

STUDY ON PRIORITIZATION OF ADAPTATION TO CLIMATE CHANGE IN ODA PROJECTS

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Amounts of Japan's official development assistance (ODA) provided to climate-sensitive sectors and its shares among the total ODA funding are analyzed. The methodology developed by Agrawara using "Organization for Economic Co-operation and Development / Creditor Reporting System (OECD/CRS)" database is utilized to identify 14 climate-sensitive sectors out of 37 development sectors. In this paper, apart from data derived from the CRS database, Japanese ODA funding data are collected from the "ODA data book 2006" in order to carry out in-depth analysis of individual projects. The 49 countries receiving more than US\$ 100 million, in principle, of net amount in ODA funding from 2001 to 2005 are selected among 151 countries supported with Japanese ODA over the 5 years.

Japanese ODA has contributed to improve climate resilience in developing countries through funding the construction of basic infrastructures and implementing projects such projects as water and food security. The shares of ODA in climate-sensitive sectors in the total ODA funding vary with regions, ranging from 20% to 50%. They reflect the developmental level and the socio-economic situation of recipients. For example, Asia receives the largest amount of ODA from Japan and its share to climate-sensitive sectors is 50–70%. Africa receives the second largest ODA from Japan; however, its share to climate-sensitive sectors is less than 20%.

Based on this study, the following steps would be effective in the promotion of mainstreaming adaptation in development policies: (i) implementing impact and vulnerability assessment of climate change in the target country and region, as the first step of resilience building; (ii) analyzing past development projects and their relation to climate risk, to learn from past experiences; and (iii) prioritizing projects by taking into consideration both the extent of climate change risks and the needs of the target countries, which are determined by a country's socio-economic development situation.

Key Words : *climate change, adaptation, development, ODA*

1. INTRODUCTION

The impacts of climate change have been observed all over the world. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR4)¹⁾ mentioned that it is likely that anthropogenic warming has had a discernible influence on many physical and biological systems. At the Toya Summit in July, 2008, the G8 leaders

agreed to curb world greenhouse gas emissions at least by half by 2050. However, according to IPCC, even though we achieve such a strict target, adaptation will be necessary to address impacts resulting from the warming which is already unavoidable due to past emissions¹⁾. Therefore, it is necessary to implement climate change policies internationally, which balances the measures that mitigate greenhouse gas emissions and those that allow adaptation to climate change.

The impacts of climate change fall into direct influences resulting from extreme climate events such as heat waves, windstorms, and floods; secondary impacts such as increases in infectious diseases, deterioration in sanitation, and impacts on ecological systems; and higher-order impacts such as increased poverty, scarcity of employment opportunities, and economic instability²⁾. Climate changes will indirectly induce such socio-economic impacts throughout the world, but particularly in developing countries, and that will inhibit from achieving Millennium Developing Goals (MDGs)³⁾.

It is important to recognize that individual adaptation measures are not effective to cope with climate change impacts. In developing countries, it is essential to improve resilience against various environmental changes by considering the impacts of, and vulnerability to, climate change when designing development policies, such as poverty alleviation programs, disaster prevention plans, nature conservation policies, agriculture, forestry, and fisheries policies, and water resource management plans⁴⁾.

In Japan, in the Kyoto Protocol Target Achievement Plan was decided by the Cabinet in April, 2005. In this plan, it was decided to continue financial aid for development measures, including adaptation measures in Small Island Development States (SIDS) and in Least Developing Countries (LDCs)⁵⁾. Based on that plan, in 2007, the Expert Committee of the Ministry of Foreign Affairs of Japan noted the following: an effective point of departure for adaptation measures is to pursue that adaptive endeavors to current climate variability, such as shortages of water resources and foods, prevention of meteorological disasters and health diseases, which will reduce vulnerability to future climate change. Another important perspective is to mainstream adaptation to climate change by proactively taking future climate change risks into consideration in current development planning and assistance⁶⁾.

Taking into consideration the above background, we analyzed the amounts and shares of Japan's bilateral official development assistance (ODA), provided in recent years to various development sectors in developing countries, which are potentially influenced by climate change. Based on the results of our analysis, we recommend strategies for prioritizing development sectors to adapt to future climate change impacts.

