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**Working Party on National Accounts**

**REGIONAL SYSTEM OF INTEGRATED ENVIRONMENT AND ECONOMIC ACCOUNTING  
(Outline of Manual for Developing Regional Hybrid Accounting System Prototype)**

*The complete document is only available in PDF format*

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# **Regional System of Integrated Environment and Economic Accounting (Outline of Manual for Developing Regional Hybrid Accounting System Prototype)**

## **1. Establishment of Japanese Hybrid Accounting System and Development of Regional Hybrid Accounting System**

The Department of National Accounts at the Cabinet Office Economic and Social Research Institute (ESRI) developed the “Hybrid Accounting System Integrating Environmental Pressures and Economic Activities” (hereinafter referred to as the Japanese hybrid accounting system) between fiscal 2001 and 2003 to indicate economic activities in the form of the national accounting matrix (NAM) on a monetary value basis and their environmental pressures in the form of the environmental accounts (EA) on a quantitative basis. This was released as the “New System of Integrated Environment and Economic Accounting” in October 2004.

Later, the department examined problems and challenges for the Japanese hybrid accounting system and concluded that the following two points should be addressed:

### **1) <Specifying waste disposal process>**

The Japanese hybrid accounting system fails to specify the process for disposal of wastes from household and industry sectors as part of economic activities or a physical cycle. This point should be improved as a recycling-oriented society is viewed as desirable.

### **2) <Developing regional accounting system>**

As indicated by the slogan “Think globally, act locally,” every environmental problem originates from local activities. Therefore, a regional hybrid account system should be developed to detect emerging environmental problems and plan effective environmental and economic policies.

In response to the conclusion, the department implemented the “Estimation of a regional system of integrated environmental and economic accounting” in fiscal 2005 and 2006 to specify the waste disposal process. In the course of the estimation, the department created a “manual for developing a regional hybrid accounting system prototype” The manual is aimed at helping prefectural government statistical and environmental administration departments, and researchers at universities and other research institutes. In creating the manual, the department cooperated with the Hyogo Prefecture government to estimate a Hyogo Prefecture pilot case version of the regional hybrid accounting system prototype to specify the waste disposal process.

## **2. Framework and Features of Regional Hybrid Accounting System**

### **(1) Framework of Regional Hybrid Accounting System**

Chart 1 illustrates the concept of a basic table for the regional hybrid accounting system. The basic table consists of economic and environmental accounts. The two-fold parallel accounting system (called hybrid accounting system) is designed to specify the relationship between the economy and environment.

The hybrid accounting system locates the prefectural national accounting matrix (NAM) based on prefectural economic accounting on a monetary value basis on the left upper side. On the left of the matrix and the lower part, an attachment to the NAM records wastes emerging as a result of economic activities

and wastes put into internal disposal operations on a quantitative basis. The environmental accounts (EA) are located on the right of the economic accounts and indicate wastes absorbed by internal disposal operations (waste disposal within waste-emitting facilities) and wastes accumulated in the economy and environment on a quantitative basis.

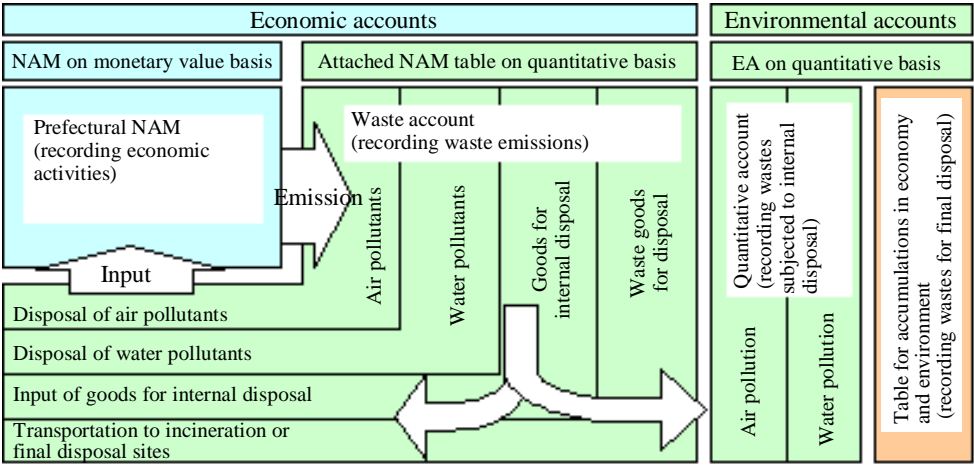


Figure 1 Concept of Basic Table for Regional Hybrid Accounting System

**(2) Features of Regional Hybrid Accounting Systems**

Following are features of the regional hybrid accounting system:

**1) <Quantitative indication of waste disposal process>**

An attached NAM table is designed to quantitatively record details of the process in which waste goods for disposal are emitted through economic activities and put into a recycling path or transported to incineration or final disposal sites.

