No.

Solomon Islands
Republic of Vanuatu
Independent State of Papua New Guinea
Kingdom of Tonga
Independent State of Samoa
Republic of Kiribati

PREPARATORY STUDY ON THE PROGRAMME FOR CLIMATE CHANGE IN THE PACIFIC ISLANDS (AGRICULTURE)

FINAL REPORT

MAY 2009

JAPAN INTERNATIONAL COOPERATION AGENCY

Nippon Koei Co., Ltd.

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Location Map of Pacific Islands in the Study Area

SUMMARY

CHAPTER 1 BACKGROUND AND OBJECTIVES OF THE STUDY

1. Background of the Study

This Study is conducted on the basis of the JICA's basic policy on the aid for the measures to the climate change in the framework of the "Cool Earth Partnership Countries" of the Government of Japan. The Study aims at strengthening the activities for cooperation to increase the adaptability to the climate change of the island countries on the Pacific Ocean.

2. Objectives of the Study

Objectives of the Study is to conduct the survey on the agricultural production sector, upon selection of the countries who have needs in the said sector for measures to the climate change, to grasp the said needs for the measures of each country and formulate the plan of the adaptation and mitigation measures of each country to strengthen the Japan's aid for the measures to the climate change of the countries in the area of the Pacific Ocean. The objective countries have been selected out of the Cool Earth Partnership Countries to be Solomon, Vanuatu, Papua New Guinea, Tonga, Samoa and Kiribati who are expected to have needs for the measures.

3. Work Plan of the Study

The Study was conducted in about two (2) months from the middle of March, 2009 to the middle of May, 2009.

The period for the whole Study is divided into the following three (3) stages.

【T1】 1st Work in Japan (preparatory works): About 0.2 month (middle to late March, 2009)

【T2】 Work in Field: About 1.2 month (late March to early May, 2009)

【T3】 2nd Work in Japan (final arrangement) About 0.2 month (early to middle May, 2009)

CHAPTER 2 SUMMARY OF THE STUDY

4. Basic Data of Objective Six (6) Countries of the Study

Basic data of the objective six (6) countries of the Study are as shown in the following **Table**.

Table Agricultural Production Basic Data by Country

Item	Solomon	Vanuatu	Papua New Guinea	Tonga	Samoa	Kiribati
Country area (km^2)	28,900	12,190	462,000	750	2,840	730
Cultivation area (km^2)*	770	1,050	8,900	260	900	370
Irrigation facilities	None	None	None	None	None	None
Agricultural land development potential	None	None	Exist	None	None	None
Year 2006 population statistics (1,000 persons)	534	221	6,187	100	185	92*
Year 2015 population forecast (1,000 persons)	589	270	7,319	104	198	107
Year 2030 population forecast (1,000 persons)	762	356	9,183	115	217	131
Food crops (land area, ha)*	18,000	20,000	240,000	15,000	30,000	2,000
(Major crops)	Sweet potato	Taro, etc.	Sweet potato	Pumpkin	Banana	Taro
Commercial crops (land area, ha)*	59,000	85,000	650,000	11,000	60,000	35,000
(Major crops)	Coconut	Coconut	Coconut	Coconut	Coconut	Coconut
Population fed on cultivation land (persons/ha)**	26.2	10.8	25.3	6.6	6.1	46.0
Ratio of import amount of foods (%) ***	26.2	10.8	25.3	6.6	6.1	46.0

Source: "Japan's ODA Projects" on HP of Ministry of Foreign Affairs of Japan: Solomon Islands, Republic of Vanuatu, Independent State of Papua New Guinea, Kingdom of Tonga, Independent State of Samoa, Republic of Kiribatu

Note *: Kiribati population at year 2006, Others at year 2005

**: Ratio of population to food crops cultivation land area of 1 ha, Source: FAO

***: Ratio of import amount of foods to whole import amount, Source: SPC

5. Issues in Agriculture Sector under Conditions of Climate Changes

In order to cope with to the adverse impacts of the climate changes, the following measures are considered:

1) Technical cooperation including capacity building of the research activities and extension services for the breeding, the selection, the cultivation, the cropping, the raising that are to be suitable for adaptation to the adverse impacts of the climate changes, and the cooperation for the building, the facilities and the equipment that are to be required for the effective activities.

2) Development study on the agricultural development for the adaptation to supplement the present food production (agriculture and livestock) for the decrease caused due to the adverse impacts of the climate change, and to cope with the future food demand (rice and the other staple cereals, vegetables, meat, etc.).

3) Restoration and improvement of the facilities for the agriculture and the livestock that have been damaged due to the adverse impacts of the climate changes.

The study has been conducted as mentioned hereinafter from a point of view how to take the effective and efficient measures to cope with the said issues and to seek the suitable approach to the target.

6. Wide Area Approach to Cooperation

Outline of the basic concept, the significance and the objective programmes on the measures to the climate changes (agricultural production) in the Pacific Islands are as described as follows:

(1) Basic concept

Though the Pacific Islands (the objective six (6) countries of the Study on the agricultural production) have the respective different lands and agricultural conditions, there are found common things in the mitigation measures and the adaptation measures to the adverse impacts on the agricultural production caused due to the climate changes. In this regard, the measures are to be studied through the wide area approach grasping the objective six (6) countries as a wide area.

(2) Significance

On the activities to be taken in the area with grasping broadly the objective six (6) countries furthermore thirteen (13) countries, it is expected that the unnecessary activities would be avoided to effectively achieve the target conducting the common research with close communication and supplementing the weak point each other. .

(3) Objective cooperation programme

1) Dispatch of the experts to the SPC Land Resources Division and to the respective countries in the area (the common ownership of the data in the area, the common research in the area, the management of implementation of projects, the extension services).

2) Activities of training in the respective countries in the area.

3) Effective and efficient implementation of projects (the development study, the technical cooperation projects, the grant aid projects, etc. to be implemented in the pilot country at first and then extended to the other countries)

7. Framework of Wide Area Approach to Cooperation

Framework of the wide area approach to the cooperation would be as follows:

(1) Role of SPC Land Resources Division

SPC Land Resources Division located in Fiji would play a role of administrative and technical coordination function for implementation of the programme in the Pacific Islands covering the

objective six (6) countries and furthermore the thirteen (13) countries of the Cool Earth Partnership.

(2) Roles of NARI and UNITECH in Papua New Guinea

In the technical field, the National Agriculture Research Institute (NARI) and the University of Technology in Papua New Guinea is expected so that those would play an important role in the frame of the cooperation programme.

(3) Roles of private sector and government concerned with livestock

Also in the technical field, in Vanuatu, the private sector and the government are expected so that those would play an important role in the frame of the cooperation programme.

(4) Roles of USP in Samoa

Also in the technical field, the University of South Pacific (USP) is expected so that those would play an important role in the frame of the cooperation programme.

8. Cooperation Programme for Climate Changes

In Solomon, Vanuatu, Samoa and Kiribati, the food security is listed as the most important subject in the agriculture sector in NAPA compiling the policy, the strategy and the action plan under the climate changes. In Papua New Guinea and Tonga who have not prepared NAPA, the food security is set as the most priority subject in the National Agriculture Development Plan (2007 - 2016) and the 8th National Development Plan (2007 - 2011).

In consideration the issue that the climate changes are affecting the said priority agricultural policy subject in each country, it is required that the cooperation programme for the measures is to be considered from a viewpoint what measures are effective to the climate changes.

In the Study this time, the Preparatory Study on the Programme for Climate Change in Pacific Islands (Agriculture) has been conducted from such point of view as grasping the condition of damages on the agricultural production, studying the needs for cooperation on the premise of the institutional system and the human resources of the objective country, confirming the consistency with NAPA and the policy on the agriculture, and then selecting the cooperation programmes with the strong necessity, the great urgency and the high priority.

After the survey and study, the wide area cooperation programme (mitigation measures and the adaptation measures) to be considered as the measures to the climate changes in the Pacific Islands (agriculture) have been formulated as follows:

(1) Mitigation measures to climate changes

There are the mitigation measures to the climate changes to be conducted under the concept of the co-benefits approach to the climate changes in the respective countries as possible, practical and effective measures as follows:

1) Effective use of the shit and waste in the rural area (at village level) of the livestock (use as fuel, introduction of biogas pit).
2) Production and use of the compost as substitute of chemical fertilizers in the rural area (at village level).
3) Introduction of the agro-forestry in the rural area (at village level) (in case absorbing carbon by fruits trees is expected).
4) Implementation of farm lands management for the purpose of prevention of flowing out of carbon from the farm land soil in the rural area (at village level).
5) Effective use of the waste from the industrial agriculture and the livestock in the agriculture and livestock fields.
6) Introduction of the irrigation system for water saving and the energy saving (small-scale gravity irrigation, etc.).
7) Use of renewal energy (other than the agricultural waste) at the agriculture and livestock industry level.
8) Introduction of the energy saving type machine and equipment in the process of the production and processing in the agriculture and the livestock and the resources saving measures.

Out of the objective six (6) countries of the Study, the contour-line vegetation is being practiced in a part of Papua New Guinea to prevent the spoil erosion from the sloping farm lands (mitigation measure of 4)). In Samoa, the Forestry Division is going to start the new project taking the agro-forestry concept (mitigation measure of 3)).

It would be necessary for the other countries to start the preparation for implementation of the mitigation measures to the climate changes through the technical cooperation to be extended in by the dispatch of the experts, etc. in the cooperation programme in the future.

(2) Adaptation measures to climate changes

The priority ranking of implementation of the adaptation measures would be determined depending upon the situation of each country and each area in the country.

For example, in Papua New Guinea, the as the adaptation measures to the climate changes, the research activities for the breeding, the selection, the cultivation, the cropping and the extension

services for the farmers and persons concerned (cropping practice and farm management) is set as the higher priority subject, while the construction of such infrastructures to prevent the sea water intrusion and inundation on the farm lands are set as the lower priority.

In the objective six (6) countries of the Study this time, the priority of the adaptation measures to prevent the farmlands and the agricultural facilities from the climate changes (cyclone, heavy rain, etc.) is set lower than it of the crop varieties and the crop cultivation.

It is to be noted that, in addition to such research of the crop varieties and the crop cultivation as mentioned the above, the activities to investigate the damages and its degree of the agricultural production and to arrange the investigation result as the basic information and data would be needed for the future .

In the cooperation programme to be extended in the future, the adaptation measure to the climate changes would be implemented through the technical and financial cooperation such as the dispatch of the experts, etc., the training, the development study, the technical cooperation project and the grant aid project (construction of facilities, supply of equipment, etc.).

The above-mentioned contents are summarized so that the cooperation programme to be extended under the wide area approach consisting of Fiji as key station and the objective six (6) countries would be as follows:

Country	Cooperation Programme
Fiji	Dispatch of Expert to Agriculture Field of SPC for Coordination of Wide Area Approach
(1) Solomon	(i) Master Plan Study on Rice Production (ii) Technical Cooperation Project for Whole Agricultural Field (iii) Dispatch of Advisor to Ministry of Agriculture and Livestock (iv) Enhancement of Updating Statistical Data
(2) Vanuatu	(i) Training of Officers in Central and Local Governments (ii) Dispatch of an expert, SV and JOCV (iii) Dispatch of Vegetable Expert (iv) Enhancement of Updating Statistical Data
(3) Papua New Guinea	(i) Training in Japan of Government Staff (ii) Improvement of UNITECH (iii) Improvement of NARI (iv) Dispatch of Expert (iv) Enhancement of Updating Statistical Data

Country	Cooperation Programme
(4) Tonga	(i) Capacity Building for Government Staff (ii) Improvement of Marketing System (iii) Variety Selection (iv) Enhancement of Updating Statistical Data
(5) Samoa	(i) Capacity Building for Government Staff (ii) Improvement of Marketing System (iii) Variety Selection (v) Enhancement of Updating Statistical Data
(6) Kiribati	(i) Capacity Building for Government Staff (ii) Improvement of Research Station (iii) Soil Improvement and Improvement of Farming Practices for Vegetables (iv) Enhancement of Updating Statistical Data

CHAPTER 3 SOLOMON ISLANDS

9. Adverse Impact and Damage due to Climate Changes and Basic Data

(1) Adverse impact and damage data

The condition of damages on the agricultural production in Solomon Islands due to the climate change has been grasped through the site visits and the questionnaire surveys to the concerned ministries and organizations and to the farmers in the area. Major ones are listed as follows:

(i) Inundation and erosion of the agricultural lands due to flood caused by heavy rain.
(ii) Collapse of the agricultural lands and the livestock facilities due to high wave and strong wind caused by cyclone.
(iii) Damage due to the salt water intrusion into the agricultural lands caused by the sea-level rise in the flat low land areas (part of the whole country area).

(2) Basic data

In addition to the above-mentioned damage information, the basic data required for more precisely grasping the needs for the cooperation have been collected.

(i) Basic data in relation to the agriculture (e.g. production quantity and cropping area, etc.) have not prepared yet.
(ii) The Solomon Islands government side (Ministry of Agriculture and Livestock) expressed clearly and strongly his wish for the Japan's cooperation and support.
(iii) The livestock industry in Solomon Islands, especially the beef production, is now under the devastating condition (20,000 head of cattle in 1986 have decreased to less than 2,000 head). The government intends to promote the livestock. However, the activities have hard

going due to limitation of the human resources and the national budget.

(3) Activities of other donors

As for the agriculture sector in Solomon Islands, since the support of donors and NGOs are limited as mentioned below, it is so considered that needs for the proper cooperation to be newly extended would be higher. If any new support would be extended from now on, because of the characteristics of the support activities of the present donors and NGOs, it would be more effective to extend the support together with the present donors and NGOs.

(i) At present, there is only one foreign countries cooperation and aid for the Ministry of Agriculture and Livestock that is the Taiwan Technical Mission continued since 1983. There is no cooperation of the other foreign donors (international organizations and countries). On the other hand, as for the future cooperation, FAO has a plan that is Regional Programme for Food Security (RPFS), in which (i) formulation of National Agriculture Development Policy (US$72,224.-) with target year of 2012, (ii) construction of Agriculture Research Centre (1 station) (US$1,450,000.-) in 2008-2010 Work Plan and (iii) supply of seeds, agricultural inputs and tools (US$250,000.-) aiming at the increase of rice production and the decrease of rice import.

(ii) At present, NGO, Kastam Garden Association, is working for the food security and the maintenance of crop diversification (conservation of traditional varieties that are going to dies out, so as to cope with the future necessity.).

10. Mitigation & Adaptation Measures and Cooperation Programme for Climate Changes

The Preparatory Study on the Programme for Climate Change in Solomon Islands in the agricultural production field has been conducted from such point of view as grasping the condition of damages on the agricultural production, studying the needs for cooperation on the premise of the institutional system and the human resources of the objective country, confirming the consistency with NAPA and the policy on the agriculture, and then selecting the cooperation programmes with the strong necessity, the great urgency and the high priority.

The cooperation programmes for Solomon Islands finally selected from such point of view are listed as follows:

(i) Master Plan Study on Rice Production
(ii) Technical Cooperation Project for Whole Agricultural Field
(iii) Dispatch of Advisor to Ministry of Agriculture and Livestock
(iv) Enhancement of Updating Statistical Data

CHAPTER 4 REPUBLIC OF VANUATU

11. Adverse Impact and Damage due to Climate Changes and Basic Data

(1) Adverse impact and damage data

The condition of damages on the agricultural production in Republic of Vanuatu due to the climate change has been grasped through the site visits and the questionnaire surveys to the concerned ministries and organizations and to the farmers in the area. Major ones are listed as follows:

(i) Damage on the coastal fishery due to extinction of the coral caused by the cyclone and the sea water temperature rise.

(ii) Falling-down of the plants and collapse of the agricultural facilities due to strong wind caused by the cyclone.

(iii) Decrease of the crop yields due to shortage in sunshine hours and solar radiation.

(2) Basic data

In addition to the above-mentioned damage information, the basic data required for more precisely grasping the needs for the cooperation have been collected.

(i) It could not be said that the basic data on the agricultural production (e.g. production quantity, cropping areas, etc.) have satisfactorily been prepared. Though the Census of Agriculture 2007 Vanuatu was conducted in the nationwide scale, the survey contents should be improved because it covers only the survey on the household number and the farm management types.

(ii) At present, there is foreign countries cooperation and aid for the Ministry of Agriculture, Forestry and Fishery that is mainly the financial aid for the Vanuatu Agricultural Research Technical Centre (VARTC) (the origin: 1962, the present organization: established in 1994) located in the Espiritu Santo Island. Major donors are EU, AFD, ADB, SPC and IFAD. Major subjects are the research on production of coconut and copra, the research on livestock and the research on breeding of coffee, cocoa, pepper, kava (superior variety).

(iii) At present, there is no adviser dispatched from foreign countries to the Ministry of Agriculture, Forestry and Fishery and the organizations under the said Ministry.

(3) Activities of other donors

As for the agriculture sector in Republic of Vanuatu, since the support of donors and NGOs are limited as mentioned below, it is so considered that needs for the proper cooperation to be newly extended would be higher. If any new support would be extended from now on, because of the characteristics of the support activities of the present donors and NGOs, it would be more effective to extend the support together with the present donors and NGOs.

(i) Donor countries for the agriculture sector are AusAID、EU、FAO, etc.

(ii) The above-mentioned agricultural census(2007) was published by the governmental organization of Vanuatu Statistics Office with support of NZAID、AusAID、EU、FAO.

(iii) EU、AFD、ADB、SPC、IFAD are conducting the financial cooperation for the Vanuatu Agricultural Research Technical Centre (VARTC).

12. Mitigation & Adaptation Measures and Cooperation Programme for Climate Changes

The Preparatory Study on the Programme for Climate Change in Republic of Vanuatu in the agricultural production field has been conducted from such point of view as grasping the condition of damages on the agricultural production, studying the needs for cooperation on the premise of the institutional system and the human resources of the objective country, confirming the consistency with NAPA and the policy on the agriculture, and then selecting the cooperation programmes with the strong necessity, the great urgency and the high priority.

The cooperation programmes for Republic of Vanuatu finally selected from such point of view are listed as follows:

(i) Training of Officers in Central and Local Governments

(ii) Dispatch of an expert, SV and JOCV

(iii) Dispatch of Vegetable Expert

(iv) Enhancement of Updating Statistical Data

CHAPTER 5 INDEPENDENT STATE OF PAPUA NEW GUINEA

13. Adverse Impact and Damage due to Climate Changes and Basic Data

(1) Adverse impact and damage data

The condition of damages on the agricultural production in Independent State of Papua New Guinea due to the climate change has been grasped through the site visits and the questionnaire surveys to the concerned ministries and organizations and to the farmers in the area. Major ones are listed as follows:

(i) Disease and wet damage due to increase of rainy days

(ii) Pest and water shortage in a drought year

(iii) High temperature sterility

(2) Basic data

In addition to the above-mentioned damage information, the basic data required for more precisely grasping the needs for the cooperation have been collected.

(i) Office of Climate Change and Sustainable Environment (OCCSE) is now leading PNG on the measures to climate change in accordance with the present Medium Term Development Strategy 2005-2010 and the next term version under preparation.

(ii) National Department of Agriculture and Livestock (NDAL) is in charge of implementation of the government's agricultural administrative activity putting stress on **the food security** in accordance with National Agriculture Development Plan (NADP) 2007-2016.

NDAL is also conducting the agricultural extension services as the government services. However, its activities are now not satisfactorily being carried out.

(iii) National Agricultural Research Institute (NARI) is conducting the agricultural research such as experiment and study in line with the strategy of OCCSE and NDAL.

(iv) The University of Technology (UNITECH) is conducting the agricultural research in relation to the climate change putting stress on the agricultural extension services.

(v) Though Papua New Guinea has not prepared NAPA, the above-mentioned OCCSE is leading the activities of measures for the climate change instead of NAPA.

(3) Activities of other donors

As for the agriculture sector in Independent State of Papua New Guinea, the supports of the donors are being extended at a high technical level as mentioned below. It is so considered that the supports for the research on the development of adaptable varieties of crops, etc. to the climate change are effectively conducted by the donors. However, there is no support of the donors for the advice and guidance on the governmental administrative services in order to reflect the result of the research upon the common ownership at a level of the Pacific Ocean wide area and the extension services in the country, etc.

(i) As the cooperation and support for the NDAL and the concerned organizations from foreign countries at present, the financial cooperation to NARI is to be noted. Under the said cooperation, NARI is conducting the research programmes at the headquarters in Lae and six (6) branch offices in the country for the five (5) classified areas and the other activities of experiment and study. Major fields are GIS, the livestock, the rice and cereals, the weeds measures, the chemical test, the agriculture related insects, and the biological measurement and statistics. Major donors are AusAID and EU. It is to be noted that NARI is conducting the activities with keeping the relation to such foreign countries as in Africa and Pacific Ocean.

(ii) At present, there is no policy adviser, etc. dispatched by the donors in NDAL and the concerned organizations.

14. Mitigation & Adaptation Measures and Cooperation Programme for Climate Changes

The Preparatory Study on the Programme for Climate Change in Independent State of Papua New Guinea in the agricultural production field has been conducted from such point of view as grasping the condition of damages on the agricultural production, studying the needs for cooperation on the premise of the institutional system and the human resources of the objective country, confirming the consistency with the policy on the agriculture, and then selecting the cooperation programmes with the strong necessity, the great urgency and the high priority.

The cooperation programmes for Independent State of Papua New Guinea finally selected from such point of view are listed as follows:

(i) Training in Japan of Government Staff
(ii) Improvement of UNITECH
(iii) Improvement of NARI
(iv) Dispatch of Expert
(v) Enhancement of Updating Statistical Data

CHAPTER 6 KINGDOM OF TONGA

15. Adverse Impact and Damage due to Climate Changes and Basic Data

(1) Adverse impact and damage data

The condition of damages on the agricultural production in Kingdom of Tonga due to the climate change has been grasped through the site visits and the questionnaire surveys to the concerned ministries and organizations and to the farmers in the area. Major ones are listed as follows:

(i) There are some reports on land erosion as well as land corruption caused by rising sea levels in some outer island such as Haapai and Vavau islands.
(ii) Damages on farm lands, crops, relevant facilities have been occurred by high waves, salt water, strong wind, which are caused by cyclones every two years.
(iii) Damages by deep water and salt water intrusion are found partly in lower land. It is hard to identify damaged area.
(iv) Drought period with high temperature is longer that normal year due to change of rainfall patter, resulting in outbreak of powdery mildew.

(2) Basic data

In addition to the above-mentioned damage information, the basic data required for more precisely grasping the needs for the cooperation have been collected.

(i) Basic agricultural information such as production, cultivated area, etc. is not sufficient. National agricultural census was conducted in 2001, however no agricultural census has been done. Therefore limited basic information on farm household and agriculture is available. It is difficult to grasp degree of damage to agricultural activity due to climate change quantitatively. Meanwhile there is some gap between statistical data in Ministry of Agriculture and Food, Forests, and Fisheries and those data in FAO, thus it is necessary to improve the precision of statistical data.

(ii) Ministry of Natural Resources and Environment has prepared mitigation plans and adaptation plans. Mitigation plans will be prepared by June this year, while September for adaptation plans. Mitigation plans cover four fields (agriculture, forestry, energy, and waste, while adaptation plans for six (6) fields such as forestry, fishery, water resources, health, and disaster risk management.

(iii) Though Tonga has not prepared NAPA, the above-mentioned Ministry of Natural Resources and Environment is leading the activities of measures for the climate change on the basis of Initial National Communication (May 2005) instead of NAPA.

(3) Activities of other donors

As for the agriculture sector in Kingdom of Tonga, various financial and technical support activities have been supplied from donors. Major activities are shown as follows:

(i) EU provides of some support activities regarding promotion of various small scale agro-processing industries and crop quarantine facility (Hot Temperature Force Air: HTFA).

(ii) FAO (RPFS: Regional Programme for Food Security) covers experiment and extension activities on promotion of livestock industry (cattle, poultry, etc.), breeding and selection of tolerant varieties on hot temperature, pests and diseases, etc.

(iii) SPC ahs conducted support services to basic investigation regarding livestock promotion (pig, feed, etc.), and germplasm preservation of root crops (taro, yam, cassava), coconut, etc.

(iv) Regarding climate change, GTZ has started projects such as promotion of agroforestry since January 2009 in Tonga, Vanuatu, and Fiji completing in four (4) years. Currently, Inception Report including action plan has been prepared, followed by workshop on problem analysis.

16. Mitigation & Adaptation Measures and Cooperation Programme for Climate Changes

As mentioned in the above, the Preparatory Study on the Programme for Climate Change in Kingdom of Tonga in the agricultural production field has been conducted from such point of

view as grasping the condition of damages on the agricultural production, studying the needs for cooperation on the premise of the institutional system and the human resources of the objective country, confirming the consistency with the policy on the agriculture, and then selecting the cooperation programmes with the strong necessity, the great urgency and the high priority.

The cooperation programmes for Kingdom of Tonga finally selected from such point of view are listed as follows:

(i) Capacity Building for Government Staff
(ii) Improvement of Marketing System
(iii) Variety Selection
(iv) Enhancement of Updating Statistical Data

CHAPTER 7 INDEPENDENT STATE OF SAMOA

17. Adverse Impact and Damage due to Climate Changes and Basic Data

(1) Adverse impact and damage data

The condition of damages on the agricultural production in Independent State of Samoa due to the climate change has been grasped through the site visits and the questionnaire surveys to the concerned ministries and organizations and to the farmers in the area. Major ones are listed as follows:

(i) There are no reports on land erosion as well as land corruption caused by rising sea levels..
(ii) Taro cultivation in Samoa got devastating damage due to cyclone attack in 1991, and also large outbreaks of Taro Leaf Blight in 1993.
(iii) Drought period with high temperature is longer that normal year due to change of rainfall pattern, however there is no outbreak of powdery mildew.

(2) Basic data

In addition to the above-mentioned damage information, the basic data required for more precisely grasping the needs for the cooperation have been collected.

(i) Basic statistical information is supplied from Agricultural Survey 2000. This survey is a sample survey for 10% out of total farm household, thus information on cultivated area and production for the whole country is not available. Continuous collection of statistical information is not arranged. In this case, it is difficult to analyse the effect of climate change on crop production.
(ii) Breeding and selection of tolerant varieties on high air temperature as well as pests / disease of major crops such as taro, coconut, etc. have been conducted in cooperation with

USP and SPC.

(iii) Ministry of Natural Resources and Environment has prepared adaptation plans to climate change. Regarding agriculture, implementation of sustainable agriculture and food security program will be expected to be carried out since May 2009, in cooperation with GEF/UNDP.

(iv) Forestry division of the Ministry of Natural Resources and Environment is planning to carry out a new project adopting the concept of agro-forestry instead of community forest program supported by GEF/FAO. Project sites are limited in Savaii island.

(3) Activities of other donors

As for the agriculture sector in Independent State of Samoa, technical assistances of other donors are not so active. However AusAID starts technical assistance for policy making, thus it seems that other donors' moves could be active, depending on the future policy to be formulated. Current situation of donors' activities are shown as follows:

(i) AusAID has supported to formulate national plan for agricultural development.

(ii) FAO and SPC have supported promotion of livestock industry, research, and extension.

(iii) As mentioned before, GEF/FAO and GEF/UNDP are going to start activities on climate change.

18. Mitigation & Adaptation Measures and Cooperation Programme for Climate Changes

The Preparatory Study on the Programme for Climate Change in Independent State of Samoa in the agricultural production field has been conducted from such point of view as grasping the condition of damages on the agricultural production, studying the needs for cooperation on the premise of the institutional system and the human resources of the objective country, confirming the consistency with NAPA and the policy on the agriculture, and then selecting the cooperation programmes with the strong necessity, the great urgency and the high priority.

The cooperation programmes for Independent State of Samoa finally selected from such point of view are listed as follows:

(i) Capacity Building for Government Staff

(ii) Improvement of Marketing System

(iii) Variety Selection

(v) Enhancement of Updating Statistical Data

CHAPTER 8 REPUBLIC OF KIRIBATI

19. Adverse Impact and Damage due to Climate Changes and Basic Data

(1) Adverse impact and damage data

The condition of damages on the agricultural production in Republic of Kiribati due to the climate change has been grasped through the site visits and the questionnaire surveys to the concerned ministries and organizations and to the farmers in the area. Major ones are listed as follows:

(i) Kiribati is not on the corridors of cyclone, therefore there are no damages caused by cyclone. However lodging and falling-down of crops and trees are caused by strong wind.
(ii) Decrease of the crop yields due to climate change is occurred year by year.

(2) Basic data

In addition to the above-mentioned damage information, the basic data required for more precisely grasping the needs for the cooperation have been collected.

(i) Major farm income source is coconut for farmers.
(ii) At present, there is foreign countries cooperation and aid for the agriculture and livestock division of the ministry supported by SPC and Taiwan Technical Mission. Taiwan technical mission is in charge of dissemination of technology on vegetable cultivation, while SPC is in charge of general aspect on climate change as well as agricultural development.
(iii) Human resources as well as facilities in the ministry is limited. Particularly it is difficult for the ministry to carry out basic analysis on soil, water quality, and quarantine by herself. All the analyses are requested to SPC Fiji or USP Fiji.

(3) Activities of other donors

As for the agriculture sector in the Republic of Kiribati, Taiwan Technical Mission supports extension activities on vegetable cultivation, livestock keeping, and fish culture. FAO supports livestock promotion and research sectors financially and technically. SPC has conducted financial and technical supports for research sector. Further SPC/IFAD has carried conservation promotion of geneplasm.

(i) Support service for extension activities on vegetable cultivation, livestock keeping, and fish culture by Taiwan Technical Mission
(ii) Support service for procurement of new breeding stock of boards and layers by FAO
(iii) Support service for crop diversification through identification and promotion of proper species, varieties and verification trial for agro-forestry, research to promote sustainable production method, etc. by FAO/SPC

(iv) Support service for conservation promotion of geneplasm of coconut, breadfruit, etc.

20. Mitigation & Adaptation Measures and Cooperation Programme for Climate Changes

As mentioned in the above, the Preparatory Study on the Programme for Climate Change in Republic of Kiribati in the agricultural production field has been conducted from such point of view as grasping the condition of damages on the agricultural production, studying the needs for cooperation on the premise of the institutional system and the human resources of the objective country, confirming the consistency with NAPA and the policy on the agriculture, and then selecting the cooperation programmes with the strong necessity, the great urgency and the high priority.

The cooperation programmes for Republic of Kiribati finally selected from such point of view are listed as follows:

(i) Capacity Building for Government Staff
(ii) Improvement of Research Station
(iii) Soil Improvement and Improvement of Farming Practices for Vegetables
(iv) Enhancement of Updating Statistical Data

PREPARATORY STUDY ON THE PROGRAMME FOR CLIMATE CHANGE IN THE PACIFIC ISLANDS
（AGRICULTURE）

FINAL REPORT

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(Annex)

Result of Questionnaire Survey

Abbreviations

ADB	Asian Development Bank
AFD	French Development Agency
ACIAR	Australian Centre for International Agricultural Research
AusAID	Australian Agency for International Development
CBD	Convention on Biological Diversity
CGIAR	Consultative Group on International Agricultural Research
CO_2	Carbon dioxide
DSAP	Development of Sustainable Agriculture in the Pacific Programme
EU	European Union
FAO	Food and Agriculture Organization
GEF	Global Environment Facility
GIS	Geographic Information System
GMOs	Genetically Modified Organisms
GTZ	German Technical Cooperation
IFAD	International Fund for Agricultural Development
Impextek	Import-Export Technology Centre
JICA	Japan International Cooperation Agency
JOCV	Japan Overseas Cooperation Volunteers
LRD	Land Resources Division
NADL	National Department of Agriculture and Livestock
NADP	National Agriculture Development Plan
NARI	National Agricultural Research Institute, PNG
NGO	Non-Governmental Organization
NZAID	New Zealand Agency for International Development
OCCSE	Office of Climate Change and Sustainable Environment
ODA	Official Development Assistance
OJT	On-the-Jop Training
PACER	Pacific Agreement on Closer Economic Relation
PDAL	Provincial Department of Agriculture and Livestock
PNG	Papua New Guinea
PGR	Plant Genetic Resource
PICTs	Pacific Island Countries and Territories
RPFS	Regional Programme for Food Security
SOPAC	South Pacific Applied Geosciences Commission
SPC	Secretariat of the Pacific Community
SPREP	South Pacific Regional Environment Programme
STABEX	Stabilization of Export Earnings System
SV	Senior Volunteer
UNDP	United Naion Development Programme
UNITECH	University of Technology, PNG
USP	University of the South Pacific
VARTC	Vanuatu Agricultural Research Technical
WHO	World Health Organization
WTO	World Trade Organization

CHAPTER 1 BACKGROUND AND OBJECTIVES OF THE STUDY

1.1 Background of the Study

Generally speaking, the lands in the Pacific Islands countries are smaller in area and lower in altitude. Major crops in the agricultural production are the root crops (taro, yam, cassava), coconut, fruits, etc. In recent years, with reflection of the diversification of eating habits, the production of vegetables is increasing. Because of characteristics of the topography of the Pacific Islands countries, parts of coastal lands are vulnerable to the sea water rise and the high tide where the collapse and decrease of agricultural lands have become problems. On the other hands, though there have been caused the adverse impacts on the agricultural production due to the climate changes such as the high temperature, the drought, the increase of the rainy days, etc., it would be found that the degree of the said impacts has not become so serious. However, as it would be felt uneasy that the climate changes would cause the serious adverse impacts and damages on the agricultural production, it should be necessary to continuously take the prudent measures from now on, too.

On the basis of such background, as an aid for the adaptation measures to the climate change in the small island countries on the Pacific Ocean the ex-Prime Minister Fukuda expressed the “Cool Earth Partnership” that is the new financial mechanism with a total amount of US$ 10 billion (Yen 1 trillion and 250 billion) at the meeting in Davos held in January, 2008. In areas of the Pacific Islands, 13 countries of Tonga, Samoa, Kiribati, Cook Islands, Niue, Tuvalu, Solomon, Vanuatu, Papua New Guinea, Nauru, Palau, Micronesia, Marshall Islands have already become members of the “Cool Earth Partnership Countries”. Out of those countries, each of Kiribati, Vanuatu, Tuvalu, Samoa, Solomon has already prepared the National Adaptation Programme of Action (herein after called NAPA) that is a comprehensive strategic paper including the adaptation measures with the support of the United Nations Development Program (hereinafter called UNDP), etc.