2. RELATION BETWEEN EXPENDITURE OF JAPANESE ODA AND CLIMATE RISK

(1) Methods

In order to implement adaptation measures in developing countries effectively, it is important to understand the extent to which development projects are affected by climate change. In this chapter, we calculate the aid amounts for development sectors potentially affected by climate impacts (hereafter, these development sectors will be called "climate risk sectors") and those for other sectors in terms of recent ODA projects supported by the Japanese Government, and regional characteristics of the shares in aid amounts for climate risk sectors were analyzed.

In this paper, we used the methodology developed by Agrawara⁸⁾ using Organization for Economic Co-operation and Development (OECD)/Creditor Reporting System (CRS)⁷⁾ database to specify climate risk sectors. The CRS database classifies ODA and other concessional finances into 37 purpose codes, which are the development sectors designated by the OECD/Development Assistance Committee (DAC). It also records amounts of ODA and other concessional finances paid by donor countries in each purpose code (Table 1). Among these codes, Agrawara⁸⁾ identified the following sectors as narrowly defined sectors potentially affected by climate change: "infectious disease," "water supply and sanitation," "economic and development policies," "social infrastructure service," "renewable energy," "agriculture, forestry, and fisheries," "tourism," "environmental conservation," and "urban and rural development." Among them, development projects in sectors such as "infectious disease," "water supply and sanitation," and farm development projects in "agriculture, forestry, and fisheries" are those that meet basic human needs in poor countries (so-called basic human needs sectors). Projects for basic human needs sectors are normally implemented with grant aid.

In addition to the aforementioned narrowly defined climate-sensitive sectors, there are broader sectors including "transport and storage," "food aid (food security)," and "urban and rural development," which are identified as broadly defined climate-sensitive sectors (According to Table 1, broadly defined climate-sensitive sectors comprise 14 DAC purpose codes). Other sectors such as "education" and "communications" are considered to be much less affected by climate change and are, therefore, classified as "non-climate-sensitive"

Table 1 OECD/DAC and CRS purpose codes in the selection of climate change projects^{7), 8)} Note: some codes shown in this table have been modified by the OECD, since publication of the paper by Agrawara⁸⁾; thus, the purpose codes in this table may not coincide with those analyzed by Agrawara⁸⁾

DAC purpose codes	Description	Sectors and DAC/CRS purpose codes classified into those that are affected by climate risk
110 (111, 112, 113, 114)	Education	Not included
120 (121, 122)	Health	Infectious diseases (122/12250)
130	Population policies/programs and reproductive health	Not included
140	Water supply and sanitation	All activities
150 (151, 152)	Government and civil society	Economic and development policy/planning (151/15110)
160	Other social infrastructure and services	Not included
210	Transport and storage	All activities
220	Communications	Not included
230	Energy generation and supply	Power generation (renewable sources) (230/230230) Hydroelectric power plants and other renewable energy (230/23065–23070)
240	Banking and financial services	Not included
250	Business and other services	Not included
311	Agriculture	All activities
312	Forestry	All activities
313	Fishing	All activities
321	Industry	Not included
322	Mineral resources and mining	Not included
323	Construction	Not included
331	Trade policy and regulations	Not included
332	Tourism	All activities
400 (410, 420, 430)	Multi-sector/cross-cutting	General environmental protection (410) Urban development and management (430/43030) Rural development (430/43040)
500 (510, 520, 530)	Commodity aid and general assistance	Food aid/security programs (520)
600	Action relating to debt	Not included
700 (710, 720, 730)	Emergency assistance and reconstruction	Emergency food aid (710) Reconstruction relief (730)
910	Administration costs of donors	Not included
920	Support to NGOs	Not included
998	Unallocated/unspecified	Not included

sectors.

Although the reason why the climate-sensitive sectors were chosen has not been explained thoroughly by Agrawara⁸⁾, it was suggested that narrowly defined climate-sensitive sectors are particularly relevant to climate change. For example, “water supply and sanitation” and “agriculture, forestry, and fishing” are vulnerable to climate-related disasters such as droughts and floods. Furthermore, some developing countries may become more vulnerable to infectious diseases due to future climate change, while “urban and rural development” may also be affected by climate change. On the other hand, according to Agrawara⁸⁾, the 3 additional broadly defined sectors have some different characteristics from the narrowly defined sectors. The “transport and storage” sector accounts for a relatively large share of the development portfolio, unlike the narrowly defined sectors such as infectious diseases. Infrastructure projects in the “transport and storage” sector are usually designed

based on detailed engineering studies, which, at the least, consider current climate risks⁸⁾ The “food aid” and “emergency assistance” sectors were not considered climate change sensitive, because activities in these sectors are generally reactive and planned as short-term projects.