**2) <Indication of internal disposal operations>**

An attached NAM table is designed to quantitatively record the process in which air or water pollutants emitted through economic activities are reduced by internal disposal operations within pollutant-emitting facilities before being accumulated in the environmental accounts. This would shed light on and appropriately evaluate business facilities' pollutant-reducing efforts under their voluntary goals and their efforts responding to environmental policies of local governments. Such efforts have never been indicated.

**3) <Economic indication of waste disposal and internal operations>**

The NAM includes a mechanism to specifically record economic activities for the above two on a monetary value basis.

**4) <Potential Applications>**

The regional hybrid account system is a prototype that is different from the Japanese hybrid accounting system and fails to include details of materials accounts, environmental problems, environmental indicators or stock accounts. But prefectural governments may be encouraged to add these contents to make their own hybrid account systems.

**3. Estimation Results for Regional Hybrid Accounting System**

Estimation results for the Hyogo Prefecture hybrid accounting system developed as a prototype are described on Tables in the manual for Developing Regional Hybrid Accounting System Prototype. Environmental protection service supply and use tables based on the SEEA2003 have also been prepared and described on Tables in the manual. The service supply and use tables allow viewers to easily see what parties provide sewage treatment, waste disposal, recycling and other environmental protection services and how these services are provided and utilized. These tables have been prepared for 1990, 1995, 2000 and 2003 (see Tables 1, 2 and 3).

Table 1 Basic Table for Regional Hybrid Accounting System (for Hyogo Prefecture in FY 2000)

Economic accounts		Economic accounts																							Attached NAM table (on quantitative basis)										Environmental accounts																																																			
		NAM (monetary value)																							Waste account										EA (quantitative basis)																																																			
		Goods and services accounts											Production account (broken down by category)												Consumption account		Income accrual account				Income distribution and use account				Accumulation account				Quantitative account																																															
		Goods and services other than those specified on the right					Industry						Government service producers						Others						Private final consumption		Gross value added				Current transfers				Capital transfer (net)				Air pollution		Water pollution																																													
Industry	Government service producers	For households and private nonprofit organizations	Recycled products	Waste disposal service	Market	Non-market	Market	Non-market	Others	Industrial activities other than those specified on the right	Recycling activities	Other waste disposal activities	Internal disposal activities in industry	Government activities other than those specified on the right	Waste incineration and final disposal activities	Other waste disposal activities	Sewage treatment activities	Internal disposal activities in government	For households and private nonprofit service producers	Temporary sector (Taxes and tariffs on imports)	Private final consumption (excluding those specified on the right)	Government final consumption	Employee income	Fixed capital consumption	Taxes on production and imports - Subsidies	Operating surplus, mixed income	Current transfers	Institutional sector (net prefectural accrual income)	Institutional sector (net prefectural disposable income)	Capital transfer (net)	Non-financial assets	Institutional sector (net prefectural savings)	Outside the prefecture	CO2	NOx	SOx	COD	T-P	T-N	Goods for internal disposal	Recyclable goods	Goods for incineration	Goods for final disposal	Final waste disposal	CO2	NOx	SOx	COD	T-P	T-N	Accumulated in economic and environmental																																			
1a	1b	1c	1d	1e	1f	1g	1h	1i	1j	2a	2b	2c	2d	2e	2f	2g	2h	2i	2j	2k	3a	3b	3c	4	5	6	7	8	9	10	11	12	13	14	15a	15b	15c	15d	15e	15f	16	17	18	19	20	21a	21b	21c	22a	22b	22c	23																																		
Industry	Government service producers	For households and private nonprofit organizations	Recycled products	Waste disposal service	Market	Non-market	Market	Non-market	Others	Industrial activities other than those specified on the right	Recycling activities	Other waste disposal activities	Internal disposal activities in industry	Government activities other than those specified on the right	Waste incineration and final disposal activities	Other waste disposal activities	Sewage treatment activities	Internal disposal activities in government	For households and private nonprofit service producers	Temporary sector (Taxes on imports, etc.)	Private final consumption (excluding those specified on the right)	Government final consumption	Employee income	Fixed capital consumption	Taxes on production and imports - Subsidies	Operating surplus, mixed income	Current transfers	Institutional sector (net prefectural accrual income)	Institutional sector (net prefectural disposable income)	Capital transfer (net)	Non-financial assets	Institutional sector (net prefectural savings)	Outside the prefecture	CO2	NOx	SOx	COD	T-P	T-N	Goods for internal disposal	Recyclable goods	Goods for incineration	Goods for final disposal	Final waste disposal	CO2	NOx	SOx	COD	T-P	T-N	Accumulated in economic and environmental																																			
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86														

