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SMR.1307 - 4

Advanced Course:
CLIMATE CHANGE IN THE MEDITERRANEAN REGION
PART II: SOCIO-ECONOMIC ASPECTS AND IMPACTS
(12 - 16 November 2001)

"Exploratory Economic Assessments of Climate Change Impacts"

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Exploratory Economic Assessments of Climate Change Impacts

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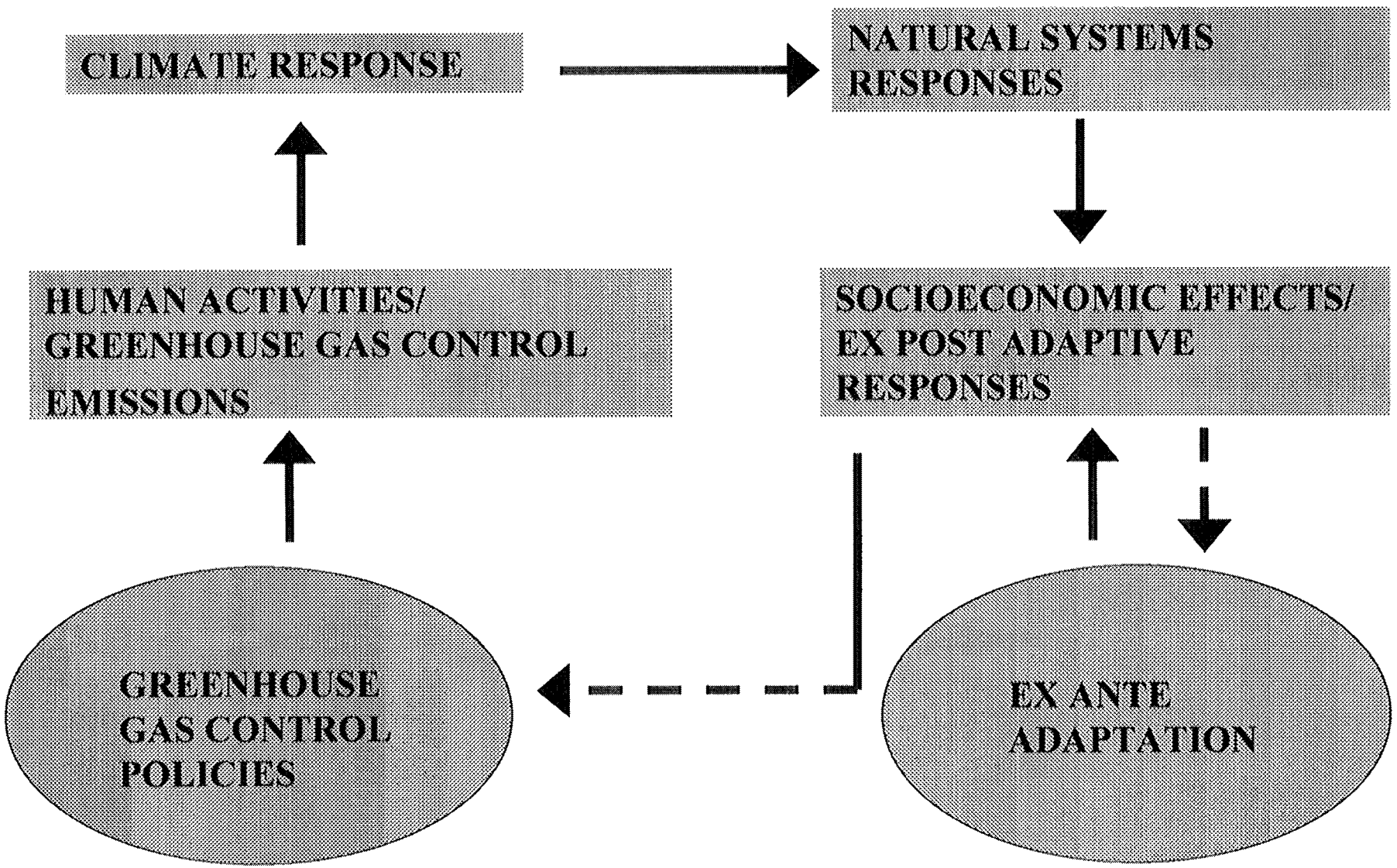
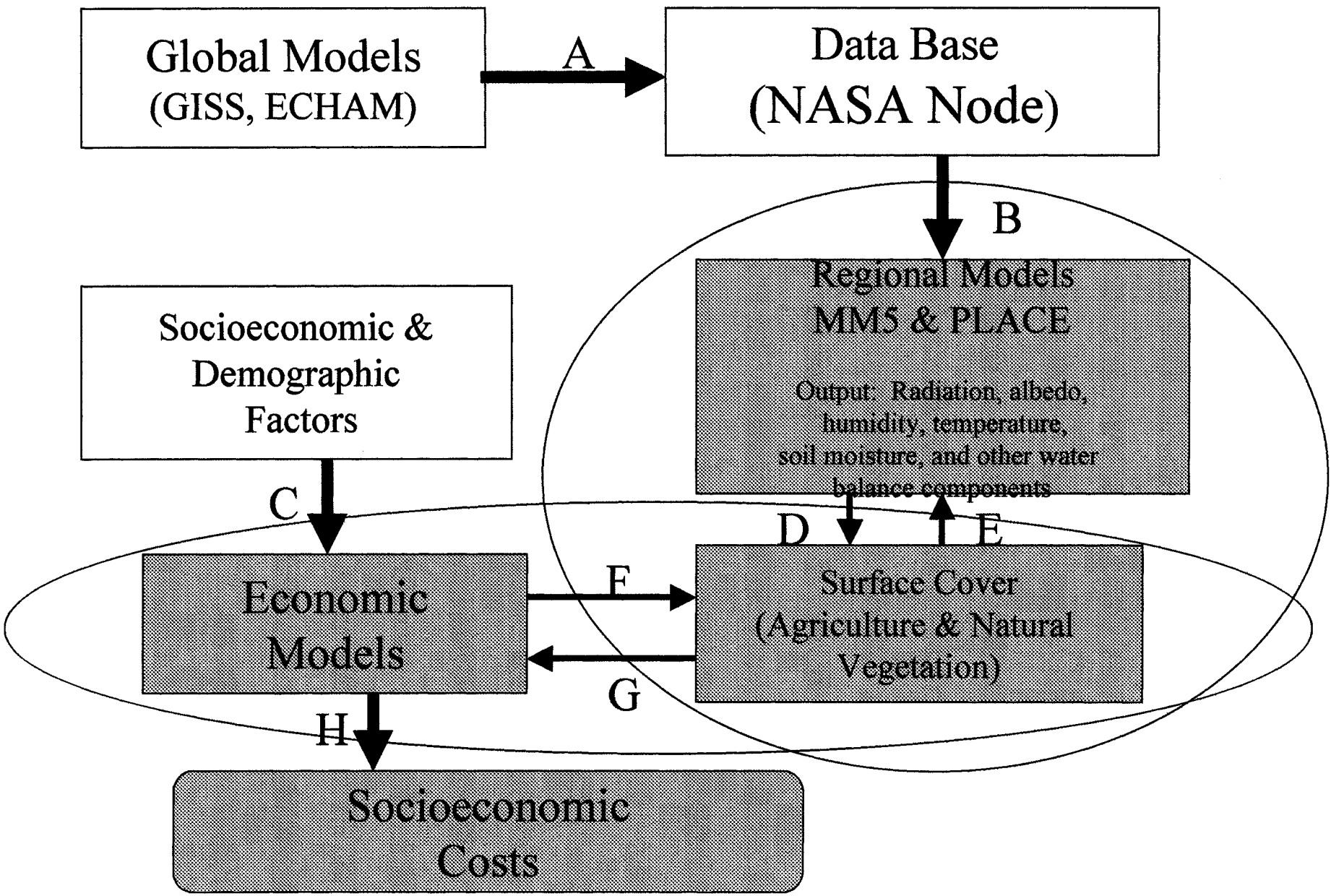
Climate Change and its Interaction with Natural, Economic and Social Processes