Although this methodology for the classification of climate risk sectors is based on a rough estimate, we used this methodology because our paper aimed at obtaining a macroscopic view of resource allocations to climate-sensitive sectors from Japan’s ODA funding. Therefore, some development projects that have been classified into the climate-sensitive sectors might be less relevant in terms of climate risks.

In this paper, ODA amounts provided to climate-sensitive sectors and its shares among the total ODA funding were calculated using the above sector classifications. Japanese ODA funding data were collected from the “ODA Data Book 2006⁹⁾” (hereafter called the “ODA Data Book”), which allows in-depth analysis of individual projects.

There are 3 types of Japanese ODA projects: yen loans, grant aid, and technical cooperation¹⁰⁾. A yen loan is provided to developing countries at low interest rates with longer repayment periods. Such loans encourage self-supporting efforts by developing countries and in many cases, may be used for large projects such as infrastructure construction. Grant aid has no repayment obligation, and is primarily provided to developing countries with lower income levels and it mainly aims to fulfill basic human needs, such as medical and health care, sanitation, environmental improvement, and human resource development. Technical cooperation covers human resource development, technical training, dispatching specialists, and supporting strategic plan development.

According to the ODA Data Book⁹⁾, the Japanese Government supported 151 countries with ODA funding between 2001 and 2005. Among them, we selected those countries that received more than US\$ 100 million of net amount in ODA funding over those 5 years, where debt repayment was subtracted from the amount of funding. As for the oceanic countries, US\$ 50 million was used as the criterion instead because of their smaller economies. Furthermore, we eliminated Myanmar, Afghanistan,

and Iraq, as these countries have not disclosed their Gross National Income (GNI) in these 5 years. For reference, the Japanese Government has paid more than US\$ 400 million for Afghanistan and more than US\$ 4 billion for Iraq. However, most of the funding was used mainly for reconstruction projects. Finally, we selected 49 countries for our study.

In this paper, we divided these 49 selected countries into 8 regions according to the classification used in the ODA Data Book⁹⁾. They are East Asia, Southwest Asia, Central Asia and Caucasus, Middle East, Africa, Central/Latin America, Oceania, and Europe (Table 2). Countries receiving Japanese ODA were limited to SIDS in Oceania, Middle and Eastern Europe, the Baltic, and the former Soviet Union for Europe. According to Table 2, the selected countries account for 81% of the ODA amount, though they comprise only one-third of the total number of countries. Therefore, we decided that calculating the shares of Japanese ODA funding to these 49 countries would be appropriate to represent a general picture of Japanese ODA funding.

Based on the Agrawara⁸⁾ classification of climate-sensitive sectors, we determined whether each project implemented in these 49 countries was

Table 2 Fundamental information on 49 developing countries selected in the study

Region	GNI per capita (US dollars)	Number of aid recipient countries	Net disbursements on bilateral ODA (million US dollars)	Number of countries selected for case study ¹	Aid amount for countries selected for case study (million US dollars)	Proportion of selected countries in region	Proportion of regional ODA provided to selected countries
East Asia	1,411	11	12,920	8	13,578	82%	105%
Southwest Asia	611	7	4,180	5	4,055	71%	97%
Central Asia and Caucasus	1,095	8	1,338	4	1,146	50%	86%
Middle East	1,416	17	5,417	4	793	24%	15%
Africa	349	46	3,736	12	2,664	26%	71%
Central/Latin America	2,762	32	2,495	9	2,211	28%	89%
Oceania	2,935	14	375	3	196	21%	52%
Europe	3,086	16	891	4	650	25%	73%
Total	1,120	151	31,351	49	25,293	33%	81%

Note: Countries receiving Japanese ODA of more than US\$ 1 million over five years (2001–2005) were selected. In the case of Oceania, countries with more than US\$ 500 thousand were selected. Myanmar, Afghanistan, and Iraq were excluded because their GNIs were unknown. (Net disbursement: repayments of loans by borrowers have been subtracted.)

