

持続可能な発展と国際開発協力（５）

1. 環境容量 (Ecological/ carrying capacity)、余剰生産量モデル

(1) 最大持続収穫量 MSY (MAC)、最大持続経済的収穫量 MEY
 $MSY > MEY \rightarrow$ ストック量 (X) については $XMSY < XMEY$
環境容量モデル・余剰生産量モデルの前提

資源利用ルール→生物資源（再生可能資源）を再生可能な範囲で最適（最大）な利用量
（利用限度）を決定するルール

森林資源（天然林・人工林）・漁業資源・牧草地

河川の浄化能力 (BOD₅)、廃棄物の同化能力 (assimilative capacity)

(2) MSY・MEY アプローチの条件：所有権（利用権）の設定（国有・私有・コモンズ）
私有制度：市場財：排除性（監視費用が低い・フリーライドがない）

競合性（技術的外部性がない）

市場価格による調整

「市場の失敗」

国有制度：公共財（純粋公共財・準公共財）非排除性・非競合性

権力・権威 (Police Power) にもとづく指令・統制 (CAC) による調整

「政府の失敗」

コモンズ（集団所有）：非排除性・競合性

権威にもとづく指令・統制(CAC)による調整

コモンズの事例：

日本の入会林野：220 万町歩（1906 年）、185 万 ha（1966 年）

日本の森林面積 2510 万 ha：国有林 31%、民有林（私 58・公 11）69%
入会林野 8.8%（1906）、7.3%（1966）

水利組合（water users association）・土地改良区、漁業権

ヨーロッパのコモンズ（アルプス共同牧草地）

インドネシアのサシ（漁業資源の共同利用制度）

グローバル・コモンズ：

IWC（国際捕鯨委員会）：

1948 年設立・現在 88 カ国、1982 年商業捕鯨モラトリウム可決、1987 年日本調査捕鯨開始、1994 年南極海産サメクチュアリー設定

商業捕鯨枠の設定方式：1971/72 年まで BWU(Blue Whale Unit)規制：16,000BWU←過大
1974 年・新管理方式 NMP(New Management Procedure)：MSY・初期資源量に基づく
MSYL の設定を目指した→初期資源量や自然死亡率などの科学的データが不足したため、科学的に信頼できる MSYL の算出が不可能であった。

1994 年・改訂管理方式 RMP(Revised Management Procedure)：目視調査と過去の捕獲統計から、一定の安全率（科学的不確実性）を加味して決定する方式：1994 年：ミンククジラ・平均 150 頭（最小 63 頭-最大 311 頭）→RMP を監視する制度である改訂管理制度 RMS への合意が出来ないため、商業捕鯨の再開は出来ず。

日本の調査捕鯨：2005/06-2010/11 年度：南極海：ミンククジラ 850 頭、ザトウクジラ 50 頭、ナガスクジラ 50 頭
2000 年-年度：北西太平洋：ミンククジラ 220 頭、ニタリクジラ 50 頭、イワシクジラ 100 頭、マッコウクジラ 10 頭

ICCAT (大西洋まぐろ類保存国際委員会)

1966 年条約、1969 年発効、現在 48 カ国

クロマグロ資源量は、未利用状態に比べて 15%へ激減している。

漁獲可能量 (TAC)：東部大西洋クロマグロ、2008 年決定 (2009 年決定)

2008 年：28,500t、2009 年：22,000t、2010 年 19,950t (13,500t)、2011 年：18,500t (未)