A Research Agenda



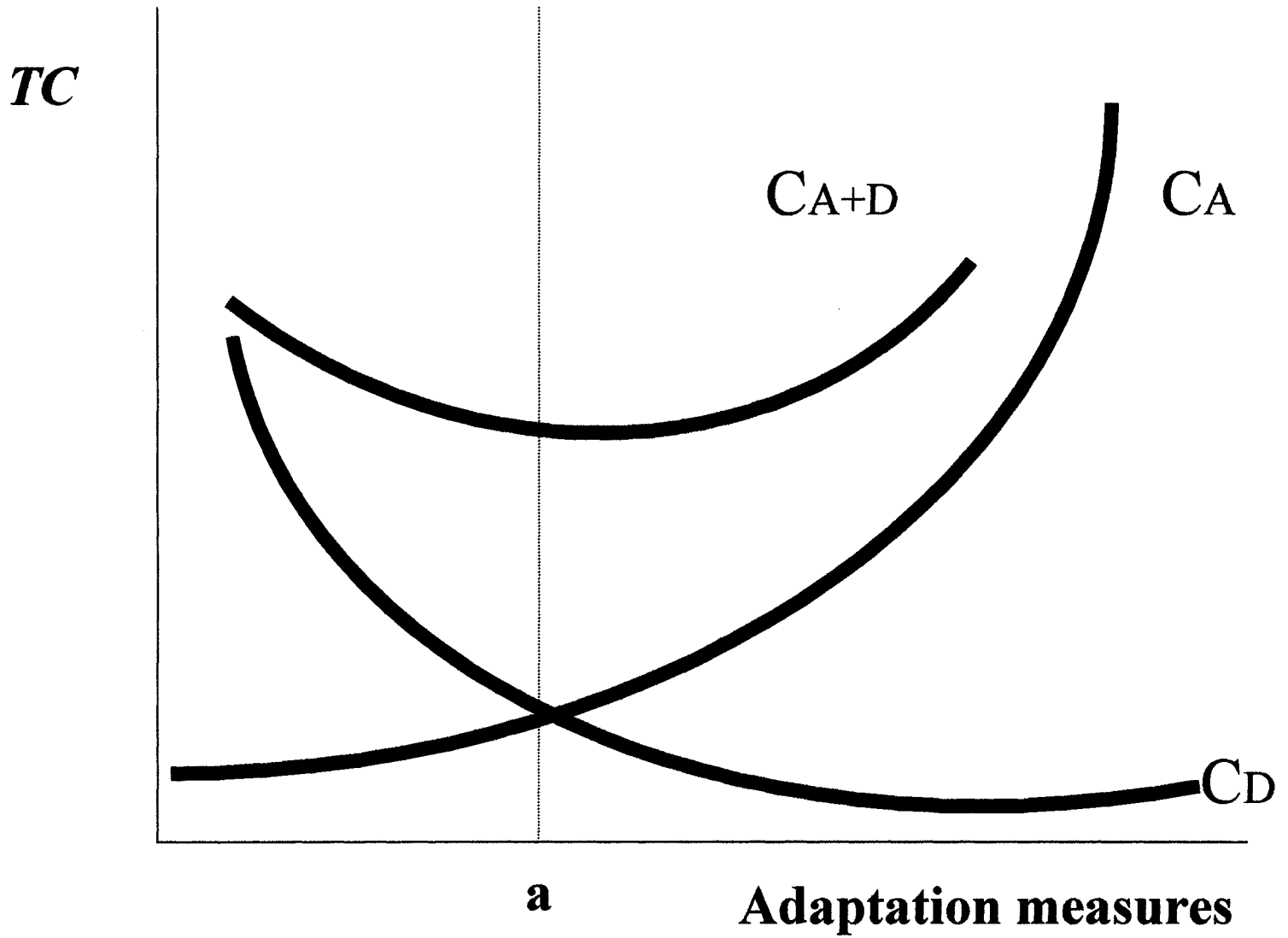
The Economic Components of CC

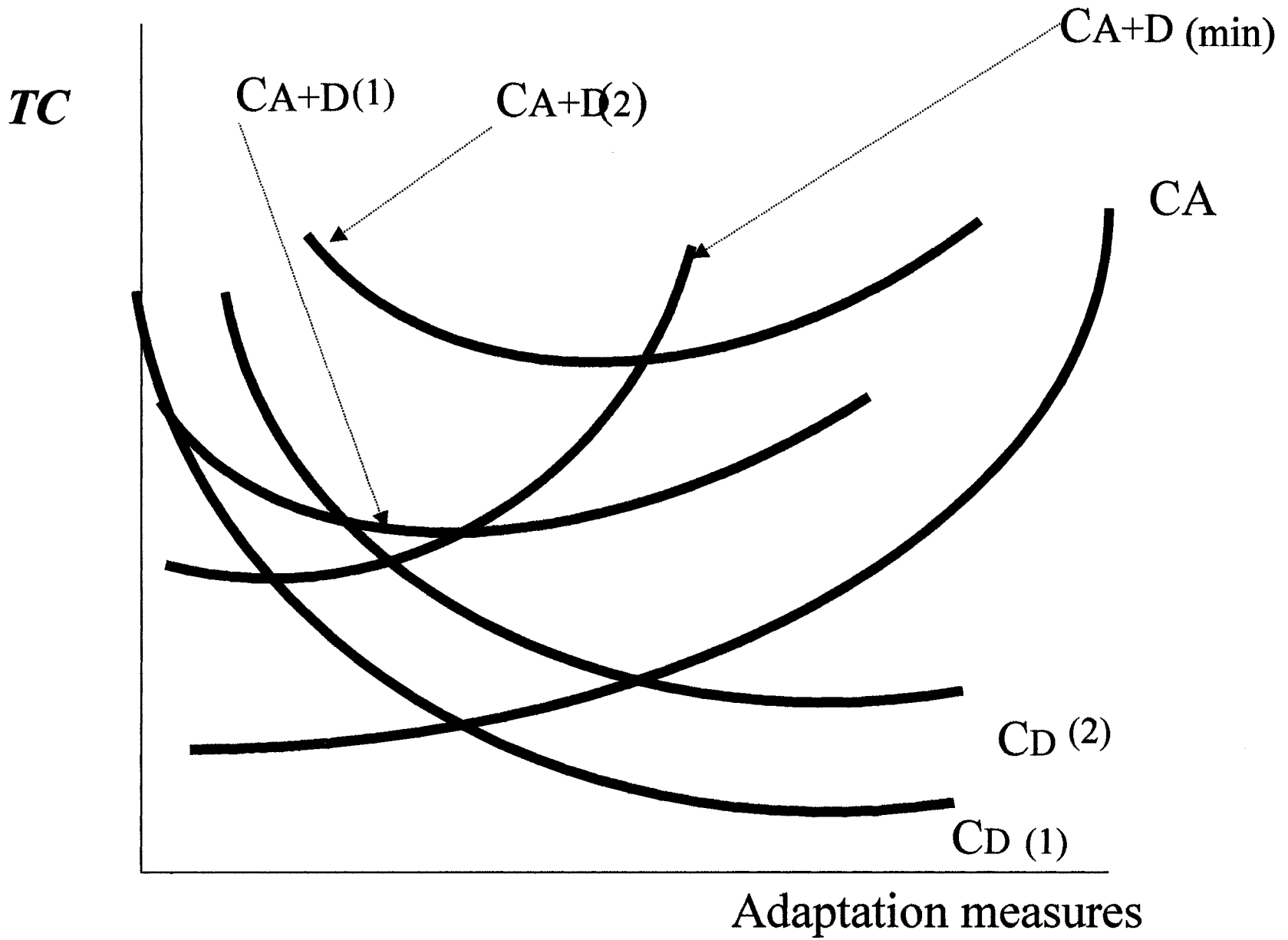
$C_T = C_T = C(e, E, a)$: *total cost*

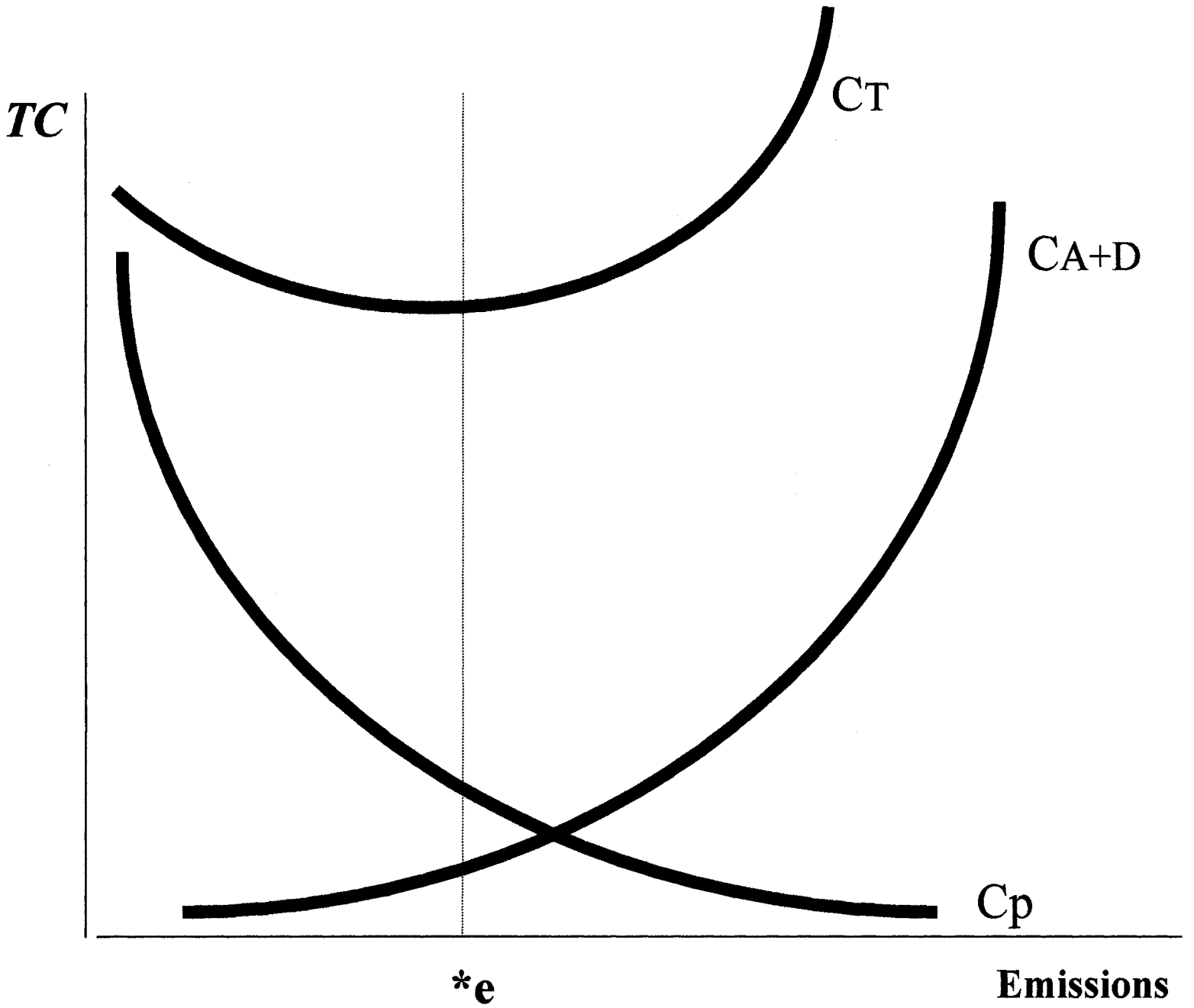
$C_T = C_D + C_A + C_P$

Direct Damage costs	$C_D(e, E, a)$
Adaptation costs	$C_A(E, a)$
Prevention (abatement) costs	$C_P(e)$

Total GHG abatement for a period:	e
Adaptation efforts:	a
total GHG concentration:	$E = \sum e$


TC
CA+D
CA
CD
a
Adaptation measures


TC
CA+D (min)
CA+D(1)
CA+D(2)
CA
CD (2)
CD (1)
Adaptation measures


TC
CT
CA+D
Cp
*e
Emissions

Assumptions

1. Analyzing The Impacts for the Benchmark "2* CO2"

2. Standard assumptions regarding Changes in Climate Factors such as Temperature, Precipitations, etc.

Assumptions (cont.)