This Study was conducted on the basis of the JICA’s basic policy on the aid for the measures to the climate change in the framework of the “Cool Earth Partnership Countries” of the Government of Japan. The Study aims at strengthening the activities for cooperation to increase the adaptability to the climate change of the island countries on the Pacific Ocean.

1.2 Objectives of the Study

Objectives of the Study is to conduct the survey on the agricultural production sector, upon selection of the countries who have needs in the said sector for measures to the climate change, to grasp the said needs for the measures of each country and formulate the plan of the adaptation and mitigation measures of each country to strengthen the Japan’s aid for the measures to the climate change of the countries in the area of the Pacific Ocean. The objective countries have

been selected out of the Cool Earth Partnership Countries to be Solomon, Vanuatu, Papua New Guinea, Tonga, Samoa and Kiribati who are expected to have needs for the measures.

1.3 Work Plan and Members of the Study

The Study was conducted in about two (2) months from the middle of March, 2009 to the middle of May, 2009.

The period for the whole Study is divided into the following three (3) stages.

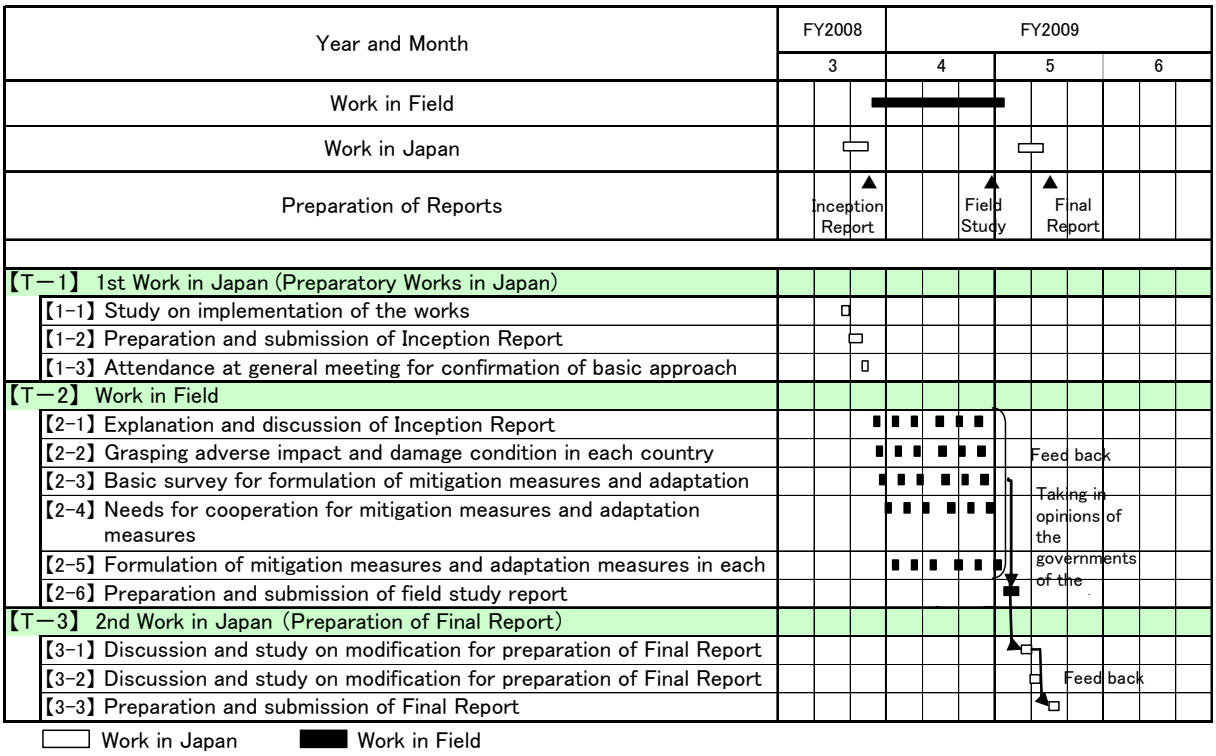
【T1】 1st Work in Japan (preparatory works): About 0.2 month (middle to late March, 2009)

【T2】 Work in Field: About 1.2 month (late March to early May, 2009)

【T3】 2nd Work in Japan (final arrangement) About 0.2 month (early to middle May, 2009)

The work items shown in the following work plan have been conducted.

Table 1-1 Overall Work Plan



The work in each country was conducted in 7 days in net working days as standard. The staying period in each country has been adjusted in consideration of the scale of country, the status of the agricultural sector (priority ranking), the flight operation condition, holidays and Easter holidays, etc.

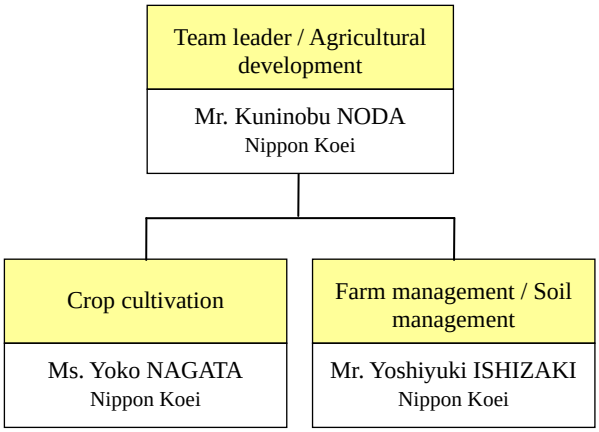
Table 1-2 Standard Study Work Schedule in Each Country

Survey schedule (draft)	Survey days 0 1 2 3 4 5 6 7 8	Remarks
1. Moving to the country		Courtesy afternoon when arriving morning
2. Discussion with government organization		
Courtesy call to JICA office / branch office		
Courtesy call to gevenment organizations and inception discussion		
Interview survey (prsent condition. strategy, needs, etc.)		Interview with questionnaire
3. Grasping present condition of the country		
Site visit, collection and analysis of data		Representative place, ongoing site
Arrangement of references		
Additional collection of data and opinion		
4. Study and discussion of mitigation measures and adaptation measures		
Study of mitigation measures and adaptation measures		
Dfiscussion of draft plan		
5. Moving to thenext country / transit country		

At the end of the work in each country, the Study Team presented the Field Study Report to discuss and modify, and submitted to each JICA office in the country.

The following members have been selected and assigned in consideration of the basic approach to the Study.

- Team leader / Agricultural development: Mr. Kuninobu NODA (Nippon Koei Co., Ltd.)
- Crop cultivation: Ms. Yoko NAGATA (Nippon Koei Co., Ltd.)
- Farm management / Soil management: Mr. Yoshiyuki ISHIZAKI (Nippon Koei Co., Ltd.)



Organization of Study Members

Table 1-3 Work Schedule

(Preparatory Study on the Programme for Climate Changes in pacific Islands (Agricultural Production))

Study Year／Month	Date	Day	Schedule									Acuumu. Days
	Group		Survey Countries Group-A			Transit Country-Common		Transit Country-B	Survey Countries Group-B			
	Country Name		PNG	Solomon	Vanuatu	Fiji	Fili		Tonga	Samoa	Kiribati	
	City Name		Port Moresby	Honiara	Port Vila	Nadi	Nadi	Auckland	Nuku' Alofa	Apia	Tarawa	
2009/3	28	Sat.	PX055 Narita 21:05 Depart.					NZ090 Narita 18:30 Depart.				1
	29	Sun.	04:30 Arriv. /PX084 12:00 Depart.	15:00 Arriv.				12:35 Arriv.				2
	30	Mon.		1				NZ866 07:15 Depart.	10:05 Arriv.			3
	31	Tue.		2					1			4
2009/4	1	Wed.		3					2			5
	2	Thu.		4					3			6
	3	Fri.		5					4			7
	4	Sat.		6					5			8
	5	Sun.		7					6			9
	6	Mon.		8					7	23:30 Arriv.		10
	7	Tue.		NF081 13:10 Depart.	15:05 Arriv.				NZ026 21:00 Depart.	1		11
	8	Wed.			1					2		12
	9	Thu.			Santo 1					3		13
Easter Holidays	10	Fri.			Santo 2							14
	11	Sat.			Santo 3							15
	12	Sun.			Santo 4							16
	13	Mon.			2							17
	14	Tue.			3					4		18
	15	Wed.			4					5		19
	16	Thu.			5					6		20
	17	Fri.			6					7		21
	18	Sat.			7					FJ252 05:35 Depart.		22
	19	Sun.			FJ260 12:05 発	15:05 Arriv.	06:35 Arriv.					23
	20	Mon.	12:40 Arriv.			PX085 09:00 Depart.						24
	21	Tue.	1				FJ231 03:30 Depart.				06:30 Arriv.	25
	22	Wed.	2								1	26
	23	Thu.	3				14:30 Arriv.				FJ230 11:30 Depart.	27
	24	Fri.	4				2					28
	25	Sat.	5				3					29
	26	Sun.	6				4					30
	27	Mon.	7				5					31
	28	Tue.	8				6					32
	29	Wed.	9				7					33
	30	Thu.	10				8					34
2009/5	1	Fri.	11				9					35
	2	Sat.	12:40 Arriv. /PX054 14:15 Depart. 19:55 Narita				PX085 09:00 Depart.					36
	3	Sun.										
	4	Mon.										
	5	Tue.										

Note **Group-A: Mr. Kuninobu NODA（Team Leader/ Agricultural Development）**, Survey Days: 36 Days
Ms. Yoko NAGATA (Crop Cultivation)
Group-B: Mr. Yoshiyuki ISIZAKI（Farm Management / Soil Management）, Survey Days: 36 Days
A meeting was held for information exchange in the team in the afternoon of April 19 at Nadi in Fiji, the common transit country.
Group-B conducted the survey in Kiribati (Tarawa) on 21-22 April and moved to Fiji to conduct the survey of Kiribati and the whole Study area at SPC, etc. at Suva. Then, Group-B joined Group-A at Port Moresby via Nadi from Tarawa in Kiribati on 2 May.

CHAPTER 2 SUMMARY OF THE STUDY

2.1 Basic Data of Objective Six (6) Countries of the Study

Basic data of the objective six (6) countries of the Study are as shown in the following **Table 2-1**.

Table 2-1 Agricultural Production Basic Data by Country

Item	Solomon	Vanuatu	Papua New Guinea	Tonga	Samoa	Kiribati
Country area (km^2)	28,900	12,190	462,000	750	2,840	730
Cultivation area (km^2)*	770	1,050	8,900	260	900	370
Irrigation facilities	None	None	None	None	None	None
Agricultural land development potential	None	None	Exist	None	None	None
Year 2006 population statistics (1,000 persons)	534	221	6,187	100	185	92*
Year 2015 population forecast (1,000 persons)	589	270	7,319	104	198	107
Year 2030 population forecast (1,000 persons)	762	356	9,183	115	217	131
Food crops (land area, ha)*	18,000	20,000	240,000	15,000	30,000	2,000
(major crops)	Sweet potato	Taro, etc.	Sweet potato	Pumpkin	Banana	Taro
Commercial crops (land area, ha)*	59,000	85,000	650,000	11,000	60,000	35,000
(major crops)	Coconut	Coconut	Coconut	Coconut	Coconut	Coconut
Population fed on cultivation land (persons/ha)**	26.2	10.8	25.3	6.6	6.1	46.0
Ratio of import amount of foods (%) ***	26.2	10.8	25.3	6.6	6.1	46.0

Source: "Japan's ODA Projects" on HP of Ministry of Foreign Affairs of Japan: Solomon Islands, Republic of Vanuatu, Independent State of Papua New Guinea, Kingdom of Tonga, Independent State of Samoa, Republic of Kiribati

Note *: Kiribati population at year 2006, Others at year 2005

**: Ratio of population to food crops cultivation land area of 1 ha, Source: FAO

***: Ratio of import amount of foods to whole import amount, Source: SPC

2.2 Issues in Agriculture Sector under Conditions of Climate Changes

Adverse impacts on the agricultural production under the climate changes are broadly classified into the impacts acting on the agricultural crops themselves and those acting on the facilities (farm lands and buildings) required as measures for the agricultural production.

In order to cope with those issues, the following measures are considered:

1) Technical cooperation including capacity building of the research activities and extension services for the breeding, the selection, the cultivation, the cropping, the raising that are to be suitable for adaptation to the adverse impacts of the climate changes, and the cooperation for the building, the facilities and the equipment that are to be required for the effective activities.

2) Development study on the agricultural development for the adaptation to supplement the present food production (agriculture and livestock) for the decrease caused due to the

adverse impacts of the climate change, and to cope with the future food demand (rice and the other staple cereals, vegetables, meat, etc.).

3) Restoration and improvement of the facilities for the agriculture and the livestock that have been damaged due to the adverse impacts of the climate changes.

The study has been conducted as mentioned hereinafter from a point of view how to take the effective and efficient measures to cope with the said issues and to seek the suitable approach to the target as follows:.

2.3 Wide Area Approach to Cooperation

Outline of the basic concept, the significance and the objective programmes on the measures to the climate changes (agricultural production) in the Pacific Islands are as described as follows:

(1) Basic concept

Though the Pacific Islands (the objective six (6) countries of the Study on the agricultural production) have the respective different lands and agricultural conditions, there are found common things in the mitigation measures and the adaptation measures to the adverse impacts on the agricultural production caused due to the climate changes. In this regard, the measures are to be studied through the wide area approach grasping the objective six (6) countries as a wide area.

As for the area division on the wide area approach, there are set up the three (3) levels. The first level is the whole area consisting of the objective six (6) countries of the Study and Fiji where the Land Resources Division of SPC is located. The second level is divided into two (2) wide sub-areas consisting of the three (3) countries in the western sub-area (Melanesia) and the other three (3) countries in the eastern area (Polynesia) in consideration of the characteristics of the land resources, the water resources and the agriculture condition and practice. The third level is divided into seven (7) countries consisting of the objective six (6) countries for the Study and one (1) country of Fiji.

The said concept might be considered to be applied to the objective six (6) countries in the short-term and then to be extended to the thirteen (13) countries of the Cool Earth Partnership.

(2) Significance

On the activities to be taken in the area with grasping broadly the objective six (6) countries furthermore thirteen (13) countries, it is expected that the unnecessary activities would be avoided to effectively achieve the target conducting the common research with close communication and supplementing the weak point each other.

(3) Objective cooperation programme

1) Dispatch of the experts to the SPC Land Resources Division and to the respective countries in the area (the common ownership of the data in the area, the common research in the area, the management of implementation of projects, the extension services).

2) Activities of training in the respective countries in the area.

3) Effective and efficient implementation of projects (the development study, the technical cooperation projects, the grant aid projects, etc. to be implemented in the pilot country at first and then extended to the other countries)

   As for the pilot country, if such country as most affected from the adverse impacts of the climate changes, Kiribati might be considered where the ration of the food import amount of 30% to the whole import amount. The objective project would be the technical cooperation project in which the vegetable farming would be extended for the home gardens with use of the result of the research on the vegetable cropping to be done under the climate changes condition.

2.4 Framework of Wide Area Approach to Cooperation

Framework of the wide area approach to the cooperation would be as follows:

(1) Role of SPC Land Resources Division

SPC Land Resources Division located in Fiji would play a role of administrative and technical coordination function for implementation of the programme in the Pacific Islands covering the objective six (6) countries and furthermore the thirteen (13) countries of the Cool Earth Partnership.

(2) Roles of NARI and UNITECH in Papua New Guinea

In the technical field, the National Agriculture Research Institute (NARI) and the University of Technology in Papua New Guinea are conducting the research on the measures for the agricultural production to the climate changes at high level with keeping the communication with the other countries. It is expected that those would play an important role in the frame of the cooperation programme to be coordinated by SPC.

(3) Roles of private sector and government concerned with livestock

Also in the technical field, in Vanuatu, the livestock is being conducted by the private sector and the government at high level. It is expected that those would play an important role in the frame of the cooperation programme to be coordinated by SPC.

(4) Roles of USP in Samoa

Also in the technical field, in Samoa, the University of South Pacific (USP) is conducting the research on the measures for the agricultural production to the climate changes at high level as a key station covering the eastern (Polynesia) three (3) countries of Tonga, Samoa and Kiribati. It is expected that those would play an important role in the frame of the cooperation programme to be coordinated by SPC.

2.5 Cooperation Programme for Climate Changes

In Solomon, Vanuatu, Samoa and Kiribati, the food security is listed as the most important subject in the agriculture sector in NAPA compiling the policy, the strategy and the action plan under the climate changes. In Papua New Guinea and Tonga who have not prepared NAPA, the food security is set as the most priority subject in the National Agriculture Development Plan (2007 - 2016) and the 8th National Development Plan (2007 - 2011).

In consideration the issue that the climate changes are affecting the said priority agricultural policy subject in each country, it is required that the cooperation programme for the measures is to be considered from a viewpoint what measures are effective to the climate changes.

In the Study this time, the various kinds of issue and measures have been investigated through the questionnaire survey to the offices, the organizations and the persons concerned (refer to the result of questionnaire survey attached hereto). With use of the said survey result, the present condition, the needs and the measures have been concretely and objectively analyzed and studied using the matrixes (refer to the tables in each chapter).

Through the said way, the Preparatory Study on the Programme for Climate Change in Pacific Islands (Agriculture) has been conducted from such point of view as grasping the condition of damages on the agricultural production, studying the needs for cooperation on the premise of the institutional system and the human resources of the objective country, confirming the consistency with NAPA and the policy on the agriculture, and then selecting the cooperation programmes with the strong necessity, the great urgency and the high priority.

After such survey and study, the wide area cooperation programme (mitigation measures and the adaptation measures) to be considered as the measures to the climate changes in the Pacific Islands (agricultural production) have been formulated as follows:

(1) Mitigation measures to climate changes

In order to make the discussion more simple and easier, if the point would be focused on CO_2 as the major cause of the climate changes, it could be said that the mitigation measures to the climate changes are the measures for decreasing quantity of CO_2 exhausted and the CO_2

absorbing.

In discussion of the quantity of CO_2 exhausted, out of the total CO_2 quantity exhausted in the world, 7.2 billion tons (source: White Paper of the Ministry of Agriculture, Forestry and Fishery in Japan, 2007 (Present Condition)), the it of Papua New Guinea is reported to be 1.2 million tons and those of the other five (5) countries are 0.0 million tons (source: Data Book of The World 2009). It means that the total quantity of 1.2 million tons of the objective six (6) countries is equivalent to 0.0002 (0.2%) to one (1) of the whole quantity of 7.2 billion tons of the world. Under such situation, the discussion would be how to decrease the quantity.

There is the shifting burning farming as one of the activity with CO_2 gas exhausting that is being practiced in the objective six (6) countries. In consideration of it from the relationship of the quantity exhausted, it would not be so effective and practical to decrease the shifting burning cultivation at the present time because the negative effect (moving to the agriculture with fertilizer and chemicals) is too large in comparison with the benefit from CO_2 gas decrease.

On the other hand, the point of view of absorbing CO_2 gas, the introduction of the agro-forestry as mentioned herein after is to be considered. It would be possible and practical to adopt it according to the condition of the countries.

From the said point of view, there are the mitigation measures to the climate changes to be conducted under the concept of the co-benefits approach to the climate changes in the respective countries as possible, practical and effective measures as follows:

1) Effective use of the shit and waste in the rural area (at village level) of the livestock (use as fuel, introduction of biogas pit).
2) Production and use of the compost as substitute of chemical fertilizers in the rural area (at village level).
3) Introduction of the agro-forestry in the rural area (at village level) (in case absorbing carbon by fruits trees is expected).
4) Implementation of farm lands management for the purpose of prevention of flowing out of carbon from the farm land soil in the rural area (at village level).
5) Effective use of the waste from the industrial agriculture and the livestock in the agriculture and livestock fields.
6) Introduction of the irrigation system for water saving and the energy saving (small-scale gravity irrigation, etc.).
7) Use of renewal energy (other than the agricultural waste) at the agriculture and livestock industry level.

8) Introduction of the energy saving type machine and equipment in the process of the production and processing in the agriculture and the livestock and the resources saving measures.

Out of the objective six (6) countries of the Study, the contour-line vegetation is being practiced in a part of Papua New Guinea to prevent the spoil erosion from the sloping farm lands (mitigation measure of 4)). In Samoa, the Forestry Division is going to start the new project taking the agro-forestry concept (mitigation measure of 3)).

It would be necessary for the other countries to start the preparation for implementation of the mitigation measures to the climate changes through the technical cooperation to be extended in by the dispatch of the experts, etc. in the cooperation programme in the future.

(2) Adaptation measures to climate changes

If the adaptation measure to the climate changes would be grasped from the relationship between the expected effect and the required cost, for example, it might be evaluated that the effect of measures for protecting the flat low lands along the coast from the sea water rise (17cm during these 100 years, source: White Paper of the Ministry of Agriculture, Forestry and Fishery in Japan, 2007 (Present Condition)) would be so smaller than the cost required for the construction of the coastal dike to prevent the area from the inundation and the drainage pump station to drain the excess water of the heavy rain. However, it should be considered from the policy of the country. If the country decides that such structures should be constructed to save the inhabitants in such area, the government would invest the national budget to such works.

As mentioned the above, the priority ranking of implementation of the adaptation measures would be determined depending upon the situation of each country and each area in the country.

For example, in Papua New Guinea, the as the adaptation measures to the climate changes, the research activities for the breeding, the selection, the cultivation, the cropping and the extension services for the farmers and persons concerned (cropping practice and farm management) is set as the higher priority subject, while the construction of such infrastructures to prevent the sea water intrusion and inundation on the farm lands are set as the lower priority.

In the objective six (6) countries of the Study this time, the priority of the adaptation measures to prevent the farmlands and the agricultural facilities from the climate changes (cyclone, heavy rain, etc.) is set lower than it of the crop varieties and the crop cultivation.

It is to be noted that, in addition to such research of the crop varieties and the crop cultivation as mentioned the above, the activities to investigate the damages and its degree of the agricultural production and to arrange the investigation result as the basic information and data would be needed for the future.

In the cooperation programme to be extended in the future, the adaptation measure to the climate changes would be implemented through the technical and financial cooperation such as the dispatch of the experts, etc., the training, the development study, the technical cooperation project and the grant aid project (construction of facilities, supply of equipment, etc.).

The above-mentioned contents are summarized so that the cooperation programme to be extended under the wide area approach consisting of Fiji as key station and the objective six (6) countries would be as follows:

Country	Cooperation Programme
Fiji	Dispatch of Expert to Agriculture Field of SPC for Coordination of Wide Area Approach
(1) Solomon	(i) Master Plan Study on Rice Production (ii) Technical Cooperation Project for Whole Agricultural Field (iii) Dispatch of Advisor to Ministry of Agriculture and Livestock (iv) Enhancement of Updating Statistical Data
(2) Vanuatu	(i) Training of Officers in Central and Local Governments (ii) Dispatch of an expert, SV and JOCV (iii) Dispatch of Vegetable Expert (iv) Enhancement of Updating Statistical Data
(3) Papua New Guinea	(i) Training in Japan of Government Staff (ii) Improvement of UNITECH (iii) Improvement of NARI (iv) Dispatch of Expert (v) Enhancement of Updating Statistical Data
(4) Tonga	(i) Capacity Building for Government Staff (ii) Improvement of Marketing System (iii) Variety Selection (iv) Enhancement of Updating Statistical Data
(5) Samoa	(i) Capacity Building for Government Staff (ii) Improvement of Marketing System (iii) Variety Selection (iv) Enhancement of Updating Statistical Data
(6) Kiribati	(i) Capacity Building for Government Staff (ii) Improvement of Research Station (iii) Soil Improvement and Improvement of Farming Practices for Vegetables (iv) Enhancement of Updating Statistical Data

CHAPTER 3 SOLOMON ISLANDS

3.1 Adverse Impact and Damage due to Climate Changes and Basic Data

(1) Adverse impact and damage data

The condition of damages on the agricultural production in Solomon Islands due to the climate change has been grasped through the site visits and the questionnaire surveys to the concerned ministries and organizations and to the farmers in the area.

The damages on the agricultural production due to the climate change are actually not concretely grasped with the specific figures and are discussed only in a qualitative way. In consideration of the said situation that the basic data such as the agricultural statistics are not well prepared, it could be said that the analysis of the cause of the climate change is not well discussed in such way of clarifying if the damages on the agricultural lands and products are being caused due to the climate change or the mere sometime abnormal weather condition.

Information of the damages obtained through the survey and investigation is as shown in **Table 3-1**. Major ones are listed as follows:

(i) Inundation and erosion of the agricultural lands due to flood caused by heavy rain.
(ii) Collapse of the agricultural lands and the livestock facilities due to high wave and strong wind caused by cyclone.
(iii) Damage due to the salt water intrusion into the agricultural lands caused by the sea-level rise in the flat low land areas (part of the whole country area).

(2) Basic data

In addition to the above-mentioned damage information, the basic data required for more precisely grasping the needs for the cooperation have been collected.

(i) Basic data in relation to the agriculture (e.g. production quantity and cropping area, etc.) have not prepared yet.
(ii) The Solomon Islands government side (Ministry of Agriculture and Livestock) expressed clearly and strongly his wish for the Japan’s cooperation and support.
(iii) The livestock industry in Solomon Islands, especially the beef production, is now under the devastating condition (20,000 head of cattle in 1986 have decreased to less than 2,000 head). The government intends to promote the livestock. However, the activities have hard going due to limitation of the human resources and the national budget.

(3) Activities of other donors

As for the agriculture sector in Solomon Islands, since the support of donors and NGOs are limited as mentioned below, it is so considered that needs for the proper cooperation to be newly

extended would be higher. If any new support would be extended from now on, because of the characteristics of the support activities of the present donors and NGOs, it would be more effective to extend the support together with the present donors and NGOs.

(i) At present, there is only one foreign countries cooperation and aid for the Ministry of Agriculture and Livestock that is the Taiwan Technical Mission continued since 1983. There is no cooperation of the other foreign donors (international organizations and countries). On the other hand, as for the future cooperation, FAO has a plan that is Regional Programme for Food Security (RPFS), in which (i) formulation of National Agriculture Development Policy (US$72,224.-) with target year of 2012, (ii) construction of Agriculture Research Centre (1 station) (US$1,450,000.-) in 2008-2010 Work Plan and (iii) supply of seeds, agricultural inputs and tools (US$250,000.-) aiming at the increase of rice production and the decrease of rice import.

(ii) At present, NGO, Kastam Garden Association, is working for the food security and the maintenance of crop diversification (conservation of traditional varieties that are going to dies out, so as to cope with the future necessity.).

3.2 Study on Needs for Cooperation

The cooperation needs that have been grasped through the site visit and the questionnaire survey to the concerned ministries and organizations and the farmers are shown in **Table 3-2**. Further, the cooperation needs are described with the classification of (i) cooperation needs presented by the government of the recipient country, (ii) cooperation needs confirmed by government of recipient country through discussion with the study team and (iii) Cooperation needs recognized through evaluation of the study team as follows:

(1) Cooperation needs presented by government of recipient country

Intension of the Ministry of Agriculture and Livestock is as follows:

(i) Technical guidance by foreign countries for the mitigation measures (measures for mitigation of the climate change itself) and the adaptation measures (measures to adverse impact and damage due to the climate change).

(ii) Technical guidance by foreign countries for formulation of the policy, the strategy and the action plan for the food security under the climate change condition.

(iii) Taking the change of taste of people in the country in recent years into the planning and the project implementation (the increase of production of rice and beef, and the decrease of import).

(iv) Technical and financial aid required for the planning and the implementation of project of measures to the food security.

(2) Cooperation needs confirmed by government of recipient country through discussion with the study team

The above-mentioned cooperation needs were presented by the government of the recipient country and any other cooperation needs were not added through the discussion with the Study team.

(3) Cooperation needs recognized through evaluation of the study team

As mentioned in the above, there is no quantitative damage data grasped from the point of the climate change. It is necessary to establish the monitoring system and conduct the monitoring activities for grasping the damage condition quantitatively and qualitatively in order to execute effectively the concrete mitigation measures and adaptation measures.

3.3 Study on Mitigation & Adaptation Measures and Cooperation Programme for Climate Changes

The results of the analysis of the direction of the cooperation and the cooperation programme based on the cooperation needs for the mitigation measures and the adaptation measures by damage item are shown in **Table 3-3**.

The cooperation programmes are described with the classification of (i) cooperation programme presented by the government of the recipient country, (ii) cooperation programme confirmed by government of recipient country through discussion with the study team and (iii) Cooperation programme recognized through evaluation of the study team as follows:

(1) Cooperation programme presented by government of recipient country

The cooperation programmes presented by the Ministry of Agriculture and Livestock are as follows:

(i) Conducting the Master Plan Study on Rice Production in Solomon Islands, in which the sustainable (re-cycle type) of the rice production (upland rice and paddy rice) in well combination of the whole agriculture practices.

(ii) Technical cooperation project for each field of the whole agriculture

- The technical cooperation team to be dispatched would be composed of the agronomist, the irrigation engineer and the farm management specialist.
- In the agronomist's field, the construction and operation of the research station for development of the adaptable varieties to the climate change and the extension services would be made.
- In the irrigation engineer's field, the practical method to be applied step by step in accordance with the level would be considered to the irrigation facilities (intake structure, etc) construction.

- In the farm management specialist's field, the practical method to be applied step by step in accordance with the level would be considered to the cultivation practice, the tools & equipment to be introduced, the facilities and building (post-harvest), and the establishment of marketing and distribution of agricultural products.

(iii) Dispatch of an advisor for governmental policy and administration services (dispatch of expert) to the Ministry of Agriculture and Livestock

- The advisor to advise, guide and support the formulation of the policy, the strategy and the action plan for restoration and promotion of the agriculture and livestock to be made from now on, and to advise, guide and support the reasonable and efficient activities in the ordinary administrative services to be made every year.

(2) Cooperation programme confirmed by government of recipient country through discussion with the study team

The above-mentioned cooperation programme was presented by the government of the recipient country and any other cooperation programme was not added through the discussion with the Study team.

(3) Cooperation programme recognized through evaluation of the study team

The above-mentioned cooperation programme was presented by the government of the recipient country and any other cooperation programme was not added with recommendation of the Study team.

3.4 Mitigation & Adaptation Measures and Cooperation Programme for Climate Changes

As mentioned in the above, the Preparatory Study on the Programme for Climate Change in Solomon Islands in the agricultural production field has been conducted from such point of view as grasping the condition of damages on the agricultural production, studying the needs for cooperation on the premise of the institutional system and the human resources of the objective country, confirming the consistency with NAPA and the policy on the agriculture, and then selecting the cooperation programmes with the strong necessity, the great urgency and the high priority.

It is noted that, on 2nd April, 2009, the Permanent Secretary, Mr. Henry Pika, the Director of Extension & Training, Mr. John M. Harunari, Team Leader of Taiwan Technical Mission, Mr. Michael Hsu and Team Leader of JICA Study Team (agricultural Production) discussed at the Ministry of Agriculture and Livestock. In the meeting, the government side of Solomon (the Ministry of Agriculture and Livestock) expressed clearly and strongly the expectation for the government of Japan to extend the cooperation and support.

The cooperation programmes for Solomon Islands finally selected from such point of view are shown in **Table 3-4**, out of which the programmes with high priority are listed as follows:

(i) Master Plan Study on Rice Production
(ii) Technical Cooperation Project for Whole Agricultural Field
(iii) Dispatch of Advisor to Ministry of Agriculture and Livestock
(iv) Enhancement of Updating Statistical Data

Table 3-1 Adverse Impacts and Damages Matrix by Country

Country: Solomon

Damage items due to climate change		Damage condition: Damage by crop: Major food crops: Taro Damage<1	Yam Damage<1	S. potato Damage<1	Banana Damage<1	Total	Ave.	×80%(a)<2	Cash crops: Coconut Damage<1	×20%(b)<2	Damage Degree (a)+(b)
①Damage due to water shortage, drying, etc.	Soil water shortage	2	3	2	3	10	2.5	2.0	2	0.4	2.4
	Disease, pest	2	2	2	2	8	2.0	1.6	2	0.4	2.0
	Salinity	2	2	1	2	7	1.8	1.4	3	0.6	2.0
②Damage due to heavy rain	Submerged	3	1	3	2	9	2.3	1.8	2	0.4	2.2
	Erosion	3	2	3	2	10	2.5	2.0	2	0.4	2.4
	Facility damage	3	1	2	1	7	1.8	1.4	2	0.4	1.8
③Damage due to cyclone	High wave (flood)	3	2	3	2	10	2.5	2.0	2	0.4	2.4
	Strong wind (lodging)	2	2	3	3	10	2.5	2.0	2	0.4	2.4
	Flood (submerged)	3	2	2	2	9	2.3	1.8	2	0.4	2.2
	Agricultural facilities damage	3	3	2	2	10	2.5	2.0	2	0.4	2.4
④Sea water rise	High tide (flood・lodging)	3	3	1	2	9	2.3	1.8	2	0.4	2.2
	Salt water intrusion	3	3	1	3	10	2.5	2.0	3	0.6	2.6
⑤high temperature	Death	3	3	1	2	9	2.3	1.8	2	0.4	2.2
	Sterility	2	3	2	1	8	2.0	1.6	2	0.4	2.0
⑥Daylight	Too much daylight	1	1	1	1	4	1.0	0.8	1	0.2	1.0
	Daylight shortage	2	3	2	2	9	2.3	1.8	2	0.4	2.2

Note) <1: Damage on agricultural products due to climate change in each country is evaluated with 5 degrees of 1~5.
Degree 1: No damage.
Degree 2: There is a little damage, not so serious. Monitoring from now on is required.
Degree 3: There is damage. Emergency measures are not needed to be taken. Monitoring from now on is required. Medium-term and long-term mitigation and adaptation measures are required.
Degree 4: There is big damage due to serious adverse impact on agricultural production in each country. Short-term mitigation and adaptation measures are required.
Degree 5: There is very big damage due to very much serious adverse impact on agricultural production in each country. Emergency mitigation and adaptation measures are required.
<2: Through the work in field, the study team estimated that 80% out of total agricultural production value in the whole country were attributed to major food crops, while 20% to cash crop. Thus the weighted damage was estimated, applying those proportions.