禁漁期：はえ縄 6/1-12/31、まき網 6/15 から翌年 4/15

漁獲証明書制度 (IUU 漁業対策)、モニタリング

ATLANTIC YELLOWFIN TUNA SUMMARY	
Maximum Sustainable Yield (MSY)	~130,600 t ¹ (124,100-136,500)
2006 Yield ³	~146,600 t ² (128,200-152,500)
	108,160 t
Current Yield ³ (2008)	107,859 t
Replacement Yield (2006)	~ 130,000 t
Relative Biomass B_{2006}/B_{MSY} ⁴	0.96 (0.72-1.22)
Relative Fishing Mortality: $F_{current}/F_{MSY}$ ⁴	0.86 (0.71-1.05)
$F_{current}/F_{0.1}$ ⁵	1.26 (1.11-1.44)
$F_{current}/F_{20\%SPR}$ ⁵	0.81 (0.73-0.93)
$F_{current}/F_{30\%SPR}$ ⁵	1.12 (1.01-1.29)
$F_{current}/F_{40\%SPR}$ ⁵	1.52 (1.35-1.73)
Management measures in effect:	
- Effective fishing effort not to exceed 1992 level [Rec. 93-04].	
- Rec. 04-01, effective 2005. Season/area closure. Although this measure was intended to reduce the catches of juvenile bigeye tuna, as this is a complete closure, impacts are expected on all tropical tunas.	

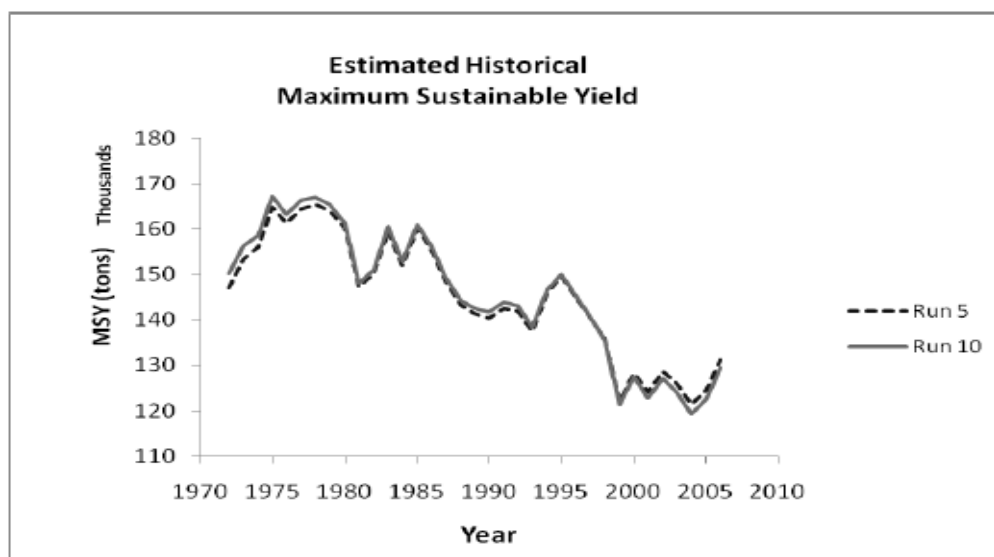
NOTE $F_{current}$ refers to F_{2006} in the case of ASPIC, and the geometric mean of F across 2003-2006 in the case of VPA. As a result of the constant trend in recruitment estimated by the VPA model, F_{MAX} is used as a proxy for F_{MSY} for VPA results.

¹ Estimates (with 80% confidence limits) based upon results of the age-structured model (VPA).

² Estimates (with 80% confidence limits) based upon results of the non-equilibrium production model (ASPIC).

³ The assessment was conducted using the available catch data through 2006. Subsequent revisions have reduced reported catch levels slightly to 107,859 t.⁴ Median (25th-75th percentiles) from joint distribution of age-structured and production model bootstrap outcomes considered.

⁵ Result exclusively from VPA and yield-per-recruit analyses.



YFT-Figure 9. Estimates of historical MSY values for Atlantic yellowfin obtained through the age-structured model analysis, which considers the changes in selectivity that have occurred.

Source: ICCAT Report 2008-2009(II)

(3) コモンズ論

「コモンズの悲劇」: Hardin, G.(1968), The Tragedy of Commons, *Science* 162, pp.1243-1248

ハーディンは、環境資源などの「コモンズ」は、利用者が私的便益のみを考慮した合理的行動をとると、コモンズ全体としては過剰利用となり、結果としてコモンズの崩壊が必然化するとした。←ハーディンは「コモンズ（共有資源）」と「オープン・アクセス」における資源（非コモンズ、自由財）を混同していたとの批判

ハーディンの主張の要点：環境・資源問題の根本は人口問題であり、人口抑制のためには技術主義的手法は根本的限界があり、「自由の制限」＝「社会的強制」の必要性和そうした社会的強制を可能にする社会的規範（social norms）・社会的制度（institutions）の重要性を指摘した点。

