

Environmental Sustainability based Budget Allocation System

By T.-C. Pan, J.-J. Kao and C.-M. Lin

- Introduction
- ESI Frameworks
- ESIs vs. Budget items
- Key Indicators
- System Configuration
- Case Study
- Summary

Tze-Chin PAN, PhD Candidate
Inst. of Environ. Engrg.
National Chiao Tung Univ.
Taiwan, ROC.

Email:
tcpan.ev89g@nctu.edu.tw





Introduction

- Sustainable Development
 - Brundtland Commission (1987): Our Common Future
 - ...
- Major national policy goal: Improving Sustainability.
- In Taiwan, each local government is encouraged to establish its own set of sustainable development indicators (SDIs).





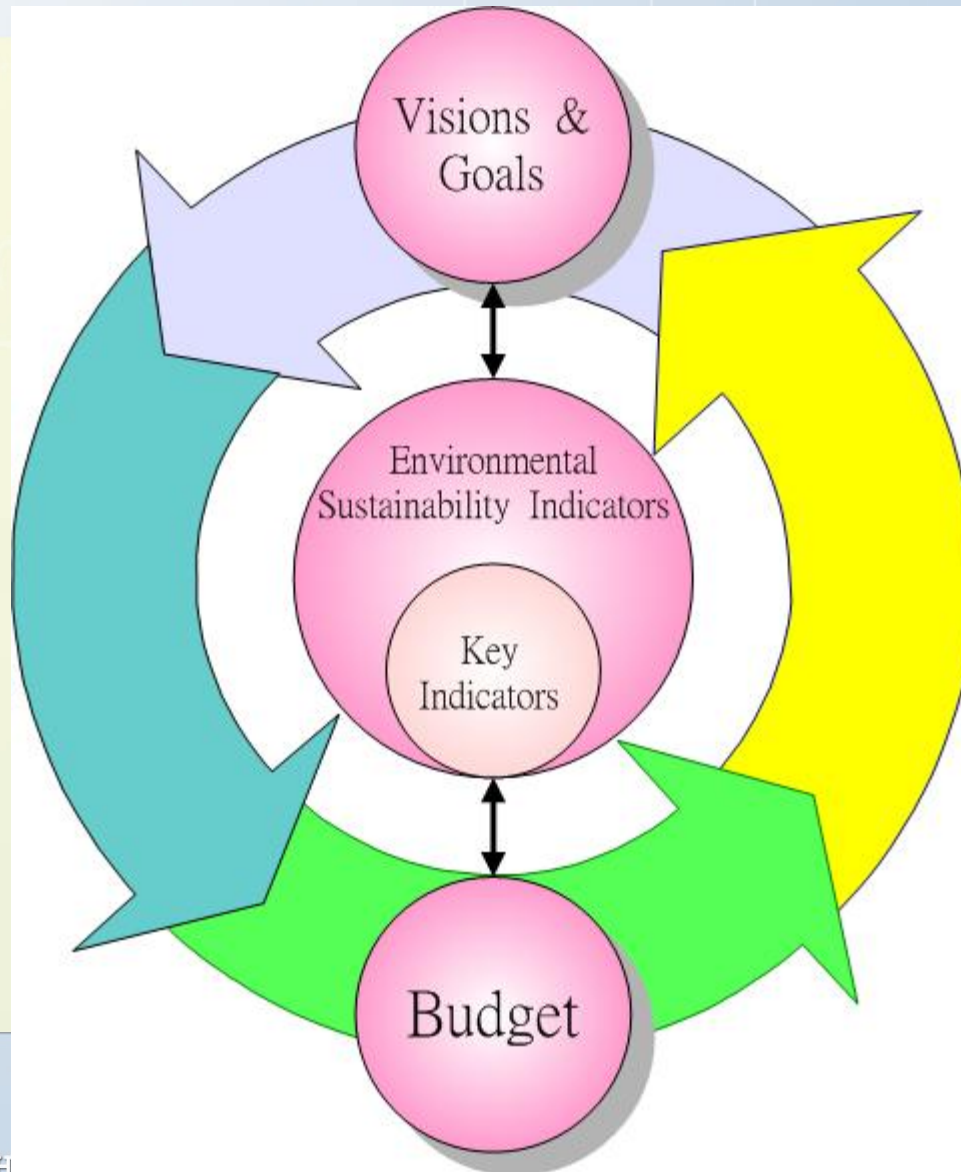
Introduction

- Existing Environmental Sustainability Indicator (ESI) and budget allocation are generally two **independent** systems.
- Environmental Sustainability based Budget Allocation System
 - Assist a local authority with making appropriate budget allocations for improving environmental sustainability in an effective manner.