**Table 2 Regional Environmental Protection Service Supply Table (for Hyogo Prefecture in FY 2000)**

Unit: million yen

		Industry				Government service producers				For households and private non-profit service producers	Temporary sector (Taxes and tariffs on imports - Consumption tax on gross capital formation + Imputed interest)	Row total		
		Industrial activities other than those specified on the right	External environmental protection activities		Internal disposal activities in industry	Government activities other than those specified on the right	External environmental protection activities						Internal disposal activities in government	
			Recycling activities	Other waste disposal activities			Waste incineration and final disposal activities	Other waste disposal activities	Sewage treatment activities					
2a	2b	2c	2d	2e	2f	2g	2h	2i	2j	2k				
Goods and services account	Industry	1a	15,524,717	76,324	21,463	12,488	682,062	18,843	44,689		336,285	723,554	17,440,425	
	Government service producers	1b	40,275	0	0		796		0		367		41,438	
	For households and private nonprofit organizations	1c	20	0	0		0		0		0		20	
	Recycled products	1d	102,286										102,286	
	Waste disposal service	1e	50,419				19,857				1,182		71,458	
	Waste disposal	Market	1f	5,724										5,724
		Non-market	1g					513				50		563
	Sewage	Market	1h	27,282	11	404								27,697
		Non-market	1i					3,468	269	7		1,151		4,895
	Others	1j												0
Intermediate input total			15,750,723	76,335	21,867	12,488	706,696	0	19,112	44,696	0	339,035	723,554	17,694,506
Income account	Gross value added	Employee income	4	8,725,717	7,671	35,780	4,009	1,262,843	43,288	14,730	284,862	0	10,378,900	
		Fixed capital consumption	5	3,191,636	1,798	4,872	2,130	464,580	10,619	1,153	32,840	0	3,709,628	
		Taxes on production and imports - Subsidies	6	1,614,737	604	7,441	0	-1,721	369	1,635	5,672	35,109	1,663,846	
		Operating surplus, mixed income	7	5,153,000	1,744	4,088							-723,554	4,435,278
Gross value added total			18,685,090	11,817	52,181	6,139	1,725,702	0	54,276	17,518	0	323,374	-688,445	20,187,652
Goods and services account	Industry	1a	34,435,813			18,627							34,489,549	
	Government service producers	1b					2,432,398						2,432,398	
	For households and private nonprofit organizations	1c									662,409		662,409	
	Recycled products	1d		88,152									88,152	
	Waste disposal service	1e			74,048								74,048	
	Waste disposal	Market	1f						7,427					7,427
		Non-market	1g						65,961					65,961
	Sewage	Market	1h							67,459				67,459
		Non-market	1i							-5,245				-5,245
	Others	1j											0	
Output total			34,435,813	88,152	74,048	18,627	2,432,398	0	73,388	62,214	0	662,409	35,109	37,882,158
Estimation errors			0	0	0	0	0	0	0	0	0	0	0	0

**Table 3 Regional Environmental Protection Service Use Table (for Hyogo Prefecture in FY 2000)**

Unit: million yen

		Goods and services other than those specified on the right			Industry		Government service producers				Row total			
		Industry	Government service producers	For households and private nonprofit organizations	Recycled products	Waste disposal service	Waste disposal		Sewage			Others		
							Market	Non-market	Market	Non-market				
1a	1b	1c	1d	1e	1f	1g	1h	1i	1j					
Domestic output			34,489,549	2,432,398	662,409	88,152	74,048	7,427	65,961	67,459	-5,245		37,882,158	
Statistical mismatches		13	-841,267										-841,267	
Transfer from outside the prefecture		14	14,187,302	31,006	24,781	17,469	3,835	0		4			14,264,397	
Supply total			47,835,584	2,463,404	687,190	105,621	77,883	7,427	65,961	67,463	-5,245	0	51,305,288	
Production account (intermediate demand)	Industry	Industrial activities other than those specified below	2a	15,524,717	40,275	20	102,286	50,419	5,724		27,282			15,750,723
		External environmental protection activities	2b	76,324	0	0					11			76,335
		Other waste disposal activities	2c	21,463	0	0					404			21,867
		Internal disposal activities in industry	2d	12,488										12,488
	Government service producers	Government activities other than those specified below	2e	682,062	796	0		19,857		513			3,468	706,696
		External environmental protection activities	2f											0
		Other waste disposal activities	2g	18,843	0	0						269		19,112
		Sewage treatment activities	2h	44,689	0	0						7		44,696
		Internal disposal activities in government	2i											0
		For households and private non-profit service producers	2j	336,285	367	0		1,182			50		1,151	339,035
Temporary sector (Taxes on imports, etc.)	2k	723,554											723,554	
Intermediate demand total			17,440,425	41,438	20	102,286	71,458	5,724	563	27,697	4,895	0	17,694,506	
Final demand	Consumption account	Private final consumption expenditure	3a	9,921,364	144,496	548,760	3,285	6,416	1,703		39,727			10,665,751
		Internal disposal activities (environmental protection consumption)	3b											0
		Government final consumption	3c	855,409	2,244,072	122,852					65,398		-10,140	3,277,591
	Non-financial assets	12	4,995,035	0	0	50	0	0	0	0	0	0	0	4,995,085
Transfer to outside the prefecture		14	14,623,351	33,398	15,558	0	9	0		39			14,672,355	
Final demand total			30,395,159	2,421,966	687,170	3,335	6,425	1,703	65,398	39,766	-10,140	0	33,610,782	
Demand total			47,835,584	2,463,404	687,190	105,621	77,883	7,427	65,961	67,463	-5,245	0	51,305,288	
Estimation errors (supply - demand)			0	0	0	0	0	0	0	0	0	0	0	