Selected countries¹ within each region are as follows:

East Asia (8 countries): Indonesia, Cambodia, China, Philippines, Vietnam, Malaysia, Mongolia, Laos

Southwest Asia (5 countries): India, Sri Lanka, Nepal, Pakistan, Bangladesh

Central Asia and Caucasus (4 countries): Uzbekistan, Kazakhstan, Kirgiz, Azerbaijan

Middle East (4 countries): Egypt, Tunisia, Morocco, Jordan

Africa (12 countries): Angola, Ethiopia, Ghana, Kenya, Democratic Republic of Congo, Zambia, Senegal, Tanzania, Nigeria, Madagascar, Malawi, Mozambique

Central/Latin America (9 countries): El Salvador, Guatemala, Dominican Republic, Nicaragua, Paraguay, Brazil, Peru, Bolivia, Honduras

Oceania (3 countries): Samoa, Republic of Palau, Fiji

Europe (4 countries): Serbia-Montenegro, Bulgaria, Bosnia and Herzegovina, Romania

classified into climate-sensitive sectors. For each country, we determined the aid amounts in both narrowly and broadly defined climate-sensitive sectors and their share to the total aid amount. Debt forgiveness, as listed in the classification of ODA Data Book⁹⁾ and the CRS database⁸⁾, was counted as an expenditure by the recipient countries. On the other hand, repayment of loans by recipients was neglected in the calculation because this paper only aimed to analyze the allocation of Japan's ODA. Technical cooperation projects, the third type of ODA, were included in the total aid amount of each recipient country; however, they were not used in calculating climate-sensitive sectors, because the amount assigned to each technical cooperation project was unknown.

(2) Results

Figure 1 shows the regional distribution of Japanese ODA funding from 2001 to 2005 to the 49 selected countries in the narrowly and broadly defined climate-sensitive sectors based on the method mentioned above. **Table 3** presents a regional comparison of the shares of Japanese ODA amounts in the major climate-sensitive sectors. The aid to the 8 countries selected in East Asia and the 5 countries selected in Southwest Asia over the 5 years amounted to more than one trillion yen and accounted for 73% of the total Japanese ODA funding in the same period. After Asia, the next biggest share of ODA funding was in the 12 countries selected in Africa, which accounted for nearly 500 billion yen over the 5 years. In **Table 2**, Egypt and Morocco are placed in the Middle East according to the ODA Data Book. Therefore, it is assumed that the ODA share by all African countries would be more than the amount shown in **Figure 1**.

Figure 1 and **Table 3**, show that the broadly defined climate-sensitive sectors account for a relatively large share of the total ODA expenditure. These broad sectors account for more than 50% of the ODA in East Asia, Southwest Asia, and Middle East, while they accounted for less than 20% in the African region. Among the 12 selected African countries, aid to the broad sectors was less than 100 billion yen, of which 51% was spent on debt forgiveness.

Table 3 compares the shares of climate-sensitive sectors. The "transport and storage" sector accounted for either the largest or the second largest share in each region. The other high share climate-sensitive sectors were "environmental conservation" in East Asia, "water supply and sanitation" in Southwest Asia, Central Asia and Caucasus and Europe, "food aid" in Africa, and "agriculture, forestry, and fishing" in Oceania. "Environmental conservation"

in East Asia accounted for 14.6% of the total aid, which overwhelmed the share of aid in other regions because of the undertaking of environmental aid projects in China. In the African region, 2.5% of the total aid amount was used for "infectious disease" projects and 3.1% of that was for "food aid," which means that projects on basic human needs were particularly focused on in this region.

Table 2 suggests that the Southwest Asian and African regions can be considered as the least developed regions in the world, since the GNI per capita of both these regions is less than US\$ 1000. However, the development projects in these two regions were different. In Southwest Asia, there were several yen loan projects in the "water supply and sanitation," "transport," and "agriculture" sectors. On the other hand, there were few projects in climate-sensitive sectors in Africa, where aid, in the form of grants, was predominantly spent on infectious disease control, support for poor farmers, and food aid with grant aid.

This analysis indicates that the shares of the total ODA within the climate-sensitive sectors varies regionally and ranged from 20% to 50%. This suggests that Japanese ODA has contributed in improving climate change-related resilience in ODA recipient countries through the construction of basic infrastructures and implementing projects aimed at reducing water and food scarcity, natural disasters, and health problems.

3. CLIMATE SENSITIVITY AND ADAPTATION MEASURES

The World Bank¹¹⁾ estimated that ODA and concessional finances would be affected by climate change, and that additional costs to adapt to climate risks resulting from changes in the design of conventional facilities and structures in development projects may be 10–20% of the original development budget. Based on that estimate, Takemoto and Mimura⁴⁾ estimated that worldwide, the additional annual costs for ODA projects that incorporate climate risks would be US\$ 2.2–4.3 billion while other international organizations have also estimated such global adaptation costs in developing countries (**Table 4**).