コモンズの悲劇と囚人のジレンマ（prisoner's dilemma game）

一回限り（one shot）の非協調ゲーム：プレイヤーは「拘束性を持った契約」を結べない。
完全情報の仮定

囚人のジレンマにおけるペイオフ

	S2	L2
S1	5, 5	-1, 8
L1	8, -1	0, 0

2人の農民による、共同牧草地への放牧、

多くの家畜を放牧（L）する戦略と少なく放牧（S）する戦略

「第1の農民にとって、第2の農民がSを選択すると、自分はLを選択した方が3単位だけ利益を多く得られる。また、かりに第2の農民がLを選択しても、第1の農民にとってはSを選択したときの-1単位より、Lを選択した0単位の利得の方が大きく、Lを選択する。」

→均衡解（ナッシュ均衡）は（0,0）→個人の合理性と社会の合理性の乖離

社会的合理性（5,5）への可能性

協調ゲーム：拘束力を持った契約←監視制度、制裁や罰金制度→歴史上の「コモンズ」

非協調・繰り返しゲーム：社会的学習による協調行動、社会的割引率が大きくない

オストロム（Ostrom）の持続的コモンズ（CPR）の7（8）条件

Ostrom, E. (1990), *Governing the Commons*, Cambridge UP

Ostrom, E. et al.(1994), *Rules, Games, and Common Pool Resources*, Univ. Michigan Pr.

- ①コモンズ（資源）の境界のみならずコモンズの構成員も明瞭に定義できること。
- ②時間・場所・技術等を定めたコモンズ利用ルール（appropriation rule）、労働や原材料の提供などを定めたコモンズ管理ルール（provision rule）、コモンズ地域特性（local condition）が相互に関連していること。
- ③コモンズのルールの変更はコモンズ・メンバーの参加によって行われること。
- ④コモンズの資源状態、メンバーの行動が監視されること（monitoring Cost）。
- ⑤ルール違反に対する制裁は、違反の程度に応じてなされ、制裁額は違反から得られる利得より有意に多きこと（sanction, penalty）。
- ⑥利用者間の利害の不一致を低コストで調整できる機構が存在すること。
- ⑦コモンズを組織し、管理する権利が、コモンズに属していない外部の政府機関等によって大きく侵害されないこと。
- ⑧各段階（1から7）の必要に応じて、多層的な構造であること。

2. SD 指標、持続性指標

(1) UN-CSD

Phase 1: 1995-1996; Development of Indicator Methodology Sheets; Agenda 21, DSR

Phase 2: 1996-1998; Training and capacity building (UNDP Capacity 21),

National testing (22 力国)

Phase 3: 1998-2000; Lessons learned, Evaluation of testing results and indicator set

Table 2: DSR Framework for Sustainable Development Indicators

SD Dimension	Chapter of Agenda 21	Driving Force Indicators	State Indicators	Response Indicators
Social				
Economic				
Environmental				
Institutional				