Source: Chapter 7, Manual (p.153)

#### 4. Applications of Regional Hybrid Accounting System

We considered the applications of the regional hybrid accounting system, including indicators, model analyses and regional data's comparison with national data.

##### (1) Environmental Efficiency Improvement Index

The manual for estimation of the regional hybrid accounting system presents the environmental efficiency improvement index that was used as a sustainability indicator for the 2004 “New System of Integrated Environment and Economic Accounting.”

$$\begin{aligned} \text{Environmental Efficiency Improvement Index} &= \left( 1 - \frac{\left( \frac{EP}{DF} \right)_{\text{term-end}}}{\left( \frac{EP}{DF} \right)_{\text{term-start}}} \right) \times 100 \\ &= \left( 1 - \frac{\text{Term-end EP/Term-start EP}}{\text{Term-end DF/Term-start DF}} \right) \times 100 \end{aligned}$$

Here, the DF stands for “driving force” including gross prefectural product and prefectural consumption expenditure and the EP for “environmental pressure.” When the DF grows faster than the EP, the index is positive. A positive index is interpreted as indicating some improvement in environmental efficiency. In the reverse case, a negative index is interpreted as showing some deterioration in environmental efficiency. If prefectural environmental policy costs are adopted as the DF and emissions of the policy's target substance as the EP, the index may be utilized as an indicator of improvement in environmental policy efficiency.

The index may be designed for each environmental theme. Regarding wastes, final waste disposal volume per unit GDP may be indicated. Furthermore, the index may be created for greenhouse gas effects (global warming), acidification or any other theme.

**Table 4** shows analysis results for the Japanese version and the Hyogo Prefecture prototype version. Adopted as the DF is gross prefectural product for gross emissions, production value for emissions attributed to production, and private final consumption expenditure for emissions attributed to private final consumption.

**Table 4 Changes in Environmental Efficiency Improvement Index (decoupling index)**

(Unit: %)

Item			Change from previous data						Note
			FY 1995/1990		FY 2000/1995		FY 2003/2000		
			Hyogo	Japan	Hyogo	Japan	Hyogo	Japan	
Global warming (Greenhouse gas)	CO2, etc.	Emission total	16.38	1.26	-16.63	2.13	-2.07	—	
		From production activities	16.87	-2.69	-18.64	3.45	-2.03	—	
		From private final consumption	-18.13	0.96	-14.49	-7.11	5.43	—	
Acid rain	NOX	Gross emissions	21.29	6.38	-5.85	7.40	-8.72	—	Nitrogen oxide
		From production activities	20.29	3.15	-11.18	4.40	-8.57	—	
		From private final consumption	4.91	-5.45	25.86	30.66	-1.54	—	
	SOX	Gross emissions	29.38	16.97	-0.46	12.93	-11.81	—	Sulfur oxide
		From production activities	28.24	13.61	-4.06	11.35	-11.65	—	
		From private final consumption	15.28	7.11	20.82	26.64	-4.43	—	
Wastes Final disposal volume		Total final disposal volume	28.65	30.86	24.64	34.70	27.67	—	
		From production activities	25.35	—	25.84	—	24.27	—	
		From private final consumption	-6.22	—	37.38	—	68.12	—	

Sources: "System of Integrated Economic and Environmental Accounting," "Hyogo Prefecture System of Integrated Economic and Environmental Accounting," C

Source: Chapter 8, Manual, p.191

## (2) SAM Multiplier Analysis Based on Regional Hybrid Accounting System

In this study, we estimated social accounting matrix (SAM) multipliers. SAM multipliers are used for analyzing economic spillover effects that change in public investment, exports and other variables externalized in the model would have on production of goods and services, household income and the like through the SAM-specified economic cycle (including intermediate trade, distribution of value added to households and household final consumption expenditure).

The hybrid accounting system also features records on pollutants emitted through economic activities, waste disposal processes and waste accumulations. Therefore, we can take advantage of pollutant/waste input, output and accumulation factors from the hybrid accounting system to analyze the emission, disposal and accumulation of pollutants/wastes through invigoration of economic activities.

We analyzed three cases -- "greater export growth," "greater internal disposal activities" and "greater consumption of recycled products by households". Here are the estimation results for the "greater export growth" case.