The World Bank estimated that the adaptation costs associated with ODA and other concessional finances, Foreign Direct Investment (FDI) and Gross Domestic Investment (GDI) would reach from US\$ 4 billion to 41 billion annually¹¹⁾. The United Nations Development Programme (UNDP) indicated that costs for adaptation to climate change impacts in

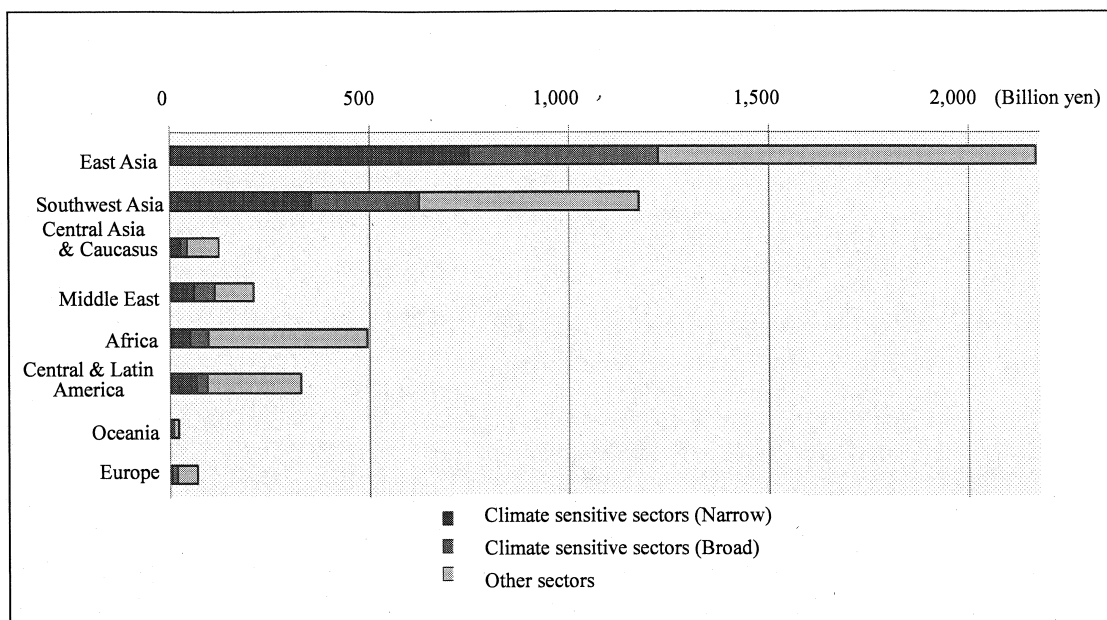


Figure 1 Regional distribution of Japanese ODA funding from 2001 to 2005 to the 49 selected countries in the narrowly and broadly defined climate-sensitive sectors.

Table 3 Comparison of regional shares of Japanese ODA amounts in 49 selected countries over 2001–2005 in major sectors affected by climate risk (units = %). Technical cooperation projects were excluded in accounting sectors affected by climate risk. Shaded cells show the 2 climate-sensitive sectors accounting for the largest aid amounts within each region.

Region	ODA amount (billion yen)	Sectors affected by climate risk (broad)	Infectious disease	Water supply and sanitation	Transport and storage	Agriculture, forestry, and fishing	Environmental conservation	Food aid	Emergency aid
East Asia	2,168	56.4	0.3	8.9	21.6	5.5	14.6	0.3	0.1
Southwest Asia	1,175	53.1	1.2	10.9	21.8	9.6	1.9	0.3	1.0
Central Asia and Caucasus	122	34.5	0.0	18.0	14.2	2.2	0.0	0.1	0.0
Middle East	209	52.7	0.6	13.6	23.8	4.3	0.6	0.0	0.0
Africa	492	19.4	2.5	2.9	5.6	2.7	0.0	3.1	0.4
Central/Latin America	327	28.5	0.4	9.5	9.0	2.7	0.0	0.0	0.1
Oceania	22	31.4	0.0	0.0	25.6	5.5	0.1	0.0	0.2
Europe	67	26.9	0.0	1.1	23.7	0.0	0.0	0.0	0.0

Table 4 Estimation of future annual adaptation costs in developing countries ^{4), 11), 12), 13)}

Takemoto and Mimura	US\$ 2.2–4.3 billion	Additional conventional ODA to
World Bank	US\$ 4–41 billion	Additional financial investments
UNDP	US\$ 86 billion	By 2015
UNFCCC	US\$ 28–67 billion	By 2030

development finance would amount to US\$ 86 billion worldwide¹²⁾. Furthermore, the United Nations Framework Convention on Climate Change (UNFCCC) estimated that the additional cost for

climate adaptation measures in non-Annex I parties (i.e., developing countries) would range from US\$ 28 billion to US\$ 67 billion¹³⁾ by 2030.

