6 ÈME FORUM MONDIAL DE L'EAU

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Climate Change Adaptation for Irrigation and Drainage in Asia

Mr. Shinsuke Ota

Chairman of ARTF-CC
(Asian Regional Task Force on Climate Change)

Vice-President Hon of ICID
(International Commission on Irrigation and Drainage)

JN-CID

MARSEILLE, FRANCE '12

LE TEMPS DES SOLUTIONS

ICID·CIID

Who am I ?

FAO Land and Water Inventory

UNESCO IWRM Guidelines

Task Force on Climate Change in ICID

Policy-making

Measures to conserve and enhance farmland, water and environment

National Irrigation and Drainage Promotion Plan

Planning Standard of Land Reclamation

International

Domestic

M/P & F/S of IWRM projects and Agricultural cooperation projects by JICA

Project-implementation

Administration of Japan Water Agency

Seino Irrigation (head works and canal) Project

Chusei Irrigation (dam and canal) Project

What is ICID?

The International Commission on Irrigation and Drainage

ICID was established in 1950 as a Scientific, Technical and Voluntary Not-for-profit Non-Governmental International Organization (NGO), now consisting of 110 member countries.

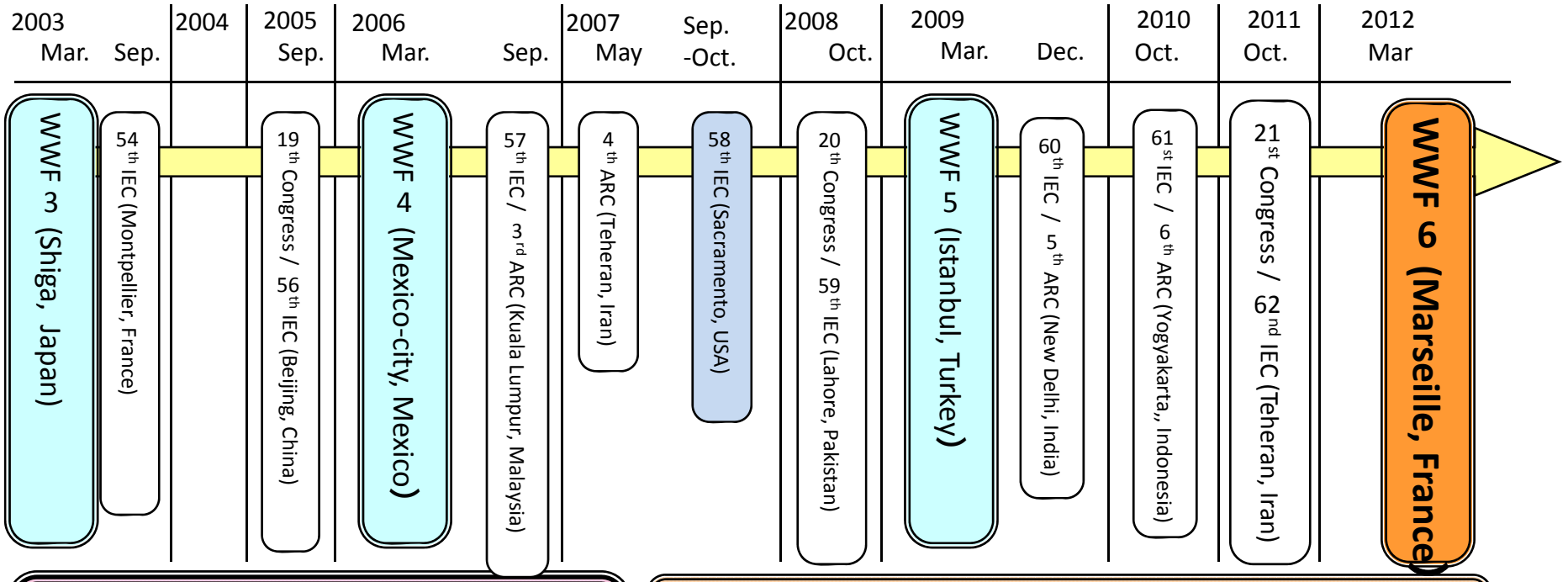
ICID is dedicated to enhancing the worldwide supply of food and fibre for all people by improving water and land management and the productivity of irrigated and drained lands through appropriate management of water, environment and application of irrigation, drainage and flood management techniques.