Introduction





ESI Frameworks

- **General frameworks**
 - Administrative division
 - Property
- **Driving force-State-Response (DSR)**
 - can not reflect regional characteristics.
- **Strength-Weakness-Opportunity-Threat (SWOT)**
 - Region-specific factors: visions & goals, geographical features; pollution patterns & characteristics, etc.





ESI Frameworks

- **Strength-Weakness-Opportunity-Threat (SWOT)**
 - **Strength:** Good value, positive trend, but sometimes difficulty to improve them further.
 - **Weakness:** Decreasing trend or hard to improve because local characteristics
 - **Opportunity:** Unacceptable value, negative trend, it is likely to improve by integrating available resources.
 - **Threat:** Unacceptable value or Good value, negative trend, possible to improve, but difficult.





ESIs vs. Budget items

- Linking all indicators with budget items is impractical.
 - Relationship: Multiple \leftrightarrow Multiple
 - Duplicate or Redundant links
 - Complex and hard to evaluate
- e.g. \Rightarrow River Pollution Index and BOD





Key Indicators

- No duplication
- Reflect the progress for achieving visions and goals
 - The number of managed permitted dischargers
→ does not reflect the real improvement
- Easy to collect and calculate
 - Health risk is essential, but hard to assess.





Key Indicators

- **Can be directly linked to specific budget items**
 - e.g. the benthic index of biological integrity
=> most investments for improving this index are indirect

- **Should not be strongly affected by external and background factors**
 - The indicator for downstream suspended solid (SS) concentration is often affected by significant rainfalls upstream.





System Configuration

Environmental Sustainability Accounting System

Visions & Goals

ESIs and KIs Management

ESI and KI Selection

Target year and value
Achievement rate

ESI Framework

SWOT

DSR

Administrative division

Property

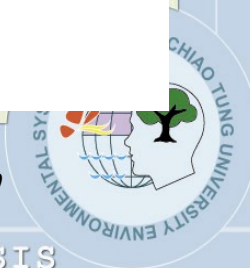
ESIs vs. Budget items

Linkages between KI and Budget item

Budget allocation Analysis

Effectiveness evaluation

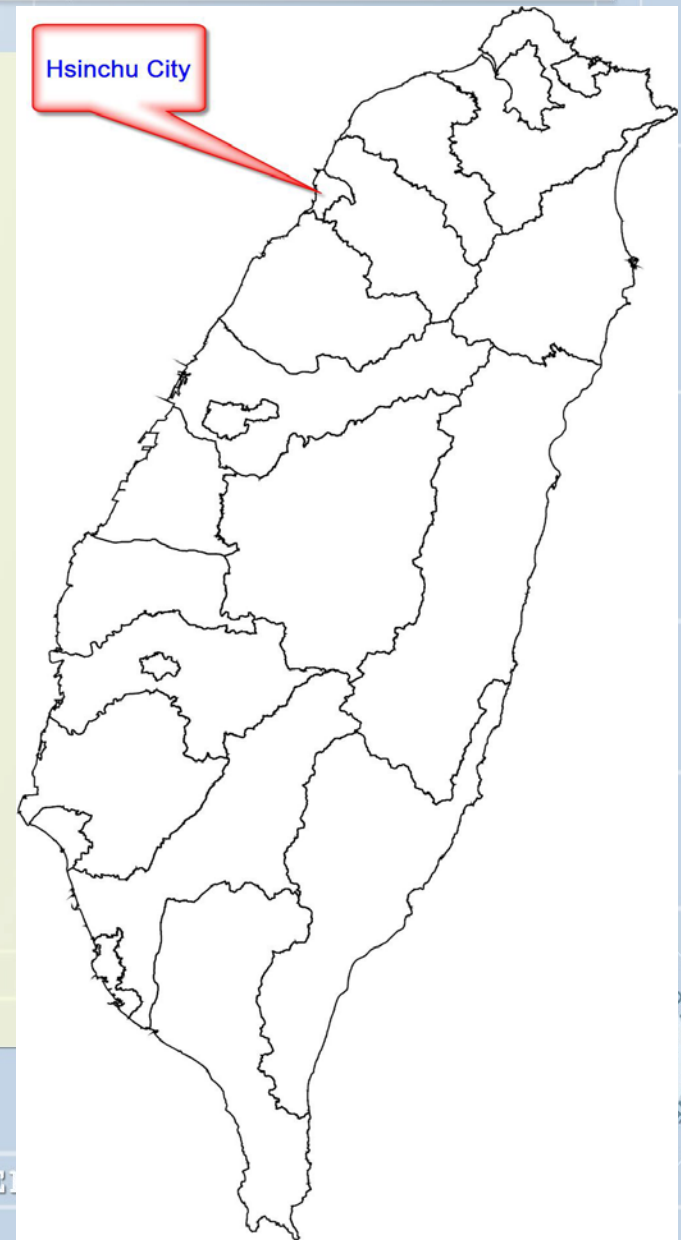
Allocation Adjustment





Case Study – Study Area

- Hsinchu City in Taiwan, Republic of China.
- About 103 km² with three major rivers passing through it.
- Population: 403,638