Table 3-2 Cooperation Needs Matrix by Country

Country: Solomon

Mitigation measures and adaptation measures[1]	Needs of country		Cooperation of other donors and organizations			Comment of Study team
	Needs outline	Degree of needs [2]	Organization name	Aid outline	Aid period	
① Change of cropping season	Climate change is observed. But Change of cropping season is not required.	1	nil	nil	nil	Necessity on change of cropping pattern is not found in the result of questionnaire survey to farmers.
② Variety improvement of crops	Improvement of local varieties	3	nil	nil	nil	Tolerant varieties to drought and high air temperature are required to be selected from local varieties.
③ Soil improvement	Salt damage is found in limited area	1	Taiwan	Technical supporting for preparation of organic fertilizer	More than 2 years and 4 months	Its needs are not high because area is limited.
④ Measures to disease and pest	Outbreak of diseases and pests in dry season is not so serious.	1	nil	nil	nil	Some sort of technical advices are necessary.
⑤ Improvement of irrigation facilities	Required for mitigation of flooding and drought	3	nil	nil	nil	There are few irrigation facilities.
⑥ Drainage improvement	Required for mitigation of flooding	1	nil	nil	nil	Needs is low, but it is required for mitigation on flooding damage.
⑦ Soil erosion prevention	Protection of topsoil erosion of farm land due to downpour and long rain	1	nil	nil	nil	Planting along countour is required.
⑧ Prevention of salt water intrusion to agricultural land (heightening of dike, etc.)	Salt water intrusion due to sea level rise is observed in limited area.	1	nil	nil	nil	Its needs are not high because area is limited.
⑨ Capacity building (policy, administration)	Dispatch of policy adviser is strongly required due to poor capability for policy formulation of government staff.	3	nil	nil	nil	It is necessary to do capacity building for awareness raising and enhancing the ability to resolve the issue.
⑩ Construction of research station and research farm	Research station including fields was washed away.	3	FAO	unknown	unknown	It is necessary to do improvement of crop varieties

⑪	Improvement of marketing system of agri. products (improvement of roads, etc.)	Market system and distribution channel are not completed.	1	nil	nil	nil	Needs is high, but its impact might be low due to self-sufficient economy.
⑫	Improvement of extension organization and agri. cooperatives, etc.	Extension organization is available, but staffing and capacity are not sufficient.	3	nil	nil	nil	It is important for increase of future agricultural production.
⑬	Other mitigation measures and adaptation measures	Introduction of new promising crops suitable to climate change is required.	3	nil	nil	nil	It is not urgent, but medium- to long term action could be required.
⑭	Other mitigation measures and adaptation measures	Enhancement of organization for updating statistical data	3	nil	nil	nil	It is required to update.

Note <1 : Mitigation and adaptation measures mentioned above were determined as countermeasures against damages caused by climate change through the work in field by the study team.

<2 : The degree of needs of the mitigation measures and the adaptation measures to the climate change in the agricultural production sector in the country are expressed with the degrees as follows:

Degree 1: Needs for cooperation for the concerned country is low.

Degree 2: Needs for cooperation for the concerned country is not low but not urgent.

Degree 3: Needs for cooperation for the concerned country is very much high.

Table 3-3 Direction and Programmes of Cooperation Study Matrix by Country

Country: Solomon

Damage on Agricultural Product due to Climate Change			Mitigation measures・Adaptation measures ＜3	Basic Survey ＜4					Cooperation Needs				Priority ＜7	Cooperation Programmes ＜8
Damage Item＜1		Degree＜2		Technical possibility (effect)	Economic possibility (effect)	Institutional possibility (effect)	Human resources possibility (effect)	Sub-Total	Needs degree＜5	Evaluation by the study team (requirement / importance)	Sub-Total	Activities of other Donors ＜6		
①Damage or Production Decrease by Drought	Shortage of soil water	2.4	① Change of cropping season ⑤ Improve. of irrigation facilities	4	3	4	4	3.75	3	2	2.50	On-going project by Taiwan / NGO	3.96	A, B, D, F
	Disease / Pests / animal	2.0	④ Measures to diseases and pests	4	3	4	4	3.75	1	3	2.00		3.54	A,B,D
	Salt water	2.0	③ Soil improvement	3	3	4	3	3.25	1	3	2.00	On-going project by Taiwan / NGO	3.29	A,B,D
②Damage or Production Decrease by Downpour	Submerge	2.2	⑥ Drainage improvement	3	3	2	3	2.75	1	1	1.00		2.21	F
	Topsoil erosion	2.4	⑦ Prevention of soil errosion	3	3	2	3	2.75	1	3	2.00		3.04	A,B,D
	Damage of irrigation facilities	1.8	⑥ Drainage improvement	3	3	2	3	2.75	1	1	1.00		2.21	F
③Damage or Production Decrease by Cyclone	High waves	2.4	⑧ Prevent. of salt water intrusion to agri. land (heighten of dike)	2	2	2	2	2.00	1	1	1.00		1.83	F
	Strong wind (lodging)	2.4	① Change of cropping season	4	4	4	4	4.00	1	2	1.50		3.25	A,B,D
	Flooding	2.2	⑥ Drainage improvement	3	3	2	3	2.75	1	1	1.00		2.21	F
	Damage of irrigation facilities	2.4	⑤ Improve. of agricultural facilities	4	3	2	4	3.25	2	2	2.00		3.29	E
④Sea Level Rise	High tide (submerged / lodged)	2.2	⑧ Prevent. of salt water intrusion to agri. land (heighten of dike)	2	2	2	2	2.00	1	1	1.00		1.83	F
	Salt water intrusion	2,6		2	2	2	2	2.00	1	1	1.00		1.83	F
⑤Increase of Air Temperature	Death	2.2	② Improvement of crop varieties	4	4	4	4	4.00	3	3	3.00	On-going project by Taiwan / NGO	4.50	A,B,D
	Sterility	2.0		4	4	4	4	4.00	3	3	3.00	On-going project by Taiwan / NGO	4.50	A,B,D
⑥Daylight	Too much daylight	1.0	② Improvement of crop varieties	4	4	4	4	4.00	3	3	3.00	On-going project by Taiwan / NGO	4.50	A,B,D
	Daylight shortage	2.2		4	4	4	4	4.00	3	3	3.00	On-going project by Taiwan / NGO	4.50	A,B,D
⑦Others ＜9			⑨ Capa. buid. ⑫ (Policy, Admi., Extension)	5	5	3	5	4.50	3	3	3.00	On-going project by Taiwan / NGO	4.75	A,B
			⑩ Recovery of research station and	5	5	5	5	5.00	3	3	3.00		5.00	A,B,D.E
			⑩ New const. of research station and fields	5	5	2	5	4.25	3	3	3.00		4.62	A,B,D.E
			⑪ Improve. of market system of agri. products (incl. market /road)	3	3	2	4	3.00	1	1	1.00		2.33	A,B,C,E,F
			⑬ Intro. of crops suitable to climate change	4	4	4	4	4.00	3	3	3.00	On-going project by Taiwan / NGO	4.50	A,B,C,D
			⑭ Enhancement of organization for updating statistical data	4	3	3	3	3.25	3	3	3.00	On-going project by Taiwan / NGO	4.12	A,B
Weight				0.25	0.25	0.25	0.25	1.00	0.50	0.50	1.00			
Weight				0.500					(5/3) * 0.500= 0.833				1.00	

Note: ＜1: Damage items transferred from Table 3-1.

＜2: Degree of damage transferred from Table 3-1.

＜3: Each measures should cover activities for capacity building.

＜4: The degree of possibility based on the basic survey is decided in accordance with following criteria:

Level 1: No possibility and no effect.

Level 2: Possible but not practical and not adaptable to actual condition.

Level 3: Possible but priority level is low. Medium-term and long-term measures are required. Long-term effect is expected.

Level 4: Possible. Short-term measures are required. Effect is high.

Level 5: Possibility is high. Urgent measures are required. Effect is high.

＜5: The degree of the needs of the concerned country is expressed with the degree obtained in Table 2.

＜6: As for the other donors' action, no point is to be given in case that there is the similar project plan or under implementation. In case of no implementation plan and no implementation, point (3 points) is to be given.

＜7: The total score on the priority ranking is to be the total of points calculated from the respective items with weights. The higher points show the higher priority ranking.

＜8: Considering the standard of cooperation programs of JICA, A: dispatch of expert / JOCV / SV, B: Overseas training, C: Development Study, D: Technical Assistance, E: Grant aid project (construction / procurement), F: Grant aid project (civil engineering)

＜9: These measures are required to carry out as a part of food security measures under the condition of climate change.

Table 3-4 Cooperation Programme on Agricultural Production (Solomon)

No.	Needs	Cooperation Programme and Expected Activities	Measures	Objective Area	Organiza-tion	Adaptable Scheme	Consistency with NAPA	Consistency with Policy	Needs	Urgency	Priority
1	Capa. buid. (Policy, Admi., Extension)	Master Plan Study on Rice Production: Implementation of sustainable agriculture with rice production (upland and lowland rice) to be planned	Adaptation	Whole country	-	Development study	High	High	High	High	High
2	Capa. buid. (Policy, Admi., Extension)	Technical Cooperation Project for Whole Agricultural Field: Technical cooperation team to be composed of agronomist, irrigation engineer, and farm management specialist. In agronomist' s field, construction and operation of research station, and extension services should be considered. In irrigation engineer' s field, construction of irrigation facilities (intake structure, etc) in accordance with technical level of the time should be practically considered. In farm management specialist' s field, proper application of cultivation practice, tools & equipment, facilities and building (post-harvest), and establishment of marketing and distribution channel of agricultural products in accordance with technical level of the time should be considered.	Adaptation	Whole country	-	Technical cooperation project	High	High	High	High	High
3	Capa. buid. (Policy, Admi., Extension)	Dispatch of Advisor to Ministry of Agriculture and Livestock: The expert to advise, guide and support the formulation of the policy, the strategy and the action plan for restoration and promotion of the agricultural and livestock production to be made from now on, and to advise, guide and support reasonable and efficient activities.	Adaptation	Whole country	-	Dispatch of expert, etc.	High	High	High	High	High
4	Enhancement of updating statistical data	Enhancement of Updating Statistical Data: Capacity building for steady data collection. Support on data collection and strengthening monitoring system.	Adaptation	Central. and local gov.	-	Expert	High	Medium	High	High	High
5	Improve. of agricultural facilities	Rehabilitation and Improvement of Livestock Facilities: Rehabilitation and improvement of livestock facilities in the whole country damaged by the cyclone.	Adaptation	Whole country	-	Grant aid	Low	High	High	Low	Low

CHAPTER 4 REPUBLIC OF VANUATU

4.1 Adverse Impact and Damage due to Climate Changes and Basic Data

(1) Adverse impact and damage data

The condition of damages on the agricultural production in Republic of Vanuatu due to the climate change has been grasped through the site visits and the questionnaire surveys to the concerned ministries and organizations and to the farmers in the area.

The damages on the agricultural production due to the climate change are actually not concretely grasped with the specific figures and are discussed only in a qualitative way. In consideration of the said situation that the basic data such as the agricultural statistics are not well prepared, it could be said that the analysis of the cause of the climate change is not well discussed in such way of clarifying if the damages on the agricultural lands and products are being caused due to the climate change or the mere sometime abnormal weather condition.

Information of the damages obtained through the survey and investigation is as shown in **Table 4-1**. Major ones are listed as follows:

(i) Damage on the coastal fishery due to extinction of the coral caused by the cyclone and the sea water temperature rise.
(ii) Falling-down of the plants and collapse of the agricultural facilities due to strong wind caused by the cyclone.
(iii) Decrease of the crop yields due to shortage in sunshine hours and solar radiation.

(2) Basic data

In addition to the above-mentioned damage information, the basic data required for more precisely grasping the needs for the cooperation have been collected.

(i) It could not be said that the basic data on the agricultural production (e.g. production quantity, cropping areas, etc.) have satisfactorily been prepared. Though the Census of Agriculture 2007 Vanuatu was conducted in the nationwide scale, the survey contents should be improved because it covers only the survey on the household number and the farm management types.
(ii) At present, there is foreign countries cooperation and aid for the Ministry of Agriculture, Forestry and Fishery that is mainly the financial aid for the Vanuatu Agricultural Research Technical Centre (VARTC) (the origin: 1962, the present organization: established in 1994) located in the Espiritu Santo Island. Major donors are EU, AFD, ADB, SPC and IFAD. Major subjects are the research on production of coconut and copra, the research on livestock and the research on breeding of coffee, cocoa, pepper, kava (superior variety).
(iii) At present, there is no adviser dispatched from foreign countries to the Ministry of Agriculture, Forestry and Fishery and the organizations under the said Ministry.

(3) Activities of other donors

As for the agriculture sector in Republic of Vanuatu, since the support of donors and NGOs are limited as mentioned below, it is so considered that needs for the proper cooperation to be newly extended would be higher. If any new support would be extended from now on, because of the characteristics of the support activities of the present donors and NGOs, it would be more effective to extend the support together with the present donors and NGOs.

(i) Donor countries for the agriculture sector are AusAID、EU、FAO, etc.

(ii) The above-mentioned agricultural census(2007) was published by the governmental organization of Vanuatu Statistics Office with support of NZAID、AusAID、EU、FAO.

(iii) EU、AFD、ADB、SPC、IFAD are conducting the financial cooperation for the Vanuatu Agricultural Research Technical Centre (VARTC).

4.2 Study on Needs for Cooperation

The cooperation needs that have been grasped through the site visit and the questionnaire survey to the concerned ministries and organizations and the farmers are shown in **Table 4-2**. Further, the cooperation needs are described with the classification of (i) cooperation needs presented by the government of the recipient country, (ii) cooperation needs confirmed by government of recipient country through discussion with the study team and (iii) Cooperation needs recognized through evaluation of the study team as follows:

(1) Cooperation needs presented by government of recipient country

Intension of the Ministry of Agriculture, Forestry and Fishery is as follows:.

(i) Technical guidance by foreign countries for the mitigation measures (measures for mitigation of the climate change itself) and the adaptation measures (measures to adverse impact and damage due to the climate change).

(ii) Technical guidance by foreign countries for formulation of the policy, the strategy and the action plan for the food security under the climate change condition aiming at (i) improvement of crop varieties, (ii) increase of kinds of research subject in the existing research station and field, (iii) improvement of distribution system of agricultural products and (iv) improvement of the extension system and the agricultural cooperative.

(iii) Taking the change of taste of people in the country in recent years into the planning and the project implementation (decrease of import of rice and vegetables).

(iv) Technical and financial aid to the capacity building required for the planning and the implementation of project of measures to the food security

(2) Cooperation needs confirmed by government of recipient country through discussion with the study team

The above-mentioned cooperation needs were presented by the government of the recipient country and any other cooperation needs were not added through the discussion with the Study team.

(3) Cooperation needs recognized through evaluation of the study team

As mentioned in the above, there is no quantitative damage data grasped from the point of the climate change. It is necessary to establish the monitoring system and conduct the monitoring activities for grasping the damage condition quantitatively and qualitatively in order to execute effectively the concrete mitigation measures and adaptation measures.

4.3 Study on Mitigation & Adaptation Measures and Cooperation Programme for Climate Changes

On 8th April, 2008, the Director of Department of Agriculture, Mr. Ruben Bakeo Markward, the Principal Agriculture Officer, Mr. James Wasi, the Food Security Officer, Ms. Annick Stevens Taticka, the Team Leader of JICA Study Team (Agricultural Production), Mr. Kuninobu Noda, the Crop Cultivation Expert, Ms. Yoko Nagata and the Program Officer of JICA Vanuatu Office, Mr. Joel JONAS, discussed at the Department of Agriculture.

The results of the analysis of the direction of the cooperation and the cooperation programme based on the cooperation needs for the mitigation measures and the adaptation measures by damage item are shown in **Table 4-3**.

The cooperation programmes are described with the classification of (i) cooperation programme presented by the government of the recipient country, (ii) cooperation programme confirmed by government of recipient country through discussion with the study team and (iii) Cooperation programme recognized through evaluation of the study team as follows:

(1) Cooperation programme presented by government of recipient country

The cooperation programmes presented by the Ministry of Agriculture, Forestry and Fishery are as follows:

(i) Training of officers in the central government and the local government on the whole agriculture sector in the organization for training on the tropical agriculture in Japan.

- Practical training of the crop cultivation and the farm management for the sustainable (recycle type) agriculture mainly in the traditional farming practices (root crops, banana, fruits, etc.) and the commercial farming (production and processing of coconut, and livestock) (e.g. training in the Asian Rural Institute - Institute for training of leaders in rural areas in Asia -)

- 1st year: an officer of the Department of Agriculture in the Ministry of Agriculture, Forestry and Fishery), 2nd year: an officer of the Agriculture Extension Office in Sanma Province (Espiritu Santo Island) and 3rd year: an officer of the Agricultural Extension Office in Tafea Province (Tanna Island).

(ii) Dispatch of an expert, SV and JOCV for the whole agriculture

- Continuous renewal dispatch of the expert to advise the government policy and administrative services to the central government (Ministry of Agriculture, Forestry and Fishery).
- Dispatch of a SV (Senior Volunteer) or a JOCV to the local government (Agriculture Extension Office in Sanma Province).

(2) Cooperation programme confirmed by government of recipient country through discussion with the study team

- Dispatch of a short-term expert of the vegetables to VARTC.

(3) Cooperation programme recognized through evaluation of the study team

The above-mentioned cooperation programme was presented by the government of the recipient country and any other cooperation programme was not added with recommendation of the Study team.

4.4 Mitigation & Adaptation Measures and Cooperation Programme for Climate Changes

As mentioned in the above, the Preparatory Study on the Programme for Climate Change in Republic of Vanuatu in the agricultural production field has been conducted from such point of view as grasping the condition of damages on the agricultural production, studying the needs for cooperation on the premise of the institutional system and the human resources of the objective country, confirming the consistency with NAPA and the policy on the agriculture, and then selecting the cooperation programmes with the strong necessity, the great urgency and the high priority.

It is noted that, on 17th April, 2009, the Director of Department of Agriculture, Mr. Ruben Bakeo Markward, the Principal Agriculture Officer, Mr. James Wasi, the Food Security Officer, Ms. Annick Stevens Taticka, the Volunteer Programme Coordinator of JICA Vanuatu Office, Mr. Toshiyuki Omachi, the Program Officer of the said JICA office, Mr. Joel JONAS, the Team Leader of JICA Study Team (Agricultural Production), Mr. Kuninobu Noda, and the Crop Cultivation Expert, Ms. Yoko Nagata discussed and confirmed the contents of the cooperation programme again at the final meeting.

The cooperation programmes for Republic of Vanuatu finally selected from such point of view are shown in **Table 4-4**, out of which the programmes with high priority are listed as follows:

(i) Training of Officers in Central and Local Governments

(ii) Dispatch of an expert, SV and JOCV

(iii) Dispatch of Vegetable Expert

(iv) Enhancement of Updating Statistical Data

Table 4-1 Adverse Impacts and Damages Matrix by Country

Country: Vanuatu

Damage items due to climate change		Damage condition									Damage Degree (a)+(b)
		Damage by crop									
		Major food crop							Cash crop		
		Taro	Yam	S. potato	Banana	Total	Ave.	×80%(a)<2	Coconut	×20%(b)<2	
		Damage<1	Damage<1	Damage<1	Damage<1				Damage<1		
①Damage due to water shortage, drying, etc.	Soil water shortage	1	1	2	1	5	1.3	1.0	1	0.2	1.2
	disease, pest	1	1	2	1	5	1.3	1.0	2	0.4	1.4
	Salinity	1	1	2	1	5	1.3	1.0	1	0.2	1.2
②Damage due to heavy rain	Submerged	1	1	1	1	4	1.0	0.8	2	0.4	1.2
	Erosion	1	1	2	1	5	1.3	1.0	2	0.4	1.4
	Facility damage	1	1	2	1	5	1.3	1.0	2	0.4	1.4
③Damage due to cyclone	High wave (flood)	2	2	1	2	7	1.8	1.4	2	0.4	1.8
	Strong wind (lodging)	3	3	1	3	10	2.5	2.0	4	0.8	2.8
	Flood (submerged)	2	2	1	2	7	1.8	1.4	2	0.4	1.8
	Agricultural facilities damage	3	3	2	3	11	2.8	2.2	2	0.4	2.6
④Sea water rise	High tide (flood・lodging)	2	2	1	2	7	1.8	1.4	2	0.4	1.8
	Salt water intrusion	2	2	1	2	7	1.8	1.4	2	0.4	1.8
⑤high temperature	Death	1	1	1	1	4	1.0	0.8	1	0.2	1.0
	Sterility	1	1	1	1	4	1.0	0.8	1	0.2	1.0
⑥Daylight	Too much daylight	1	1	1	1	4	1.0	0.8	1	0.2	1.0
	Daylight shortage	2	2	3	2	9	2.3	1.8	3	0.6	2.4

Note) <1: Damage on agricultural products due to climate change in each country is evaluated with 5 degrees of 1~5.

Degree 1: No damage.

Degree 2: There is a little damage, not so serious. Monitoring from now on is required.

Degree 3: There is damage. Emergency measures are not needed to be taken. Monitoring from now on is required. Medium-term and long-term mitigation and adaptation measures are required.

Degree 4: There is big damage due to serious adverse impact on agricultural production in each country. Short-term mitigation and adaptation measures are required.

Degree 5: There is very big damage due to very much serious adverse impact on agricultural production in each country. Emergency mitigation and adaptation measures are required.

<2: Through the work in field, the study team estimated that 80% out of total agricultural production value in the whole country were attributed to major food crops, while 20% to cash crop. Thus the weighted damage was estimated, applying those proportions.

Table 4-2 Cooperation Needs Matrix by Country

Country: Vanuatu

Mitigation measures and adaptation measures[1]	Needs of country		Cooperation of other donors and organizations			Comment of Study team
	Needs outline	Degree of needs [2]	Organization name	Aid outline	Aid period	
① Change of cropping season	Climate change is observed. Cropping season should be changed.	2	AFD,EU,ADB,SPC, CIRAD,ACIAR,POPACA IAC,IPGRI,IFAD,COGENT (Financial assistance to VARTC)	Financial Assistance	na	It is found through questionnaire survey that farmers change cropping season.
② Variety improvement of crops	Improvement of local variety to climate change . Introduction of new crops	3	AFD,EU,ADB,SPC, CIRAD,ACIAR,POPACA IAC,IPGRI,IFAD,COGENT (Financial assistance to VARTC)	Financial Assistance	na	Tolerant varieties to humidity and shortage of daylight are required to be selected from local varieties or new varieties.
③ Soil improvement	Damage by volcanic acid rain in limited area	3	nil	nil	nil	Some sort of measures should be considered.
④ Measures to disease and pest	Outbreak of diseases and pests is not so serious.	2	nil	nil	nil	Some sort of technical advices are necessary.
⑤ Improvement of irrigation facilities	Irrigation facilities are required.	2	nil	nil	nil	There are few irrigation facilities.
⑥ Drainage improvement	Required for prevention of submergence condition and securing road network	2	nil	nil	nil	Long rain make some parts of road network impassable.
⑦ Soil erosion prevention	Some parts on the coast line has been eroded due to sea level rise.	3	nil	nil	nil	Aforestation of mangrove is required.
⑧ Prevention of salt water intrusion to agricultural land (heightening of dike, etc.)	There are salt water intrusion due to sea level rise in limited area.	2	nil	nil	nil	Needs is required for limited area.
⑨ Capacity building (policy, administration)	Staff for policy formulation is required.	3	nil	nil	nil	It is necessary to do capacity building for awareness raising and enhancing the ability to resolve the issue.
⑩ Construction of research station and research farm	There is no section for vegetable. There is only one research station.	3	nil	nil	nil	It is necessary to do improvement of crop varieties
⑪ Improvement of marketing system of agri. products (improvement of roads, etc.)	Market system and distribution channel are not completed.	3	nil	nil	nil	Improvement of market facilities and training market management.
⑫ Improvement of extension organization and agri. cooperatives,	Extension organization is available, but staffing and capacity are not sufficient.	3	nil	nil	nil	It is necessary to increase staffing and promote extension activities.

	etc.						
⑬	Other mitigation measures and adaptation measures	Enhancement of organization for updating statistical data	3	nil	nil	nil	It is required to update.

Note <1 : Mitigation and adaptation measures mentioned above were determined as countermeasures against damages caused by climate change through the work in field by the study team.

<2 : The degree of needs of the mitigation measures and the adaptation measures to the climate change in the agricultural production sector in the country are expressed with the degrees as follows:

Degree 1: Needs for cooperation for the concerned country is low.

Degree 2: Needs for cooperation for the concerned country is not low but not urgent.

Degree 3: Needs for cooperation for the concerned country is very much high.

Table 4-3 Direction and Programme of Cooperation Study Matrix by Country

Country: Vanuatu

Damage on Agricultural Product due to Climate Change			Mitigation measures・Adaptation measures ＜3	Basic Survey ＜4					Cooperation Needs				Priority ＜7	Cooperation Programmes ＜8
Damage Item＜1		Degree＜2		Technical possibility (effect)	Economic possibility (effect)	Institutional possibility (effect)	Human resources possibility ＜	Sub-Total	Needs degree＜5	Evaluation by the study team	Sub-Total	Activities of other Donors ＜6		
①Damage or Production Decrease by Drought	Shortage of soil water	1.2	① Change of cropping ⑤ season Improve. of irrigation facilities	4	3	3	4	3.50	2	2	2.00	EU, ADB, etc.	3.42	A, B, D, F
	Disease / Pests / animal	1.4	④ Measures to diseases and pests	3	3	3	3	3.00	2	2	2.00		3.17	A,B,D
	Salt water	1.2	③ Soil improvement	3	3	3	3	3.00	3	3	3.00		4.00	A,B,D
②Damage or Production Decrease by Downpour	Submerge	1.2	⑥ Drainage	3	3	2	3	2.75	2	2	2.00		3.04	F
	Topsoil erosion	1.4	⑦ Prevention of soil errosion	3	3	2	3	2.75	2	2	2.00		3.04	A,B,D
	Damage of irrigation facilities	1.4	⑥ Drainage improvement	3	3	2	3	2.75	3	3	3.00		3.87	F
③Damage or Production Decrease by Cyclone	High waves	1.8	⑧ Prevent. of salt water intrusion to agri. land (heighten of dike)	2	2	2	2	2.00	2	2	2.00		2.67	F
	Strong wind (lodging)	2.8	① Change of cropping season	4	4	4	4	4.00	2	2	2.00	EU, ADB, etc.	3.67	A,B,D
	Flooding	1.8	⑥ Drainage improvement	3	3	2	3	2.75	2	2	2.00		3.04	F
	Damage of irrigation facilities	2.6	⑤ Improve. of agricultural facilities	4	3	2	3	3.00	3	3	3.00		4.00	E
④Sea Level Rise	High tide (submerged / lodged)	1.8	⑧ Prevent. of salt water intrusion to agri. land (heighten of dike)	2	2	2	2	2.00	2	2	2.00		2.67	F
	Salt water intrusion	1.8		2	2	2	2	2.00	2	2	2.00		2.67	F
⑤Increase of Air Temperature	Death	1.0	② Improvement of crop varieties	4	4	4	4	4.00	3	3	3.00	EU, ADB, etc.	4.50	A,B,D
	Sterility	1.0		4	4	4	4	4.00	3	3	3.00	EU, ADB, etc.	4.50	A,B,D
⑥Daylight	Too much daylight	1.0	② Improvement of crop varieties	4	4	4	4	4.00	1	2	1.50	EU, ADB, etc.	3.25	A,B,D
	Daylight shortage	2.4		4	4	4	4	4.00	3	3	3.00	EU, ADB, etc.	4.50	A,B,D
⑦Others ＜9			⑨⑫ Capa. buid. (Policy, Admi., Extension)	5	5	3	5	4.50	3	3	3.00		4.75	A,B
			⑩ Extension of research station and fields	5	5	2	4	4.00	3	3	3.00		4.50	A,B,D. E
			⑪ Improve. of market system of agri. products (incl.	5	5	3	4	4.25	3	3	3.00		4.62	A,B,C, E,F
			⑬ Enhancement of organization for updating statistical data	4	3	3	3	3.25	3	3	3.00		4.12	A,B
Weight				0.25	0.25	0.25	0.25	1.00	0.50	0.50	1.00			
Weight				0.500					(5/3) * 0.500= 0.833				1.00	

Note: ＜1: Damage items transferred from Table 4-1.

＜2: Degree of damage transferred from Table 4-1.

＜3: Each measures should cover activities for capacity building.

＜4: The degree of possibility based on the basic survey is decided in accordance with following criteria:

Level 1: No possibility and no effect.

Level 2: Possible but not practical and not adaptable to actual condition.

Level 3: Possible but priority level is low. Medium-term and long-term measures are required. Long-term effect is expected.

Level 4: Possible. Short-term measures are required. Effect is high.

Level 5: Possibility is high. Urgent measures are required. Effect is high.

＜5: The degree of the needs of the concerned country is expressed with the degree obtained in Table 2.

＜6: As for the other donors' action, no point is to be given in case that there is the similar project plan or under implementation. In case of no implementation plan and no implementation, point (3 points) is to be given.

＜7: The total score on the priority ranking is to be the total of points calculated from the respective items with weights. The higher points show the higher priority ranking.

＜8: Considering the standard of cooperation programs of JICA, A: dispatch of expert / JOCV / SV, B: Overseas training, C: Development Study, D: Technical Assistance, E: Grant aid project (construction / procurement), F: Grant aid project (civil engineering)

＜9: These measures are required to carry out as a part of food security measures under the condition of climate change.

Table 4-4 Cooperation Programme on Agricultural Production (Vanuatu)

No.	Needs	Cooperation Programme and Expected Activities	Measures	Objective Area	Organiza -tion	Adaptable Scheme	Consistency with NAPA	Consistency with Policy	Needs	Urgency	Priority
1	Capa. buid. (Policy, Admi., Extension)	Training of Officers in Central and Local Govemments: Training of officers in the central government and the local government on the whole agriculture sector in organization for training. Practical training of crop cultivation and farm management for sustainable (recycle type) agriculture mainly in traditional farming practices (root crops, banana, fruits, etc.) and commercial farming (production and processing of coconut, livestock. 1st year: an officer of the Department of Agriculture in the Ministry of Agriculture, Forestry and Fishery), 2nd year: an officer of the Agriculture Extension Office in Sanma Province (Espiritu Santo Island) and 3rd year: an officer of the Agricultural Extension Office in Tafea Province (Tanna Island).	Adaptation	Whole country Sanma Province Agricultural Extension Office in Tafea Province	−	Training	High	High	High	High	High
2		Dispatch of Expert, SV and JOCV: Continuous renewal dispatch of experts to advise government policy and administrative services to the central government (Ministry of Agriculture, Forestry and Fishery), while SV (Senior Volunteer) or JOCV for the local government (Agriculture Extension Office in Sanma Province).	Adaptation	Whole country Sanma Province	−	Dispatch of expert, etc.	High	High	High	High	High
3		Dispatch of Vegetable Expert: Dispatch of a short-term expert of the vegetables to VARTC.	Adaptation	Whole country	−	Dispatch of expert, etc.	High	High	High	High	High
4	Enhancement of updating statistical data	Enhancement of Updating Statistical Data: Capacity building for steady data collection. Support on data collection and strengthening monitoring system.	Adaptation	Central. and local gov.	−	Expert	High	Medium	High	High	High
5	Improve. of agricultural facilities	Rehabilitation and Improvement of Agricultural Facilities: Rehabilitation and improvement of agricultural facilities (store, processing, distribution) in the whole country damaged by the cyclone.	Adaptation	Whole country	−	Grant aid	Low	High	High	Low	Low

CHAPTER 5 INDEPENDENT STATE OF PAPUA NEW GUINEA

5.1 Adverse Impact and Damage due to Climate Changes and Basic Data

(1) Adverse impact and damage data

The condition of damages on the agricultural production in Independent State of Papua New Guinea due to the climate change has been grasped through the site visits and the questionnaire surveys to the concerned ministries and organizations and to the farmers in the area.

The damages on the agricultural production due to the climate change are actually not concretely grasped with the specific figures and are discussed only in a qualitative way. In consideration of the said situation that the basic data such as the agricultural statistics are not well prepared, it could be said that the analysis of the cause of the climate change is not well discussed in such way of clarifying if the damages on the agricultural lands and products are being caused due to the climate change or the mere sometime abnormal weather condition.

Information of the damages obtained through the survey and investigation is as shown in **Table 5-1**. Major ones are listed as follows:

(i) Disease and wet damage due to increase of rainy days
(ii) Pest and water shortage in a drought year
(iii) High temperature sterility

(2) Basic data

In addition to the above-mentioned damage information, the basic data required for more precisely grasping the needs for the cooperation have been collected.

(i) Office of Climate Change and Sustainable Environment (OCCSE) is now leading PNG on the measures to climate change in accordance with the present Medium Term Development Strategy 2005-2010 and the next term version under preparation.
(ii) National Department of Agriculture and Livestock (NDAL) is in charge of implementation of the government's agricultural administrative activity putting stress on **the food security** in accordance with National Agriculture Development Plan (NADP) 2007-2016.
NDAL is also conducting the agricultural extension services as the government services. However, its activities are now not satisfactorily being carried out.
(iii) National Agricultural Research Institute (NARI) is conducting the agricultural research such as experiment and study in line with the strategy of OCCSE and NDAL.
(iv) The University of Technology (UNITECH) is conducting the agricultural research in relation to the climate change putting stress on the agricultural extension services.