Objects & Activities of ICID

The Mission is to stimulate and promote the development and application of the arts, sciences and techniques of engineering, agriculture, economics, ecological and social sciences in managing water and land resources for irrigation, drainage, flood management and river training applications, including research and development and capacity building for achieving sustainable irrigated agriculture.

Scientists and engineers work together to fulfill the mission through holding various meetings, publishing books, and actively contributing to the success of conferences such as WWF6.

ASRWG Activities to date and in future

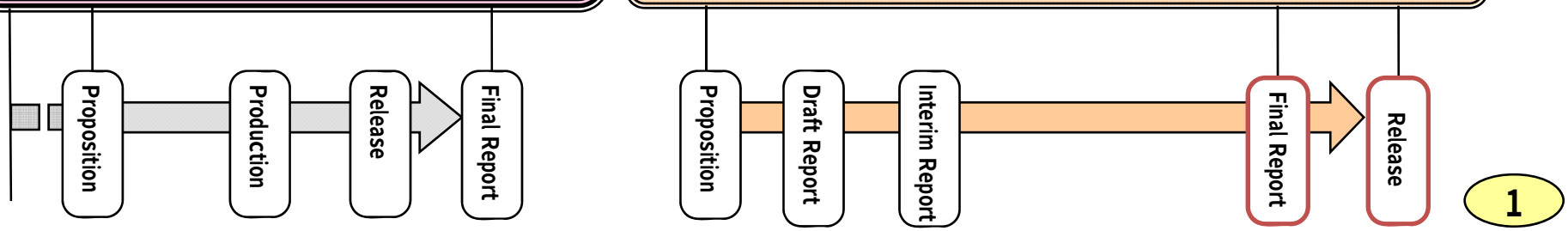


Multiple roles Diversity of irrigation water (2003-2007);

"Multiple roles Diversity of irrigation water" was started in ASRWG at 2003 and the results of these deliberations were summarized as the suggestion presented as WWF4 (Mexico in 2006).

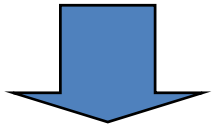
A Strategy for Irrigation and Drainage adapted to Climate Change in Asia (2007-2012);

As the next work in ASRWG, "A Strategy for Irrigation and Drainage adapted to Climate Change in Asia" was decided to start based on ARTF-CC in ASRWG at Sacramento in 2007.
The result of this deliberations will be presented at WWF6 (France in 2012)



Goal of ARTF-CC

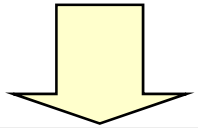
ARTF-CC reviews country-wise information and extracts practical lessons from various cases



Goal of ARTF-CC

ARTF-CC prepares the concise report consisting of country-wise information and extracted lessons, which will be really useful for government officials, researchers, practitioners and others tackling C.C.