3.Disregard mitigation (abatement) costs.

4. Standard assumptions regarding demographic & economic developments.

Assessment Methods

- The "**Bottom up" approach:** *Summing up impacts in all affected Sectors*
- ⇒ Agriculture: 1. *The **Ricardian Approach***
- 2. *The **production function Approach***

- The "**Top-down approach**": *Macro-economic modeling*

The analyzed impacts:

1. Agricultural production
2. Water resources
3. Sea-level rise
4. Bio-diversity
5. Energy use
6. Amenities (including health)
7. Extreme weather events

Base IPCC global scenarios

- IPCC Average Scenario ("IS92a"): CO2 concentration will double from pre-industrial level by the year 2060

- IPCC projections: temperatures in this region are expected to rise by up to 2°c by that time.

- IPCC forecasts for sea-level rise in 2060 range between 10-55 cm., with an average prediction of 29 cm.

Estimations of damages to the U.S. in bil. $ due to 2*CO2 (Tol 95)

Tol (°2.5)	Titus (°4.0)	Nord (°3.0)	Cline (°2.5)	Fankh (° 2.5)	Study / Impact
8.5	5.0	9.7	5.1	7.9	Sea level rise
5.0	/	/	3.5	7.4	Bio diversity
5.0	1.0	1.0	15.2	0.6	Agric.
/	38.0	/	2.9	1.0	Forestry
/	7.1	/	9.0	6.9	Energy
/	9.9	/	6.1	13.7	Water

Tol (°2.5)	Titus (°4.0)	Nord (°3.0)	Cline (°2.5)	Fankh (° 2.5)	Study / Impact
/	/	38.1	1.5	/	Other sectors
12.0	/	/	/	/	Amenity
37.7	8.2	/	5.0	10.0	Morbidity
/	52.1	/	3.0	6.4	Air Water pollution
0.3	/	/	0.7	0.2	Natural hazards
1.0	/	/	0.4	0.5	Immig.

Tol (°2.5)	Titus (°4.0)	Nord (°3.0)	Cline (°2.5)	Fankh (° 2.5)	Study / Impact
74.0	121.3	50.3	53.5	60.2	Total U.S.A
1.5	2.5	1.0	1.1	1.2	Total (%GDP)
315.7		220.0		269.6	Total Global
1.9		1.33		1.4	Total Global (%GDP)

Estimates of the regional impacts of climate change

	First Generation	Mendelsohn et al.		Nordhaus / Boyer	Tol
	2.5°C	1.5°C	2.5°C	2.5°C	1.0°C
North America	-1.5				3.4(1.2)
USA	-1.0 to -1.5		0.3	-0.5	
OECD Europe	-1.3				3.7 (2.2)
EU	-1.4			-2.8	
OECD Pacific	-1.4 to -2.8				1.0 (1.1)
Japan			-0.1	-0.5	
Eastern Europe & fUSSR	0.3				2.0 (3.8)
Eastern Europe				-0.7	
fUSSR	-0.7				
Russia			11.1	0.7	
Middle East	-4.1			-2.0[c]	1.1 (2.2)
Latin America	-4.3				-0.1 (0.6)
Brazil			-1.4		
South & Southeast Asia	-8.6				-1.7 (1.1)
India			-2.0	-4.9	
China	-4.7 to -5.2		1.8	-0.2	2.1 (5.0)[d]
Africa	-8.7			-3.9	-4.1 (2.2)
DCs		0.12	0.03		
LDCs		0.05	-0.17		
World					
output weighed	-1.5 to -2.0		0.1	-1.5	2.3 (1.0)
population weighed				-1.9	
@ world ave. prices					-2.7 (0.8)
equity weighed					0.2 (1.3)

Exploratory Economic Assessments of Climate Change Impacts in Israel: *Agriculture*

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Agriculture and Climate Change

Climatic factors:

- Temperature,
- Precipitation
- Moisture
- Solar radiation
- Soil degradation
- Pest impact

Atmospheric changes

- Future Changes in CO_2 levels
- Other Atmospheric changes

Human induced factors

- Crop adaptation
- Other adaptation measures

Evaluation models

Spatial Models

Structural Models (Ricardian Approach)

Adaptation options to water shortfall

- Water resource infrastructure: (dams & reservoirs)
- Wastewater reclamation
- Desalination
- Weather modification :(cloud seeding)

Adaptation options (cont.)