(v) Though Papua New Guinea has not prepared NAPA, the above-mentioned OCCSE is leading the activities of measures for the climate change instead of NAPA.

(3) Activities of other donors

As for the agriculture sector in Independent State of Papua New Guinea, the supports of the donors are being extended at a high technical level as mentioned below. It is so considered that the supports for the research on the development of adaptable varieties of crops, etc. to the climate change are effectively conducted by the donors. However, there is no support of the donors for the advice and guidance on the governmental administrative services in order to reflect the result of the research upon the common ownership at a level of the Pacific Ocean wide area and the extension services in the country, etc.

(i) As the cooperation and support for the NDAL and the concerned organizations from foreign countries at present, the financial cooperation to NARI is to be noted. Under the said cooperation, NARI is conducting the research programmes at the headquarters in Lae and six (6) branch offices in the country for the five (5) classified areas and the other activities of experiment and study. Major fields are GIS, the livestock, the rice and cereals, the weeds measures, the chemical test, the agriculture related insects, and the biological measurement and statistics. Major donors are AusAID and EU. It is to be noted that NARI is conducting the activities with keeping the relation to such foreign countries as in Africa and Pacific Ocean.

(ii) At present, there is no policy adviser, etc. dispatched by the donors in NDAL and the concerned organizations.

5.2 Study on Needs for Cooperation

The cooperation needs that have been grasped through the site visit and the questionnaire survey to the concerned ministries and organizations and the farmers are shown in **Table 5-2**. Further, the cooperation needs are described with the classification of (i) cooperation needs presented by the government of the recipient country, (ii) cooperation needs confirmed by government of recipient country through discussion with the study team and (iii) Cooperation needs recognized through evaluation of the study team as follows:

(1) Cooperation needs presented by government of recipient country

(i) NDAL expressed his intention as follows:

- Technical and financial aid is necessary for strengthening the agricultural extension services.
- NDAL intends to play a role in effective extension of the NARI’s research achievements.

(ii) NARI and UNITECH expressed their intension as follows:

- Improvement of the facilities, equipment and tools for the research is needed.
- NDAL and UNITECH intend to play a role in earlier realization of the comprehensive and practical measures to the climate change in the agricultural production sector, which are now being achieved.

(2) Cooperation needs confirmed by government of recipient country through discussion with the study team

― Activities in Madang Province for Smallholder Rice Production Promotion Project (JICA) were successfully completed, and the Provincial Department of Agriculture and Livestock (PDAL) has taken over the achievement. Now, PDAL is conducting the activities to increase the number of rice production farmers in accordance with his own 5-year development plan "Promotion of Sustainable Smallholder Rice Production in Madang Province 2008-2013 (October 2008). However, it is to be noted that the JICA Expert for Smallholder Rice Production has pointed out the fear of the disease and pest damage on the rice that has been caused partly and explained the necessity for taking measures immediately.

(3) Cooperation needs recognized through evaluation of the study team

As mentioned in the above, there is no quantitative damage data grasped from the point of the climate change. It is necessary to establish the monitoring system and conduct the monitoring activities for grasping the damage condition quantitatively and qualitatively in order to execute effectively the concrete mitigation measures and adaptation measures.

5.3 Study on Mitigation & Adaptation Measures and Cooperation Programme for Climate Changes

The results of the analysis of the direction of the cooperation and the cooperation programme based on the cooperation needs for the mitigation measures and the adaptation measures by damage item are shown in **Table 5-3**.

The cooperation programmes are described with the classification of (i) cooperation programme presented by the government of the recipient country, (ii) cooperation programme confirmed by government of recipient country through discussion with the study team and (iii) Cooperation programme recognized through evaluation of the study team as follows:

(1) Cooperation programme presented by government of recipient country

Through a series of discussions made from 21st to 30th April, the government side of PNG (NDAL, PDAL, NARI, UNITECH) expressed clearly the expectation for the government of

Japan to extend the cooperation and support for implementation of the measures listed as follows:

(i) Training in Japan for strengthening of the administrative capacity of the government's officials in Momase Regional Office under NDAL and the officials in PDAL in Madang Province, who would be in charge of the actual government's administrative activities with receiving the advices made by the said JICA expert.

(ii) Providing UNITECH in Lae with the facilities, equipment and tools for the research and the support for his extension services.

(iii) Providing NARI Headquarters in Lae and the six (6) NARI branches in the country with the facilities, equipment and tools for the research especially on measures to the disease and pest damages the vegetable, the fruits and the cereals.

(2) Cooperation programme confirmed by government of recipient country through discussion with the study team

The above-mentioned cooperation programme was presented by the government of the recipient country and any other cooperation programme was not added through the discussion with the Study team.

(3) Cooperation programme recognized through evaluation of the study team

― Continuous renewal dispatch of an adviser (JICA expert) on policy, strategy and governmental administrative services to Momase Regional Office under NDAL.

- He would support the government's activities to strengthen the collaboration of NARI and UNITECH to improve the agricultural extension services.

5.4 Mitigation & Adaptation Measures and Cooperation Programme for Climate Changes

As mentioned in the above, the Preparatory Study on the Programme for Climate Change in Independent State of Papua New Guinea in the agricultural production field has been conducted from such point of view as grasping the condition of damages on the agricultural production, studying the needs for cooperation on the premise of the institutional system and the human resources of the objective country, confirming the consistency with the policy on the agriculture, and then selecting the cooperation programmes with the strong necessity, the great urgency and the high priority.

It is noted that the government side of PNG, NARI and UNITECH together with NDAL, expressed clearly the expectation for the government of Japan to extend the cooperation and support for implementation the measures listed as below.

The cooperation programmes for Independent State of Papua New Guinea finally selected from such point of view are shown in **Table 5-4**, out of which the programmes with high priority are listed as follows:

(i) Training in Japan of Government Staff
(ii) Improvement of UNITECH
(iii) Improvement of NARI
(iv) Dispatch of Expert
(v) Enhancement of Updating Statistical Data

Table 5-1 Adverse Impacts and Damages Matrix by Country

Country: Papua New Guinea

Damage items due to climate change		Damage condition									Damage Degree (a)+(b)
		Damage by crop									
		Major food crop							Cash crop		
		Taro	Yam	S. potato	Banana	Total	Ave.	×80%(a)<2	Coconut	×20%(b)<2	
		Damage<1	Damage<1	Damage<1	Damage<1				Damage		
①Damage due to water shortage, drying, etc.	Soil water shortage	3	3	3	2	11	2.8	2.2	1	0.2	2.4
	disease, pest	2	3	3	3	11	2.8	2.2	3	0.6	2.8
	Salinity	2	2	3	3	10	2.5	2.0	1	0.2	2.2
②Damage due to heavy rain	Submerged	3	3	3	3	12	3.0	2.4	3	0.6	3.0
	Erosion	3	3	3	3	12	3.0	2.4	1	0.2	2.6
	Facility damage	1	1	1	1	4	1.0	0.8	1	0.2	1.0
③Damage due to cyclone	High wave (flood)	3	3	3	3	12	3.0	2.4	3	0.6	3.0
	Strong wind (lodging)	1	3	1	3	8	2.0	1.6	1	0.2	1.8
	Flood (submerged)	3	3	3	3	12	3.0	2.4	4	0.8	3.2
	Agricultural facilities damage	1	1	1	1	4	1.0	0.8	1	0.2	1.0
④Sea water rise	High tide (flood・lodging)	3	3	3	3	12	3.0	2.4	4	0.8	3.2
	Salt water intrusion	2	2	3	3	10	2.5	2.0	2	0.4	2.4
⑤high temperature	Death	2	2	3	2	9	2.3	1.8	1	0.2	2.0
	Sterility	2	2	3	2	9	2.3	1.8	1	0.2	2.0
⑥Daylight	Too much daylight	2	2	1	1	6	1.5	1.2	1	0.2	1.4
	Daylight shortage	2	2	1	1	6	1.5	1.2	1	0.2	1.4

Note) <1: Damage on agricultural products due to climate change in each country is evaluated with 5 degrees of 1~5.
Degree 1: No damage.
Degree 2: There is a little damage, not so serious. Monitoring from now on is required.
Degree 3: There is damage. Emergency measures are not needed to be taken. Monitoring from now on is required. Medium-term and long-term mitigation and adaptation measures are required.
Degree 4: There is big damage due to serious adverse impact on agricultural production in each country. Short-term mitigation and adaptation measures are required.
Degree 5: There is very big damage due to very much serious adverse impact on agricultural production in each country. Emergency mitigation and adaptation measures are required.
<2: Through the work in field, the study team estimated that 80% out of total agricultural production value in the whole country were attributed to major food crops, while 20% to cash crop. Thus the weighted damage was estimated, applying those proportions.

Table 5-2 Cooperation Needs Matrix by Country

Country: Papua New Guinea

Mitigation measures and adaptation measures[1]	Needs of country		Cooperation of other donors and organizations			Comment of Study team Organization name
	Needs outline	Degree of needs[2]	Organization name	Aid outline	Aid period	
① Change of cropping season	Climate change is observed. Cropping season should be changed.	2	nil	nil	nil	Fluctuation of climate change by annual is quite big. So shifting of cropping season is required.
② Variety improvement of crops	Improvement of local variety to climate change . Introduction of new crops	3	ACIAR	Variety selection of Taro and Yam	na	It is necessary to select varieties, which are tolerant to high humid, salinity, drought
③ Soil improvement	Partly soil has been impoverished, but there's not necessarily an urgent need	1	nil	nil	nil	In urban area, farm land is squeezed due to population pressure. Therefore, it is difficult to arrange enough fallow period, resulting in low fertility of soil.
④ Measures to disease and pest	Outbreak of diseases and pests is serious due to high temperature or drought.	3	nil	nil	nil	New diseases / pests spread due to imbalance of ecosystem caused by climate change.
⑤ Improvement of irrigation facilities	Agriculture has been kept depending on rain. It is necessary to consider some sort of irrigation facilities	1	Taiwan Technical Mission	Study on irrigation possibility is checked by irrigation engineer, which will be sent in May 2009.	Since May 2009	It is expected that irrigation facilities adaptable to capacity of the country be constructed.
⑥ Drainage improvement	Required for prevention of submergence condition and securing road network for marketing	2	nil	nil	nil	Long rain make some parts of road network impassable due to land sliding.
⑦ Soil erosion prevention	Prevention of erosion of top soil of farm land, due to downpour and long rain.	3	nil	nil	nil	Dissemination of contour planting
⑧ Prevention of salt water intrusion to agricultural land (heightening of dike, etc.)	There are salt water intrusion due to sea level rise in limited area.	2	nil	nil	nil	Needs is sufficiently required for limited area.

⑨	Capacity building (policy, administration)	Staff for policy formulation is required.	1	AusAID	Dispatching adviser to central government	na	It is necessary to do capacity building for awareness raising and enhancing the ability to resolve the issue.
⑩	Construction of research station and research farm	Facilities and equipment are not sufficient, although research station is available.	3	EU	Construction of research institute		It is necessary to do improvement of crop varieties
⑪	Improvement of marketing system of agri. products (improvement of roads, etc.)	Market system and distribution channel are not completed.	3	nil	nil	nil	Construction of road network is delayed due to land acquisition. Market is also limited within local society.
⑫	Improvement of extension organization and agri. cooperatives, etc.	Extension organization is available, but staffing and capacity are not sufficient.	3	nil	nil	nil	Extension organization is vulnerable. Christian NGO has quite big responsibility.
⑬	Other mitigation measures and adaptation measures	Introduction of new promising crops suitable to climate change is required.	3	nil	nil	nil	It is not urgent, but medium- to long term action could be required.
⑭	Other mitigation measures and adaptation measures	Enhancement of organization for updating statistical data	3	nil	nil	nil	It is required to update.

Note <1 : Mitigation and adaptation measures mentioned above were determined as countermeasures against damages caused by climate change through the work in field by the study team.

<2 : The degree of needs of the mitigation measures and the adaptation measures to the climate change in the agricultural production sector in the country are expressed with the degrees as follows:

Degree 1: Needs for cooperation for the concerned country is low.
Degree 2: Needs for cooperation for the concerned country is not low but not urgent.
Degree 3: Needs for cooperation for the concerned country is very much high.

Table 5-3 Direction and Programme of Cooperation Study Matrix by Country

Country: Papua New Guinea

Damage on Agricultural Product due to Climate Change			Mitigation measures・Adaptation measures ＜3	Basic Survey ＜4					Cooperation Needs				Priority ＜7	Cooperation Programmes ＜8
Damage Item＜1		Degree ＜2		Technical possibility (effect)	Economic possibility (effect)	Institutional possibility (effect)	Human resources possibility (effect)	Sub-Total	Needs degree ＜5	Evaluation by the study team (countermeasure)	Sub-Total	Activities of other Donors ＜6		
①Damage or Production Decrease by Drought	Shortage of soil water	3.4	① Change of ⑤ cropping season Improve. of	5	5	3	3	4.00	2	2	2.00	Taiwan Technical Mission	3.67	A, B, D, F
	Disease / Pests / animal	3.4	④ Measures to diseases and pests	4	5	3	4	4.00	3	3	3.00		4.50	A,B,D
	Salt water	2.8	③ Soil improvement	3	3	2	2	2.50	2	2	2.00		2.92	A,B,D
②Damage or Production Decrease by Downpour	Submerge	4.4	⑥ Drainage	3	3	2	3	2.75	3	2	2.50		3.46	F
	Topsoil erosion	4.0	⑦ Prevention of soil errosion	3	4	2	3	3.00	2	2	2.00		3.17	A,B,D
	Damage of irrigation facilities	1.0	⑥ Drainage improvement	3	3	3	3	3.00	1	2	1.50		2.75	F
③Damage or Production Decrease by Cyclone	High waves	4.2	⑧ Prevent. of salt water intrusion to agri. land (heighten of dike)	2	2	2	2	2.00	2	2	2.00		2.67	F
	Strong wind (lodging)	2.2	① Change of cropping season	5	5	2	3	3.75	1	2	1.50		3.12	A,B,D
	Flooding	4.2	⑥ Drainage improvement	3	3	2	3	2.75	2	2	2.00		3.04	F
	Damage of irrigation facilities	1.0	⑤ Improve. of agricultural facilities	4	3	2	4	3.25	1	2	1.50		2.87	E
④Sea Level Rise	High tide (submerged / lodged)	4.2	⑧ Prevent. of salt water intrusion to agri. land (heighten of dike)	2	2	2	2	2.00	2	2	2.00		2.67	F
	Salt water intrusion	3.0		2	2	2	2	2.00	2	2	2.00		2.67	F
⑤Increase of Air Temperature	Death	2.2	② Improvement of crop varieties	4	4	4	4	4.00	3	3	3.00		4.50	A,B,D
	Sterility	2.0		4	4	4	4	4.00	3	3	3.00		4.50	A,B,D
⑥Daylight	Too much daylight	1.4	② Improvement of crop varieties	4	4	4	4	4.00	1	2	1.50	ACIAR	3.25	A,B,D
	Daylight shortage	1.4		4	4	4	4	4.00	1	2	1.50		3.25	A,B,D
⑦Others ＜9			⑨ Capa. buid. ⑫ (Policy, Admi., Extension)	5	5	3	5	4.50	3	3	3.00	AusAID(only central Government)	4.75	A,B
			⑩ Construction of research station and research farm	5	5	5	5	5.00	3	3	3.00		5.00	A,B,D. E
			⑩ New construction of research station and research	5	5	2	5	4.25	1	1	1.00	EU	2.96	A,B,D. E
			⑪ Improvement of marketing system of agri. products (including improvement of	3	3	2	4	3.00	3	2	2.50		3.58	A,B,C, E,F
			⑬ Introduction of new promising crops suitable to climate change is required.	5	4	4	4	4.25	3	3	3.00		4.62	A,B,D
			⑭ Enhancement of organization for updating statistical data	4	3	3	3	3.25	3	3	3.00		4.12	A,B
Weight				0.25	0.25	0.25	0.25	1.00	0.50	0.50	1.00			
Weight				0.500					(5/3) * 0.500= 0.833				1.00	

Note: ＜1: Damage items transferred from Table 5-1.

＜2: Degree of damage transferred from Table 5-1.

＜3: Each measures should cover activities for capacity building.

＜4: The degree of possibility based on the basic survey is decided in accordance with following criteria:

Level 1: No possibility and no effect.

Level 2: Possible but not practical and not adaptable to actual condition.

Level 3: Possible but priority level is low. Medium-term and long-term measures are required. Long-term effect is expected.

Level 4: Possible. Short-term measures are required. Effect is high.

Level 5: Possibility is high. Urgent measures are required. Effect is high.

＜5: The degree of the needs of the concerned country is expressed with the degree obtained in Table 2.

＜6: As for the other donors' action, no point is to be given in case that there is the similar project plan or under implementation. In case of no implementation plan and no implementation, point (3 points) is to be given.

＜7: The total score on the priority ranking is to be the total of points calculated from the respective items with weights. The higher points show the higher priority ranking.

＜8: Considering the standard of cooperation programs of JICA, A: dispatch of expert / JOCV / SV, B: Overseas training, C: Development Study, D: Technical Assistance, E: Grant aid project (construction / procurement), F: Grant aid project (civil engineering)

＜9: These measures are required to carry out as a part of food security measures under the condition of climate change.

Table 5-4 Cooperation Programme on Agricultural Production (Papua New Guinea)

No.	Needs	Cooperation Programme and Expected Activities	Measures	Objective Area	Organiza-tion	Adaptable Scheme	Consistency with NAPA	Consistency with Policy	Needs	Urgency	Priority
1	Capa. buid. (Policy, Admi., Extension)	Training in Japan of Government Staff: Strengthening of the administrative capacity of the government's officials.	Adaptation	Momase Regional Office PDAL in Madang Province	−	Training	−	High	High	High	High
2	Construction of research station and research farm	Improvement of UNITECH: Rehabilitation of facilities and supply of equipment and tools for research and extension services	Adaptation	UNITECH in Lae	AusAID, EU	Grant aid	−	High	High	High	High
3	Capa. buid. (Policy, Admi., Extension)	Improvement of NARI: Providing NARI Headquarters in Lae and the six (6) NARI branches in the country with facilities, equipment and tools for research especially on measures to the disease and pest damages of vegetable, fruits and cereals.	Adaptation	NARI HQ in Lae and 6 branches	AusAID, EU	Grant aid	−	High	High	High	High
4	Capa. buid. (Policy, Admi., Extension)	Dispatch of Expert: Continuous renewal dispatch of an adviser (JICA expert) on policy, strategy and governmental administrative services to Momase Regional Office under NDAL. He would support the government's activities to strengthen the collaboration of NARI and UNITECH to improve the agricultural extension services.	Adaptation	Momase Regional Office under NDAL	−	Training	−	High	High	High	High
5	Capa. buid. (Policy, Admi., Extension)	Enhancement of Updating Statistical Data: Capacity building for steady data collection. Support on data collection and strengthening monitoring system.	Adaptation	Whole country	−	Expert	−	Medium	High	High	High
6	Drainage improvement	Drainage Improvement: Decrease of damage on crops due to inundation caused by the heavy rain.	Adaptation	Whole country	−	Grant aid	−	Low	High	Low	Low

CHAPTER 6 KINGDOM OF TONGA

6.1 Adverse Impact and Damage due to Climate Changes and Basic Data

(1) Adverse impact and damage data

The condition of damages on the agricultural production in Kingdom of Tonga due to the climate change has been grasped through the site visits and the questionnaire surveys to the concerned ministries and organizations and to the farmers in the area.

The damages on the agricultural production due to the climate change are actually not concretely grasped with the specific figures and are discussed only in a qualitative way. In consideration of the said situation that the basic data such as the agricultural statistics are not well prepared, it could be said that the analysis of the cause of the climate change is not well discussed in such way of clarifying if the damages on the agricultural lands and products are being caused due to the climate change or the mere sometime abnormal weather condition.

Information of the damages obtained through the survey and investigation is as shown in **Table 6-1**. Major ones are listed as follows:

(i) There are some reports on land erosion as well as land collapse caused by rising sea levels in some outer island such as Haapai and Vavau islands.

(ii) Damages on farm lands, crops, relevant facilities have been occurred by high waves, salt water, strong wind, which are caused by cyclones every two years.

(iii) Erosion and collapse of farm lands and roads by deep water and salt water intrusion are found partly in lower land.

(iv) Drought period with high temperature is longer than that in normal year due to change of rainfall patter, resulting in outbreak of Powdery Mildew as well as production decrease.

(2) Basic data

In addition to the above-mentioned damage information, the basic data required for more precisely grasping the needs for the cooperation have been collected.

(i) Basic agricultural information such as production, cultivated area, etc. is not sufficient. National agricultural census was conducted in 2001, however no agricultural census has been done. Therefore limited basic information on farm household and agriculture is available. It is difficult to grasp degree of damage to agricultural activity due to climate change quantitatively. Meanwhile there is some gap between statistical data in Ministry of Agriculture and Food, Forests, and Fisheries and those data in FAO, thus it is necessary to improve the precision of statistical data.

(ii) Ministry of Natural Resources and Environment has prepared mitigation plans and adaptation plans. Mitigation plans will be prepared by June this year, while September for

adaptation plans. Mitigation plans cover four fields (agriculture, forestry, energy, and waste, while adaptation plans for six (6) fields such as forestry, fishery, water resources, health, and disaster risk management.

(iii) Though Tonga has not prepared NAPA, the above-mentioned Ministry of Natural Resources and Environment is leading the activities of measures for the climate change on the basis of Initial National Communication (May 2005) instead of NAPA.

(3) Activities of other donors

As for the agriculture sector in Kingdom of Tonga, various financial and technical support activities have been supplied from donors. Major activities are shown as follows:

(i) EU provides of some support activities regarding promotion of various small scale agro-processing industries and crop quarantine facility (Hot Temperature Force Air: HTFA).

(ii) FAO (RPFS: Regional Programme for Food Security) covers experiment and extension activities on promotion of livestock industry (cattle, poultry, etc.), breeding and selection of tolerant varieties on hot temperature, pests and diseases, etc.

(iii) SPC ahs conducted support services to basic investigation regarding livestock promotion (pig, feed, etc.), and germplasm preservation of root crops (taro, yam, cassava), coconut, etc.

(iv) Regarding climate change, GTZ has started projects such as promotion of agroforestry since January 2009 in Tonga, Vanuatu, and Fiji completing in four (4) years. Currently, Inception Report including action plan has been prepared, followed by workshop on problem analysis.

6.2 Study on Needs for Cooperation

The cooperation needs that have been grasped through the site visit and the questionnaire survey to the concerned ministries and organizations and the farmers are shown in **Table 6-2**. Further, the cooperation needs are described with the classification of (i) cooperation needs presented by the government of the recipient country, (ii) cooperation needs confirmed by government of recipient country through discussion with the study team and (iii) Cooperation needs recognized through evaluation of the study team as follows:

(1) Cooperation needs presented by government of recipient country

Intentions of the Ministry are shown as follows:

(i) Promotion of commercial crop cultivation is required in order to improve living standard of farmers. Therefore it is required to find promising export commodities, strengthen plant protection system, establish quality standard.

(ii) Strengthening distribution system of agricultural commodities is required. Particularly, improvement and enhancement of market infrastructure, quality standard, farmers' association, post-harvesting, etc. are essential components. Therefore financial and technical assistances are required for them.

(iii) Technical guidance by foreign countries for formulation of the policy, the strategy and the action plan for the food security under the climate change condition aiming at (i) improvement of self-sufficiency, (ii) improvement of facilities in the existing research stations and fields, (iii) improvement of extension system as well as farmers' organization, (iv) promotion of agro-processing, and (v) enhancement of private partnership.

(iv) Technical and financial aid to the capacity building required for the planning and the implementation of project of measures to the food security.

(v) Technical and financial aid to the capacity building required for improvement of statistical information system

(2) Cooperation needs confirmed by government of recipient country through discussion with the study team

The above-mentioned cooperation needs were presented by the government of the recipient country and any other cooperation needs were not added through the discussion with the Study team.

(3) Cooperation needs recognized through evaluation of the study team

As mentioned in the above, there is no quantitative damage data grasped from the point of the climate change. It is necessary to establish the monitoring system and conduct the monitoring activities for grasping the damage condition quantitatively and qualitatively in order to execute effectively the concrete mitigation measures and adaptation measures.

6.3 Study on Mitigation & Adaptation Measures and Cooperation Programme for Climate Changes

The results of the analysis of the direction of the cooperation and the cooperation programme based on the cooperation needs for the mitigation measures and the adaptation measures by damage item are shown in **Table 6-3**.

The cooperation programmes are described with the classification of (i) cooperation programme presented by the government of the recipient country, (ii) cooperation programme confirmed by government of recipient country through discussion with the study team, and (iii) cooperation programme recognized through evaluation of the study team as follows:

(1) Cooperation programme presented by government of recipient country

Through meetings and discussions with the Ministry, it was clarified that support services provided from Japanese government, which widely covers overall sectors in cooperation with donors, is strongly expected. The ministry strongly desires technical and financial assistance for the following subjects:

(i) Capacity building for central and local government officers

- Dispatch of the expert to advise the government policy and administrative services to the MInistry
- Dispatch of adviser as well as training for officials, aiming at capacity building for awareness raising and enhancing the ability to resolve the issue, regarding policy, administration, and extension
- Dispatch of experts for On-the-Job Training on data collection and strengthening monitoring system

(ii) Technical cooperation regarding promotion of agricultural activities

- Improvement of the crop cultivation and the farm management for the sustainable agriculture mainly in the traditional farming practices (root crops, banana, etc.) and the commercial farming (production and processing of coconut, fruits, etc.).
- Improvement of marketing infrastructure for stable supply of agricultural products (storage, processing facilities, etc.), and collection and supply of marketing information for export of agricultural products.
- Selection of varieties, which are tolerant to Powdery Mildew or other major disease / pests and hot air temperature
- Introduction of new promising crops suitable to climate change
- Improvement of facilities as well as instrument in research stations, and implementation of OJT for capacity development of officers in charge.

(2) Cooperation programme confirmed by government of recipient country through discussion with the study team

The above-mentioned cooperation programme was presented by the government of the recipient country and any other cooperation programme was not added through the discussion with the Study team.

(3) Cooperation programme recognized through evaluation of the study team

The above-mentioned cooperation programme was presented by the government of the recipient country and any other cooperation programme was not added with recommendation of the Study team.

6.4 Mitigation & Adaptation Measures and Cooperation Programme for Climate Changes

As mentioned in the above, the Preparatory Study on the Programme for Climate Change in Kingdom of Tonga in the agricultural production field has been conducted from such point of view as grasping the condition of damages on the agricultural production, studying the needs for cooperation on the premise of the institutional system and the human resources of the objective country, confirming the consistency with the policy on the agriculture, and then selecting the cooperation programmes with the strong necessity, the great urgency and the high priority.

Especially, regarding climate change, the ministry strongly expect some support activities that is (i) enhancement of updating agricultural statistics to grasp the degree of damage properly, (ii) capacity building for government staff as well as farmers to react future situation of climate change, and (iii) improvement of farming practices against climate change as well as enhancement of research and extension activities for improvement of crop productivity.

The cooperation programmes for Kingdom of Tonga finally selected from such point of view are shown in **Table 6-4**, out of which the programmes with high priority are listed as follows:

(i) Capacity Building for Government Staff
(ii) Improvement of Marketing System
(iii) Variety Selection
(iv) Enhancement of Updating Statistical Data

Table 6-1 Adverse Impacts and Damages Matrix by Country

Country: Tonga

Damage items due to climate change		Damage condition									Damage Degree (a)+(b)
		Damage by crop									
		Major food crop							Cash crop		
		Taro Damage<1	Yam Damage<1	S. potato Damage<1	Banana Damage<1	Total	Ave.	×90%(a)<2	Coconut Damage<1	×10%(b)<2	
①Damage due to water shortage, drying, etc.	Soil water shortage	2	2	2	2	8	2.0	1.8	2	0.2	2.0
	Disease, pest	3	2	2	2	9	2.3	2.1	2	0.2	2.3
	Salinity	2	2	2	2	8	2.0	1.8	2	0.2	2.0
②Damage due to heavy rain	Submerged	1	1	1	1	4	1.0	0.9	1	0.1	1.0
	Erosion	1	1	1	1	4	1.0	0.9	2	0.2	1.1
	Facility damage	1	1	1	1	4	1.0	0.9	1	0.1	1.0
③Damage due to cyclone	High wave(flood)	1	1	1	1	4	1.0	0.9	1	0.1	1.0
	Strong wind(lodging)	2	2	2	3	9	2.3	2.1	2	0.2	2.3
	Flood(submerged)	1	1	1	1	4	1.0	0.9	1	0.1	1.0
	Agricultural facilities damage	2	2	2	1	7	1.8	1.6	2	0.2	1.8
④Sea water rise	High tide(flood・lodging)	1	1	1	1	4	1.0	0.9	2	0.2	1.1
	Salt water intrusion	1	1	1	1	4	1.0	0.9	2	0.2	1.1
⑤high temperature	Death	1	1	1	2	5	1.3	1.2	1	0.1	1.3
	Sterility	1	1	1	1	4	1.0	0.9	1	0.1	1.0
⑥Daylight	Too much daylight	1	1	1	1	4	1.0	0.9	1	0.1	1.0
	Daylight shortage	1	1	1	1	4	1.0	0.9	1	0.1	1.0

Note) <1: Damage on agricultural products due to climate change in each country is evaluated with 5 degrees of 1~5.
Degree 1: No damage.
Degree 2: There is a little damage, not so serious. Monitoring from now on is required.
Degree 3: There is damage. Emergency measures are not needed to be taken. Monitoring from now on is required. Medium-term and long-term mitigation and adaptation measures are required.
Degree 4: There is big damage due to serious adverse impact on agricultural production in each country. Short-term mitigation and adaptation measures are required.
Degree 5: There is very big damage due to very much serious adverse impact on agricultural production in each country. Emergency mitigation and adaptation measures are required.
<2: Through the work in field, the study team estimated that 90% out of total agricultural production value in the whole country were attributed to major food crops, while 10% to cash crop. Thus the weighted damage was estimated, applying those proportions.

Table 6-2 Cooperation Needs Matrix by Country

Country: Tonga

Mitigation measures and adaptation measures[<1]	Needs of country		Cooperation of other donors and organizations			Comment of Study team
	Needs outline	Degree of needs [<2]	Organization name	Aid outline	Aid period	
① Change of cropping season	Drought and rainy period has shifted.	1	China	na	na	Currently the cropping pattern is not reviewed, though cultivation seasons of vegetables and root crops are slightly affected due to drought. Cropping season would be shifted in the future.
② Variety improvement of crops	Drought period and rainfall pattern have been changed, so yield of coconut (var.: local tall) has become down, while Taro has been affected due to shortage of water. Breeding of resistant varieties to drought and high temperature for fruits and Taro are necessary.	3	SPC GTZ China	na	na	Breeding of drought and high temperature resistant varieties have not been carried out.
③ Soil improvement	It is required to improve soil fertility	2	China	na	na	Promotion of compost preparation for soil improvement is necessary.
④ Measures to pest and disease	Powdery mildew for Taro is serious.	3	SPC GTZ China	na	na	Resistant varieties (species) are required.
⑤ Improvement of irrigation facilities	Previously, packet irrigation was introduced. However, that techniques is expensive for farmers.	2	nil	nil	nil	It is not practical, but it is expected that vegetable be cultivated, applying supplemental irrigation with rain harvesting.
⑥ Drainage improvement	Flooding is come out in residential area, but not in farm land.	1	nil	nil	nil	It is not so urgent subject.
⑦ Soil erosion prevention	It is necessary at coastal area.	2	nil	nil	nil	Planting of mangrove as well as some vegetation is

						required..
⑧ Prevention of salt water intrusion to farmland (heightening of dike, etc.)	Currently it is not so serious.	1	nil	nil	nil	Countermeasures should be conducted for limited area.
⑨ Capacity building (policy, administration)	Staff for policy formulation is required.	3	FAO	na	na	It is necessary to do capacity building for awareness raising and enhancing the ability to resolve the issue.
⑩ Construction of research station and research farm	Facilities of Research Station are required to be rehabilitated due to deterioration.	2	SPC GTZ	na	na	Rehabilitation is necessary.
⑪ Improvement of marketing system of agri. products (improvement of roads, etc.)	Marketing system and distribution system are developed.	2	Stabex（EU）	Promotion of export and agro-processing	na	Standard and marketing information are required.
⑫ Improvement of extension organization and agricultural cooperatives, etc.	Extension organization is available, but their capacity can not meet farmers' requirement.	3	FAO	na	na	It is necessary to promote capacity development of extension staff. Further organization for market and distribution should be developed.
⑬ Other mitigation and adaptation measures	Introduction of new promising crops suitable to climate change is required.	2	nil	nil	nil	It is not urgent, but medium- to long term action could be required.
⑭ Other mitigation and adaptation measures	Enhancement of organization for updating statistical data	3	FAO	na	na	It is required to update.

Note <1 : Mitigation and adaptation measures mentioned above were determined as countermeasures against damages caused by climate change through the work in field by the study team.

<2 : The degree of needs of the mitigation measures and the adaptation measures to the climate change in the agricultural production sector in the country are expressed with the degrees as follows:

Degree 1: Needs for cooperation for the concerned country is low.

Degree 2: Needs for cooperation for the concerned country is not low but not urgent.

Degree 3: Needs for cooperation for the concerned country is very much high.