Now completed

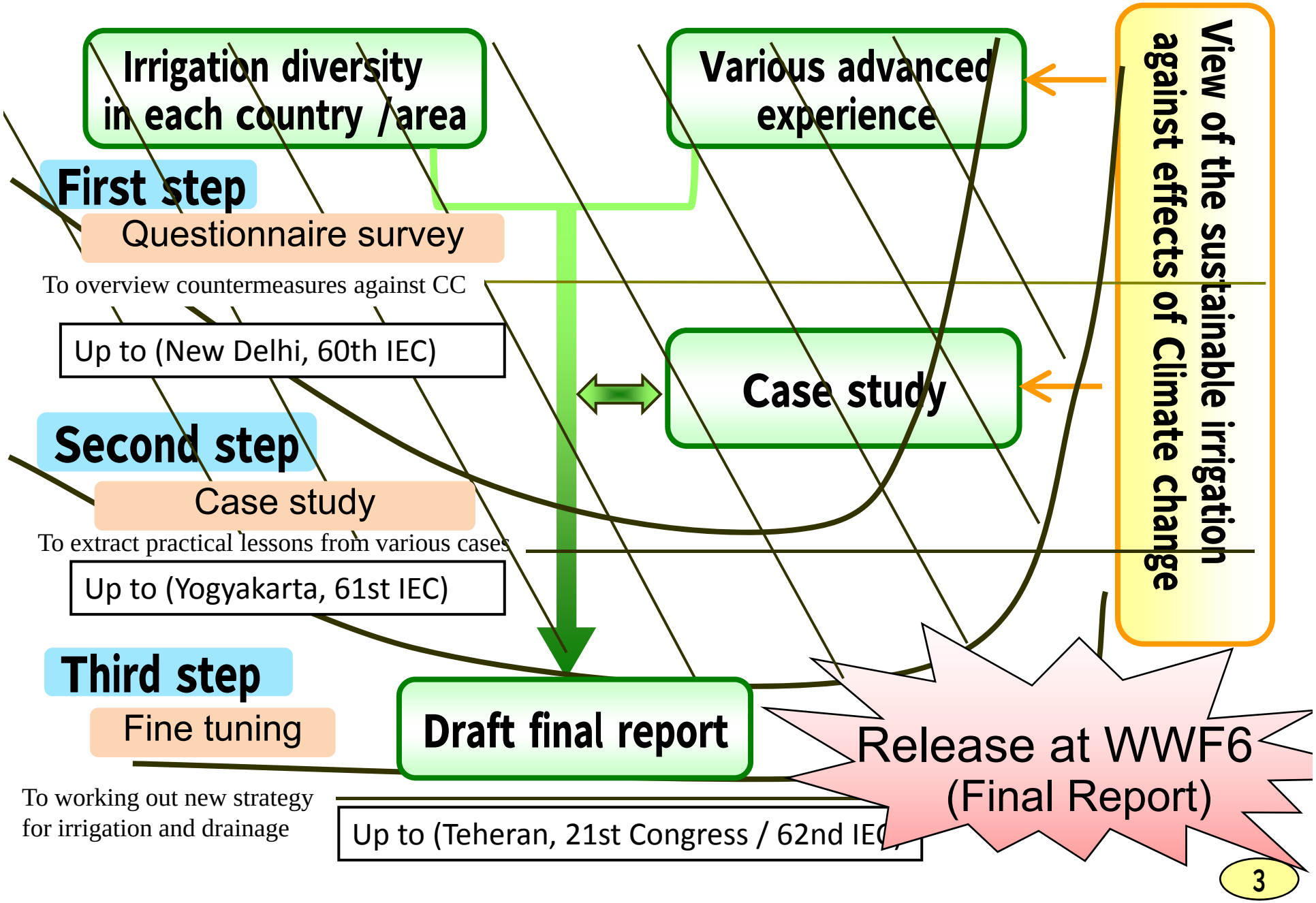


Ultimate Goal

The contents of the report are applied to formulate strategies and policies in various countries, which will contribute to mitigate & adapt to C.C.

Expected to be utilized

Work plan of ARTF-CC



Principles of the study

- To focus on climatic condition and irrigation/ drainage status of each country.
- To have a wider view covering governance, peoples' recognition & social movement and local practices in addition to science & technology.
- To collect a variety of case studies taking geographical distribution into consideration
- To extract keys for success really useful to find out appropriate countermeasures.

Contents of the Final Report

1. Introduction
2. Questionnaire survey — 1st step
   - 2-1. Survey method
   - 2-2. Analysis of filled-out questionnaires
3. Case study — 2nd step
   - 3-1. Case study format
   - 3-2. Analysis of the collected case studies
4. How to make use of the study result
5. Conclusion

1st step Contents of the Questionnaire

Q1：Basic data regarding irrigated agriculture

ex. average precipitation, agricultural area

Q2：Existing policies regarding irrigation, drainage and flood control

ex. source development and establishment of facilities (with grading their importance)

Q3：General recognition and assessment of the effects of climate change

ex. media coverage, government session, governmental organizations

Q4：Examples of the effects that seem to be caused by climate change

Q5：National strategy or the basic direction for measures to cope with climate change