Table 4: CSD Theme Indicator Framework

SOCIAL		
Theme	Sub-theme	Indicator
Equity	Poverty (3)	Percent of Population Living below Poverty Line
		Gini Index of Income Inequality
		Unemployment Rate
	Gender Equality (24)	Ratio of Average Female Wage to Male Wage
Health (6)	Nutritional Status	Nutritional Status of Children
	Mortality	Mortality Rate Under 5 Years Old
		Life Expectancy at Birth
	Sanitation	Percent of Population with Adequate Sewage Disposal Facilities
	Drinking Water	Population with Access to Safe Drinking Water
	Healthcare Delivery	Percent of Population with Access to Primary Health Care Facilities
		Immunization Against Infectious Childhood Diseases
		Contraceptive Prevalence Rate
Education (36)	Education Level	Children Reaching Grade 5 of Primary Education
		Adult Secondary Education Achievement Level
	Literacy	Adult Literacy Rate
Housing (7)	Living Conditions	Floor Area per Person
Security	Crime (36, 24)	Number of Recorded Crimes per 100,000 Population
Population (5)	Population Change	Population Growth Rate
		Population of Urban Formal and Informal Settlements
ENVIRONMENTAL		
Theme	Sub-theme	Indicator
Atmosphere (9)	Climate Change	Emissions of Greenhouse Gases
	Ozone Layer Depletion	Consumption of Ozone Depleting Substances
	Air Quality	Ambient Concentration of Air Pollutants in Urban Areas
Land (10)	Agriculture (14)	Arable and Permanent Crop Land Area
		Use of Fertilizers
		Use of Agricultural Pesticides
	Forests (11)	Forest Area as a Percent of Land Area
		Wood Harvesting Intensity
	Desertification (12)	Land Affected by Desertification
Urbanization (7)	Area of Urban Formal and Informal Settlements	
Oceans, Seas and Coasts (17)	Coastal Zone	Algae Concentration in Coastal Waters
	Fisheries	Percent of Total Population Living in Coastal Areas
		Annual Catch by Major Species
Fresh Water (18)	Water Quantity	Annual Withdrawal of Ground and Surface Water as a Percent of Total Available Water
	Water Quality	BOD in Water Bodies
		Concentration of Faecal Coliform in Freshwater
Biodiversity (15)	Ecosystem	Area of Selected Key Ecosystems
		Protected Area as a % of Total Area
	Species	Abundance of Selected Key Species

ECONOMIC		
Theme	Sub-theme	Indicator
Economic Structure (2)	Economic Performance	GDP per Capita
		Investment Share in GDP
	Trade	Balance of Trade in Goods and Services
	Financial Status (33)	Debt to GNP Ratio
		Total ODA Given or Received as a Percent of GNP
Consumption and Production Patterns (4)	Material Consumption	Intensity of Material Use
	Energy Use	Annual Energy Consumption per Capita
		Share of Consumption of Renewable Energy Resources
		Intensity of Energy Use
	Waste Generation and Management (19-22)	Generation of Industrial and Municipal Solid Waste
		Generation of Hazardous Waste
		Generation of Radioactive Waste
		Waste Recycling and Reuse
	Transportation	Distance Traveled per Capita by Mode of Transport
INSTITUTIONAL		
Theme	Sub-theme	Indicator
Institutional Framework (38, 39)	Strategic Implementation of SD (8)	National Sustainable Development Strategy
	International Cooperation	Implementation of Ratified Global Agreements
Institutional Capacity (37)	Information Access (40)	Number of Internet Subscribers per 1000 Inhabitants
	Communication Infrastructure (40)	Main Telephone Lines per 1000 Inhabitants
	Science and Technology (35)	Expenditure on Research and Development as a Percent of GDP
	Disaster Preparedness and Response	Economic and Human Loss Due to Natural Disasters

International Goals, Targets, and Standards Related to Themes and Sub-Themes of Indicators of Sustainable Development

SOCIAL		
Theme	Sub-theme	Goals, Targets, and Standards
Equity	Poverty	i) Reduce proportion of people living in extreme poverty in developing countries by at least one-half by 2015 compared to 1990 (<i>Copenhagen95</i>). ii) Universal access to paid employment (<i>Copenhagen95</i>).
	Gender Equality	Eliminate discriminatory practices in employment (<i>Beijing</i>)
Health	Nutrition Status	Reduce severe and moderate malnutrition among under 5 year old children by 50% from 1990 to 2000 (<i>New York90, Copenhagen95, Beijing95, Rome96</i>).
	Mortality	Reduce mortality rate for children under 5 years old by two-thirds of 1990 levels by 2015 (<i>Cairo94, New York90</i>)
	Sanitation	Universal access to sanitary waste disposal (<i>Rio de Janeiro92, Copenhagen95, Beijing95</i>)
	Drinking Water	Universal access to safe drinking water supply by 2025 (<i>Rio de Janeiro92, Copenhagen95, Beijing95</i>)
	Healthcare Delivery	i) Universal access to primary health care and reproductive health services by 2015 (<i>Cairo94, Copenhagen95, Beijing95</i>) ii) Universal immunization against measles (<i>New York90,</i>) iii) Universal access to safe and reliable contraceptive methods (<i>Cairo94</i>)
Education	Education Level	Universal access, and completion of primary education by 2015 (<i>Jomtien90, Cairo94, Beijing95</i>)
	Literacy	Adult literacy reduced by half of the 1990 level by 2000 (<i>Jomtien90, Copenhagen95, Beijing95</i>)
Housing	Living Conditions	Provision of sufficient living space and avoidance of overcrowding (<i>Habitat II</i>)
Security	Crime	Significantly reduce violence and crime (<i>Cairo95</i>)
Population	Population Change	Stabilize world population (<i>Cairo94</i>)
ENVIRONMENTAL		
Theme	Sub-theme	Goals, Targets, and Standards
Atmosphere	Climate Change	i) Reduce overall developed country emissions of CO ₂ equivalents by 5% of 1990 levels by 2008-2012 (<i>Kyoto97</i>) ii) Stabilize GHG concentrations in the atmosphere at a level that prevents dangerous anthropogenic interference with the climate system (<i>FCCC</i>)
		ODS consumption elimination schedule: halons by 1994; CFC, carbon tetrachloride, HBFC, and methyl chloroform by 1996; methyl bromide by 2010; and HCFC by 2030 (<i>Montreal Protocol and Amendments and Adjustments</i>)
	Air Quality	National air quality standards based on WHO air quality guidelines