We used the model for simulation for "a 10% increase in other goods and service" as a specific "greater export growth case." Specifically, the amount of 14.6 trillion yen at the intersection of the "outside the prefecture" row (Row 14) with the "industry for goods and services other than those specified below" (Column 1a) would be increased 10%. The amount is the value of other goods and services exports.

Estimation results are shown in Table 5. In the above case, production through "industrial activities other than those specified below" would increase 7.2% on greater demand. Recycled products for intermediate and final consumption would increase on production and income growth. As waste disposal service consumption expands, production would increase 7.2% through "recycling activities" and 5.4% through "other waste disposal activities." For the same reason, production through government "sewage treatment activities" would rise 7.2%. As a result, net prefectural disposable income would rise 5.8%, employee income 5.7%, and operating surplus and mixed income 8.4%. Private final consumption would grow 5.8%.

Such greater economic production would bring about additional emissions of pollutants and

wastes. 1) The production and consumption expansion would boost CO<sub>2</sub> emissions by 7.0% from a baseline case for CO<sub>2</sub>, NO<sub>x</sub> emissions by 7.1% and SO<sub>x</sub> emissions by 7.2%. 2) The production and consumption expansion would increase CO<sub>2</sub> emissions for internal disposal by 6.3%, NO<sub>x</sub> emissions by 6.7% and SO<sub>x</sub> emissions by 6.8%. 3) Pollutant and waste emissions after reductions through internal disposal would be accumulated. Accumulations would be 7.1% more than in a baseline case for CO<sub>2</sub> and NO<sub>x</sub> and 7.2% more for SO<sub>x</sub>.

Accumulations in 3) should be reduced after internal disposal of pollutants and wastes. But this table, while specifying the pollutant and waste disposal process in 2), fails to estimate eventual emission reductions through internal disposal activities. Effects of internal disposal activities thus fail to be recorded. The accurate estimation of the process in 2) should be a future challenge.

The estimation results also indicate that chemical oxygen demand (COD) would increase 6.5%, total phosphorus (T-P) emissions 6.6% and total nitrogen (T-N) emissions 6.7%. Disposal would expand 3.4% for COD, 4.1% for T-P and 4.5% for T-N. These emissions after reductions through disposal would be accumulated in the environment. A gap between emissions and input may be accumulated without disposal. Accumulations would thus increase 6.5% for COD, 6.6% for T-P and 6.7% for T-N.

Goods for incineration would increase 6.6% or 213,000 tons. In this model, “waste incineration and final disposal activities” are treated as exogenous variables, leading the increase to be accumulated without disposal.

**Table 5 SAM Multiplier Analysis of Greater Export Growth Case (FY 2000)**

					Estimation results	Gap	Ratio(%)	Baseline		
Economic accounts	NAM (monetary value)	Goods and service account	Goods and services other than those specified on the right	Industry	1a	51,299,302.3	3,463,718.3	7.2	47,835,584.0	
				Government service producers	1b	2,474,787.0	11,383.0	0.5	2,463,404.0	
				For households and private nonprofit organization	1c	719,267.1	32,077.1	4.7	687,190.0	
			Industry	Recycled products	1d	113,222.1	7,601.1	7.2	105,621.0	
				Waste disposal service	1e	82,055.7	4,172.7	5.4	77,883.0	
			Government service producers	Waste disposal	Market	1f	7,941.0	514.0	6.9	7,427.0
					Non-market	1g	65,965.7	4.7	0.0	65,961.0
				Sewage	Market	1h	71,783.0	4,320.0	6.4	67,463.0
					Non-market	1i	-5,172.9	72.1	-1.4	-5,245.0
		Production account (broken down by category)	Industry	Industry activities other than those specified below		2a	36,929,269.8	2,493,456.7	7.2	34,435,813.1
				External environmental protection activities	Recycling activities	2b	94,495.9	6,343.9	7.2	88,152.0
					Other waste disposal activities	2c	78,015.3	3,967.3	5.4	74,048.0
				Internal disposal activities in industry		2d	19,975.6	1,348.7	7.2	18,626.9
			Government service producers	Government service producers		2e	2,443,637.8	11,239.8	0.5	2,432,398.0
				External environmental protection activities	Other waste disposal activities	2g	73,906.7	518.7	0.7	73,388.0
					Sewage treatment activities	2h	66,605.9	4,391.9	7.1	62,714.0
				For households and private non-profit service producers		2j	693,329.4	30,920.4	4.7	662,409.0
		Consumption account		Private final consumption	Private final consumption	3a	11,289,176.6	623,425.4	5.8	10,665,751.0
		Income accrual account	Gross value added	Employee income		4	12,164,186.4	655,056.4	5.7	11,509,130.0
				Taxes on production and imports - Subsidies		6	1,781,584.2	117,738.2	7.1	1,663,846.0
				Operating surplus, mixed income		7	4,808,745.2	373,467.2	8.4	4,435,278.0
		Income distribution and use account	Current transfer (by category)		8	18,372,443.4	904,011.4	5.2	17,468,432.0	
			Institutional sector (net prefectural accrual income)		9	37,126,959.2	2,050,273.2	5.8	35,076,686.0	
Institutional sector (net prefectural disposable accrual income)			10	20,756,850.8	1,146,261.8	5.8	19,610,589.0			
Accumulation accounts	Capital transfer (net)		11	219,152.0	0.0	0.0	219,152.0			
	Non-financial asstets		12	5,262,745.3	267,660.3	5.4	4,995,085.0			
	Institutional sector (net prefecture savings)		13	5,315,474.0	270,342.0	5.4	5,045,132.0			

