)	336	336	336	336	336	336	336	336	336	336	336	336	336	336	336	336	336	336	336	336	336
Cost of production (US$)		1560	1560	1560	1560	1560	1560	1560	1560	1560	1560	1560	1560	1560	1560	1560	1560	1560	1560	1560	1560
YEARS		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Total Revenue (Production value)		3375	3375	3375	3375	3375	3375	3375	3375	3375	3375	3375	3375	3375	3375	3375	3375	3375	3375	3375	3375
Cash flow/year		-1356	1344	1344	1344	1344	1344	1344	1344	1344	1344	1344	1344	1344	1344	1344	1344	1344	1344	1344	1344
NPV/year		-1290.2	1216.7	1158	1101.51	1048	997	948.81	903	859	817.3	777.6	739.9	704	669.82	637.3	606.4	576.97	548.97	522.3	497
NPV		**11339**																			
		-1356	-12	1332	2676	4020	5364	6708	8052	9396	10740	12084	13428	14772	16116	17460	18804	20148	21492	22836	24180
IRR		**99%**																			
PBP (Years)		**2**																			



Thank You

When the well is dry, we will know the worth of water

Benjamin Franklin

ICARAD-JICA

A SOLID PARTNERSHIP for CHANGE