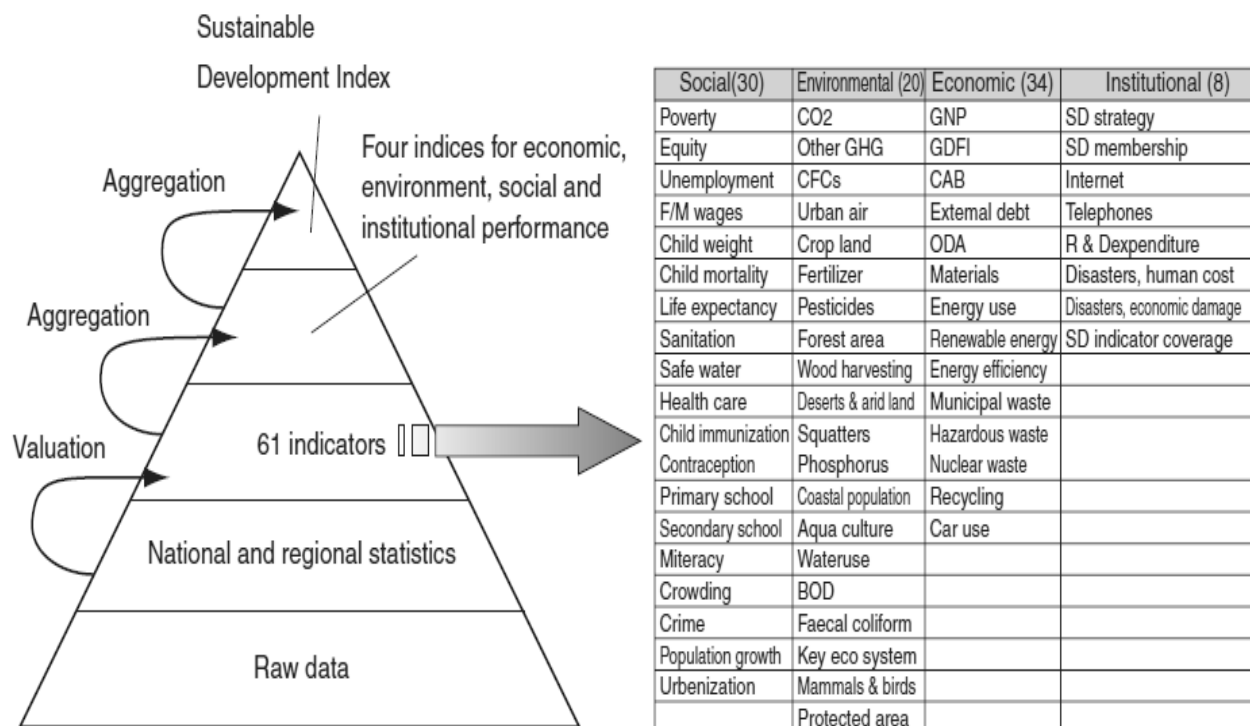
ENVIRONMENTAL (continued)		
Theme	Sub-theme	Goals, Targets, and Standards
Land	Agriculture	Reduce the number of undernourished people to half their present level no later than 2015 (<i>Rome96</i>)
	Forests	i) All tropical timber products traded internationally shall originate from sustainably managed forest by 2000 (<i>International Tropical Timber Organization</i>) ii) National targets set under the sustained yield principle
	Desertification	
	Urbanization	
Oceans, Seas and Coasts	Coastal Zone	
	Fisheries	
Fresh Water	Water Quantity	Withdrawal limits may apply to specific international treaties between countries
	Water Quality	National water quality standards based on WHO guidelines for drinking water quality
Biodiversity	Ecosystem	10% protected area for each major ecosystem type by 2000 (<i>Caracas92</i>)
	Species	
ECONOMIC		
Theme	Sub-theme	Goals, Targets, and Standards
Economic Structure	Economic Performance	
	Trade	
	Financial Status	Total ODA from developed countries should be at least 0.7% of GNP (<i>United Nations</i>)
Consumption and Production Patterns	Material Consumption	
	Energy Use	
	Waste Generation and Management	i) National targets may apply for solid waste reduction and recycling ii) Prevent and minimize the generation of hazardous wastes (<i>Agenda 21</i>) iii) IAEA safety standards for the management of radioactive wastes
	Transportation	
INSTITUTIONAL		
Theme	Sub-theme	Goals, Targets, and Standards
Institutional Framework	Strategic Implementation of SD	National sustainable development strategies that reflect all interests formulated by all countries by 2002 (<i>United Nations General Assembly97</i>)
	International Coop.	
Institutional Capacity	Information Access	
	Communications Infrastructure	
	Science and Technology	One researcher engaged in R&D per 1000 population [for Africa] (<i>UNESCO95</i>)
	Disaster Preparedness and Response	Improve the capacity of each country to mitigate the effects of natural disasters expeditiously and effectively (<i>United Nations General Assembly89</i>)