Table 5-2 SAM Multiplier Analysis of Greater Export Growth Case (FY 2000)

						Emissions				Disposal				Accumulations				
						Estimation results			Baseline	Estimation results			Baseline	Estimation results			Baseline	
						Gap	Ratio (%)			Gap	Ratio (%)			Gap	Ratio (%)			
Economic accounts	Attached NAM table (on quantitative basis)	Waste account	Air pollution	CO2 etc	15a	83,081.4	5,418.4	7.0	77,663.0	82,586.0	4,923.0	6.3	77,663.0	0.0	0.0	—	0.0	
				NOx	15b	125,725.5	8,381.5	7.1	117,344.0	125,242.8	7,898.8	6.7	117,344.0	0.0	0.0	—	0.0	
				SOx	15c	52,213.7	3,490.7	7.2	48,723.0	52,057.4	3,334.4	6.8	48,723.0	0.0	0.0	—	0.0	
			Water pollution	COD	15d	31,649.8	1,931.9	6.5	29,717.9	30,728.6	1,010.7	3.4	29,717.9	0.0	0.0	—	0.0	
				T-P	15e	2,064.6	128.4	6.6	1,936.2	2,015.3	79.2	4.1	1,936.2	0.0	0.0	—	0.0	
				T-N	15f	31,897.0	2,005.8	6.7	29,891.2	31,232.9	1,341.7	4.5	29,891.2	0.0	0.0	—	0.0	
			Waste goods for disposal	Goods for internal	16	0.0	0.0	—	0.0	0.0	0.0	—	0.0	0.0	0.0	0.0	—	0.0
				Total emissions		0.0	0.0	—	0.0	0.0	0.0	—	0.0	0.0	0.0	0.0	—	0.0
				Recyclable goods	17	10,170.2	683.8	7.2	9,486.4	10,169.1	682.7	7.2	9,486.4	1.1	1.1	—	0.0	
				Goods for incineration	18	3,419.8	213.0	6.6	3,206.8	3,206.8	0.0	0.0	3,206.8	213.0	213.0	—	0.0	
				Goods for final disposal	19	2,501.9	144.9	6.1	2,357.0	2,357.0	0.0	0.0	2,357.0	144.9	144.9	—	0.0	
			Final waste disposal	20	2,357.0	0.0	0.0	2,357.0	0.0	0.0	—	0.0	2,357.0	0.0	0.0	0.0	2,357.0	
Environmental accounts	EA (quantitative basis)	Quantitative account	Air pollution	CO2 etc	21a	82,659.2	4,996.2	6.4	77,663.0	0.0	0.0	—	0.0	83,154.6	5,491.6	7.1	77,663.0	
				NOx	21b	125,242.8	7,898.8	6.7	117,344.0	0.0	0.0	—	0.0	125,725.5	8,381.5	7.1	117,344.0	
				SOx	21c	52,057.4	3,334.4	6.8	48,723.0	0.0	0.0	—	0.0	52,213.7	3,490.7	7.2	48,723.0	
			Water pollution	COD	22a	30,728.6	1,010.7	3.4	29,717.9	0.0	0.0	—	0.0	31,649.8	1,931.9	6.5	29,717.9	
				T-P	22b	2,015.3	79.2	4.1	1,936.2	0.0	0.0	—	0.0	2,064.6	128.4	6.6	1,936.2	
				T-N	22c	31,232.9	1,341.7	4.5	29,891.2	0.0	0.0	—	0.0	31,897.0	2,005.8	6.7	29,891.2	

Source: Chapter 8, Manual, p.219

### (3) Comparison of Regional (Hyogo Prefecture) and Japanese Hybrid Accounting Systems

Relations between economic activities and their environmental pressures may vary depending on regional economic systems and environmental protection efforts. In analyzing a regional accounting system, therefore, it may be important for us to compare regional data with national data and specify a region's share of waste emissions and environmental protection service spending for the whole of the nation.

Here is a comparison of Hyogo Prefecture data with nationwide data regarding pollutant and waste emissions, and emissions per unit production value and final consumption expenditure (Tables 7 to 11). These tables indicate pollutant and waste emissions in Hyogo Prefecture and Japan, and Hyogo's share of Japan's total emissions. As for pollutant and waste emissions accompanying production activities, we have estimated emissions per unit production value (100 million yen). In a similar way, we have also estimated emissions per unit final consumption expenditure (100 million yen). Hyogo's emissions per unit production value and final consumption expenditure are compared with nationwide data for 2000.