In addition to the development finance schemes described above, there are frameworks on multilateral funds available under the UNFCCC and other organizations that aim at implementing climate adaptation measures, such as the Least Developed Countries Fund (LDCF), the Special Climate Change Fund (SCCF), and the Global Environment Facility (GEF). However, the total amount available will be

less than US\$ 275 million. In addition, an Adaptation Fund may be available by 2010 under the Kyoto Protocol; however, it can only provide between US\$ 80 million and US\$ 300 million. There is a possibility that the available funds may be increased through a new framework on climate change to be established for the post-2013 period. However, even if we take these factors into account, it will be difficult to fully cover the additional costs of such adaptation⁴⁾.

The Expert Committee of the Ministry of Foreign Affairs of Japan recommended “to mainstream adaptation to climate change by proactively taking future climate change risks into account in current development planning and assistance”⁶⁾. This approach would overcome the conflict between the responses to climate change and the development needs of developing countries, and would bring about a win-win situation in sustainable development planning. However, given the financial situation mentioned above, prioritizing development policies with a focus on climate change adaptation is required. In the following section of this paper, a possible prioritization of adaptation measures in Asia and Africa is examined.

(1) Climate risk and priority in adaptation measures in Asia

In Asia, about 4 billion people, which are nearly 60% of the world population, reside and the number is projected to increase further in the 21st century. Asia has achieved a high level of economic growth, particularly China and ASEAN countries, and it is anticipated that the share of Asian GDP to the world's total GDP will increase to approximately 30% by 2015¹⁴⁾. Thailand and Malaysia are in transition to become donors to less developed countries, and China has not taken yen loans before the 2008 Beijing Olympic Games. In general, the number of countries that are, or will soon be, no longer recipients of ODA is increasing in Asia. Such widespread economic development will contribute to enhancing the region's potential resilience to climate change. On the other hand, there are a number of countries that need financial support, including ODA, such as Cambodia and Bangladesh that are still least developed within the region. Similarly, India needs funding for a number of large infrastructure projects⁹⁾.

The IPCC AR4 indicates that crop yields in Asia are likely to decrease substantially by the end of this century¹⁾. For example, it is projected that crop yields in Central Asia (30–50°N, 40–75°E) and Southern Asia (30–50°N, 75–100°E, i.e., most of Southwest Asia) may decrease by up to 30% even if direct positive physiological effects of CO₂ are taken into account¹⁾.

With regard to water resources, populations experiencing water related stresses, such as flooding or drought, are projected to increase from 120 million to 1.2 billion¹⁾. In Asia, nearly half of the population currently resides in the coastal zone, and it is anticipated that people living in inland rural areas will migrate to coastal cities¹⁵⁾¹⁶⁾. With accelerated rising of sea level and increased storminess, coastal areas in Asia are particularly vulnerable to climate change impacts. It is also projected that urban environment problems such as air and water pollution, heat-island effects, transportation-induced pollution, and hygiene problems in slum areas will be exacerbated; such impacts will be superimposed on other adverse effects of climate change¹⁾¹⁶⁾.

The East Asian and Southeast Asian regions have been given the highest priority for ODA from Japan, and more than one-half of that aid was for climate-sensitive sectors. From 2001 to 2005, the amount of ODA funds provided to the “agriculture, forestry, and fishes” sector in the 8 selected countries in East Asia and the 5 selected countries in Southwest Asia were approximately 118 billion yen (5.5% of the total aid amount) and 112 billion yen (9.6% of the total), respectively (Table 3). Various projects were implemented, including the construction of irrigation facilities, rural development, poor farmers' supporting programs, and cooperation on agricultural technology, with yen loans, grant aid, and other types of cooperation in Indonesia, Philippines, Vietnam, India, Sri Lanka, and Cambodia⁹⁾. In addition to the above projects, construction of multipurpose cyclone shelters and meteorological radar systems in Bangladesh was supported by grant aid, totaling 1.54 billion yen, while grant aid for flooding disasters amounted to approximately 100 million yen⁹⁾. In Vietnam, a coastal afforestation project was supported with a 1.03 billion yen grant aid, and a water environmental improvement plan for Ho Chi Minh City was

implemented through the provision of a 20 billion yen loan⁹⁾.