Core Indicators and the Driving Force-State-Response Framework

SOCIAL					
Theme	Sub-theme	Indicator	DF	S	R
Equity	Poverty	Percent of Population Living below the Poverty Line		X	
		Gini Index of Income Inequality		X	
		Unemployment Rate	X		
	Gender Equality	Ratio of Average Female Wage to Male Wage		X	
Health	Nutrition Status	Nutritional Status of Children		X	
	Mortality	Mortality Rate Under 5 Years Old		X	
		Life Expectancy at Birth		X	
	Sanitation	Percent of Population with Adequate Sewage Disposal Facilities		X	
	Drinking Water	Population with Access to Safe Drinking Water		X	
	Healthcare Delivery	Percent of Population with Access to Primary Health Care Facilities			X
		Immunization Against Infectious Childhood Diseases			X
		Contraceptive Prevalence Rate			X
Education	Education Level	Children Reaching Grade 5 of Primary Education	X		
		Adult Secondary Education Achievement Level	X		
	Literacy	Adult Literacy Rate	X		
Housing	Living Conditions	Floor Area per Person		X	
Security	Crime	Number of Recorded Crimes per 100,000 Population		X	
Population	Population Change	Population Growth Rate	X		
		Population of Urban Formal and Informal Settlements		X	
ENVIRONMENTAL					
Theme	Sub-theme	Indicator	DF	S	R
Atmosphere	Climate Change	Emissions of Greenhouse Gases	X		
	Ozone Layer Depletion	Consumption of Ozone Depleting Substances	X		
	Air Quality	Ambient Concentration of Air Pollutants in Urban Areas		X	
Land	Agriculture	Arable and Permanent Crop Land Area		X	
		Use of Fertilizers	X		
		Use of Agricultural Pesticides	X		
	Forests	Forest Area as a Percent of Land Area		X	
		Wood Harvesting Intensity	X		
	Desertification	Land Affected by Desertification		X	
Oceans, Seas and Coasts	Urbanization	Area of Urban Formal and Informal Settlements		X	
	Coastal Zone	Algae Concentration in Coastal Waters		X	
		Percent of Total Population Living in Coastal Areas	X		
	Fisheries	Annual Catch by Major Species	X		