**Table 6** indicates population, production value, gross domestic or prefectural product and final consumption expenditure data for Japan and Hyogo Prefecture. It shows that Hyogo accounts for 4.4% of Japan's population, 4.0% of the nation's production value and gross domestic product, and 3.8% of nationwide final consumption expenditure.

**Table 6 Comparison of Population, Production Value, Gross Domestic Product and Final Consumption Expenditure Data (between Japan and Hyogo Prefecture for 2000)**

	Population	Production value (in producer prices)	Gross domestic (prefectural) product (in producer prices)	Final consumption expenditure (for private and government sectors)
	1,000 persons	1 billion yen	1 billion yen	1 billion yen
Japan	126,887	941,271	506,373	369,770
Hyogo Prefecture	5,551	37,882	20,188	13,943
Hyogo's share (%)	4.4	4.0	4.0	3.8

**Table 7** shows a comparison of air pollutant emissions, and emissions per unit production value and final consumption expenditure in Japan and Hyogo Prefecture.

Hyogo's CO<sub>2</sub> emissions accompanying final consumption totaled 8,663,000 t-CO<sub>2</sub> accounting for 3.8% of nationwide emissions. Hyogo's CO<sub>2</sub>, NO<sub>x</sub> and SO<sub>x</sub> emissions accompanying production and its NO<sub>x</sub> and SO<sub>x</sub> emissions accompanying final consumption captured 6.0% of the Japanese total.

Hyogo's CO<sub>2</sub> emissions per final consumption expenditure came to 62.1 tons CO<sub>2</sub>

equivalent per 100 million yen, equivalent to 102.1% of the nationwide level. This means that Hyogo's CO<sub>2</sub> emissions per final consumption expenditure are almost equal to the nationwide level. In contrast, production-caused CO<sub>2</sub>, NO<sub>x</sub> and SO<sub>x</sub> emissions per production value and consumption-caused NO<sub>x</sub> and SO<sub>x</sub> emissions per final consumption expenditure are some 50% more than national levels.

**Table 7 Air Pollutant Emissions, and Emissions per Unit Production Value and Final Consumption Expenditure (in Japan and Hyogo Prefecture for 2000)**

		Air pollutant emissions			Air pollutant emissions per unit production value and final consumption expenditure		
		CO <sub>2</sub> , etc.	NO <sub>x</sub>	SO <sub>x</sub>	CO <sub>2</sub>	NO <sub>x</sub>	SO <sub>x</sub>
		1,000 t-CO <sub>2</sub>	1,000 t-NO <sub>x</sub>	1,000 t-SO <sub>x</sub>	t-CO <sub>2</sub> /100 million yen	Kg-NO <sub>x</sub> /100 million yen	Kg-SO <sub>x</sub> /100 million yen
Production activities	Japan	1,107,922	1,889	775	117.7	200.6	82.3
	Hyogo Prefecture	69,000	109	46	182.1	288.0	121.6
	Hyogo's share, ratio (%)	6.2	5.8	5.9	154.8	143.5	147.7
Final consumption	Japan	225,023	143	45	60.9	38.7	12.2
	Hyogo Prefecture	8,663	8	3	62.1	59.2	19.2
	Hyogo's share, ratio (%)	3.8	5.8	5.9	102.1	153.1	157.6

**Table 8** shows a comparison of water pollutant emissions, and emissions per unit production value and final consumption expenditure in Hyogo Prefecture and Japan.

Hyogo's COD and T-N emissions accompanying production activities and final consumption expenditure account for about 4.0% of Japan's total. Emissions per unit production value and final consumption expenditure were equal to or less than the national levels. Overall, these Hyogo figures were slightly lower than national levels.

T-P emissions accompanying production activities in Hyogo accounted for 4.8% of Japan's total. Those accompanying final consumption captured 4.0% of Japan's total. Hyogo's T-P emissions per unit production value came to 118.1% of the national level and those per unit final consumption expenditure stood at 106.5% of the national level. These emissions per unit production and consumption in Hyogo were slightly higher than national levels.

**Table 8 Water Pollutant Emissions, and Emissions per Production Value and Final Consumption Expenditure (in Japan and Hyogo Prefecture for 2000)**

		Water pollutant emissions			Water pollutant emissions per unit production value and final consumption expenditure		
		COD	T-P	T-N	COD	T-P	T-N
		1,000 t	1,000 t	1,000 t	kg/100 million yen	Kg/100 million yen	Kg/100 million yen
Production activities	Japan	360	23	466	38.2	2.4	49.5
	Hyogo Prefecture	14	1	19	36.8	2.9	48.9
	Hyogo's share, ratio (%)	3.9	4.8	4.0	96.4	118.1	98.8
Final consumption	Japan	406	21	325	109.8	5.7	87.9
	Hyogo Prefecture	16	1	11	113.0	6.0	81.5
	Hyogo's share, ratio (%)	3.9	4.0	3.5	102.9	106.5	92.7

**Tables 9 to 11 show waste emission data in Japan and Hyogo Prefecture.**

**Table 9** indicates waste emissions accompanying production activities and final consumption, and emissions per unit production value and final consumption expenditure in Hyogo Prefecture.