Case Study – Web-based System

Environmental Sustainability based Budget Allocation System

HOME Log Out

ESI	Vision	Budget Allocation
<p>By Division</p> <p><input checked="" type="checkbox"/> All divisions</p> <p><input type="checkbox"/> Toxic Substance Management</p> <p><input type="checkbox"/> Air Pollution Control</p> <p><input type="checkbox"/> Water Quality Management</p> <p><input type="checkbox"/> Waste Management</p>	<p>Vision</p> <ul style="list-style-type: none"> Sustainable Hisnchu City: => Build a livable and healthy city. 	<p><input checked="" type="checkbox"/> All divisions</p> <p><input type="checkbox"/> Toxic Substance Management</p> <p><input type="checkbox"/> Air Pollution Control</p> <p><input type="checkbox"/> Water Quality Management</p> <p><input type="checkbox"/> Waste Management</p>
<p>Classification Framework:</p> <p><input checked="" type="radio"/> By Division</p> <p><input type="radio"/> By Property</p> <hr/> <p><input type="radio"/> P-DSR</p> <p><input checked="" type="radio"/> P-SWOT</p>	<p>Goals</p> <ul style="list-style-type: none"> Improve air quality to the excellent level, and reduce greenhouse gases emission. Provide clean water and protect aquatic habitat. Achieve zero waste, convert all waste to resources. Avoid the risk from toxic substances. 	

Vision

Goals

Indicator classification frameworks

Budget allocation

Powered by apache, php, xoops, mysql, jggraph, javascript





Case Study – SWOT framework

Environmental Sustainability

Indicators classified into the Strength, Weakness, Opportunity, and Threat groups.

HOME Log Out

Visions | Goals

Visions | Goals

Indicator Management

P-SWOT

S W O T

Figure: Radar Bar None

ESI Management

Budget

Allocation List

ESI vs. Expenditure

Figure: Pie Bar

Year

2003 2002 Select

Indicator Key Indicator Reference

Sort by: Value+ Value- Show: All Key Indicator Indicator and Indicator

ESI: Strength

	Abbr.	Unit	Target		Achievement		Budget	
			Value	Year	2003	2003	2003	2003
<input checked="" type="checkbox"/>	RWI	%	100	2006	99.1	31173		
<input checked="" type="checkbox"/>	RWB	%	100	2006	96.7	4591		
<input checked="" type="checkbox"/>	RHWR	%	100	2006	100.0	-		
<input checked="" type="checkbox"/>	RAGW	ton/Year	200	2006	64.9	-		
<input checked="" type="checkbox"/>	ARC	ton/Year	22000	2006	71.4	-		

Show Marked Indicator Show All Indicators

ESI: Weakness

	Abbr.	Unit	Target		Achievement		Budget	
			Value	Year	2003	2003	2003	2003
<input checked="" type="checkbox"/>	WAPC	kg/day	0.9	2006	30.0	107		
<input checked="" type="checkbox"/>	TGWA	ton/Year	60000	2006	4.8	-		
<input checked="" type="checkbox"/>	TWA	ton/Year	120000	2006	33.0	-		
<input checked="" type="checkbox"/>	AHWC	ton/Year	6000	2006	36.6	-		

Show Marked Indicator Show All Indicators

ESI: Threat

	Abbr.	Unit	Target		Achievement		Budget	
			Value	Year	2003	2003	2003	2003
<input checked="" type="checkbox"/>	AHW	ton/Year	20000	2006	45.2	161		
<input checked="" type="checkbox"/>	AFA	ton/Year	40000	2006	67.0	161		
<input checked="" type="checkbox"/>	AGWC	ton/Year	70000	2006	28.6	-		
<input checked="" type="checkbox"/>	ALW	ton/Year	700	2006	70.0	-		
<input checked="" type="checkbox"/>	AWI	ton/Year	130000	2006	95.4	-		

Show Marked Indicator Show All Indicators

ESI: Opportunity

	Abbr.	Unit	Target		Achievement		Budget	
			Value	Year	2003	2003	2003	2003
<input checked="" type="checkbox"/>	AHWT	ton/Year	500	2006	19.0	-		
<input checked="" type="checkbox"/>	RWC	%	10	2006	10.0	75		
<input checked="" type="checkbox"/>	DAGC	ton/day	400	2006	72.0	-		
<input checked="" type="checkbox"/>	AGWT	ton/Year	120000	2006	13.4	4030		
<input checked="" type="checkbox"/>	RWR	%	20	2006	31.8	8646		