Although such intensive ODA funding can potentially strengthen resilience in Asia, climate change may impose further impacts on agriculture, water resources, coastal zones, and urban environments, which could result in international socio-economic conflicts in the future. Therefore, it is necessary and even beneficial for developed countries, including Japan, to help developing countries to improve their resilience against climate change. When implementing such measures, priority should be given to those sectors where economic development and private investment is low, but vulnerability is high. Therefore, ODA for Asia should be prioritized in the following areas: (i) construction of irrigation facilities, rural development, and technical cooperation in crop breeding in LDCs and India; and (ii) upgrading preventive measures against climatic disasters. For those countries that have already graduated from receiving ODA, it is necessary to develop their resilience further within climate-sensitive sectors by using concessional finances, other than ODA, as well as private investment from international development organizations.

(2) Climate risk and priority in adaptation measures in Africa

Africa is among the regions that are most vulnerable to the impacts of climate change. The region's vulnerability is aggravated by the interaction of multiple stresses such as poverty (33 out of the 47 countries are LDCs⁹⁾), complex governance, and limited access to capital including markets, infrastructure, and technology¹⁾.

The economies of many African countries depend on agriculture, and the IPCC AR4 estimated that by 2100, agricultural production is likely to decrease by 2–7% of the GDP in parts of the Sahara and by 2–4% of GDP in Western and central Africa due to dry conditions¹⁾. The IPCC also estimated that, by 2080, a significant decrease in suitable rain-fed land and cereals production would occur as a result of climate change¹⁾. With regard to water resources, the size of the population with increased water stress in Africa is projected to be 75–250 million and 350–600 million people by the 2020s and 2050s, respectively¹⁾. One model analysis has shown that the population facing

the greatest water stress by 2055 would increase in North and South Africa, while East and West Africa is likely to experience a reduction in water stress¹⁾. In addition, human health can be negatively impacted by climate change; for example, there is concern about an increase in malaria in Southern Africa and in the East African highlands¹⁾.

High priority has been assigned to Africa, which has received the second largest amount of the Japanese ODA next to Asia. However, the share of expenditures in the climate-sensitive sectors in the 12 selected countries, as shown in **Table 2**, is less than 20% (Table 3). As shown in Table 3 and the ODA Data Book, 2.5% (12 billion yen) of the ODA was spent for “infectious diseases” including protection against malaria and eradication of polio, while 2.9% (14 billion yen), 2.7% (13 billion yen), and 3.1% (15 billion yen) were used for “water supply and sanitation,” “agriculture, forestry, and fishes,” including support for poor farmers, and “food aid” in the selected countries of Africa, respectively. Most of these projects are to fulfill the basic human needs, with expenditures on infrastructure, such as irrigation and transport facilities, accounting for a much lower amount.

There is no doubt that the achievement of MDGs is an important aspect of ODA in Africa. However, given the severe impacts of climate change, it is necessary to strengthen funding support in climate-sensitive sectors such as water resources and agriculture. Therefore, an appropriate combination of projects aimed at meeting basic human needs and preparing for future climate risks is needed. The areas deemed to be of highest priority are: (i) the basic human needs sectors, particularly in LDCs over the short term; (ii) support of infrastructure construction related to water supply, sanitation, irrigation, and disaster prevention facilities over the middle and long terms; and (iii) technical cooperation in such areas as agricultural productivity.

Another important area for international cooperation is increasing the capacity of technologies to estimate the impacts of climate change precisely⁴⁾ so that prioritized areas on adaptation measures could be specified appropriately in longer terms. In particular, scientific capabilities for climate impact assessments are limited in Africa compared with those in other regions such as Asia¹⁾.