Hyogo's waste emissions accompanying production activities totaled 27,337,000 tons accounting for 6.4% of Japan's total. Those accompanying final consumption came to 1,806,000 tons capturing 5.0% of the national total.

Hyogo's waste emissions per unit production value stood at 72,164 kilograms per 100 million yen, some 60% higher than the national level. Those per unit final consumption expenditure were about 30% higher than the national level. These Hyogo figures were thus much higher than national levels.

**Table 9 Waste Emissions, and Emissions per Unit Production Value and Final Consumption (in Japan and Hyogo Prefecture for 2000)**

		Wastes	
		Emissions	Emissions per unit production value and final consumption expenditure
		1,000 t	Kg/100 million yen
Production activities	Japan	424,841	45,123
	Hyogo Prefecture	27,337	72,164
	Hyogo's share, ratio (%)	6.4	159.9
Final consumption	Japan	35,992	9,734
	Hyogo Prefecture	1,806	12,949
	Hyogo's share, ratio (%)	5.0	133.0

**Table 10** gives a comparison of recyclable goods emissions accompanying production activities and final consumption, and recycled volume per unit production value in the recycling industry in Hyogo Prefecture and Japan.

Hyogo Prefecture's recyclable goods emissions came to 9,486,000 tons accounting for 4.9% of Japan's total. Recycled volume per unit production value in the recycling industry stood at 10,761 tons per 100 million yen, equivalent to only 87.6% of the national level. The Hyogo level is thus lower than the national level.

**Table 11** indicates a comparison of final waste disposal volume and volume per unit production value in the waste disposal industry in Hyogo Prefecture and Japan. Hyogo's final waste disposal volume totaled 2,357,000 tons accounting for 4.2% of Japan's total. Final disposal volume per unit production value in the waste disposal industry stood at 1,599 tons per 100 million yen, equivalent to 97.6% of the national level.

**Table 12** indicates examples of regional environmental assessment indexes.

The indexes are as follows.

- 1) Hybrid accounting: Input-output ratio, Goal attainment ratio, others
- 2) Corporate activity index: Environmental conservation activities, Environmental conditions, Waste disposal activities
- 3) Other indexes: Others (Economic efficiency indicator, Induced final disposal volume, and General social indicators)

**Table 10 Recyclable Goods Emissions and Recycled Volume per Production Value in Recycling Industry (in Japan and Hyogo Prefecture for 2000)**

		Recyclable goods emissions	Recycled volume per production value in recycling industry
		1,000 t	t/100 million yen
Production activities	Japan	186,700	11,955
	Hyogo Prefecture	9,266	10,511
	Hyogo's share, ratio (%)	5.0	87.9
Final consumption	Japan	5,160	330
	Hyogo Prefecture	221	250
	Hyogo's share, ratio (%)	4.3	75.7
Total	Japan	191,860	12,285
	Hyogo Prefecture	9,486	10,761
	Hyogo's share, ratio (%)	4.9	87.6

**Table 11 Emissions of Wastes for Final Disposal and Final Disposal Volume per Unit Production in Waste Disposal Industry (in Japan and Hyogo Prefecture for 2000)**

		Final waste disposal volume	Final waste disposal volume per production value in waste disposal industry
		1,000 t	t/100 million yen
Production activities	Japan	48,613	1,435
	Hyogo Prefecture	2,154	1,461
	Hyogo's share, ratio (%)	4.4	101.8
Final consumption	Japan	6,901	204
	Hyogo Prefecture	203	138
	Hyogo's share, ratio (%)	2.9	67.6
Total	Japan	55,514	1,639
	Hyogo Prefecture	2,357	1,599
	Hyogo's share, ratio (%)	4.2	97.6

**Table 12 Examples of Regional Environmental Assessment Indexes**

Index	Item	
Hybrid accounting system indexes	Input-output ratio	Benefit/cost
	Goal attainment ratio	Achievement/Goal Environmental pressure indicators
	Others	Wastes Air environment
Corporate activity index	Environmental conservation activities	Environmental conservation Environmental assessment
	Environmental conditions	Environmental loss from internal factors Environmental loss from external factors
	Waste disposal activities	Environmental conservation cost Raw materials cost for disposal Capital cost for disposal Labor cost for disposal
Other indexes	Others	Economic efficiency indicator Induced final disposal volume General social indicators

Source: "Manual for Developing Regional Hybrid Accounting System," Cabinet Office, 2007