Show Marked Indicator Show All Indicators

Powered by apache, php, xoops, mysql, jgraph, javascript

3

NATIONAL CHIAO TUNG UNIVERSITY ENVIRONMENTAL SYSTEMS ANALYSIS



Case Study – Budget allocation

2003 Allocation Table for a Budget Item		
Code:1810046-02-02-71	Status:Allocated	
Budget Item: Project to inspect air pollution sources	Budget allocated: 155 Unit:NT\$1000	
Basic Expense	<input type="text" value="10"/> %	<input type="text" value="15.5"/>
Planning	<input type="text" value="10"/> %	<input type="text" value="15.5"/>
SOX Emission	<input type="text"/> %	<input type="text"/>
NOX Emission	<input type="text"/> %	<input type="text"/>
NMHC Emission	<input type="text"/>	<input type="text"/>
CO Emission	<input type="text"/>	<input type="text"/>
Greenhouse Gases Emission	<input type="text"/>	<input type="text"/>
PM10	<input type="text"/>	<input type="text"/>
Number of Days with PSI Exceeding 100	<input type="text"/> %	<input type="text"/>
Violation Ratio of Industrial Sources	<input type="text" value="39"/> %	<input type="text" value="60.45"/>
Violation Ratio of Construction Sources	<input type="text" value="15"/> %	<input type="text" value="23.25"/>
Violation Ratio of Mobile Sources	<input type="text" value="26"/> %	<input type="text" value="40.3"/>
New KI: <input type="text"/>	<input type="text"/> %	<input type="text"/>
Total	100%	155

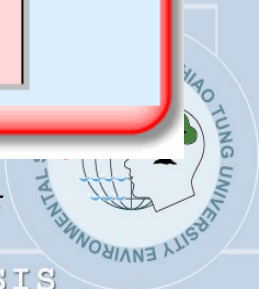
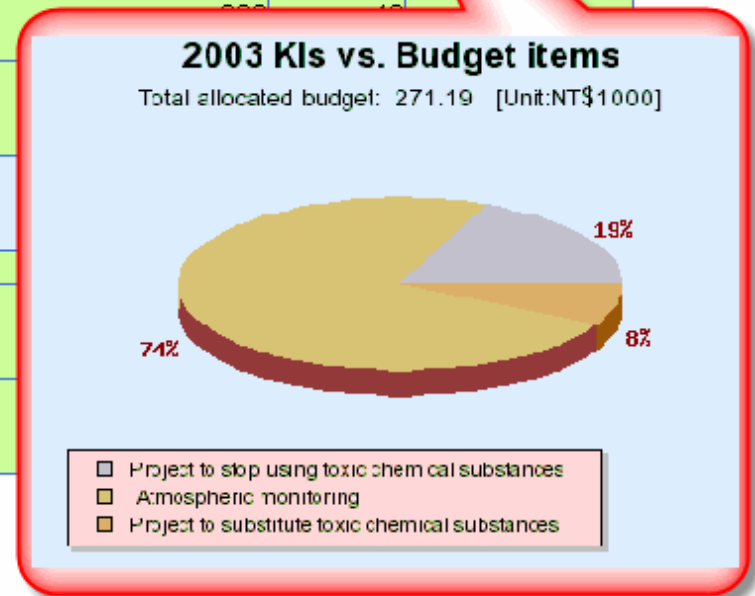
KIs

Budget allocated



Case Study – KI vs. Budget items

KIs vs. Budget items						
Name	Code	Item Name	2003 Budget			Note
			Achievement Rate [%]	Budget [Unit:NT\$1000]	[%]	
Concentration of Toxic Chemical Substance in Air [TI2]	Sum		50.0	271.19	2.4	--
		Project to stop using toxic chemical substances		50.4	5	
		Atmospheric monitoring				
		Project to substitute toxic chemical substances				
Storage of Toxic Chemical Substance [TI4]	Sum		22.2			
		Overtime				
		Project to stop using toxic chemical substances				
		Project to substitute toxic chemical substances				





Summary

- Selecting an appropriate set of long-term measurable ESIs with an appropriate framework is essential.
- A system to integrate the ESI and the budgetary allocation systems.
- The system can facilitate the analysis of the relationships between expenditures and ESIs.





Summary

- With the proposed system, the local authority can evaluate the budget allocated to each KI and make the necessary adjustments to improve regional environmental sustainability.
- The complete system is still under development... (to be continued)





**Thank you
for your attention**