Table 5 Major climate risks, results of Japanese ODA to climate-sensitive sectors, and prioritizing areas for climate adaptation measures in Asia and Africa^{1), 9), 15), 16)}

Regions	Major climate risks	Past Japanese ODA to climate-sensitive sectors	Prioritized areas on adaptation measures
Asia	<p>More than 60% of the world's population concentrates in Asia. Coastal areas such as Mekong delta and Bangladesh are particularly vulnerable.</p> <p>Shortage of food supply due to decrease in crop yields and increase in population.</p> <p>Increase of population density, rise in sea level, increase in risk of flooding, and tidal wave due to rise in sea level, etc.</p> <p>Shortage of water supply due to melting of glaciers in the Himalayan Mountains, etc.</p>	<p>Share of ODA funding to East and Southwest Asia accounts for more than 70%.</p> <p>Shares of climate-sensitive sectors in East and Southwest Asia to the total Japanese ODA are more than 50%.</p> <p>Number of loan projects on infrastructure construction, such as irrigation, transportation, water supply and sanitation, environmental protection facilities are implemented in countries in the course of economic development.</p> <p>Grant aid projects such as those for disaster prevention were implemented in poor countries such as Bangladesh.</p>	<p>Official aids to projects, such as construction of irrigation facilities, rural development, and technological cooperation on breeding of crops should be prioritized in LDCs and developing countries that comprise many poor people such as India.</p> <p>Official aids for measures to prevent disasters should be prioritized.</p> <p>For countries becoming donors of ODA, projects in such sectors as agriculture, water supply, environmental conservation in urban areas should be implemented with support of concessional finance and private finance other than ODA.</p> <p>Technological cooperation on climate change impacts assessment should be implemented.</p>
Africa	<p>Economies of many countries depend on agriculture.</p> <p>A significant decrease in suitable rain-fed land and cereal production would occur because of climate change by 2080.</p> <p>Poverty and dispute will exacerbate vulnerability to climate change.</p> <p>The population at risk of increased water stress in Africa is projected to be 75–250 million and 350–600 million people by the 2020s and 2050s, respectively.</p> <p>Human health can be further negatively impacted by climate change such as malaria in Southern Africa and in Eastern African highlands.</p>	<p>ODA amount by Japan is high, next to Asian region.</p> <p>Share of climate change sectors is small (19.4%), high rate in basic human needs sectors, such as infectious disease, drinking water, support for poor farmers for LDCs.</p> <p>High amounts of aid for food and disaster prevention.</p>	<p>ODA for basic human needs sectors for achieving MDGs should be prioritized mainly in LDCs.</p> <p>In the mid and long terms, (i) ODA for facilitating self-support of recipients with loans in such sectors as water supply and sanitation, agriculture and disaster prevention should be enhanced which will support sustainable development. (ii) Technological cooperation on climate change impacts assessment should be implemented.</p>

4. CONCLUSIONS

This paper analyzed the amounts and shares of Japanese bilateral ODA in funding sectors, which are potentially affected by climate change. In addition,

the relationship between development policies and the risk of climate change was examined through a regional comparative study. **Table 5** summarizes the major risks of climate change, the past Japanese ODA to climate-sensitive sectors, and the prioritized areas for adaptation measures suggested for Asia and Africa. Japanese ODA has contributed to improve climate resilience in developing countries through

funding the construction of basic infrastructures and implementing projects that reduce water and food scarcity, assist in recovery from natural disasters, and health problems. The share of ODA spent in climate-sensitive sectors in the total ODA funding varied regionally from 20% to 50%, and reflected the level of development and the socio-economic situation of the recipient countries.

Based on this study, we found that it is essential to understand vulnerability to climate change in developing countries appropriately, to learn good practices and lessons from past development cooperation projects, and to specify prioritized development sectors and the most effective projects for implementing adaption policies on the mid- and long-term basis. Therefore, the following steps would be effective in the promotion of mainstream adaptation in development policies: (i) implementing impact and vulnerability assessments of climate change in the target country and region, as the first step of resilience building; (ii) analyzing past development projects and their relation to climate risk to learn from past experiences; and (iii) prioritizing projects by taking into consideration both the extent of climate change risks and the needs of the target countries, which are determined by a country's socio-economic development situation. For example, for least developed countries, the basic human needs sectors should be supported through grant aid programs as a first priority, while for countries with an emerging economy, but which still require ODA, enhancing financial support to vulnerable sectors should be accomplished through yen loan projects. Developing countries, which have become ODA donors through advances in their economic development, should deal with climate risks through FDIs and domestic investment projects. Furthermore, it is important to incorporate climate adaptation in various development plans with the cooperation of international organizations, such as the UNFCCC, in all the developing countries.

In this paper, we only analyzed Japanese ODA activities. In order to discuss mainstreaming adaptation in development policies more thoroughly, it is important to expand this analysis to include the ODA activities of other donor countries, as well as the aid from development funds other than ODAs, including adaptation funds and private finances.

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