Table 6-3 Direction and Programme of Cooperation Study Matrix by Country

Country: Tonga

Damage on Agricultural Product due to			Mitigation measures・Adaptation measures ＜3	Basic Survey ＜4					Cooperation Needs				Priority ＜7	Cooperation Programmes ＜8
Damage Item＜1		Degree＜2		Technical possibility (effect)	Economic possibility (effect)	Institutional possibility (effect)	Human resources possibility (effect)	Sub-Total	Needs degree＜5	Evaluation by the study team (requirement / importance)	Sub-Total	Activities of other Donors ＜6		
①Damage or Production Decrease by Drought	Shortage of soil water	2.0	① Change of ⑤ cropping season Improve. of	3	3	3	3	3.00	1	2	1.50	China	2.75	A, B, D, F
	Disease / Pests / animal	2.3	④ Measures to ② diseases and pests	3	3	3	3	3.00	3	3	3.00	SPC GTZ、China	4.00	A,B,D
	Salt water	2.0	③ Soil improvement	3	3	3	3	3.00	2	3	2.50		3.58	A,B,D
②Damage or Production Decrease by Downpour	Submerge	1.0	⑥ Drainage	3	3	2	3	2.75	1	1	1.00		2.21	F
	Topsoil erosion	1.1	⑦ Prevention of soil errosion	3	3	2	3	2.75	2	2	2.00		3.04	A,B,D
	Damage of irrigation facilities	1.0	⑥ Drainage improvement	2	2	2	2	2.00	2	1	1.50		2.25	F
③Damage or Production Decrease by Cyclone	High waves	1.0	⑧ Prevent. of salt water intrusion to agri. land (heighten of dike)	2	2	2	2	2.00	1	1	1.00		1.83	F
	Strong wind (lodging)	2.3	① Change of cropping season	4	4	3	3	3.50	2	2	2.00		3.42	A,B,D
	Flooding	1.0	⑥ Drainage improvement	3	3	2	3	2.75	1	1	1.00		2.21	F
	Damage of irrigation facilities	1.8	⑤ Improve. of agricultural facilities	4	3	2	3	3.00	1	1	1.00		2.33	E
④Sea Level Rise	High tide (submerged / lodged)	1.1	⑧ Prevent. of salt water intrusion to agri. land (heighten of dike)	2	2	2	2	2.00	1	1	1.00		1.83	F
	Salt water intrusion	1.1		2	2	2	2	2.00	1	1	1.00		1.83	F
⑤Increase of Air Temperature	Death	1.3	② Improvement of crop varieties	3	3	3	3	3.00	2	3	2.50	SPC GTZ	3.58	A,B,D
	Sterility	1.0		3	3	3	3	3.00	2	3	2.50	SPC GTZ	3.58	A,B,D
⑥Daylight	Too much daylight	1.0	② Improvement of crop varieties	3	3	3	3	3.00	1	3	2.00	SPC GTZ	3.17	A,B,D
	Daylight shortage	1.0		3	3	3	3	3.00	1	3	2.00	SPC GTZ	3.17	A,B,D
⑦Others ＜9			⑨ Capa. buid. ⑫ (Policy, Admi., Extension)	5	5	3	5	4.50	3	3	3.00	FAO China	4.75	A,B
			⑩ Construction of research station and research	4	4	3	4	3.75	2	3	2.50	SPC GTZ	3.96	A,B,D.E
			⑪ Improvement of marketing system of agri. products (including improvement of	4	4	4	4	4.00	2	3	2.50	Stabex (EU)	4.08	A,B,C,E,F
			⑬ Introduction of new promising crops suitable to climate change is required.	3	3	3	3	3.00	2	2	2.00		3.17	A,B,D
			⑭ Enhancement of organization for updating statistical data	3	3	3	3	3.00	3	3	3.00	FAO	4.00	A,B
Weight				0.25	0.25	0.25	0.25	1.00	0.50	0.50	1.00			
Weight				0.500					(5/3) * 0.500= 0.833				1.00	

Note: ＜1: Damage items transferred from Table 6-1.

＜2: Degree of damage transferred from Table 6-1.

＜3: Each measures should cover activities for capacity building.

＜4: The degree of possibility based on the basic survey is decided in accordance with following criteria:

Level 1: No possibility and no effect.

Level 2: Possible but not practical and not adaptable to actual condition.

Level 3: Possible but priority level is low. Medium-term and long-term measures are required. Long-term effect is expected.

Level 4: Possible. Short-term measures are required. Effect is high.

Level 5: Possibility is high. Urgent measures are required. Effect is high.

＜5: The degree of the needs of the concerned country is expressed with the degree obtained in Table 2.

＜6: As for the other donors' action, no point is to be given in case that there is the similar project plan or under implementation. In case of no implementation plan and no implementation, point (3 points) is to be given.

＜7: The total score on the priority ranking is to be the total of points calculated from the respective items with weights. The higher points show the higher priority ranking.

＜8: Considering the standard of cooperation programs of JICA, A: dispatch of expert / JOCV / SV, B: Overseas training, C: Development Study, D: Technical Assistance, E: Grant aid project (construction / procurement), F: Grant aid project (civil engineering)

＜9: These measures are required to carry out as a part of food security measures under the condition of climate change.

Table 6-4 Cooperation Programme on Agricultural Production (Tonga)

No.	Needs	Cooperation Programme and Expected Activities	Measures	Objective Area	Organiza-tion	Adaptable Scheme	Consistency with NAPA	Consistency with Policy	Needs	Urgency	Prior-ity
1	Capacity. building. (Policy, Administration., Extension)	Capacity Building for Government Staff: Dispatch of adviser as well as training for officials, aiming at capacity building for awareness raising and enhancing the ability to resolve the issue, regarding policy, administration, and extension	Adaptation measures	Central. and local government	FAO China	Expert	Medium	High	High	High	High
2	Improvement of marketing system of agricultural products for export (including improvement of roads, etc.)	Improvement of Marketing System: Improvement of marketing infrastructure for stable supply of agricultural products, and collection and supply of marketing information for export and import of agricultural products.	Adaptation measures	Central. and local government., and stakeholders for marketing	Stabex (EU)	Study	Medium	High	High	Medium	High
3	Measures to diseases and pests Improvement of varieties	Variety Selection: Selection of varieties, which are tolerant to Powdery Mildew or other major disease / pests	Adaptation measures	Research institute	SPC GTZ	Expert	High	High	High	Medium	High
4	Enhancement of updating statistical data	Enhancement of Updating Statistical Data: Capacity building for steady data collection. Support on data collection and strengthening monitoring system.	Adaptation measures	Central. and local gov.	FAO	Expert	Medium	Medium	High	High	High
5	Construction of research station and research farm	Improvement of Facilities and Capacity Building: Improvement of facilities and equipment in research institute, and capacity development of staff. Practical training on animal hygiene as well as quality of livestock products.	Adaptation measures	Research institute	SPC GTZ	Grant aid	Medium	Medium	Medium	Medium	Medium
6	Soil improvement	Soil Improvement: Based on introduction of organic fertilizer and compost, development and dissemination of cultivation method for root crops and major vegetables	Adaptation measures	Research institute Pilot area	nil	Technical cooperation,	Medium	Medium	Medium	Medium	Medium
7	Prevention of soil erosion	Prevention of Soil Erosion: Promotion of contour farming as well as improvement of farming practices in order to prevent soil erosion	Adaptation measures	Research institute Pilot area	nil	Technical cooperation,	Medium	Medium	Medium	Medium	Medium

CHAPTER 7 INDEPENDENT STATE OF SAMOA

7.1 Adverse Impact and Damage due to Climate Changes and Basic Data

(1) Adverse impact and damage data

The condition of damages on the agricultural production in Independent State of Samoa due to the climate change has been grasped through the site visits and the questionnaire surveys to the concerned ministries and organizations and to the farmers in the area.

The damages on the agricultural production due to the climate change are actually not concretely grasped with the specific figures and are discussed only in a qualitative way. In consideration of the said situation that the basic data such as the agricultural statistics are not well prepared, it could be said that the analysis of the cause of the climate change is not well discussed in such way of clarifying if the damages on the agricultural lands and products are being caused due to the climate change or the mere sometime abnormal weather condition.

Information of the damages obtained through the survey and investigation is as shown in **Table 7-1**. Major ones are listed as follows:

(i) There are few reports on land erosion as well as land collapse caused by rising sea levels..

(ii) Taro cultivation in Samoa got devastating damage due to cyclone attack in 1991 and also large outbreaks of Taro Leaf Blight in 1993. In this occasion, Taro Niue, which is a major variety, had met serious damage of no production. Currently, geneplasm preservation of taro and other major crops as well as breeding and selection of tolerant varieties have been conducted.

(iii) Drought period with high temperature is longer than that of normal year due to change of rainfall pattern. Therefore, there are some cases, which crop production has been reduced.

(2) Basic data

In addition to the above-mentioned damage information, the basic data required for more precisely grasping the needs for the cooperation have been collected.

(i) Basic statistical information is supplied from Agricultural Survey 2000. This survey is a sample survey for 10% out of total farm household, thus information on cultivated area and production for the whole country is not available. Continuous collection of statistical information is not arranged. In this case, it is difficult to analyse the effect of climate change on crop production.

(ii) Breeding and selection of tolerant varieties on high air temperature as well as pests / disease of major crops such as taro, coconut, etc. have been conducted in cooperation with USP and SPC.

(iii) Ministry of Natural Resources and Environment has prepared adaptation plans to climate change. Regarding agriculture, implementation of sustainable agriculture and food security program will be expected to be carried out since May 2009, in cooperation with GEF/UNDP.

(iv) Forestry division of the Ministry of Natural Resources and Environment is planning to carry out a new project adopting the concept of agro-forestry instead of community forest program supported by GEF/FAO. Project sites are limited in Savaii island.

(3) Activities of other donors

As for the agriculture sector in Independent State of Samoa, technical assistances of other donors are not so active. However AusAID starts technical assistance for policy making, thus it seems that other donors' moves could be active, depending on the future policy to be formulated. Current situation of donors' activities are shown as follows:

(i) AusAID has supported to formulate national plan for agricultural development.

(ii) FAO and SPC have supported promotion of livestock industry, research, and extension.

(iii) As mentioned before, GEF/FAO and GEF/UNDP are going to start activities on climate change.

7.2 Study on Needs for Cooperation

The cooperation needs that have been grasped through the site visit and the questionnaire survey to the concerned ministries and organizations and the farmers are shown in **Table 7-2**. Further, the cooperation needs are described with the classification of (i) cooperation needs presented by the government of the recipient country, (ii) cooperation needs confirmed by government of recipient country through discussion with the study team and (iii) Cooperation needs recognized through evaluation of the study team as follows:

(1) Cooperation needs presented by government of recipient country

Intentions of the Ministry are shown as follows:

(i) Promotion of commercial crop cultivation is required in order to improve living standard of farmers. Therefore it is required to find promising export commodities, strengthen plant protection system, establish quality standard.

(ii) Technical guidance by foreign countries for the mitigation measures (measures for mitigation of the climate change itself) and the adaptation measures (measures to adverse impact and damage due to the climate change).

(iii) Technical guidance by foreign countries for formulation of the policy, the strategy and the action plan for the food security under the climate change condition aiming at (i) improvement of marketing system, (ii) improvement of facilities in the existing

research stations and fields, (iii) improvement of extension system as well as farmers' organization, (iv) promotion of agro-processing, (v) promotion of irrigation facilities, and (vi) promotion of animal industry.

(iv) Technical and financial aid to the capacity building required for the planning and the implementation of project of measures to the food security as well as improvement of statistical information system.

(2) Cooperation needs confirmed by government of recipient country through discussion with the study team

The above-mentioned cooperation needs were presented by the government of the recipient country and any other cooperation needs were not added through the discussion with the Study team.

(3) Cooperation needs recognized through evaluation of the study team

As mentioned in the above, there is no quantitative damage data grasped from the point of the climate change. It is necessary to establish the monitoring system and conduct the monitoring activities for grasping the damage condition quantitatively and qualitatively in order to execute effectively the concrete mitigation measures and adaptation measures.

7.3 Study on Mitigation & Adaptation Measures and Cooperation Programme for Climate Changes

The results of the analysis of the direction of the cooperation and the cooperation programme based on the cooperation needs for the mitigation measures and the adaptation measures by damage item are shown in **Table 7-3**.

The cooperation programmes are described with the classification of (i) cooperation programme presented by the government of the recipient country, (ii) cooperation programme confirmed by government of recipient country through discussion with the study team and (iii) Cooperation programme recognized through evaluation of the study team as follows:

(1) Cooperation programme presented by government of recipient country

Through meetings and discussions, the ministry strongly desires technical and financial assistance for the following subjects:

(i) Capacity building for central and local government officers

- Dispatch of the expert to advise the government policy and administrative services to the MInistry

- Dispatch of adviser as well as training for officials, aiming at capacity building for awareness raising and enhancing the ability to resolve the issue, regarding policy, administration, and extension
- Dispatch of experts for On-the-Job Training on data collection and strengthening monitoring system

(ii) Technical cooperation regarding promotion of agricultural activities

- Improvement of the crop cultivation and the farm management for the sustainable agriculture mainly in the traditional farming practices (root crops, banana, etc.) and the commercial farming (production and processing of coconut, fruits, etc.).
- Improvement of marketing infrastructure for stable supply of agricultural products (storage, processing facilities, etc.), and collection and supply of marketing information for import and export of agricultural products.
- Selection of varieties, which are tolerant to Leaf Blight or other major disease / pests and hot air temperature
- Introduction of new promising crops suitable to climate change
- Improvement of facilities as well as instrument in research stations, and implementation of OJT for capacity development of officers in charge.

(2) Cooperation programme confirmed by government of recipient country through discussion with the study team

The above-mentioned cooperation programme was presented by the government of the recipient country and any other cooperation programme was not added through the discussion with the Study team.

(3) Cooperation programme recognized through evaluation of the study team

The above-mentioned cooperation programme was presented by the government of the recipient country and any other cooperation programme was not added with recommendation of the Study team.

7.4 Mitigation & Adaptation Measures and Cooperation Programme for Climate Changes

As mentioned in the above, the Preparatory Study on the Programme for Climate Change in Independent State of Samoa in the agricultural production field has been conducted from such point of view as grasping the condition of damages on the agricultural production, studying the needs for cooperation on the premise of the institutional system and the human resources of the objective country, confirming the consistency with NAPA and the policy on the agriculture, and then selecting the cooperation programmes with the strong necessity, the great urgency and the high priority.

Further, it is understandable that Ministry of Agriculture and Fisheries sufficiently recognizes degree of future climate change, and thus the ministry desires the supporting activities for capacity building, improvement of agricultural productivity (quality and quantity), strengthening basic information (agricultural statistics), etc.

The cooperation programmes for Independent State of Samoa finally selected from such point of view are shown in **Table 7-4**, out of which the programmes with high priority are listed as follows:

(i) Capacity Building for Government Staff
(ii) Improvement of Marketing System
(iii) Variety Selection
(v) Enhancement of Updating Statistical Data

Table 7-1 Adverse Impacts and Damages Matrix by Country

Country: Samoa

Damage items due to climate change		Damage condition								Damage Degree (a)+(b)
		Damage by crop								
		Major food crop						Cash crop		
		Taro Damage<1	Cacao Damage<1	Banana Damage<1	Total	Ave.	×90%(a)<2	Coconut Damage<1	×10%(b)<2	
①Damage due to water shortage, drying, etc.	Soil water shortage	2	2	2	6	1.5	1.4	2	0.2	1.6
	Disease, pest	3	3	2	8	2.0	1.8	2	0.2	2.0
	Salinity	2	2	2	6	1.5	1.4	1	0.1	1.5
②Damage due to heavy rain	Submerged	1	1	1	3	0.8	0.7	1	0.1	0.8
	Erosion	1	1	1	3	0.8	0.7	1	0.1	0.8
	Facility damage	1	1	1	3	0.8	0.7	1	0.1	0.8
③Damage due to cyclone	High wave(flood)	1	1	1	3	0.8	0.7	1	0.1	0.8
	Strong wind(lodging)	2	3	3	8	2.0	1.8	3	0.3	2.1
	Flood(submerged)	1	1	1	3	0.8	0.7	1	0.1	0.8
	Agricultural facilities damage	1	1	1	3	0.8	0.7	1	0.1	0.8
④Sea water rise	High tide(flood･lodging)	1	1	1	3	0.8	0.7	1	0.1	0.8
	Salt water intrusion	1	1	1	3	0.8	0.7	1	0.1	0.8
⑤high temperature	Death	1	1	1	3	0.8	0.7	1	0.1	0.8
	Sterility	1	1	1	3	0.8	0.7	1	0.1	0.8
⑥Daylight	Too much daylight	1	1	1	3	0.8	0.7	1	0.1	0.8
	Daylight shortage	1	1	1	3	0.8	0.7	1	0.1	0.8

Note) <1: Damage on agricultural products due to climate change in each country is evaluated with 5 degrees of 1~5.
Degree 1: No damage.
Degree 2: There is a little damage, not so serious. Monitoring from now on is required.
Degree 3: There is damage. Emergency measures are not needed to be taken. Monitoring from now on is required. Medium-term and long-term mitigation and adaptation measures are required.
Degree 4: There is big damage due to serious adverse impact on agricultural production in each country. Short-term mitigation and adaptation measures are required.
Degree 5: There is very big damage due to very much serious adverse impact on agricultural production in each country. Emergency mitigation and adaptation measures are required.
<2: Through the work in field, the study team estimated that 90% out of total agricultural production value in the whole country were attributed to major food crops, while 10% to cash crop. Thus the weighted damage was estimated, applying those proportions.

Table 7-2 Cooperation Needs Matrix by Country

Country : Samo

Mitigation measures and adaptation measures[1]	Needs of Applicable Country		Cooperation of other donors and organizations			Comment of study team
	Needs outline	Degree of needs [2]	Organization name	Aid outline	Aid period	
① Change of cropping season	Drought period and rainfall pattern have been changed, thus change of cropping patter is necessary.	2	nil	nil	nil	In the future the cropping pattern should be reviewed and changed.
② Variety improvement of crops	Drought period and rainfall pattern have been changed, breeding of resistant varieties to drought and high temperature are necessary.	3	nil	nil	nil	Besides breeding of Taro varieties for export has been carried out.
③ Soil improvement	Generally farm lands have a lot of rocks. Therefore land preparation is very difficult.	1	nil	nil	nil	Steady clearing of rocks from farm lands is required for vegetable farmers.
④ Measures to pest and disease	During rainy season, diseases and pests come out, but it's not so serious. Regarding Taro, TLB resistant varieties have been disseminated, thus its damage is not so serious.	3	SPC USP	Breeding of Taro Leaf Blight (TLB) resistant varieties carried out by University of South Pacific (USP) under financial support of SPC. Meanwhile, IPM, parmaculture, integrated farming system, etc. have been introduced	na	Through demonstration activities, IPM, parmaculture, integrated farming system, etc. should be recommended.
⑤ Improvement of irrigation facilities	It is necessary to mitigate some damage of drought.	2	SPC	Packet irrigation as well as hydroponics vegetable production were demonstrated.	2008	Including certain technique for rain harvesting, demonstration activities should be promoted.
⑥ Drainage improvement	Flooding threatens some residential area, but drainage improvement for farm land is not so important.	1	nil	nil	nil	It is not necessary.
⑦ Soil erosion prevention	Some farm land has been washed away during wet season, due to	2	nil	nil	nil	Countermeasures should be conducted for limited area.

	effect of drought.					
⑧ Prevention of salt water intrusion to farmland (heightening of dike, etc.)	In north-western area in Savaii island, salt water intrusion is serious..	1	nil	nil	nil	Countermeasures should be conducted for limited area.
⑨ Capacity building	Staff for policy formulation is required.	3	nil	nil	nil	It is necessary to do capacity building for awareness raising and having the ability to resolve the issue.
⑩ Construction of laboratory and experimental field	Facilities of NUU Agricultural Research Station are required to be rehabilitated. New facilities such as pipe house and green house are required.	2	nil	nil	nil	Rehabilitation is necessary.
⑪ Improvement of distribution system for agricultural products (including improvement of road etc.)	Marketing system and distribution system as well as quality standard are not developed.	3	nil	nil	nil	Rehabilitation on market infrastructure is also needed.
⑫ Improvement of extension organization and agricultural cooperatives, etc	Farmers are not satisfied with extension services due to low capacity of extension officers. .	3	nil	nil	nil	It is necessary to promote capacity development of extension staff. Further organization for market and distribution should be developed.
⑬ Other mitigation and adaptation measures	Introduction of new promising crops suitable to climate change is required.	2	nil	nil	nil	It is not urgent, but required to consider it in the medium- and long-term.
⑭ Other mitigation and adaptation measures	Enhancement of organization for updating statistical data	3	nil	nil	nil	Enhancement of organization for updating statistical data

Note <1 : Mitigation and adaptation measures mentioned above were determined as countermeasures against damages caused by climate change through the work in field by the study team.

<2 : The degree of needs of the mitigation measures and the adaptation measures to the climate change in the agricultural production sector in the country are expressed with the degrees as follows:

Degree 1: Needs for cooperation for the concerned country is low.
Degree 2: Needs for cooperation for the concerned country is not low but not urgent.
Degree 3: Needs for cooperation for the concerned country is very much high.

Table 7-3 Direction and Programme of Cooperation Study Matrix by Country

Country: Samoa

Damage on Agricultural Product due to			Mitigation measures・Adaptation measures ＜3	Basic Survey ＜4					Cooperation Needs				Priority ＜7	Cooperation Programmes ＜8
Damage Item＜1		Degree ＜2		Technical possibility (effect)	Economic possibility (effect)	Institutional possibility (effect)	Human resources possibility (effect)	Sub-Total	Needs degree＜5	Evaluation by the study team (requirement / not required)	Sub-Total	Activities of other Donors ＜6		
①Damage or Production Decrease by Drought	Shortage of soil water	1.6	① Change of ⑤ cropping season Improve. of	3	3	3	3	3.00	2	2	2.00	SPC	3.17	A, B, D, F
	Disease / Pests / animal	2.0	④ Measures to ② diseases and pests	3	3	3	3	3.00	3	3	3.00	SPC	4.00	A,B,D
	Salt water	1.5	③ Soil improvement	3	3	3	3	3.00	1	3	2.00		3.17	A,B,D
②Damage or Production Decrease by Downpour	Submerge	0.8	⑥ Drainage	3	3	2	3	2.75	1	1	1.00		2.21	F
	Topsoil erosion	0.8	⑦ Prevention of soil errosion	3	3	2	3	2.75	2	2	2.00		3.04	A,B,D
	Damage of irrigation facilities	0.8	⑥ Drainage improvement	3	3	2	3	2.75	2	1	1.50		2.62	F
③Damage or Production Decrease by Cyclone	High waves	0.8	⑧ Prevent. of salt water intrusion to agri. land (heighten of dike)	2	2	2	2	2.00	1	1	1.00		1.83	F
	Strong wind (lodging)	2.1	① Change of cropping season	4	4	4	4	4.00	2	2	2.00		3.67	A,B,D
	Flooding	0.8	⑥ Drainage improvement	3	3	2	3	2.75	1	1	1.00		2.21	F
	Damage of irrigation facilities	0.8	⑤ Improve. of agricultural facilities	3	3	2	3	2.75	1	1	1.00		2.21	E
④Sea Level Rise	High tide (submerged / lodged)	0.8	⑧ Prevent. of salt water intrusion to agri. land (heighten of dike)	2	2	2	2	2.00	1	1	1.00		1.83	F
	Salt water intrusion	0.8		2	2	2	2	2.00	1	1	1.00		1.83	F
⑤Increase of Air Temperature	Death	0.8	② Improvement of crop varieties	3	3	3	3	3.00	3	3	3.00	SPCが協力	4.00	A,B,D
	Sterility	0.8		3	3	3	3	3.00	3	3	3.00	SPCが協力	4.00	A,B,D
⑥Daylight	Too much daylight	0.8	② Improvement of crop varieties	3	3	3	3	3.00	1	3	2.00	SPCが協力	3.17	A,B,D
	Daylight shortage	0.8		3	3	3	3	3.00	1	3	2.00	SPCが協力	3.17	A,B,D
⑦その他＜9			⑨ Capa. buid. ⑫ (Policy, Admi., Extension)	5	5	3	5	4.50	3	3	3.00	SPCが協力	4.75	A,B
			⑩ Construction of research station and research	3	3	3	3	3.00	2	3	2.50	USP、JICAが協力	3.58	A,B,D.E
			⑪ Improvement of marketing system of agri. products (including improvement of	4	4	4	4	4.00	3	3	3.00		4.50	A,B,C,E,F
			⑬ Introduction of new promising crops suitable to climate change is required.	3	3	3	3	3.00	2	2	2.00		3.17	A,B,D
			⑭ Enhancement of organization for updating statistical data	3	3	3	3	3.00	3	3	3.00		4.00	A,B
Weight				0.25	0.25	0.25	0.25	1.00	0.50	0.50	1.00			
Weight				0.500					(5/3) * 0.500= 0.833				1.00	

Note: ＜1: Damage items transferred from Table 7-1.

＜2: Degree of damage transferred from Table 7-1.

＜3: Each measures should cover activities for capacity building.

＜4: The degree of possibility based on the basic survey is decided in accordance with following criteria:

Level 1: No possibility and no effect.

Level 2: Possible but not practical and not adaptable to actual condition.

Level 3: Possible but priority level is low. Medium-term and long-term measures are required. Long-term effect is expected.

Level 4: Possible. Short-term measures are required. Effect is high.

Level 5: Possibility is high. Urgent measures are required. Effect is high.

＜5: The degree of the needs of the concerned country is expressed with the degree obtained in Table 2.

＜6: As for the other donors' action, no point is to be given in case that there is the similar project plan or under implementation. In case of no implementation plan and no implementation, point (3 points) is to be given.

＜7: The total score on the priority ranking is to be the total of points calculated from the respective items with weights. The higher points show the higher priority ranking.

＜8: Considering the standard of cooperation programs of JICA, A: dispatch of expert / JOCV / SV, B: Overseas training, C: Development Study, D: Technical Assistance, E: Grant aid project (construction / procurement), F: Grant aid project (civil engineering)

＜9: These measures are required to carry out as a part of food security measures under the condition of climate change.

Table 7-4 Cooperation Programme on Agricultural Production (Samoa)

No.	Needs	Cooperation Programme and Expected Activities	Measures	Objective Area	Organiza-tion	Adaptable Scheme	Consistency with NAPA	Consistency with Policy	Needs	Urgency	Prior-ity
1	Capacity. building.	Capacity Building for Government Staff: Dispatch of adviser as well as training for officials, aiming at capacity building for awareness raising and enhancing the ability to resolve the issue, regarding policy, administration, and extension	Adaptation measures	Central. and local government	FAO China	Expert	Medium	High	High	High	High
2	Improvement of marketing system of agricultural products for export	Improvement of Marketing System: Improvement of marketing infrastructure for stable supply of agricultural products, and collection, supply of marketing information for export and import of agricultural products, and rehabilitation of marketing infrastructure.	Adaptation measures	Central. and local government., and stakeholders for marketing	Stabex (EU)	Study	Medium	High	High	Medium	High
3	Measures to diseases and pests	Variety Selection: Selection of varieties, which are tolerant to Leaf Blight or other major disease / pests	Adaptation measures	Research institute	SPC GTZ	Expert	High	High	High	Medium	High
4	Enhancement of updating statistical data	Enhancement of Updating Statistical Data: Capacity building for steady data collection. Support on data collection and strengthening monitoring system.	Adaptation measures	Central. and local gov.	FAO	Expert	Low	Medium	High	High	High
5	Change of cropping season	Improvement of Farming Practices: Verification trial for sustainable agriculture with local farming (root crops, banana, etc.) and commercial farming (coconut, fruits, etc.).	Adaptation measures	Central. and local gov. Research institute	SPC	Technical cooperation,	High	Medium	Medium	Medium	Medium
6	Construction of research station and research farm	Improvement of Facilities and Capacity Building: Improvement of facilities and equipment in research institute, and capacity development of staff.	Adaptation measures	Research institute	SPC GTZ	Grant aid	Medium	Medium	Medium	Medium	Medium
7	Soil improvement	Soil Improvement: Based on introduction of organic fertilizer and compost, development and dissemination of cultivation method for root crops and major vegetables	Adaptation measures	Pilot area	nil	Technical cooperation,	Medium	Medium	Medium	Medium	Medium

CHAPTER 8 REPUBLIC OF KIRIBATI

8.1 Adverse Impact and Damage due to Climate Changes and Basic Data

(1) Adverse impact and damage data

The condition of damages on the agricultural production in the Republic of Kiribati due to the climate change has been grasped through the site visits and the questionnaire surveys to the concerned ministries and organizations and to the farmers in the area.

The damages on the agricultural production due to the climate change are actually not concretely grasped with the specific figures and are discussed only in a qualitative way. In consideration of the said situation that the basic data such as the agricultural statistics are not well prepared, it could be said that the analysis of the cause of the climate change is not well discussed in such way of clarifying if the damages on the agricultural lands and products are being caused due to the climate change or the mere sometime abnormal weather condition.

Information of the damages obtained through the survey and investigation is as shown in **Table 8-1**. Major ones are listed as follows:

(i) Kiribati is not on the corridors of cyclone, therefore there are no damages caused by cyclone. However lodging and falling-down of crops and trees are caused by strong wind.
(ii) Decrease of the crop yields due to climate change is occurred year by year.

(2) Basic data

In addition to the above-mentioned damage information, the basic data required for more precisely grasping the needs for the cooperation have been collected.

(i) Major farm income source is coconut for farmers.
(ii) At present, there is foreign countries cooperation and aid for the agriculture and livestock division of the ministry supported by SPC and Taiwan Technical Mission. Taiwan technical mission is in charge of dissemination of technology on vegetable cultivation, while SPC is in charge of general aspect on climate change as well as agricultural development.
(iii) Human resources as well as facilities in the ministry is limited. Particularly it is difficult for the ministry to carry out basic analysis on soil, water quality, and quarantine by herself. All the analyses are requested to SPC Fiji or USP Fiji.

(3) Activities of other donors

As for the agriculture sector in the Republic of Kiribati, Taiwan Technical Mission supports extension activities on vegetable cultivation, livestock keeping, and fish culture. FAO supports

livestock promotion and research sectors financially and technically. SPC has conducted financial and technical supports for research sector. Further SPC/IFAD has carried conservation promotion of geneplasm.

(i) Support service for extension activities on vegetable cultivation, livestock keeping, and fish culture by Taiwan Technical Mission
(ii) Support service for procurement of new breeding stock of boards and layers by FAO
(iii) Support service for crop diversification through identification and promotion of proper species, varieties and verification trial for agro-forestry, research to promote sustainable production method, etc. by FAO/SPC
(iv) Support service for conservation promotion of geneplasm of coconut, breadfruit, etc.

8.2 Study on Needs for Cooperation

The cooperation needs that have been grasped through the site visit and the questionnaire survey to the concerned ministries and organizations and the farmers are shown in **Table 8-2**. Further, the cooperation needs are described with the classification of (i) cooperation needs presented by the government of the recipient country, (ii) cooperation needs confirmed by government of recipient country through discussion with the study team and (iii) Cooperation needs recognized through evaluation of the study team as follows:

(1) Cooperation needs presented by government of recipient country

Intentions of the Ministry are shown as follows:

(i) There are no technical assistances on agriculture sector from Japanese government. Your assistance is strongly requested.
(ii) Technical guidance by foreign countries for the mitigation measures (measures for mitigation of the climate change itself) and the adaptation measures (measures to adverse impact and damage due to the climate change).
(iii) Technical guidance by foreign countries for formulation of the policy, the strategy and the action plan for the food security under the climate change condition aiming at (i) improvement of self-sufficiency of food (especially vegetables), (ii) improvement of facilities in the existing research stations and fields, (iii) improvement of infrastructures on distribution system of agricultural products, (iv) improvement of extension system as well as farmers' organization, and (v) cooperation with private sectors.
(iv) Technical and financial aid to the capacity building required for the planning and the implementation of project of measures to the food security.

(2) Cooperation needs confirmed by government of recipient country through discussion with the study team

The above-mentioned cooperation needs were presented by the government of the recipient country and any other cooperation needs were not added through the discussion with the Study team.

(3) Cooperation needs recognized through evaluation of the study team

As mentioned in the above, there is no quantitative damage data grasped from the point of the climate change. It is necessary to establish the monitoring system and conduct the monitoring activities for grasping the damage condition quantitatively and qualitatively in order to execute effectively the concrete mitigation measures and adaptation measures.

8.3 Study on Mitigation & Adaptation Measures and Cooperation Programme for Climate Changes

The results of the analysis of the direction of the cooperation and the cooperation programme based on the cooperation needs for the mitigation measures and the adaptation measures by damage item are shown in **Table 8-3**.

The cooperation programmes are described with the classification of (i) cooperation programme presented by the government of the recipient country, (ii) cooperation programme confirmed by government of recipient country through discussion with the study team and (iii) Cooperation programme recognized through evaluation of the study team as follows:

(1) Cooperation programme presented by government of recipient country

Through meetings and discussions with the Ministry of Environment, Land, and Agriculture Development, requests on technical cooperation ~~s~~ to be expected from Japanese government are announced as follows:

(i) Capacity building for central and local government officers

- Dispatch of the expert to advise the government policy and administrative services to the Ministry
- Dispatch of adviser as well as training for officials, aiming at capacity building for awareness raising and enhancing the ability to resolve the issue, regarding policy, administration, and extension
- Dispatch of experts for On-the-Job Training on dissemination of vegetable cultivation.
- Dispatch of experts for On-the-Job Training on data collection and strengthening monitoring system

(ii) Technical cooperation regarding promotion of agricultural activities

- Improvement of the crop cultivation and the farm management for the sustainable agriculture mainly in the traditional farming practices (root crops, breadfruits, etc.) and the commercial farming (production and processing of coconut, fruits, etc.).
- Based on introduction of organic fertilizer and compost, development and dissemination of cultivation method for major vegetables
- Introduction of new promising crops suitable to climate change
- Improvement of facilities as well as instrument in research stations, and capacity building and supply of equipment for soil and water analysis, plant quarantine, and animal health (including incubator)

(2) Cooperation programme confirmed by government of recipient country through discussion with the study team

The above-mentioned cooperation programme was presented by the government of the recipient country and any other cooperation programme was not added through the discussion with the Study team.

(3) Cooperation programme recognized through evaluation of the study team

The above-mentioned cooperation programme was presented by the government of the recipient country and any other cooperation programme was not added with recommendation of the Study team.