- Conservation
- Structure of the Economy
- Institutional changes
- Vegetation management

Regional Studies

- Lebanese Ministry of Environment (1999)
- Egyptian Environmental Affairs Agency (1999)
- Yates & Stezepeck (1998)
- Eid (1994)

Forecasts for Israel

2020 : 0.3 – 0.4°c

2050 : 0.7 – 0.8°c

2100 : 1.6 – 1.8°c

Changes in Temperatures

2020 : (–2) – (–1)%

2050 : (–4) – (–2)%

2100 : (–4) – (–8)%

Changes in Precipitation

Agriculture- Basic Data

- Agriculture's Part in Israel GDP is 2.8%.
- Value of Agr. production: 2.3 bill. $
- The sum of all Agr. Production estimated in 644.5 M tons

- Israel total water consumption: Approx. 2.000 M m.c
- Agriculture Consumption: 1200-1300 M m.c

Assumptions

- One limiting factor: Precipitation
- All water shortage absorbed by Agriculture
- No structural change due to Adaptation
- Real prices remain constant

Scenarios

S-1 assumes that the entire water shortfall is absorbed by The Agriculture sector.

S-2 Adaptation: Water shortfall is allocated according to productivity of the water among crops

S-3 Assumes that all shortfall is replaced by desalinated water at 0.80$ per CM.

Scenario I (The "Naive" Scenario)

$$TD = \sum_{i=1}^{n} \Delta Yi \times Pi$$

TD= annual damage in monetary terms

i = crop group

Pi = Average price per ton for crop group i

ΔYi=Change in yields for crop group i.

Scenario I (Cont.)

$$\Delta Yi = f(\Delta Wi) + \Delta a$$

Wi= total amount of water consumed by all groups
Δ Wi= total change in water consumption.

$$\Delta Wi \equiv \Delta W \times \frac{Wi}{TW}$$

Damage Calculation

$$Y_i = a + b(W_i) + c(W_i)^2$$

where

Y_i = yield per dunam (0.1 hectare) for crop i

W_i = irrigation water input per dunam of crop i.

a = constant (incorporates yield with only natural rainfall)

b, c = coefficients

Damage Calculation (Cont.)

Group	Selected crop
Citrus	Oranges
Fruits	Avocado, apples
Cereals & Oils	Wheat
Fibers	Cotton
Vegetables	Tomato, Watermelon Potato

Scenario II

$$TD = \sum_{i=1}^{n} (\Delta Yi \times Pi) + \Delta Yj \times Pj$$

$$\Delta Yi = f(\Delta a)$$

j= The sub group in which the marginal revenue is the lowest.

Scenario II (cont.)