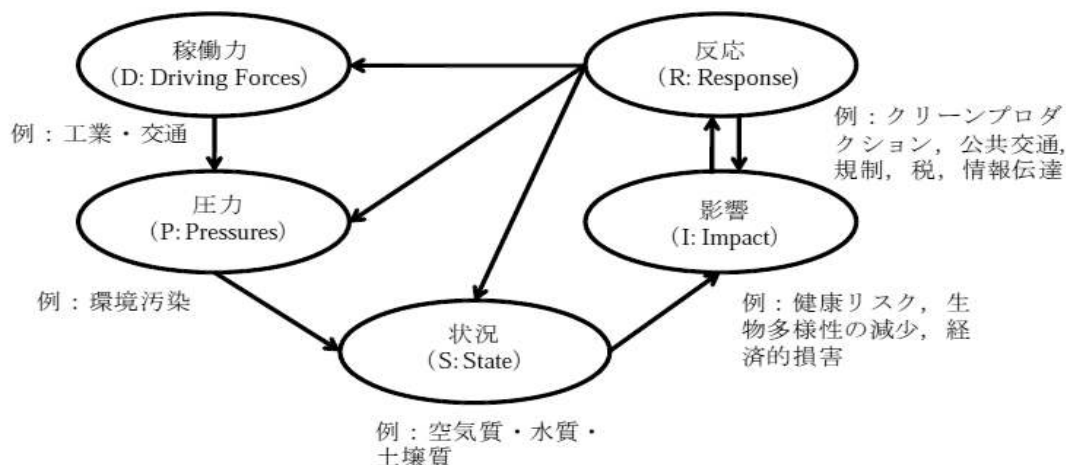
ENVIRONMENTAL					
Theme	Sub-theme	Indicator	DF	S	R
Fresh Water	Water Quantity	Annual Withdrawal of Ground and Surface Water as a Percent of Total Available Water	X		
	Water Quality	BOD in Water Bodies		X	
		Concentration of Faecal Coliform in Freshwater		X	
Biodiversity	Ecosystem	Area of Selected Key Ecosystems		X	
		Protected Area as a Percent of Total Area			X
	Species	Abundance of Selected Key Species		X	
ECONOMIC					
Theme	Sub-theme	Indicator	DF	S	R
Economic Structure	Economic Performance	GDP per Capita	X		
		Investment Share in GDP	X		
	Trade	Balance of Trade in Goods and Services		X	
	Financial Status	Debt to GNP Ratio		X	
		Total ODA Given or Received as a Percent of GNP	X		
Consumption and Production Patterns	Material Consumption	Intensity of Material Use		X	
	Energy Use	Annual Energy Consumption per Capita	X		
		Share of Consumption of Renewable Energy Resources		X	
		Intensity of Energy use		X	
	Waste Generation and Management	Generation of Industrial and Municipal Solid Waste	X		
		Generation of Hazardous Waste	X		
		Generation of Radioactive Waste	X		
		Waste Recycling and Reuse			X
	Transportation	Distance Traveled per Capita by Mode of Transport		X	
INSTITUTIONAL					
Theme	Sub-theme	Indicator	DF	S	R
Institutional Framework	Strategic Implementation of SD	National Sustainable Development Strategy			X
	International Cooperation	Implementation of Ratified Global Agreements			X
Institutional Capacity	Information Access	Number of Internet Subscribers per 1000 Population		X	
	Communication Infrastructure	Main Telephone Lines per 1000 Population		X	
	Science and Technology	Expenditure on Research and Development as a % of GDP			X
	Disaster Preparedness and Response	Economic and Human Loss Due to Natural Disasters	X		

Figure 7 Aggregation between Environmental Indicators and Social Indicators (IISD-Dashhboard)



Source: IISD website

DPSIR (OECD)



(出所) LEAD (Livestock, Environment and Development) Initiative. (1999) より筆者修正

図 1. DPSIRフレームワーク

3. 講義日程

第1部 持続可能な発展（SD）の概念と理論

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3. 持続可能性の理論 4/21、4/28
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5. 途上国の貧困と開発 5/19
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7. 途上国の開発と環境 6/02

第3部 国際開発援助と持続可能な発展

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- 9-10. 開発援助政策の理論と評価 6/16
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