8.4 Mitigation & Adaptation Measures and Cooperation Programme for Climate Changes

As mentioned in the above, the Preparatory Study on the Programme for Climate Change in Republic of Kiribati in the agricultural production field has been conducted from such point of view as grasping the condition of damages on the agricultural production, studying the needs for cooperation on the premise of the institutional system and the human resources of the objective country, confirming the consistency with NAPA and the policy on the agriculture, and then selecting the cooperation programmes with the strong necessity, the great urgency and the high priority.

Regarding agriculture, Kiribati has not received any technical assistance ~~s~~ from Japan for the time being. Therefore the Ministry of Environment, Land, and Agriculture Development has a strong expectation on technical cooperation from Japan. Kiribati has limited farm land, and thus big proportion of food consumption relies on import in Kiribati. Namely import amount of agricultural commodities accounts for 30% out of total import amount. It means that Kiribati ranks second after the Federated States of Micronesia. Food security is the first priority subject in

Kiribati, therefore it is expected to obtain the technical assistance from Japan, regarding mitigation of food import.

The cooperation programmes for Republic of Kiribati finally selected from such point of view are shown in **Table 8-4**, out of which the programmes with high priority ranking are listed as follows:

(i) Capacity Building for Government Staff
(ii) Improvement of Research Station
(iii) Soil Improvement and Improvement of Farming Practices for Vegetables
(iv) Enhancement of Updating Statistical Data

Table 8-1 Adverse Impacts and Damages Matrix by Country

Country: Kiribati

Damage items due to climate change		Damage condition								Damage Degree (a)+(b)
		Damage by crop								
		Major food crop						Cash crop		
		Taro Damage<1	Banana Damage<1	Bread Fruit Damage<1	Total	Ave.	×80%(a)<2	Coconut Damage<1	×20%(b)<2	
①Damage due to water shortage, drying, etc.	Soil water shortage	2	2	2	6	1.5	1.2	2	0.4	1.6
	Disease, pest	3	2	2	7	1.8	1.4	2	0.4	1.8
	Salinity	2	2	2	6	1.5	1.2	1	0.2	1.4
②Damage due to heavy rain	Submerged	1	1	1	3	0.8	0.6	1	0.2	0.8
	Erosion	1	1	1	3	0.8	0.6	1	0.2	0.8
	Facility damage	1	1	1	3	0.8	0.6	1	0.2	0.8
③Damage due to cyclone	High wave(flood)	1	1	1	3	0.8	0.6	1	0.2	0.8
	Strong wind(lodging)	2	3	3	8	2.0	1.6	2	0.4	2.0
	Flood(submerged)	1	1	1	3	0.8	0.6	1	0.2	0.8
	Agricultural facilities damage	1	1	1	3	0.8	0.6	1	0.2	0.8
④Sea water rise	High tide(flood・lodging)	1	1	1	3	0.8	0.6	1	0.2	0.8
	Salt water intrusion	1	1	1	3	0.8	0.6	1	0.2	0.8
⑤high temperature	Death	1	1	1	3	0.8	0.6	1	0.2	0.8
	Sterility	1	1	1	3	0.8	0.6	1	0.2	0.8
⑥Daylight	Too much daylight	1	1	1	3	0.8	0.6	1	0.2	0.8
	Daylight shortage	1	1	1	3	0.8	0.6	1	0.2	0.8

Note) <1: Damage on agricultural products due to climate change in each country is evaluated with 5 degrees of 1~5.

Degree 1: No damage.

Degree 2: There is a little damage, not so serious. Monitoring from now on is required.

Degree 3: There is damage. Emergency measures are not needed to be taken. Monitoring from now on is required. Medium-term and long-term mitigation and adaptation measures are required.

Degree 4: There is big damage due to serious adverse impact on agricultural production in each country. Short-term mitigation and adaptation measures are required.

Degree 5: There is very big damage due to very much serious adverse impact on agricultural production in each country. Emergency mitigation and adaptation measures are required.

<2: Through the work in field, the study team estimated that 80% out of total agricultural production value in the whole country were attributed to major food crops, while 20% to cash crop. Thus the weighted damage was estimated, applying those proportions.

Table 8-2 Cooperation Needs Matrix by Country

Country : Kiribati

Mitigation measures and adaptation measures[<1]	Needs of country		Cooperation of other donors and organizations			Comment of study team
	Needs outline	Degree of needs[<2]	Organization name	Aid outline	Aid period	
① Change of cropping season	Drought period and rainfall pattern have been slightly changed, however change of cropping patter is not necessary.	1	nil	nil	nil	It is not necessary to change cropping pattern.
② Variety improvement of crops	Drought period and rainfall pattern have been changed, so yield of coconut (var.: local tall) has become down, while Taro has been affected due to high temperature. Therefore, breeding of resistant varieties to drought and high temperature for fruits and Taro are necessary.	3	Taiwan Technical Mission	Dissemination of proper technology and crops as well as training of farmers and extension officers	Since 2004	Breeding of drought and high temperature resistant varieties have not been carried out.
③ Soil improvement	Calcium content in coral soil is high, so not suitable for vegetables cultivation	3	Taiwan Technical Mission	Introduction of compost and green manure	Since 2004	Improvement of soil fertility is an essential point.
④ Measures to pest and disease	Beetles for Taro (only Tarawa island) and rot for breadfruit are popular	3	SPC	Monitoring activities have been continued.	Na	Resistant varieties (species) are required.
⑤ Improvement of irrigation facilities	Previously, packet irrigation as well as hydroponics are introduced. However, those techniques are expensive for farmers. Partly Christian organization and Taiwan Technical Mission have operated	2	USP	In 2008, workshop for hydroponics were held in Kilibati. However it is not practical, from the financial view point.	2008	It is not practical, but it is expected that vegetable cultivation in home garden, applying supplemental irrigation with rain harvesting. Promotion of vegetable cultivation in each home is required.
⑥ Drainage improvement	Not necessary	1	nil	nil	nil	It is not necessary.
⑦ Soil erosion prevention	It is necessary at coastal area partly	2	nil	nil	nil	Planting of mangrove as well as some vegetation

						is required..
⑧ Prevention of salt water intrusion to agricultural land (heightening of dike, etc.)	Currently it is not so serious.	2	nil	nil	nil	Countermeasures should be conducted for limited area.
⑨ Capacity building (policy, administration)	Staff for policy formulation is required.	3	nil	nil	nil	It is necessary to do capacity building for awareness raising and having the ability to resolve the issue.
⑩ Construction of research station and research farm	Facilities of Research Station are required to be rehabilitated. Especially, water analysis, soil analysis, tissue culture, etc. are important functions to be required.	3	SPC	Technical support to research station	na	Rehabilitation of facilities as well as replacement of equipment is necessary.
⑪ Improvement of marketing system of agri. products (including improvement of roads, etc.)	Marketing system and distribution system are not developed.	3	nil	nil	nil	Some needs on access roads and bridge are needed.
⑫ Improvement of extension organization and agricultural cooperatives, etc	Farmers are not satisfied with extension services due to low capacity of extension officers. .	3	nil	nil	nil	It is necessary to promote capacity development of extension staff. Further organization for market and distribution should be developed.
⑬ Other mitigation and adaptation measures	Introduction of new promising crops suitable to climate change is required.	2	nil	nil	nil	It is not urgent, but required to consider it in the medium- and long-term.
⑭ Other mitigation and adaptation measures	Enhancement of organization for updating statistical data	3	nil	nil	nil	Enhancement of organization for updating statistical data

Note <1 : Mitigation and adaptation measures mentioned above were determined as countermeasures against damages caused by climate change through the work in field by the study team.

<2 : The degree of needs of the mitigation measures and the adaptation measures to the climate change in the agricultural production sector in the country are expressed with the degrees as follows:

Degree 1: Needs for cooperation for the concerned country is low.
Degree 2: Needs for cooperation for the concerned country is not low but not urgent.
Degree 3: Needs for cooperation for the concerned country is very much high.

Table 8-3 Direction and Programme of Cooperation Study Matrix by Country

Country: Kiribati

Damage on Agricultural Product due to Climate Change			Mitigation measures・Adaptation measures ＜3	Basic Survey ＜4					Cooperation Needs				Priority ＜7	Cooperation Programmes ＜8
Damage Item＜1		Degree＜2		Technical possibility (effect)	Economic possibility (effect)	Institutional possibility (effect)	Human resources possibility (effect)	Sub-Total	Needs degree＜5	Evaluation by the study team (requirement / importance)	Sub-Total	Activities of other Donors ＜6		
①Damage or Production Decrease by Drought	Shortage of soil water	1.6	① Change of ⑤ cropping season Improve. of	3	3	3	4	3.25	3	2	2.50	Taiwan	3.71	A, B, D, F
	Disease / Pests / animal	1.8	④ Measures to ② diseases and pests	3	3	3	3	3.00	3	2	2.50	SPC	3.58	A,B,D
	Salt water	1.4	③ Soil improvement	4	3	3	3	3.25	3	3	3.00	Taiwan	4.12	A,B,D
②Damage or Production Decrease by Downpour	Submerge	0.8	⑥ Drainage	3	3	2	3	2.75	1	1	1.00		2.21	F
	Topsoil erosion	0.8	⑦ Prevention of soil errosion	3	3	2	3	2.75	2	2	2.00	Taiwan	3.04	A,B,D
	Damage of irrigation facilities	0.8	⑥ Drainage improvement	3	3	2	3	2.75	2	1	1.50		2.62	F
③Damage or Production Decrease by Cyclone	High waves	0.8	⑧ Prevent. of salt water intrusion to agri. land (heighten of dike)	1	1	1	1	1.00	1	1	1.00		1.33	F
	Strong wind (lodging)	2.0	① Change of cropping season	4	4	3	3	3.50	2	2	2.00	Taiwan	3.42	A,B,D
	Flooding	0.8	⑥ Drainage improvement	1	1	1	1	1.00	1	1	1.00		1.33	F
	Damage of irrigation facilities	0.8	⑤ Improve. of agricultural facilities	2	2	2	2	2.00	1	1	1.00	Taiwan	1.83	E
④Sea Level Rise	High tide (submerged / lodged)	0.8	⑧ Prevent. of salt water intrusion to agri. land (heighten of dike)	2	2	2	2	2.00	1	1	1.00		1.83	F
	Salt water intrusion	0.8		2	2	2	2	2.00	3	1	2.00		2.67	F
⑤Increase of Air Temperature	Death	0.8	② Improvement of crop varieties	3	3	3	3	3.00	3	2	2.50	SPC Taiwan	3.58	A,B,D
	Sterility	0.8		3	3	3	3	3.00	3	2	2.50		3.58	A,B,D
⑥Daylight	Too much daylight	0.8	② Improvement of crop varieties	3	3	3	3	3.00	3	2	2.50	SPC	3.58	A,B,D
	Daylight shortage	0.8		3	3	3	3	3.00	3	2	2.50		3.58	A,B,D
⑦Others ＜9			⑨ Capa. buid. ⑫ (Policy, Admi., Extension)	5	5	3	5	4.50	3	3	3.00	FAO Taiwan	4.75	A,B
			⑩ Construction of research station and research	4	4	3	3	3.50	3	3	3.00	SPC	4.25	A,B,D.E
			⑪ Improvement of marketing system of agri. products (including improvement of	3	3	3	3	3.00	3	3	3.00		4.00	A,B,C,E,F
			⑬ Introduction of new promising crops suitable to climate change is required.	3	3	3	3	3.00	3	3	3.00		4.00	A,B,D
			⑭ Enhancement of organization for updating statistical data	4	3	3	3	3.25	3	3	3.00	FAO	4.12	A,B
Weight				0.25	0.25	0.25	0.25	1.00	0.50	0.50	1.00			
Weight				0.500					(5/3) * 0.500= 0.833				1.00	

Note: ＜1: Damage items transferred from Table 8-1.

＜2: Degree of damage transferred from Table 8-1.

＜3: Each measures should cover activities for capacity building.

＜4: The degree of possibility based on the basic survey is decided in accordance with following criteria:

Level 1: No possibility and no effect.

Level 2: Possible but not practical and not adaptable to actual condition.

Level 3: Possible but priority level is low. Medium-term and long-term measures are required. Long-term effect is expected.

Level 4: Possible. Short-term measures are required. Effect is high.

Level 5: Possibility is high. Urgent measures are required. Effect is high.

＜5: The degree of the needs of the concerned country is expressed with the degree obtained in Table 2.

＜6: As for the other donors' action, no point is to be given in case that there is the similar project plan or under implementation. In case of no implementation plan and no implementation, point (3 points) is to be given.

＜7: The total score on the priority ranking is to be the total of points calculated from the respective items with weights. The higher points show the higher priority ranking.

＜8: Considering the standard of cooperation programs of JICA, A: dispatch of expert / JOCV / SV, B: Overseas training, C: Development Study, D: Technical Assistance, E: Grant aid project (construction / procurement), F: Grant aid project (civil engineering)

＜9: These measures are required to carry out as a part of food security measures under the condition of climate change.

Table 8-4 Cooperation Programme on Agricultural Production (Kiribati)

No.	Needs	Cooperation Programme and Expected Activities	Measures	Objective Area	Organiza-tion	Adaptable Scheme	Consistency with NAPA	Consistency with Policy	Needs	Urgency	Prior-ity
1	Capacity. building. (Policy, Administration., Extension)	Capacity Building for Government Staff: Dispatch of adviser as well as training for officials, aiming at capacity building for awareness raising and enhancing the ability to resolve the issue, regarding policy, administration, and extension	Adaptation measures	Central. and local government	FAO Taiwan	Expert	—	High	High	High	High
2	Improvement of research station	Improvement of Research Station: Improvement of facilities as well as instrument in research stations, and capacity building and supply of equipment for soil and water analysis, plant quarantine, and breeding (including incubator)	Adaptation measures	Research institute	SPC	Grant aid	—	High	High	High	High
3	Soil improvement	Soil Improvement and Improvement of Farming Practices for Vegetables: Based on introduction of organic fertilizer and compost, development and dissemination of cultivation method for root crops and major vegetables	Adaptation measures	Pilot area	Taiwan	Technical assistance,	—	High	High	High	High
4	Enhancement of updating statistical data	Enhancement of Updating Statistical Data: Capacity building for steady data collection. Support on data collection and strengthening monitoring system.	Adaptation measures	Central. and local gov.	FAO	Expert	—	Medium	High	High	High
5	Change of cropping season	Improvement of Farming Practices: Verification trial for sustainable agriculture with traditional farming (root crops, coconut, etc.) and kitchen garden (vegetables.).	Adaptation measures	Central. and local gov. Research institute	Taiwan	Technical assistance,	—	High	Medium	Medium	Medium
6	Improvement of marketing system of agricultural products for export	Improvement of Marketing System: Improvement of marketing infrastructure for stable supply of agricultural products, and collection and supply of marketing information for export and import of agricultural products.	Adaptation measures	Central. and local government., and stakeholders for marketing	nil	Study	—	High	Medium	Medium	Medium
7	Measures to diseases and pests	Variety Selection: Selection of varieties, which are tolerant to Beetle or other major disease / pests	Adaptation measures	Research institute	Taiwan	Expert	—	High	Medium	Medium	Medium

Annex

(1) Solomon Result of Questionnaire Survey on Ministry of Agriculture and Livestock

The day of interview：31st March 2009
Interviewee：MAL planning division director: Mr. Frank Maeaba

1. Basic Data

- The structure of Ministry of Agriculture and Livestock were reorganized in 2008. The name of each division and personnel arrangement will be completed until 2010.
- The number of posts and number are unknown. Ask to human resource division in Ministry of Land, Housing and Statistics. Other data are not available.

2. Agricultural Data

- The office encountered the damage of the downpour, and most data was lost.
- As for the soil distribution chart, preservation as a digital document is being done by National Archives. It is possible to inspect it, but not possible to take out and to copy it.
- As for data related to livestock, forestry, and the fishery, ask for each ministry or division.
- The data of domestic consumption are not available. Because most of people lives in self sufficient life.
- Rate of self-sufficiency is not understood.
- There is no importing and exporting data except copra and cacao.
- The market information is limited to the exported item (copra and cacao).
- In terms of domestic processed food, there is peanut butter (Bali Bao Company). However it is a private sector, the data is unknown.
- The tuna and bonito are exported in the fishery.
- There is no exporting data though the manioc (cassava) chips and the banana chips are exported to New Zealand.
- CEMA (Commodities Export Marketing Authority) does the quality control of agricultural products. However, only copra and the cocoa
- The water resource management law is revising now.
- There is Quarantine Law, and it is unavailable here. Ask for it in quarantine and the bio-security division.
- Neither the number nor the names are understood because there are few agricultural cooperatives.

3. Agricultural production, Extension and Cooperative

Production Plan

- The production of cocoa is increased up to 5000t within ten years. Because the cocoa trees become old, we are replanting new trees. It will take 2~3 year by bearing. In addition, the improvement of transportation and processing, development of new markets are scheduled.
- Crops of which it increases production are being examined now. Though the pineapple, coffee, kava, chili and cardamom that had been exported till ethnic tension (1998-2001) then failed.
- An easy machine and the farming tools are scheduled to be improved.
- The development plan and the agricultural policy are at the stage of final drafts with the FAO

cooperation.

Stable Seed Supply System

- The seed is not supplied by the Government. It privately gathers or it is sold to the farmer to divide into the ditty bag and bought in the market (mainly produced in Taiwan). (1 small parcel :10 Solomon dollar) ← The price was confirmed in the market.

Stable Supply of Fertilizer and Chemicals and the Suited Application

- The import volume of the fertilizer is not understood in the Ministry of Agriculture and livestock.
- An organic fertilizer is not especially recommended by the Government. Agricultural chemicals are not recommended too. There is not a standard of the pesticide residue either. The Kastam Gaden Association (NGO) recommends the use of an organic fertilizer and offer information such as organic agrochemicals.
- If information on agricultural chemicals and the fertilizer is necessary, comes to the ministry proper of agriculture and the stock raising ministry, a free copy can be available at Headquarter of Ministry of Agriculture and Livestock.
- In terms of post harvests, neither management nor the development of legal systems has been done yet.
- There is no quality criterion yet. (Note: There is the one of CEMA for copra and the cocoa.)
- There is not a safety inspection standard yet either.

Land reclamation

- The land ownership system is reviewed for the farmland improvement and farmland development. Registry (registered association) records from the developed area (city part) by priority by the land recording bill. (87% is owned by the customary law, and the remainder 13% is recorded legally.)

Soil conservation

- The landslide has happened frequently because of the harvesting timber and the downpour. Hereafter, the introduction of the agriculture method of substitution (perma-culture and organic farming) will be aimed at as a policy because present agriculture is slash-and-burn farming.

Soil pollution and deterioration

- At present, there is no soil contamination because the commercial fertilizer is hardly used. Damage caused by the intrusion of salt water is serious in atoll of Ontong Java and Sikaiana in Stewart islands.

Irrigation facilities

- There are no irrigation facilities excluding rice paddy.

Husbandry

- It collapses now though the cow produced before. The chicken and the pig are produced at each home. The chicken is sold in the local market. Beef and chicken are being imported now.

Economy on each sector

- Forestry and mining 60-70％, Agriculture 25％, Fishery less than 10％, Others less than 5％
- Gold is produced in Guadalcanal Island and Nickel is produced in Santa Isabelle Island (Sumitomo Metal Industries, Ltd. is participating in the tender).

Engaging population according to sector

- Forestry less than 1％, Agriculture 80-85％、Fishery less than 1％, Mining less than 1％, Civil servant 10~15%, and company employee and other 7%

Agricultural extension system

- Network Ministry of Agriculture and Livestock headquarter－Provincial office（9Provinces）－District

office（2-3 persons in each）

- Total number of extension workers:125（Note：according to Ministry of Land, Housing and Survey, the total number is 137）
- The content of service is a distribution of the technical guidance to the farmer (Agriculture, forestry, and livestock are included) and of the book and the manual (through Information division).
- The content of service is different in each province. Because the needs of each province are different from.
- Training has the technical guidance of JICA for cattle raising.
- Though it is limited region, the Kastam Gaden association that is international NGO of the science and technology also cooperates in extension works.

Farm management

- Farm management has not been guided yet. Because most of the farmers are illiteracy, the education to them is difficult. They are engaging in farming by the traditional knowledge now. Agribusiness has been trained though it is a few.

Government subsidy

- The production technical guidance of the cocoa, the coconut and the kava, in addition, the technical guidance of stock raising goes free of charge.
- 2% of the budget of the Ministry of Agriculture and Livestock is applied to assistance. Everyone can apply if he has the account of the project name, the name of the manager, and the project. (The conserve budget in 2008 is 40 million Solomon dollars)

4. Climate Change and the Damage on Agriculture

Damage due to climate change

- Flood (Several times per year caused by heavy rain), cyclone (once a year), and high tide (Observe it with Sikaiana for the first time), high temperatures (Once or twice a year, exceeding 36 degrees), and solar radiation (Lack: in Guadalcanal Island because of the long rain, Excess: once a year in Santa Cruz Island). Drought (However, damage from a drought occurs from the serious one once ten years. It occurs in some provinces for the dry season). The earthquake (The large one occurs once in 50-60 years. The small one occurs frequently). The tsunami occurs once in 50-60 years. A forest fire is not wild fire, but is usually manmade fire).
- Especially, there are a lot of landslides, and is unusually an influence such as collapses of the coral reef by the inflow of mud and sand to the sea.

Damaged region

- The damage of the flood following the heavy rain is especially serious in Malaita], Guadalcanal, and Western Province. Farm products are flooded, topsoil flows out, and there is damage (level 5) to which facilities including bridges etc. Damage to facilities by cyclonic is also serious (level 4). A decrease of the mangrove is high the level of damage (level 4).

Damage on each crop

- The damage on the taro are the soil water intrusion to farmland and the water source by the sea level rising, and is serious in Sikaiana and Ontong Java(level 5). The topsoil outflow is high the damage level

(level 4).

- The damage on the yam stand out in Central island Province. The damages are drought, the facilities destruction by cyclone, saline intrusion to farmland by sea level rising, growth inhibition and sterility by high temperature, excess of solar radiation, forest fire caused by wild fire(autogenous ignition), lodging by landslide, topsoil drainage in the coast line, soil erosion by sea level rising(entire level 3).
- The damage on cassava (manioc) is in whole islands. The damage level of the topsoil drainage by the heavy rain is high (level 4). In addition, the damage of inundation due to flood, salt water inundation by high tide are level 3.
- The damage on sweet potato is very serious. The damages are inundation by flood, topsoil drainage by heavy rain and salt water inundation by high tide (entire level 5.
- The damages on the banana are decrease of soil moisture by drought, inundation by flood, salt damage by cyclone and salt water inundation by sea level rising (entire level 3).
- The damage on the corn is a decrease of soil moisture by drought, topsoil outflow by heavy rain, inundation of high tide caused by cyclone, seawater intrusion to water source, and withering and sterility by high temperatures (entire level 3).
- The damages on the rice are prevailing of pest and disease caused by drought, harmful animals during drought, inundation of high tide caused by cyclone, and lodging by strong wind caused by cyclone(entire level 4). The damage from salinization after drought, inundation by flood after heavy rain, inundation due to flood after cyclone (entire level 3).
- The damage on the beans is soil erosion by heavy rain along coast and soil erosion by sea level rising (entire level 3).
- The damage on coconut is soil erosion by sea level rising, and decrease of mangrove, (entire level 4, exclude Renbell Province). Salinization after drought and intrusion of sea water to water source caused by sea level rising (level3).

Impact on climate change by agriculture

- Not applicable.
- Agricultural wastes (farm machines and tools, vinyl and plastic) have been left as it is.
- There is a big project named EIA (Environmental Impact Assessment Study) for environmental assessment.
- There is no restriction to agricultural chemicals and the commercial fertilizer.
- No restriction to agricultural residue either.
- For the sustainable agriculture, multifunction of agriculture specifies an agricultural system and the problem of existing agricultural method.
- For enlightening agricultural persons, the group for sending information (Information division) is set up.

5. Social Impact and Damage on Agriculture

- Not remarkable.
- The outflow of manpower is very few. There is a case to go to the plantation in Malaysia.

6. Needs for Adaptation Measures

- The budget is not understood
- It is used for research.
- There are no research facilities.
- School of Natural Resources in Solomon Islands College of Higher Education experiments for the gene resource protection of the plants.
- Improvement of post harvest on taro has been done by the exporter in New Zealand. The Government has not gone.
- The vaccine is extended of chicken and pig's vaccines in these five years
- There is a feeding standard for regime and pasture.
- World Bank, EU, and AusAID do 3-5 year's project for the rural development. The contents of project are capacity building and training for logistic works.
- The international student is sent to Taiwan and Japan.

7. Mitigation Measures and Adaptation Measures

- Now we are working on to address the problem of climate change.

8. Foreign Aid Process and Other Countries' Assistance

- The procedure of accepting proposal
  ① Submit a proposal to the Ministry of Foreign Affaire.
  ② Submit an application form to the related Ministry.
  ③ The related ministry approves of the proposal.
- The countries or organization to assist agricultural sector other than Japan are Taiwan, AusAID, EU, and FAO.

(2) Solomon Result of Questionnaire Survey on Taiwan Technical Mission

I. Taiwan Technical Mission

The day of interview：2nd April 2009
Interviewee：Taiwan Rice Project, Project leader, Mr. Michael Hsu

1. Basic Data

- Name of donor：Taiwan Technical Mission
- Address of office：P.O.Box487, Honiara Solomon Islands
- Phone No.：Office 30717, Mobile 96860（＋677）
- Representative：Mr. David Huang
- Nation：Republic of China (Taiwan)
- Number of staff：10
- Project site：Lunga, Honiara, Solomon Islands

2. Project Contents

Policy

- Bilateral relationship between Taiwan and Solomon Islands

Activity results

- R.O.C. has operated agricultural programme since1983. The latest test and demonstration field (including paddy field) has implemented for 3 years and 4 months.

Activity sector

- R.O.C mainly deals with agricultural sector. In addition, R.O.C provides medical service to rural farmers.

Ongoing projects

- Multiple farm operation: Combination of rice, vegetable, fruits and livestock farming. Using the residue of beer brewery and pig manure for fertilizer. Feeding pig and chicken by the residue of vegetable and fruits. Rice husks are used for the bed in the livestock barn, and it is kept clean.

Implemented projects

- Technical help for farming: cultivation of rice, nursery for vegetables, fruits multiplication (cutting, grafting),

Outcome of the projects

- Extension of sustainable agriculture

Beneficiary

- Local farmers

Limitation and obstacles

- High temperature and high humidity

3. Countermeasures to Climate Change

- N.A.

4. Collaboration with Other Donors or NGOs

- Any other donors have not assisted agriculture sector in this country for more than 25 years. R.O.C. is

the only one donor that has helped Ministry of Agriculture and Livestock. R.O.C. provided 1 million US dollars per year. R.O.C. enforced medical programme for rural farmers. The budget for this programme is also 1 million US dollars per year.

II. UNDP

Day of interview：3rd April 2009
Interviewee：Mr. Mitsugu Saito
Adaptation Plan

- Sustainable Land Management(PLM) project: Strengthen systemic institutional and individual capacity of SLM into each level of decision making
- Pacific Adaptation to Climate Change(PACC) project：implement long-term adaptation measures to increase the resiliency. Solomon Islands focus on the sustainable agriculture in low-lying atoll islands.

(3) Solomon Result of Questionnaire Survey on Kastam Gaden Association

The day of interview : 6th April 2009
Interviewee : Mr. Lawlence Atu

1. Basic Data

- The name of NGO : Kastam Gaden Association
- Address of office : Honiara, Guadalcanal, Solomon Islands
- Phone NO. : 72129
- Local NGO
- Representative : Mr. Jack Kalistio
- Project site : Honiara (Experimental and Demonstration field)

2. Project contents

Policy and project

- Food security and diversity
- It has been for 14 years (established in 1995).
- The main sector working on is agriculture.

Ongoing project

- Distribution of seed material (mainly tubers)
- Improving varieties
- Training of organic farming
- Recycling of agricultural residue
- Poultry (chicken and duck raising)

Enforced project

- Provision of seed (sweet potato, yam, cassava, potato, banana),
- Provision of seed of vegetables (beans, tomato, corn, eggplant, Chinese cabbage and slippery cabbage)
- The beneficiary is ordinary farmers (membership system, membership fee=SBD15/year)

The limitation and obstacles

- Not enough land
- Not piggery

Remaining issue to be solved

- Collaboration with Ministry of Agriculture and livestock

3. Countermeasure to Climate Change

- Collection of varieties (banana 120 kinds)
- Introduction of new variety (cassava)

4. Collaboration with donors and other NGO

Assistance of JICA

- Office Building were built by Grass root project of JICA

Collaboration with Other Donors

- AusAID, EU, Taiwan(AVRDC[1]), CIP[2], Oxfam, ICCD[3]

1 Asian Vegetable Research and Development Centre
2 International potato centre
3 International Center for Clubhouse Development

(4) Solomon Result of Questionnaire Survey on Farmer

The day of interview：3rd April 2009
Interviewee：Farmer in Tomba village Mr. Michael Saihana

1. Social, Economical Background

Basic Data

- Name: Michael Saihana
- Age: 30 years old
- Sex: Male
- Number of family:18 people
- The main livings: Agriculture, forestry
- Position in the village (Village chief's younger brother. His elder sister, Mary Noel is village chief).

Income

- The income every year is not understood.
- Estimated from income every week: Timber140, 400 Solomon dollars (SDB), copra 2,080 SDB, banana 52,000SDB, beans 3,120-4,680 SDB, leafy vegetables 7,800-9,360 SDB. Total 205,400-208,520 SDB per year

2. Agriculture, Land Use, and Water Resource

Livestock

- Nothing

Fruits

- Coconut 1 ha, cocoa 1ha, banana 1ha, and others 1 ha

Land ownership

- Flat land 4ha、mountainous land 100ha, private ownership of all.

Land use

- Home garden (cultivation around house) cassava, potato, and leafy vegetables

Farming

- There is no change of the cultivation season.
- Because father was former agricultural extension worker, farming is learnt from father. It is learned in the village each other.
- Because we are negligent, the land out of cultivation. It becomes impossible to cultivate the current crops from changeable weather such as heavy rain.
- If you want to multiply cassava, cut the trunk of cassava and put it. The potato is cut in some and is planted. Other seeds are bought in the market in Honiara. It is possible to buy it because it is dividing into a small bag.

Production

- Once copra dried and then is shipped by 20 bags/100kg a week. One bag is 2 SDB.
- The banana is the main income source. It becomes 1000 SDB a week.
- One wrapping peas is 3 SDB. They will ship 20-30 wraps a week. (60-90 SDB/week)
- One basket of the leafy vegetable is 5-6 SDB. They will ship 30 baskets a week. in an (150-180 SDB/week)
- They will ship three cubic meters of timber a week. (2,700 SDB/week)

Self-sufficient situation on food

- Tubers (cassava, sweet potato): Though it is self-sufficient level, in occasion, they need to buy it. Banana and beans: It is far more than family’s requirement. Meat and fish: It is quite insufficient.

Agricultural support service

- There is no round of the extension worker at all. I want to come.
- Neither agricultural chemicals nor the fertilizer are completely used.
- Credit is not used at all.

Restricting factor and improvement point in agriculture

Restricting factor in cultivation

- 1. Damage caused by weather pattern change(flood, 2. Lack of capital, 3. Lack of credit, 4. Limitation of market access, 5. Lack of agricultural extension service
- Damage by wildlife: Rat(Cocoa, cassava and sweet potato)
- Damage by insects: Locust(leafy vegetables), Asian honeybee and melon fly(banana and cocoa), worms (Tubers, fruits and vegetables)
- Damage by disease: black pod disease(Cocoa)
- The time of a disease expansion**:** about ten years ago
- The reason of sick expansion: :irregular weather
- As for the weed, various kinds have grown in the field.

Restricting factor on equipment side

- Inundation by flood, 2. Lack of water in dry season(The rivers dries up at the dry season though getting water is taken from the brook), 3. Lack of the means for transportation

Restricting factor and improvement of livestock raising

- There is no domestic animal.

Hope to the future

- 1. Cultivation of adaptable crops to climate change, 2. Increase of crop production, 3. Improvement of processing
- 1. Diversification of crops, 2. Compound type agriculture
- 1. Decreasing of flood and inundation, 2. Water supply by appropriate irrigation in dry season, 3. Supply of agricultural materials
- 1. Offer of agricultural credit, 2. Agricultural extension system(demonstration and filed guidance), 3. Supply seed that is adaptable the climate

Disaster

- Flood (1-2 in year), the high temperature damage (once a year), the lack of solar radiation (once a year), the drought (once a year), and the earthquake (Once 20 years).
- Damage on each crops: Coconut (It was swept away due to the flood, and the one that had not been thrown either dropped all the fruits). Tubers (It was covered with mud and having rotted). The vegetables (It was swept away due to the flood). Houses (It was swept away due to the flood and broke).

Agricultural residue

- They throw away.

(1) Vanuatu Result of Questionnaire Survey on Ministry of Agriculture, Forestry and Fisheries

Day of interview: 14th April 2009
Interviewee: Mr. James Wasi (Agricultural chief technical officer of the Ministry of Agriculture, Forestry and Fisheries)

1. Basic Data

- As for the organizational chart and the staff assignment of the Ministry of Agriculture, Forestry and Fisheries, it is possible to obtain on 17th April 2009.

2. Agricultural Data

Policy

- FAO made the rural development policy (livestock, fishery, forestry, and agriculture) in 2007. It is being revised now. However, it is a strategy and not an implement plan.

Environmental problems

- NACCC takes charge in environmental issues. The director of NACCC is Mr. Brian Philip and the chairman is Mr. Josam Napato.

Land Issues

- Ministry of Land takes charge in land issues. The secretary general is Mr. Russell Nari.

3. Agricultural Production, Extension and Cooperative

Production plan

- Office of the Prime Minister takes charge in making production plan.

Stable seed supply system

- Most of seed from China and Australia.