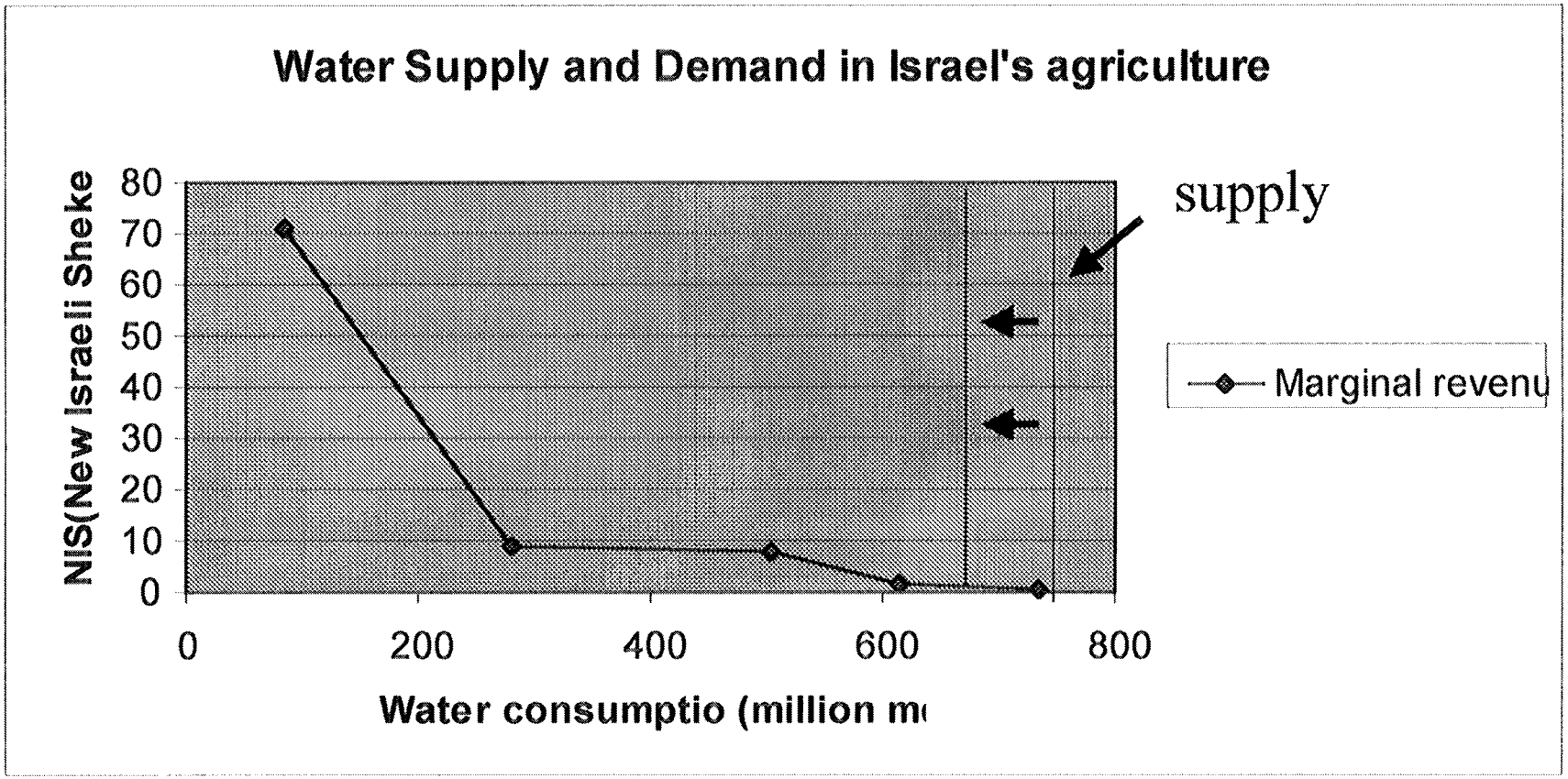
$$\frac{\partial Yj}{\partial W} \times Pj \leq \frac{\partial Yi}{\partial W} \times Pi$$

$$Dj = f(\Delta Wj) - \lambda TC(\Delta Yj)$$

$$\lambda = \frac{\Delta Yj(w)}{Yj(w)}$$

$$\Delta Wj = \Delta W$$

Scenario II (cont.)



Total Damage

Scenario	I	II	III
total Damage (mill $)	208	101	125

Sharing Scarce Water Resources through International Water Rights Markets: An *Illustrative* Application to the Middle East

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Table 2. Current uses, social benefits and shadow prices of water (no trade)

Entity	Use level[a] MCM	Social benefit[b] ($ millions)	Shadow price[c] ($/CM)
GS	70	123	1.03
IS	941	1183	0.21
JO	491	701	0.46
NE	559	340	—
SY	4500	2204	0.22
WB	110	143	0.70
Total		4744	

Notes: [a]See Table 1.
[b]These are not net benefit figures in the sense that they include production cost (pumping and average conveyance cost *within* the country).
[c]The shadow price reflects the value of the water *in situ*.

Table 1
A social planner's allocation without Nile water

Demand regions	Use level in MCM				Econo benefi (mil. $
	Israel total	West Bank	Gaza	Total use	
Israel	742	0	0	742	1145
Negev	427	14	0	441	371
West Bank	132	96	0	228	225
Gaza	200	0	70	270	329
Total supply	1500	110	70		
Shadow price in $/CM	0.29	0.46	0.46		