Fertilizer and agricultural chemicals

- It is hardly used.

Soil conservation

- We do not have any countermeasure to soil erosion though there is soil erosion in the coast area.

Soil contamination and soil deterioration

- At present, there is no soil contamination because the commercial fertilizer is hardly used. The damage due to saline intrusion is in coast area.

Livestock

- The production of cattle is a major industry of Republic of Vanuatu.
- However main fodder is pasture. Because the fodder of the cattle in Vanuatu is only pasture. Fodder is not especially produced. The mixed forage is not given. Therefore, the stock raising farmer doesn't purchase fodder.

Agricultural extension system

- The government is providing service for the stock raising farmer.
- Government veterinarian called out occasionally to check on animals with health problems.
- A lot of treatment is done on pigs especially with worm’s vermifuge.
- Little AI (Artificial Insemination) is carried out with Smallholder farmers due to costs involved. But

commercial farmers carry out AI on their own.

- A BVC (Bovine Venereal Campylobacteriosis) vaccination programme is taking place on affected islands of Vanuatu in order to improve birth rate.

Procurement condition of facilities on animal husbandry

- For grassland materials purchased are: 1. Barbed wire, 2. Stables(Nails) 3. Wire strainers, 4. Pasture seeds
- Total area of grassland 53,607ha. Average area of one livestock farm 6ha/household.

Government assistance

- Nothing

4. Climate Change and Damage on Agriculture

- Flood (It is unusually in the very limited area). cyclone (once a year), high tide(It is confirmed in five regions by the coastal erosion), high temperature (There is not so much influence in farm products), solar radiation (Lack: The sweet potato is damage in the sterility because of the long rain and there is not so much damage on other tubers), drought (It was once 3-4 years ago), heavy rain (Yearly rainfall exceeded 3,000mm, and the influence is remarkable), rise of seawater temperature (The fishery is influenced remarkably. Tuna's wandering course has changed especially, and the fish harvest had decreased).

Damages and its level (Level 1 means no damage and level 5 is most serious damage).

- Level 3: Collapse of agricultural building by flood, collapse of agricultural building by cyclone, inundation of sea level rising, Soil erosion of coast line by soil erosion by heavy rain, soil erosion of coastline by sea level rising
- Level 2: inundation by flood (only limited coastal area), top soil drainage by heavy rain, high tide by cyclone, lodging by cyclone, inundation by cyclone, saline intrusion to water source by sea level rising, withering by high temperature, sterility by high temperature, growth inhibition by lack of solar radiation

Other damages

- There are three active volcanoes in Vanuatu, and they cause damage of acid rain by the volcanic eruption.

Damage on crops

- The damage on taro, yam and cassava is common. Level 3: lodging by strong wind due to cyclone and destruction of agricultural facilities by cyclone. Level 2: topsoil drainage by heavy rain, destruction of agricultural facilities by flood, inundation by high tide, inundation by cyclone, sea water inundation by sea level rising, saline intrusion to water source by sea level rising, growth inhibition by solar radiation shortage.
- The damage on yam is lodging by strong wind and it is level 3.
- In the sweet potato, the damage level 3 is sterility due to the lack of solar radiation. Level 2: soil moisture shortage by the drought, pests and disease damage, topsoil drainage by heavy rain, destruction of agricultural facilities by flood.
- Banana Level 3: lodging by strong wind caused by cyclone, destruction of agricultural facilities by cyclone. Level 2: Topsoil outflow by the downpour(heavy rain), destruction of agricultural facilities by

flood, inundation by high tide, inundation by cyclone, saline inundation by sea level rising, saline intrusion to water source, and growth inhibition by solar radiation shortage.

- Corn Level 3: Lodging by the strong wind of cyclone, destruction of agricultural facilities by cyclone. Level 2: topsoil drainage by heavy rain, destruction of agricultural facilities by flood, inundation by high tide, inundation by cyclone, sea water inundation by sea level rising, saline intrusion to water source, and growth inhibition by shortage of solar radiation.
- Rice is grown very little. However there is a little damage. Level 3: sea water inundation by high tide, and lodging by strong wind of cyclone. Level 2: topsoil drainage by heavy rain, inundation by flood caused by cyclone, destruction of agricultural facilities by cyclone, withering by high temperature, sterility by high temperature, and growth inhibition by shortage of solar radiation.
- The potatoes are all imports (Note: There is production of own country in Solomon Islands).
- Beans Level 3: Lodging by the strong wind of cyclone. Inundation by flood caused by cyclone and growth inhibition by shortage of solar radiation. Level 2: topsoil drainage by heavy rain, destruction of agricultural facilities by flood, and destruction of agricultural facilities by cyclone.
- Coconut Level 4: Lodging by strong wind of cyclone. Level 3: Prevailing of pest and disease by drought, damage from wildlife(mainly wild pigs), inundation by flood, topsoil drainage by heavy rain, destruction of agricultural facilities by flood, damage from high wave of cyclone, inundation by flood caused by cyclone, destruction of agricultural facilities by cyclone, salt water inundation by sea level rising, and saline intrusion to water source.

Impact on climate change by agriculture

- Nothing observed.
- Agricultural wastes (farm machines and implements, vinyl and plastic) have been left as it is. Especially, because livestock extension workers are insufficient, the guidance of recycling is not done.
- There is no environmental assessment.
- There are no restriction to agricultural chemicals and the commercial fertilizer because the nearby 90% farmer is a no use of chemical fertilizer and agricultural chemicals.
- There is a strict regulation on cacao because it received the certification as an organic cocoa this year. An organic vanilla and an organic pepper also are restricted.
- There is an original standard because the coconut certificated as an organic product.
- Agricultural residue is not restricted either.
- In terms of the maintenance of the multi-function of agriculture, I do not especially feel the problem. Because we do organic farming. ・

5. Social Impact and Damage on Agriculture

- Land issues by a population increase. The town extends to farmland by urbanization, and the farmland is diverted to the housing lot.

6. Needs for Adaptation Measures

- Research facility related to agriculture is only VARTC, and the budget is 40 million Batu per year.

- The research related to cattle raising is done by division of Quarantine and Livestock.
- As for the research of breeding, the fruits are imported from Australia and New Caledonia. The yam is imported from Africa. There is a network on the research side.
- I think research facilities to be necessary for the agro-technology though it is not now.
- Though mechanization is not advanced now in Vanuatu, it seems it will be necessary in the future. The research of the farm machinery is working on now.
- There are no irrigation facilities.
- There are no research facilities of the soil improvement.

7. Mitigation and Adaptation Plan

- Now we are working on addressing the problems caused by climate change.
- We think about rice as one of the conversion crops. The rice development program was started as a long-term programme. It is scheduled to do in Espiritu Santo.
- The French man named Leconte in the Bamboo village is a businessman who resides in Noumea in New Caledonia.
- As for the rice programme of China, the private company only made rice for trial purposes. It has already withdrawn only in one year. Securing land was difficult.

8. Foreign Aid Process and other Countries' Assistance

- The lender states to an agricultural sector are AusAID, EU, Japan, and FAO.

(2) Vanuatu Result of Questionnaire Survey on VARTC

Day of interview：9th April 2009
Interviewee：Ms. Marie Melteras

1. Basic Data

- Name of organization：VARTC (Vanuatu Agriculture Research and Technology Center)
- Address：B.P.231, Santo, Vanuatu
- Phone No.：(678)36320, (678)36355
- Representative：Ms. Marie Melteras
- Number of stuff： 3 scientists, 5 technical staff, 2 maintenances, 1 workshop, 3 administers, 31 field labors (Total 45)
- Project site：Chapui, Santo, Vanuatu
- FieldAdministral area： 492 ha

2. Project Contents

Policy and project

- Rural development
- Advice to farmer (gardener)
- Survey of agricultural sector

Activity results

- IRHO (coconut and copra laboratory) established in 1962.
- IRCC (coffee and cacao laboratory) established in 1982.
- IRHO merged with IRCC in 1984, and it becomes CIRAD (agricultural researching international cooperation center for development).
- VARTC established in 1994.

Activity sector

- Production examination of coconut and copra
- Cattle raising examination (700 cows)
- Examination of production and breeding of coffee, cacao, pepper, and kava (variety of good quality)

Ongoing projects

- Improvement of breed of crops
- Improvement of productivity
- Improvement of agro-technology
- Drying of copra
- Beef cattle breeding and meat processing of meat for fund raising

Content of project and result that has been done up to now

- See above

Beneficiary

- Farmers (gardeners)

Limitation factor and obstacles

- Deficiency in budget (Only representative's salary is provided by the government. All the salaries of other staffs and the management expense are obtained from the experimental farm of copra and the beef cattle and fund from another donors.
- Lack of extension workers

3. Countermeasure for Climate Change

Damages due to climate change

- Excessive rainfall→ thick growing of weeds
- Prolongment of rainy season→ increase of pest and disease（especially, on coconut）
  →Restoration of road
- Change of the harvest season of yam: once a year→ It came to be able to plant year round and to harvest twice a year (February to March and October to December).
- Cropping season of vegetables: seasonal cultivation→ year round cultivation
- A traditional farming calendar has collapsed.

Countermeasures

- Improvement of breed of crops
- Improvement of cropping season
- Making of new farming calendar
- Awareness of climate change to farmers (gardeners)
- Manufacturing of organic fertilizer and organic chemicals
- Change in cropping time to cope with disaster.

Limitation and obstacles

- It costs the money and labor to control the weed.
- It costs the road maintenance and construction.

Note: The influence of the climate change is very slow and is not remarkable. It is necessary to research on the method to measure the change and the standard. In order to check the slight change, chronological comparison is important.

4. Cooperation with other donors or NGOs

- Now we collaborate with the donors and organizations below.
  AFD(,Association Française de Developpement), EU, ADB, CIRAD (French Agricultural Research Centre for International Agricultural Development), ACIAR(Australian Center for Agriculture Research), POPACA (Project d'Organisation des Producteurs Agricoles pour la Commercialisation Associative), VCC (Vanuatu Christian Council), SPC (Secretariat of the Pacific Community), IAC (International Agriculture Center),
  IPGRI (International Plant Genetic Resources Institute), IFAD (the International Fund for Agricultural Development), COGENT (International Coconut genetic resources).

Note: The POPACA is an Agricultural Development Project implemented by the Vanuatu Ministry of Agriculture and funded by the Government of France, (Ministry of Foreign Affairs, Fonds de Solidarité prioritaire, FSP) and the European Union.

(3) Vanuatu Result of Questionnaire Survey on Donors

Ⅰ. EU (European Union)

Day of interview: 8th April 2009

Interviewee: Mr. Adrien Mourgues

1. Basic Data

- Name of donor: EU (European Union)
- Address of office : P.O. Box 422, Port Vila, Republic of Vanuatu republic
- Phone No.: (678) 22501
- Project site: various places in Republic of Vanuatu

2. Project Contents

Policy and project

- As for Vanuatu, agreements are exchanged as a pilot country of NAPA with EU.
- As for the climate change measures, we cooperate with NACCC.

Activity results

- 3.2 million Euro is delivered from EU and six million Euros is delivered from GEF. In addition, one million Euro is delivered from GTZ. And the fund is offered to various projects and the activity is done.

Activity sector

- The action plan is made by World Bank, and corresponds to the natural disaster chiefly as a recovery mission from the climatic variation. Moreover, it is recognized as environmental issues, and many related projects have done.

Ongoing projects

- POPACA (It does for the small-scale, agricultural producer's income improvement by the project that the Vanuatu Ministry of Agriculture, Forestry and Fisheries does. It is done chiefly by financial support of France Government).

Outcome of the projects in the past

- The budget is applied by the sector approach with AusAID and France in agricultural sector. However, there is no sector strategy of Vanuatu Government, and the implementation is delayed. Then, the budget is being pooled to World Bank now.
- In the tourism sector, the rural sightseeing project was done.
- In the environmental sector, protect of the coral leaf, of the wild bird, and reforestation projects had been done.
- In the fishery sector, financial support was done by the cooperation of Denmark.

Outcome of the projects

- Rural development

Beneficiary

- People of the Republic of Vanuatu

Limitation and obstacles

- Lack of execution ability of the Government

3. Countermeasure to Climate Change

・ NAPA is the center of activities to cope with climate change.

4. Cooperation with other donors or NGOs

・ **Not only EU members but also AusAID, etc. collaborate with.**

・

5. Schedule for the Future

・ Establishment of Vanuatu agricultural bank is scheduled. The micro credit will be provided.

Ⅱ. AusAID

Day of interview：14th April 2009

Interviewee： Mr. Nick Cumpston, Mr. Patrick Haines, Miss Linda Gerald

1. Basic Data

・ Name of donor: AusAID (Australia Agency for International Development)

・ Address of office: P.O. Box 111, Port Vila, Republic of Vanuatu.

・ Phone No.：(678) 23341, Fax：(678)22292

・ Headquarter： Canberra

・ AusAID Pacific Branch: Suva in Fiji

・ Project site: various places in the Republic of Vanuatu

2. Project Contents

Policy and project

・ As being in Declaration of Paris, we will cooperate in respect of disaster prevention.

Activity results

・ Regional garbage disposal management project

・ Sandalwood oil analysis and extension project

・ Meteorological prediction

・ Monitoring of green house gases and sea level rising

・ Research on coconut crab

Activity sector

・ Agriculture, forestry, livestock, and fishery sector, health sector, environmental sector and disaster prevention sector

Ongoing project

・ There are a lot of small and community-based programs.

Content of project that has been done up to now

・ Livestock project

・ Forest project

・ Food self-support project

・ Road restoration and market management project that agrees with government policy (five years).

Achievement for a project

・ Disaster prevention and rural development

Beneficiary

・ People in the Republic of Vanuatu

Limitation and obstacles

- Weak capacity of Government (especially, execution ability)
- The government doesn't have a firm plan.
- The ability of the government is weak, and ODA is stronger.
- The fund allocation is difficult. Especially, the project execution is delayed. Even in 2009, it is still a stage of the plan.
- The wide area programme is difficult.
- There are the one at the government level and the one at the people level in needs.

3. Countermeasures to Climate Change

- We recognize that the issue of climate change is global environmental problems.
- Five million Euro is delivered to correspond to climate change as a budget of GEF**.**
- The prevention of disaster is a center.

4. Cooperation with other donors or NGOs

- It is necessary to cooperate with APEC nations. The development of personnel resources is done by the scheme of EU.

5. Schedule for the future

- The activity and the plan have been held since 2007. A new project is scheduled to be done in 2009.
- It is considered that the maintenance of the coral reef is important as correspond in the future. The coral reef is very important resource for tourism that is the major industry of this country. Though there is no remarkable damage, it is necessary to be making the plan now in preparation for the damage in the future.
- It is important that the Vanuatu government feel needs. As confirmed by Declaration of Paris etc., the recipient country should recognize the needs even if it is thought that the adviser is necessary by the donor country.
- The recognition of the problem by the Vanuatu government itself is important in whole politics and the administrative activity.
- The disaster prevention program for the disaster reduction will be collaborating with SOPAC of Fiji.

(4) Vanuatu Result of Questionnaire Survey on Farmer

Day of Interview：10th April 2009
Interviewee：Mr. Jack Navoc in Bamboo village in Panafo

1. Social, Economical Background

Basic data

- Name; Mr. Jack Navoc（30 years old）
- Number of people of family: 5 people
- Number in which it can work: 2 people
- The main living: Agriculture
- I belong to the agricultural producer group. There are four groups, and 36 people are working.
- The upland rice cultivation began last year.

Income

- Kava: three times a year as for 50,000 Batu/bag. 150,000Batu/year.
- Tubers including taro: several baskets per one time and 800-1000 Batu/basket. It doesn't understand as it is several-time per year.
- Vegetables: produce tomato, and chili, etc. for domestic consumption
- Fruits: produce and selling mango, grapefruits, papaya, namanbe, nagai, nagatanbol and banana, etc.
- Rice: only for selling. After milling, selling it for180 Batu/kg. The price of imported rice is 4,700 Batu/25kg. It means 188 Batu/kg. Their rice is a little cheaper than imported one.

2. Agriculture, Land Use and Water Resource

Livestock

- It is not enough to eat in the family though there is a chicken.

Fruits

- Coconut, banana, mango, papaya, and the grapefruit are the main fruits.

Food crops

- Tubers like taro and sweet potato are staple food.
- Rice is not domestically consumed but for sales though produces. We cultivate 8ha of rice by four families (2ha/one family).

Vegetables

- We produce vegetables for domestic use.

Land ownership

- Self-ownership 1000ha

Way of farming

- The seed is multiplied by us. The rice seed were given by Mr. Leconte who is a French businessman.
- No fertilizer and no agricultural chemicals

Production

- It doesn't understand.

Food self-support situation

- It is self-sufficient level excluding meat and the fish.

Agricultural support service

- There is no extension service.

Credit

- It is possible to borrow 100,000 Batu/ha from West Bank, NZ Bank, and National Bank, etc.

Note: Interrupted this interview because of rain.

(1) Papua New Guinea Result of Questionnaire Survey on National Department of Agriculture and Livestock

Day of interview：21st April 2009
Interviewee：Mr. Vele C. Kagena (Deputy secretary-Corporate Services and Policy in Department of Agriculture and Livestock), Mr. Chris Dekuku (Deputy Secretary-Climate Change)

1. Basic Data

(Scheduled obtaining the data on 24th April 2009)

2. Agricultural Data

(Scheduled obtaining the data on 24th April 2009)

3. Agricultural Production, Extension and Cooperative

Production plan

- The view and the plan for the future are done by MTDS (Mid Term Development Strategy).
- The plan from 2007 to 2016 includes NADP (National Agricultural Development Plan) made in 2006 in NDAL (National Department of Agriculture and Livestock).
- The above-mentioned plan includes the production plan of commercial crops such as coffee, cocoa, rubber and oil palm.
- Moreover, there is a description concerning the carbon trade.
- There is revised MTDS (Mid Term Development Strategy, 2010-2015 version) according to NADP (National Agricultural Development Plan).
- Though there is NSP (National Strategic Plan) as a long term plan, this is strategy.
- It is scheduled to develop concerning eight sections in NSP (National Strategy Plan). Eight sections include research and development, communication and information, food crops, fruit tree, horticulture (cassava and other food crops), forestry, fisheries, vegetables and other foods.
- FPDA (Fresh Produce Development Agency) corresponds to the food crops development.
- LTDP (Long Term Development Plan) is policy.

Soil conservation

- The landslide by heavy rain has happened in a region harvesting timber heavily. It is necessary to reforest it. Hereafter, the introduction of the agro-forestry will be aimed at because present agriculture is slush-and-burn cultivation. Moreover, the landslide by heavy rain has happened because the field used the slope as it was. A terrace type field and a contour line field are necessary.

Soil contamination and soil deterioration

- The soil erosion caused by the harvesting timber has happened. The damage of the salinization has happened in the coast line.

Irrigation facilities

- There is small-scale irrigation for stock raising etc.

Husbandry

- Forage is not enough for the dry season because the condition of stock raising is pasturing though the ranch is not well equipped. Facilities such as silages are necessary to store the forage for the dry season

as a supplement of feed. Moreover, the drying plant of pasture is also necessary.

- The piggery is a main stock raising in Papua New Guinea. The poultry, sheep raising, and the cattle raising follow. Now we work on breeding of the sheep. It is necessary to breed the short hair variety that adjusts to the tropics. The sheep in Australia and the sheep in Papua New Guinea are being crossed now.

Farm machinery and instruments

- Most farmers are using only the digging stick. It is necessary to use the cow for the plow of the field.
- We want to develop the bio-fuel as oil of the machine.
- The machine that adjusts to the actual condition of Papua New Guinea is hoped for.

4. Climate Change and Damage on Agriculture

- The drought in 1997 was serious, and food was imported from Australia. There is a drought about once ten year. It seems to be the influence of El Nino.
- The weather condition is different from the regions.

Regional damage

- There is damage from a drought in the coast area and the islands of the Northern provinces and the east provinces. Moreover, there is a region where the flood happens, too. There is salt damage on a part of the coast area and the islands. It is serious damage.

Damage on each crop

- Main staple food is sweet potato and banana, taro follow it. Cassava is not so much produced as a staple food.
- As for the sweet potato, leaf blight disease came to stand out for 2 or 3 years. A tissue culture of a certain variety of disease tolerant is done now.
- A variety named true-taro is mainly cultivated. The damage of the taro blight disease has occurred a little. Beetles' damage is serious.
- The import of tree and cutting of cocoa and coffee from Indonesia is prohibited with NAQIA (National Agriculture Quarantine and Inspection Authority) for the pest prevention now.

Impact of agriculture on climate change

- Now we are working on the awareness of the influence of the climate change on agriculture to the farmers. The workshop besides the report with media (newspaper and radio) is done in four places of Alotau, Goroka, Madang and Kokopo).
- It is scheduled to reduce the slash-and-burn farming by 100% within 20 coming years, and to change it into the agro-forestry.
- It is necessary to maintain the current state as much as possible.
- From the viewpoint of soil conservation, we want to correspond to the deforestation by the agro-forestry.
- The landslide is caused because the field is made along the slope now. In the year of 1999, the damage was especially awful. To avoid the soil erosion in the future, the contour line field making and the terrace type field making should be introduced.

5. Social Impact on Agriculture

- Soil deterioration because of shortening fallow period of shifting cultivation by a population increase.

6. Needs for Adaptation Measures

- We provide the awareness training by information
- Only one research facility is NARI (National Agricultural Research Institute) on climate change.

7. Mitigation and Adaptation Measures

Though the center of the research on the climatic change is NARI now, Mr. Chris Dekuku takes charge in investigation, research and communication in the National Department of Agriculture and Livestock.

(2) Papua New Guinea Result of Questionnaire Survey on NARI

Day of interview：22nd April 2009
Interviewee：Mr. Raghanath Ghodake(Director General), Dr. Shyam Yadav(Rice and grain), Dr. Peter A. Gendua(Rice and grain), Mr. Michael Dom(Livestock), Dr. A. Ramakrishna(Research programme leader), Mr. James Tarabu(Livestock), Mr. Stanley Amben(Livestock), Mr. Elick Guaf(Food crops, sweet potato)

1. Basic Data

- The annual budget of NARI (National Agricultural Research Institute) is 13 million Kina (It equivalent to about 500 million yen).
- The structure of NARI
  NARI Council→ Director General → Director Research→ Chief Scientist → Research Programme Leader→ Scientists
- NARI has seven branches.
- The number of staff: 391 people（44 researchers and 347 their workers）

2. Agricultural Data

- No statistical data except research results

3. Agricultural Production, Extension and Cooperative

Production plan

- The productivity of the enterprise is efficiently improved.
- Improvement of quality of product
- An increase in output
- Reduction in loss and expenditure
- Giving of additional value and commercialization
- Improvement of technology and knowledge of Farmers

Seed

- Rice & grain: Pure seeds are produced and distributed to farmers by NARI, Trukai, ICDF (Taiwan Technical Mission), and others.
- Root and tuber crops: -improved varieties, distributed by NARI.
  -Traditional varieties by farmers themselves.
- Fruits and vegetables: Temperate vegetable seeds are 100% imported.（The price in Madang market is 3.6 Kinas. It equivalent to 137 yen.）
- Promote extension of high yield variety through Field day's displays, Agricultural shows, NGOs, churches, schools, Department of Agriculture and Livestock Extension Agency.
- Farmers multiply seeds by themselves. But the Government does not support them.

Fertilizer and chemicals

- Fertilizer is only used on research farms, large commercial agricultural farms and a few semi-commercial farmers.
- Most PNG farmers (90%) do not use fertilizers.

Soil

- The government carries out soil diagnosis service for farmers.

- As a result of soil diagnosis, the Government recommends farmers to use fertilizer.
- NARI Chemistry Laboratory in Port Moresby has about 5 researchers for evaluation.
- University of Technology is National Analytical Laboratory has about 10 people for evaluation.

Organic fertilizer

- It is widely used in smallholder farmers.

Tolerance Criteria for agricultural chemical residue and standards of chemical application

- NISIT (National Institute of Standards and Industrial Technology) is making the agricultural chemicals residual standards.

Alternatives of agricultural chemicals

- Plant derived pesticides are used for pest management.
- IPM (Integrated Pest Management) is done.
- Extension of these alternatives has done by NARI, Department of Agriculture, universities (UNITECH and VUDAL), agricultural colleges and schools.

Monitoring of agricultural chemicals and publication system

- DEC (Department of Environment and Conservation) is responsible for that.

Present conditions of post harvest

- It is not well developed and needs to be developed for then.

Quality criterion

- Different commodity boards have different criteria such as cocoa and coffee boards.

Quality safety inspection system

- ICCC (The Independent Consumer Competition Commission) of Papua New Guinea conduct regular inspection of food.

Agricultural infrastructure and its operation and maintenance

- No major land improvement or land reclamation for agricultural use.
- Landslides due to heavy rainfall.
- Increase sedimentation in river and water systems.
- Mining activities cause soil erosion.
- Soil conservation measures: Use of agro-forestry system.
- Improved soil conservation techniques introduce to farmers.

Soil pollution/deterioration

- None in agricultural sector but only in some mining areas.

Provision of irrigation facilities and drainage facilities

- There are no irrigation facilities.

Animal husbandry

Supply of livestock materials

- For commercial production of poultry and piggery, 100% imported feed stuff.
- For domestic livestock, feed stuffs are produced 100% by farmers themselves and mostly unblended.
- The government has not provided vaccination and AI (Artificial Insemination) for farmers.
- Most of farmers have not any husbandry facility for the domestic animal.

Enforcement of agricultural extension

- The agricultural extension system or services is run by the Provincial Department of Agriculture in each Province.

- Training of extension trainers, manuals of related technologies, research information leaflets and workshop are the training method of extension workers.
- NARI collaborates with church organizations (Baptist, LDS: Lutheran Development Services, SDA: Salvation Army etc.) for extension.
- NARI collaborates with NGOs (World Vision, Local NGO: Bris Kanda), VDT (Village Development Trust), etc.

Farm management

- Smallholder: Mostly traditional farming practices and semi-intensive farming.
- Large farmers: High input production system.

Assistance by the government

- There is no Governmental subsidy and most farmers have no access to credit facilities.

4. Climate Change and Damage on Agriculture

Damage by climate change

- Flood（more than 4 times a year）, cyclone (more than 4times a year), high tide (more than 4 times a year), high temperature (more than 4 times a year), drought (the most serious one is in 1997), forest fire (not the autogenous ignition but a man-made fire after hunting wild pigs) (more than 4 times a year)

Damage on each crops（Level 1-5. Level 5 is the most serious one）

- **Taro Level5**: soil moisture shortage by drought, inundation by flood, topsoil drainage by heavy rain, inundation by high wave due to cyclone. **Level 4**: Prevailing of pest by drought, inundation by cyclone, inundation by sea level rising. **Level 2**: salinization by drought, saline intrusion to water source by sea level rising, withering by high temperature, sterility by high temperature, growth inhibition by shortage of solar radiation, and growth inhibition by excess solar radiation.
- Yam **Level5**: inundation by flood and topsoil drainage by heavy rain. **Level 4**: soil moisture shortage by drought, prevailing of pests by drought, inundation by high wave due to cyclone, lodging by strong wind of cyclone, inundation by flood caused by cyclone, and salt damage due to sea level rising. **Level 2**: damage by wildlife due to drought, salinization by drought, saline intrusion to water source by sea level rising, growth inhibition and sterility by high temperature, and growth inhibition by shortage and excess of solar radiation.
- **Cassava Level 5**: topsoil drainage by heavy rain and inundation by flood of cyclone. **Level 4**: inundation by flood, inundation by high wave caused by cyclone, lodging by strong wind of cyclone, and salt water inundation by sea level rising. **Level 3**: saline intrusion to water source by sea level rising. **Level 2**: soil moisture shortage by drought, damage by wild life due to drought, salinization by drought, and withering by high temperature.
- **Sweet potato Level 5**: soil moisture shortage by drought, prevailing of pests by drought, damage by wild life due to drought, salinization by drought, inundation by flood caused by heavy rain, topsoil drainage by heavy rain, inundation by high wave caused by cyclone, inundation by sea level rising, and saline intrusion to water source by sea level rising. **Level 4**: withering by high temperature. **Level 3**: sterility by high temperature. **Level 2**: prevailing disease by drought.

- **Banana Level 5**: prevailing of pests by drought. **Level 4**: salinization by drought, inundation by flood, topsoil drainage by heavy rain, inundation by high wave caused by cyclone, lodging by strong wind of cyclone, inundation by flood caused by cyclone, inundation by sea level rising, and saline intrusion to water resource by sea level rising. **Level 3**: prevailing of disease by drought. **Level 2**: soil moisture shortage by drought, damage by wild life due to drought, withering by high temperature, and sterility by high temperature.
- **Corn Level 5**: lodging by strong wind of cyclone, and inundation by flood caused by cyclone. **Level 4**: soil moisture shortage by drought, prevailing of pests by drought, damage by wild life due to drought, salinization by drought, inundation by flood due to heavy rain, topsoil drainage by heavy rain, inundation by high wave due to cyclone, inundation by sea level rising, and saline intrusion to water source by sea level rising. **Level 2**: prevailing of disease by drought, withering by high temperature, and sterility by high temperature.
- **Rice Level 5**: soil moisture shortage by drought, prevailing of pests by drought, damage by wild life due to drought, topsoil drainage by heavy rain, inundation by sea level rising, saline intrusion to water source by sea level rising, withering by high temperature, and sterility by high temperature. **Level 4**: salinization by drought, inundation by flood due to heavy rain, inundation by high wave caused by cyclone, lodging by strong wind of cyclone, and inundation by flood caused by cyclone. **Level 2**: prevailing disease by drought.
- **Potato Level 5**: soil moisture shortage by drought, topsoil drainage by heavy rain, inundation by high wave caused by cyclone, and inundation by flood caused by cyclone. **Level 4**: prevailing of pests by drought, inundation by flood due to heavy rain, and lodging by strong wind of cyclone. **Level 2**: prevailing of disease by drought and damage by wild life due to drought.
- **Beans Level 5**: soil moisture shortage by drought, prevailing of pests by drought, topsoil drainage by heavy rain, withering by high temperature, and sterility by high temperature. **Level 4**: damage by wild life due to drought, salinization by drought, inundation by flood due to heavy rain, inundation by high wave caused by cyclone, lodging by strong wind of cyclone, inundation by flood caused by cyclone, inundation by sea level rising, and saline intrusion to water source by sea level rising. **Level 2**: prevailing of disease by drought.
- **Cereals (sorghum, etc.) Level 5**: soil moisture shortage by drought, prevailing pests by drought, and topsoil drainage by heavy rain. **Level 4**: damage by wild life due to drought, salinization by drought, inundation by flood due to heavy rain, inundation by high wave caused by cyclone, lodging by strong wind of cyclone, and inundation by flood caused by cyclone. **Level 3**: inundation by sea level rising, saline intrusion to water source by sea level rising, and withering by high temperature. **Level 2**: prevailing disease by drought and sterility by high temperature.
- **Coconut Level 4**: prevailing pests by drought, inundation by flood caused by cyclone, and inundation by sea level rising. **Level 3**: inundation by flood due to heavy rain, inundation by high wave caused by cyclone. **Level 2**: prevailing disease by drought and saline intrusion to water source by sea level rising.
- **Forestry Level 5**: forest fire by drought (extended fire for hunting), lodging by mud slide, soil erosion

in coast line by heavy rain, soil erosion by sea level rising, and decrease of mangrove.

Impact on climate change by agriculture

- There is no regulation or restriction of environmental consideration on agricultural residue, fertilizer and chemicals by National Department of Agriculture and Livestock.
- There is only a test of water quality.
- Multi-function of agriculture is not examined.
- The education of the environment has the chance for the environment recognition.
- To promote awareness to agricultural people, the group (Intelligence Agency) for the information sending is set up.

5. Social Impact and Damage on Agriculture

- Population pressure
- Land ownership based on custom
- HIV, AIDS
- Rural/ Urban drift

6. Needs for Adaptation Measures

Enforcement of research institute

- There are a forest research institute, a coffee research institute, and a cocoa and coconut research institute besides NARI.

Improvement of production technology

- NARI, coffee research institute and cocoa and coconut research institute work for breeding.

Development of new variety

- Leaf blight resistant taro varieties (4 taro varieties)

Improvement of cultivation technology

- NARI, FPDA (Fresh Produce Development Agency), coffee research institute and cocoa and coconut research institute improve cultivation technique.

Development of new technology

- NARI released technologies.

Agricultural machinery and equipment development

- PSS (Project Support Services) and ATDI (Appropriate Technology Development Institute) are in charge.

Irrigation and drainage technology

- There are no research laboratories concerning irrigation.

Soil conservation technology development

- NARI is in charge.
- There is no special technological development at present.

Plant genetic resource

- NARI has done germ-plasma collection, management and storage of food crops.

Improvement of post harvest technology

- NARI, FPDA (Fresh Produce Development Agency), Taiwan Technical Mission and Trukai Industries has done.

- The Taiwan technical mission has done in the seed production of rice since 1990.
- Trukai collaborates with the Provincial Department of Agriculture and Livestock for Ramu sugar and NBPO (New Britain Palm Oil).

Stock raising technology development

- NAQIA (National Agriculture Quarantine and Inspection Authority) takes charge.
- Though it is small scale, NARI has developed feeding and management, forage production and improvement of breeding on poultry, goats, sheep, and pigs.

Stock raising new technology

- Poultry feeding system (NARI)
- Muscovey duck production system
- Rabbit production system

Information magazine related to agriculture

- PNG Agriculture, Forestry and Fisheries Journal
- NARI News)
- Rice Relay

Cooperation with other organizations

- Public universities do apply both practical and knowledge oriented research and education.
- Collaborative research with European, American, Japanese and Australian universities. And there is student exchange programme.

Extension unit of university

- Department of agriculture in PNG University of Technology is promoting agricultural technology in some selected rural areas.

7. Mitigation and Adaptation

- National Department of Agriculture and Livestock takes charge.

8. Foreign Aid Process and other countries' assistance.

- The acceptance process is below.

① NARI submits project proposal or request to the donor agencies or partners through the National Planning Office.

② National Planning Office submits proposal or request to donor.

- Lender states to agricultural sectors other than Japan are EU, Australia, and Taiwan.
- The headquarters of NARI was built with the capital of EU.
- Plant project (taro and yam) is supported by ACIAR (Australian Center for International Agricultural Research).

(3) Papua New Guinea Result of Questionnaire Survey on UNITECH

Day of interview：24th April 2009
Interviewee：Dr. Abdul Halim (Head of Department of Agriculture), Mr. Maia Wamara (Lecturer in charge of climate change), Dr. Surya Nath (Associate professor), Dr. Peter Manus(Senior lecturer), Mr. Ronni Dotaona (Lecturer), Mr. Rao Rajashekhar (Lecturer), Mr.William Nano (Lecturer), Mr. Patrick Michael (Lecturer), Dr. Gariba Danbaro (Lecturer), Mr. Gibson Kasi (Master, Unitech farm manager), Miss. Judith Mameri (Journalist-Public Relations)
Interview day: Friday, April 24, 2009

1. Basic Data

- University name: Papua New Guinea University of Technology
- Address：P.O.Box 411, Lae, Morobe Province
- Phone No.：（675）473-4450/4451, Fax：（675）473-4477、
- E-mail address：ahalim@ag.unitech.ac.pg
- Representative：Dr. Abdul Halim
- Teaching staff: 15 people
- Number of students: 250 people
- Number of subjects: ten programmes10 and about 50 subjects
- There is a curriculum concerning an agricultural environmental sustainability.
- Farm 40ha. The domestic animal is a sheep, a goat, a fowl (chicken and duck), pigs, rabbits, and freshwater fishes.
- The cow is scheduled to breed from the coming year.

2. Course content

Guideline

- 1. Education, 2. Research, 3. Extension

Programme under execution

- Especially, we make efforts to the rural development.
- Enlightenment and the extension activity to the nation, the industrial world, and to the farmers who reside in the farm village are executed as an educational, mechanical model.
- New Caledonia also refers to this model.
- The financial support of 20,000 Canadian dollars was received from CWL (Common Wealth Learning of Canada) to this model last year. The implement period from November, 2008 to June, 2009. Breeding of the freshwater fish, the peanut butter manufacturing, and technical guidance in the field site, etc. are done.

Project executed in the past

- Supply of seed.
- Technical guidance to farmers by teaching staff and student in specific region.
- Beneficiaries are the nation, the industrial world, and farmers who reside in the farm village.

Restricting factor and obstacles

- It is difficult to make enough research because the building and the research equipment are

superannuated.

Problems to be solved

- Cooperation with Provincial Division of Agriculture and Livestock and NARI（Agricultural Research Institute）.

3. Measures for Climatic Change

Damage

- A very severe drought happened because of El Nino in 1997. Fruits and tubers withered, too and it became food shortages. After the drinking water was insufficient, the temperature is rose up. Then diarrhea happened frequently.
- The sea level rose as much as 40cm on some islands such as Katalei Island, the resident left the island and migrated to another region.
- The soil erosion has happened chiefly in the Southern coast region and the Northern coast region in Papua New Guinea because of the sea level rising.
- The saline intrusion to water source has happened because of the sea level rising, too.
- Damage has occurred to the fishery because the soil erosion of the coast happened by sea level rising.
- The forecast of the drought in 1997 was not trustworthy one because of incompleteness of the weather forecast technology and had not warning. Therefore, the preparation was not done.
- There was somebody who forecasted the drought in 1997 by a traditional method.
- The drought in 1997 had to bring hunger, and to eat even the pith of the trunk of the banana.
- There was a damage by cyclone in 1997. Recently, the cyclone brought the flood to Oro in the Northern Province. Moreover, the damage of cyclone "Guba" in 2008 was large.
- The high wave by cyclone hit the Manus Province and New Ireland Province in January, 2009.
- The climate change influenced biodiversity. The change has taken place. This is because something is wrong with the ecosystem. For instance, the malaria that is only in low land before has extended to the high land by the temperature rise.
- On the contrary, it suffered from the frost damage in 1997, 1998 in 5 Highlands Provinces.
- The generation of the pest has increased by the temperature rise. For instance, there is damage of spot disease of cocoa, nematode of root crops, virus disease of sweet potato, disease of coffee, and of coconut by beetle.
- The disease that not was before has extended. One of the coconut diseases has entered from Indonesia. Though the Quarantine checks, at the same time the Quarantine is aiming at awareness of the people so as not to bring it in from Indonesia now
- The harm of the locust has increased by the drought. Up to now, the locust in the field has come to eat even the vegetables in the farmland.
- African giant snail's damage has increased in the home garden.
- The number of alien weeds such as Siam weed that not is before has increased.
- The generation of the beetle was confirmed to the rice storing on the Bougainville Island.
- Potato blight has been generated in the high land area.

- The fruit fly has been generated in fruits.
- Especially, Asian papaya fly has been generated in the papaya.
- Crop season has changed because of climate change and the crop became malnutrition.

Adaptation measures

- The rotation systems such as the fallow periods and rotation are improved.
- An effective, for soil conservation traditional way of farming is guided.
- Mulching is guided for the soil moisture maintenance. Especially, it is effective in the fruit tree such as mangoes and bananas.
- It is planned to domesticate the wild pig that lives in the forest and the marsupial named the bandicoot.
- To investigate a traditional way of farming, and to correspond to the dry weather and the frequent rain, we are working on.
- We train the people who lives in the rural area and the staff of the local government.

4. Cooperation with donors and other NGOs

Assistance of JICA

- Mr. Ito was sent to the Department of Agriculture as a senior volunteer for three years. The re-dispatch is hoped for because he was very able.

The other donors' support

- The financial support of 20,000 Canadian dollars was received from CWL (Common Wealth Learning of Canada). The implement period from November, 2008 to June, 2009. Breeding of freshwater fish, peanut butter manufacturing, and technical guidance in field site, etc.
- ACIAR (Australian Center for International Agricultural Research) in Australia provides the scholarship and gives support to the graduate school (master) .
- Taiwan supports the project of rice. Fish breeding was supported for three months in the past.

Request

- Dispatch of the able senior volunteer like Mr. Ito.
- Scholarship (for lecturer and student)
- Farmer training and capacity building
- Research equipment. Equipment for meteorological observation.
- Rebuilding of faculty laboratory built in 1970.
- Plant research and development assistance.

5. Others

Impact of social change on agriculture

- Though once the way of farming was sifting cultivation, it has changed because people tend to settle down. However, 80% or more of the farmer is still a local resident.

Proposal to JICA

- The proposal of "New research facilities and building for the development of sustainable agriculture" has been put out to JICA in August, 2008. The budget is 12 million US dollars (1.2 billion yen).

(4) Papua New Guinea Result of Questionnaire Survey on Farmers

Day of interview：27th April 2009
Interviewee： Farmers (crop cultivation) in Nagada village, Madang
Interview day: April 27, 2009

1. Social and Economical Background

Basic data

- Village population: 800 people(100 adults)
- There is no cooperative such as the producer's associations. There is an activity of the Christianity.
- There is a female group of the Christianity.
- Village where creek is enclosed. Marine products can be harvested.

Income

- Though most of food is self-sufficient, domestic animal is not produced
- The surplus food sells vegetable, potatoes, bananas, and fish, etc. by nearby road sales.
- We go to the market for 2-3 times a month to sell surplus. The transport fee is 15 Kina/person and 20 Kina/100 kg bag for tubers. There are sales of 50 Kina at one time.

2. Agriculture, Land use, and Water Resource

Husbandry

- No domestic animal.

Fruits

- We grow coconut, banana, papaya, mango, and the pineapple, etc.

Land ownership

- Private ownership: 0.5ha per person of average (cultivated land 0.2ha and the fallow land are 0.3 ha)

Land use

- Home garden (cultivation around house) : sweet potato, taro, and leafy vegetables

Way of farming

- All seeds are produced for ourselves.

Condition of food self-sufficiency

- Staple food is corn and second food crop is tubers (sweet potato and taro). We sell the surplus of tuber crops. As for banana and beans, the production is far more than family's requirement. As for the vegetables**,** t is more than family's requirement. Meat is quite insufficient. As for fish, we harvest it **f**rom the sea for our consumption and sometimes sell it.

Agricultural support service

- There is no round of the extension worker excluding rice. Rice: about three times a year.
- Neither agricultural chemicals nor the fertilizer are completely used.
- There is no credit at all.

Restricting factor and improvement in agriculture
Restricting factor on cultivation side

- 1.Damage by Giant African snails, 2.Damage on root crops by beetle, 3.Damage by locust, 4.longer dry season
- Damage by pests: locust on leafy vegetables, beetle larvae on root crops

- Damage by disease：mold on root crops
- Time of sick expansion: Last few years
- The reason for a sick expansion: Because of excessive rain

Restricting factor and improvement of stock raising

- There is no domestic animal.

Disaster

- Growth inhibition by high temperature(once a year), inundation by long rain (several times a year**)**
- The damage of each crops: The tubers rotted because of the long rain.

Agricultural residue

- We make compost from agricultural residue.
- How to make compost is transmitted from generation to generation.

(1) Tonga Result of Questionnaire Survey to Ministry of Agriculture and Food, Forests and Fisheries

Date：March 31 to April 3, 2009 (at any time)
Interviewee : Penisimani Vea（Secretary）、Emmanuel Mo'ale（economy）、Vahai Lui（agro-economy）、Heimuli Likiafu（Forestry）、Fehi Moala（Livestock）、Losaline Ma'asi（food and women in development）、Taniel Hobonoa（research and extension）, and other staff

1. Basic Information

- Ministry of Agriculture and Food, Forests, and Fisheries consist of eight divisions such as (1)Corporate Service Division, (2)Research & Extension Division, (3)Bio-security & Quality Management Division, (4)Food & Women Community Development Division, (5)Forestry Division, (6)Livestock Division, (7)Outer island Operation, and (8)Fisheries Division.
- Major statistic sources are Agricultural Census 2001 and Population Census 2006. Crop survey is conducted every year. Cultivated area is updated annually, but yield survey is not updated.

2. Agricultural Information

Policy

- Corporate Plan2009/10 to 2010/11 is available. Annual Management Plan is prepared based on the Corporate Plan.

Environmental issue

- Ministry of Natural Resources and Environment has prepared mitigation plans and adaptation plans. Mitigation plans will be prepared by June this year, while September for adaptation plans. It is expected that mitigation plans cover four fields (agriculture, forestry, energy, and waste, while adaptation plans for six fields such as forestry, fishery, water resources, health, and disaster risk management.

Land issue

- Cadastral maps for Tongatapu Island have been arranged. Data base for farmers has been prepared based on those maps.
- There are natural forests in Eua and Niuatoputapu Islands.

3. Production, Extension, and Farmers' Association

Agricultural Production

- There are some cases on promotion of organic farming, although it is still small scale.
- Quality standards for agricultural produces are not available except major export commodities such as squash, vanilla, etc.
- Export of fresh produces as well as secondary processed produces is promoted. Major export markets are New Zealand and Australia. Meanwhile export of squash has been promoted recently, its major market is Japan.
- Peak season of demand of agricultural produces from Tonga to New Zealand and Australia is during the period from May to August, which is off-season in New Zealand and Australia.
- Mechanized farming with tractor is minor.

Farm inputs (seed, fertilizer, agrochemicals)

- Certified seeds are imported from New Zealand. In Tonga, certified seeds of following vegetables are

available.

Cabbage, qing geng cai, cucumber, watermelon, radish, carrot, egg plant, string beans

- Fertilizers and agro-chemicals are rarely applied.

Soil conservation

- There is some soil erosion on the coast line.

Livestock

- Major part of local consumption of livestock products is depend on import from New Zealand and Australia. In order to promote import substitution, 40 heads of sheep were introduced and thus trial multiplication has been carried out to date. Currently expansion of cattle keeping is also considered. Meanwhile it is necessary to increase production of fodder crops accordingly, in order to expand livestock rearing.
- There are no abattoirs in Tonga. It is necessary to establish new abattoir as well as strengthen system of quality control for livestock products.

Agricultural extension activities

- Extension sector is merged with research sector into Research and Extension Division, further number of extension staff is deducted. Current number of extension staff is counted for six persons.
- Monthly community meeting is held in each district, in order to discuss constraints on agricultural activities, future activity, etc. Further agricultural information is actively disseminated through TV and radio programmes (once a month). However, familiar extension activity such as demonstration plots is hardly carried out in villages.
- Six extension offices are established in six islands as follows:

Islands	No.
(1) Tongatapu	3
(2) Vavau	1
(3) Haapai	1
(4) Eua	1
(5) Nivataputapu	1
(6) Niuafo'ou	1
Total	8

Farmers' Association (Women's activity)

- Activity concerning small scale agro-processing for women's group has been carried out, aiming at improvement of farmers' livelihood. Currently activities on poultry, mat making, etc. are supported and expected to be expanded in the future. Further the ministry expect that chips, chutney, coconut oil, etc. be promising agro-products, thus agro-processing industry be promoted for demand at home and abroad.

4. Influence of Climate Change on Agriculture

- There are no serious damages at the present moment.
- Rainy season in Tonga is from March to June, while dry season is from July to February. During the dry season, drought period is longer than in previous year. Therefore, growth of root crops is depressed.
- Powdery mildew of taro occurs frequently during the drought season.
- There are some reports on land erosion as well as land corruption caused by rising sea levels in some outer island such as Haapai and Vavau islands.

- Damages on farm lands, crops, relevant facilities have been occurred by high waves, salt water, strong wind, which are caused by cyclones, every two years.
- Damages by deep water and salt water intrusion are found partly in lower land. It is hard to identify damaged area.
- It is necessary to promote agro-forestry for mitigation of damage by climate change as well as forest conservation. Approach of mixed cropping should be considered, thus coconut, pine tree, fruit tree (citrus, mango, etc.), vegetables, etc. except taro, yam, and cassava should be applied.
- Shifting from mono-cropping to mixed cropping
- Promotion of cultivation and export of sandalwood

5. Land Issue

- Farm lands are developed for housing lots by urbanization

6. Mitigation Measures and Adaptation Measures

- Ministry of Natural Resources and Environment has prepared mitigation and adaptation plans. Mitigation plans will be finalized by June this year, while September for adaptation plans. It is expected that mitigation plans cover four fields (agriculture, forestry, energy, and waste, while adaptation plans for six fields such as forestry, fishery, water resources, health, and disaster risk management.

7. Supporting from Donors

- EU（STABEX）is supporting export promotion, while FAO/RPFS as well as SPC are supporting livestock activity and research / extension, respectively.
- Local demand of agricultural commodities in Tonga is limited, therefore it is required to strengthen market infrastructure and system aiming at promotion of export. Currently trial operation of inspection facilities for agricultural products, cold storage, HTFA facilities, etc. have been carried out. Papaya, breadfruits, egg plant, chilly, etc. are targeted crops.

(2) Tonga Interview Survey on NAPA

Date：April 1 and 6, 2009

Interviewee：Luisa Tuiafitu Malolo、Project Coordinator, Climatic Change Project, Ministry of Lands, Survey, Natural Resources, and Environment）

1. Basic Information

- Ministry of Natural Resources and Environment has prepared mitigation and adaptation plans. Mitigation plans will be finalized by June this year, while September for adaptation plans. It is expected that mitigation plans cover four fields (agriculture, forestry, energy, and waste, while adaptation plans for six fields such as forestry, fishery, water resources, health, and disaster risk management.

2. Climate Change and Its Damage

Damage by Climate Change

- There are some reports on land erosion as well as land corruption caused by rising sea levels in some outer island such as Haapai and Vavau islands.
- Damages on farm lands, crops, relevant facilities have been occurred by high waves, salt water, strong wind, which are caused by cyclones, every two years.
- Damages by deep water and salt water intrusion are found partly in lower land. It is hard to identify damaged area.

Influence of Climate Change on Agriculture

- Rainy season in Tonga is from March to June, while dry season is from July to February. During the dry season, drought period is longer than in previous year. Therefore, growth of root crops is depressed.
- Powdery mildew of taro occur frequently during the drought season.
- It is necessary to make influence of climate change as well as damage known to farmers. Further government officer should recognize damage by climate change.

3. Needs for Adaptation Measures

- Selection and breeding of varieties, which are tolerant to pests and disease as well as high temperature, have been conducted.
- Verification trial on soil improvement has been carried out.
- Regarding gene resources, the Ministry send gene information of coconut and taro.
- GTZ has carried out project (promotion of agro-forestry) regarding climate change for four years since 2009. As of May, Inception Report has been prepared.

Supported Institute

- AusAID、EU、SPC、FAO、GTZ, etc.

(3) Tonga Result of Questionnaire Survey on Farmers

Study team could not arrange interview to farmers due to circumstances beyond our control. However, the team obtained some information on farmers' situation from relevant institutes or offices as follows:

1. Socio-economic background

- Major farmers are keeping subsistence farming. Non-farm income is important for common farmers.
- Remittance from abroad is included in non-farm income. It is fair amount of remittance.
- Statistic data on agro-economy is not available in Tonga.
- Local demands of agricultural produces are limited. Therefore it is necessary to consider the promotion of export for increase of farm income.

2. Current agricultural situation

- In individual farmer, taro, yam, coconut, breadfruits, legumes, banana, vegetables, etc. are cultivated. Regarding taro cultivation, it is common to cultivate several varieties of taro in farmer's field, in order to avoid any damage of disease or pest.
- Concept of agro-forestry has been disseminated.
- Major vegetables are cabbage, egg plant, tomato, legumes, etc.
- Average holding size of farm lands by farmers is counted for 4 to 5 acres.
- Out of total farmers, 85% of farmers cultivate crops without any kinds of fertilizer. It means that farmers can get enough production of root crops without fertilizer, while Tongan people prefer root crops without fertilizer, because they prefer root crops without application of fertilizer. Samoa and Kiribati have similar preference conformation.
- Regarding agro-chemicals, 80% of farmers cultivate crops without any kinds of agro-chemicals. Recently powdery mildew has been a serious problem. Regarding its countermeasure, variety selection is more important measure rather than application of agri-chemicals.
- Regarding root crops, it is common that farmers multiply their own seeds by themselves. Meanwhile they purchase quality seeds of cabbage, qing geng cai, cucumber, watermelon, radish, carrot, egg plant, etc. from shops.

(1) Samoa Result of Questionnaire Survey to Ministry of Agriculture and Fisheries

Date：April 8 to 17, 2009 (as needed)

Interviewee：Asuao Kiriy Pouono (Chief Executive Officer), Frank Fong (Acting CEO for Planning), Seumalo Afele Faiilagi (Acting CEO for Crops)

1. Basic Information

- Agricultural basic information is obtained from Agricultural Census 2005. Statistics on production is not available.

2. Agricultural Relevant Information

Policy

- Annual Corporate Plan is prepared based on the Strategy for the Development of Samoa 2008 to 2012, which is formulated through Samoa-Australia Partnership for Development

Environment issue

- Ministry of Natural Resources and Environment has formulated some adaptation measures against climate change. Regarding agricultural issue, the ministry has plans to carry out some implementations from viewpoint of sustainable agriculture and food security, financed from GEF/UNDP. Implementation is planned to start from May 2009. Finance is arranged two million Tala (0.7 million USD), including early warning system and climate healthy program.
- Forestry Division of Ministry of Natural Resources and Environment will launch new project, which applies the concept of agro-forestry, from the year of 2009, instead of community forest program, which is technically and financially supported by GEF/FAO. Project site might be in Savaii island.

Land issue

- Proportion of national forest in forest resources in Samoa is counted for around 15%, while the balance is categorized as community forest, and managed by rural community. However there are no legal restriction, and thus deforestation is serious problem.

3. Production, Extension, and Farmers' Association

Agricultural Production

- Export of coconut oil (copra) is previously active, however recent export has decreased sharply. The ministry has supported production of taro, coconut oil (virgin coconut oil), NONU juice, etc., in order to promote export of agricultural produce.
- Trial operation of HTFA (Hot Temperature Force Air) for extirpation of fruit flies has been carried out, in order to promote stable export of fruits and vegetables. The facility is established in Atele Horticulture Centre. There are test farms for rambutan, mango, jackfruit, sawasap, mangostine, papaya, etc. New facility for HTFA is planned to be constructed for commercial operation with HTFA from next year.
- Most of vegetables for local demand is dependent on import. Therefore it is planned to promote vegetable cultivation for improvement of livelihood and promotion of import substitute.
- Verification trial of vegetable could be operated based on Chinese technical support, regarding promotion of vegetable cultivation,

Farm inputs (seed, fertilizer, agrochemicals)

- Farm inputs such as seeds are imported from New Zealand and Australia.
- Fertilizer and agro-chemicals are practically not applied.

Soil conservation

- It is not so serious, but there are some land erosion on the coast line

Livestock

- There are a lot of consumption of sheep meat. Sheep was introduced from Fiji, and has been propagated.
- In Samoa, there are no abattoir and quality standard for meat.

Extension and Farmers' Association

- High degree of professionalism is required to extension officers. So far all extension officers are deployed in central office. However they are strongly requested to cover general agriculture, in order to contribute to agricultural development in rural area.

Research

- Variety selection and multiplication for taro, yam, coconut, etc., which are major crops in Samoa
- Tolerance on disease/pest, high temperature, etc. are adopted for variety selection.
- Demonstrations considering agro-forestry, mixed cropping, permaculture, etc. have been implemented.
- Investigation on land suitability is necessary for improvement of agricultural activities due to climate change, however not yet done.
- Trial for mushroom cultivation as new crop has been conducted, based on the technical association from Japan.

4. Damage to Agriculture due to Climate Change

- There are no serious reports on damage due to climate change presently.
- There are no serious reports on land erosion or corruption owing to sea level rise.
- There are no serious reports on damage due to deep water or salt water intrusion.
- Taro industry in Samoa had destructive influence was damaged due to cyclone hitting in 1991 as well as large outbreak of Leaf Blight in 1993, resulting in serious damage of no products of Taro Niue, which is main variety in Samoa.
- Season with high temperature and drought during the period from July to November has been longer than in average year, due to change of rainfall pattern. As a result, there are water stress in taro cultivation.
- In Samoa there are no outbreak of *Powdery Mildew*, which is found occasionally in Tonga.

5. Adaptation Measures and Mitigation Measures

- Adaptation measures on early warning system and climate healthy program could be implemented in May 2009. 0.7 million USD is appropriated for implementation of those adaptation measures.

6. Support from Donors

- Supporing donors are AusAid, FAO, and SPC

(2) Samoa Result of Questionnaire Survey to Donor

I. Australian Agency for International Development (AusAID), Samoa

Date：April 7, 2009

Interviewee：Heather Dixon（2nd Secretary, Development Cooperation, AusAID）、Misileti Masoe-Satuala（Activity Manager, Development Cooperation, AusAID）

1. Basic Information

- Donor: Australian Agency for International Development (AusAID)
- Location: Australian High Commission, Beach Road, P.O.Box 704, Apia, Samoa

2. Activity

Policy

- Important sectors in Samoa are agricultural, fisheries and forestry. It supports research, capacity building and adoption of the results of previous research to underpin increases in household income and economic growth, and assist with the reduction of unemployment and improvement in food security.

Sector for activity

- Program will focus on identification and management of constraints to productivity in high-value crops, and identification and development of new high-value horticultural crops (fruits, vegetables and ornamentals) for domestic and inter-island markets.

Current project

- Improving value and marketability of coconut wood
- Integrated pest management in a sustainable production system for Brassica crops
- Evaluation of the impact of Dasheen mosaic virus on and other viruses on taro yield
- The potential for increasing the value of cocoa industries
- Draft Implementation Project (2008 – 2012) was formulated through Samoa-Australia Partnership for Development.

(3) Samoa Results of Questionnaire Survey to NGOs and Farmers' Association

Date: April 8, 2009 (Wednesday)
Interviewee: Dr. Walter Vermeulen

1. Basic Information

- Name: METI (Matuaileoo Environment Trust Inc.)
- Address: P.O. Box 1878, Apia, Samoa
- Representative: Walter Vermeulen、Executive Director
- Staffing: 16 person
- Establishment: September 2000

2. Activities

Objectives

- To undertake, promote and carry out in Samoa to support sustainable development (Water quality control, Protection of marine resource, Development of forest resource, Conservation of biological diversity, etc.)
- To undertake and promote environmental management in health, and education
- To provide training of the necessary management skills and promote capacity building

On-going projects

- Samoa Sleep Clinic
- Second-chance Education (SCE) advocacy Project
- Life Skills Coach Training in Eleven Communities
- Village Life Skills Coach Trainer Training
- Life Skills Training of Year 12 Students
- Introductory Permaculture Design Course for Farmers
- Community Coral Reef Management Training
- Coral Gardens Project
- METI's Coconut Oil and Byproducts Project
- Bamboo Crop Development Project
- Integration of Mushroom Growing & Chicken Rearing Project

Subjects to be considered

- Linkage among NGO
- Expansion of beneficiaries

3. Coordination with Donors and NGO

- SPC、AusAID、GEF, etc.

Date: April 9, 2009 (Thursday)
Interviewee：Karen Mapusua

1. Basic Information

- Name： Women in Business Development Inc.
- Address：P.O.Box 6591, Apia, Samoa
- Representative： Margaret Malua
- Staffing：17person
- Establishment：1991

2. Activities
Objectives

- WIBDI are committed to poverty alleviation and sustainable development of the rural villages, utilising the products of their environment to generate an income, and thus establishing and sustaining a rural village economy that is no longer fully dependent on remittances.

On-going projects

- Microfinance and small business training
- Skills training, for example, handicraft, printing, etc.
- Organic certification of farms to international standards
- Virgin coconut oil (VCO) production
- Fair trade labeling
- Niche market linkages for VCO, bananas, coffee, vanilla, etc.
- Facilitating export to international markets
- Disaster mitigation
- Regional outreach throughout the Pacific region

3. Coordination with Donors and NGO

- National Association of Sustainable Australia, SPC, etc.

Date: April 14, 2009 (Tuesday)
Interviewee: Jeff Atoa

1. Basic Information

- Name：Samoa Crops Co-operation Association for Export
- Address：P.O.Box 35, Apia, Samoa
- Representative： Jeff Atoa, Secretary
- Members：around 150 farmers (Holding size: 1 to 100 acres, 95% of farmers: Full-time farmers)
- Establishment：2002

2. Activities
Objectives

- Market development

- Research work and farmers' training
- Good activities within the fruit, vegetable and various other crops and processed products in the export sector

On-going activities

- Encouragement of farmers to grow and produce their own vegetables and fruits through proper seed selection, care and management and harvest and post harvest management
- Production and selling of seedlings
- Improvement of farming practices in vegetable and fruit production (composting, soil fertility improvements, rotation cropping, water management and planting techniques).
- Improvement of post harvest and processing technologies

Constraints

- Season with high temperature and drought has been shifted and longer than in average year, due to change of rainfall pattern. As a result, there are water stress and damages to crop growth.
- Incentive to become engaged in agriculture has been reduced.

(1) Kiribati Result of Questionnaire Survey to Ministry of Environment, Land, and Agricultural Development

Date：April 21 to 23, 2009
Interviewee： Kinaai Kairo (Director for agriculture and Livestock Division)

1. Basic Information

・ Population census 2005 is available as agricultural statistics. There are no other statistical informations.

2. Agricultural Relevant Information

Policy

・ MOP（Ministerial Operation Plan）2009 is available. Further annual report is prepared as conclusion of monitoring and evaluation.

Environment issue

・ Environment division of the ministry has carried out various activities based on NAPA. Regarding activities in agricultural sector, protection of island bio-diversity is a priority issue, particularly encouragement and promotion of production of staple food crops, traditional crops, and herbal medicinal crops are most important points.

Land issue

・ There are no serious constraints.

3. Production, Extension, and Farmers' Association

Seed・Fertilizer・Agro-chemicals

・ Seedlings of banana, which are propagated in tissue culture, various kinds of fruits, etc. are imported under technical cooperation of SPC.

・ Fertilizer and agro-chemicals are hardly applied.

Soil conservation

・ Afforestation of mangrove has been carried out against soil erosion on the coast line.

Livestock

・ Common livestock in Kiribati is pig and poultry. Meanwhile almost all consumed amount of cattle is covered by import.

Extension and Farmers' Association

・ Extension officers are deployed in 24 islands. It is requested to increase number of extension officers, because there are staff to be retired in this year as well as contract-based staff.

4. Damage to Agriculture due to Climate Change

・ There are no serious damage.

5. Social Impact to Agriculture

・ There are no serious constraints.

6. Adaptation Measures and Mitigation Measures

・ As mentioned above, protection of island bio-diversity is a priority issue, particularly encouragement and promotion of production of staple food crops, traditional crops, and herbal medicinal crops are most important points.

7. Supporting Activity from Donors

- Major donors are SPC and FAO.
- Regarding soil analysis, water quality analysis, and plant quarantine, it is requested to SPC, Ministry of Agriculture in Fiji, and USP in Samoa, due to lack of equipment in the research station.

(2) Fiji Result of Questionnaire Survey to SPC

Date: April 24 to May 1, 2009
Interviewee: Aleki Sisifa (Director of Land Resources Division)、Dr. Mary Taylor (Coordinator, Genetic Resources)、Sidney Suma (Biosecurity & Trade Facilitation Advisor)、Timothy Martyn (Resource Economist)

1. Basic Information

- Institute: Land Resources Division (LRD), Secretariat of the Pacific Community（SPC）
- Location:
  Land Resources Division: Fiji
  （Marine Resources Division: New Caledonia）
  （Social Resources Division: New Caledonia）
- Telephone: +679-3370733, Fiji
- Staffing: around 350 persons（Whole SPC）
- Headquarters: New Caledonia
- Member countries: 22 Pacific Island countries and territories
  1. American Samoa,
  2. Cook Islands,
  3. Federated States of Micronesia (FSM),
  4. Fiji Islands,
  5. French Polynesia,
  6. Guam,
  7. Kiribati,
  8. Marshall Islands,
  9. Nauru,
  10. New Caledonia,
  11. Niue,
  12. Northern Mariana Islands (CNMI),
  13. Palau,
  14. Papua New Guinea (PNG),
  15. Pitcairn Islands,
  16. Samoa,
  17. Solomon Islands,
  18. Tokelau,
  19. Tonga,
  20. Tuvalu,
  21. Vanuatu,
  22. Wallis and Futuna.

2. Activities

Objectives

- Sustainable management of integrated agriculture and forestry systems
- Improved biosecurity and trade facilitation.

Activities

- LRD's integrated mode of operation is founded on seven thematic area teams and three support teams working together to identify and prioritise issues and find and jointly implement solutions.
- There are various projects, including Development of Sustainable Agriculture in the Pacific (DSAP), Plant Protection in the Pacific (PPP), Pacific Regional Influenza Pandemic Preparedness Project (PRIPPP), GTZ Pacific German Regional Forestry Programme (PGRFP), AusAID Forest and Trees Programme, South Pacific Regional Initiative on Genetic Resources (SPRIG), and others.
- SPC formulate development strategy for the whole region as well as each member country. These strategy is a subject to be approved by member countries. Each member country formulate their own country strategy, based on the SPC's strategy.

3. Activities to Climate Change

- GTZ has launched Pacific-German regional climate change project, aiming to build and strengthen the capacities of pacific member countries and regional organization, to adapt to and mitigate climate change. The project has been carried out with Land Resources Division, SPC and focused activities in three countries, Fiji, Vanuatu, and Tonga. The project has a 4-year duration since 2009.

4. Supporting Activity from Donors

- Major donor: Australia, EU, New Zealand, France, Taiwan, German, United States of America
- Major international institutes for LRD

  Australian Centre for International Agricultural Research — ACIAR
  Food and Agriculture Organization — FAO
  International Plant Genetic Resources Institute — IPGRI
  United Nations Development Programme — UNDP
- Major international institutes for Marine Resources Division

  Asian Development Bank — ADB
  Global Environment Facility — GEF
  International Maritime Organization — IMO
  MacArthur Foundation
  Packard Foundation
- Major international institutes for Social Resources Division

  Centers for Disease Control and Prevention (Atlanta) - CDC
  Commonwealth Secretariat
  The Global Fund to Fight AIDS, Tuberculosis and Malaria
  United Nations Educational, Scientific and Cultural Organization — UNESCO
  United Nations Population Fund — UNFPA
  World Health Organization— WHO

(3) Fiji Result of Questionnaire Survey to NGO

Date: April 29, 2009 (Tuesday)

Interviewee: Rex Horoi (Executive Director), Etika Rupeni (Regional Programme Manager), Fakavae Taomia (Regional Programme Manager), Roshni Chand (Regional Programme Manager)

1. Basic Infromation

- NGO: FSPI (Foundation of the Peoples of the South Pacific International)
- Location: P.O. Box 18006, Level 2, Office 2, Victoria Corner Building, Suva, Fiji Island
- Representative: Rex S. Horoi
- Staff: 14 persons (headquarters only)
- Establishment: 1965

2. Activities

Objectives

- Environment management and rural development (resource management, health, education, etc.)
- Capacity buidling

On-going project

- Several projects have been implemented in the following nine countries. There are member NGO in each country, which manage implementation of the projects.
  - (1) PNG: FPCD (Foundation of Peoples and Community Development Inc.)
  - (2) Solomon: SIDT (Solomon Islands Development Trust)
  - (3) Tuvalu: TANGO(Tuvalu Association of NGO's)
  - (4) Kiribati: FSP Kiribati
  - (5) Vanuatu: FSP Vanuatu
  - (6) Fiji: Partners in Community Development Fiji
  - (7) Samoa: OLSSI(O Le Siosiomaga Society Inc.)
  - (8) Tonga: TCDT(Tonga Community Development Trust)
  - (9) East Timor: Timor Aid

Subjects to be considerd

- Coordination among NGOs and government concerned
- Expansion of beneficiaries

3. Coordination with Donors and NGO

- EU、DFID、Darwin Institute、IUCN、nzaid、ADB、Canada Fund、SPREP、AFAP、AFD