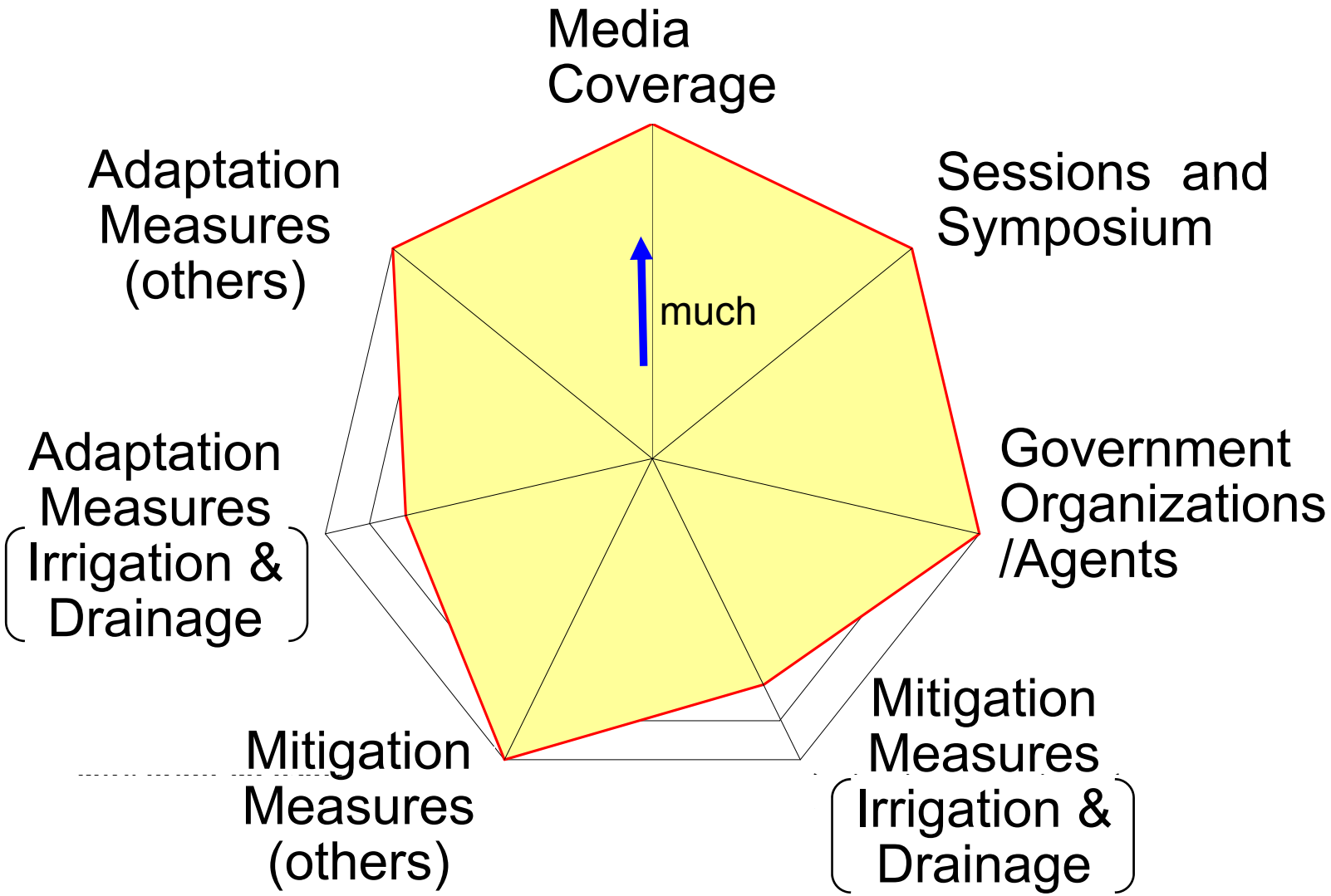
ex. mitigation or adaptation measures for climate change and other fields

Q6：Studies and research results concerning climate change

Q7：Other comments

1st step

Radar chart of results : Q3 and Q4

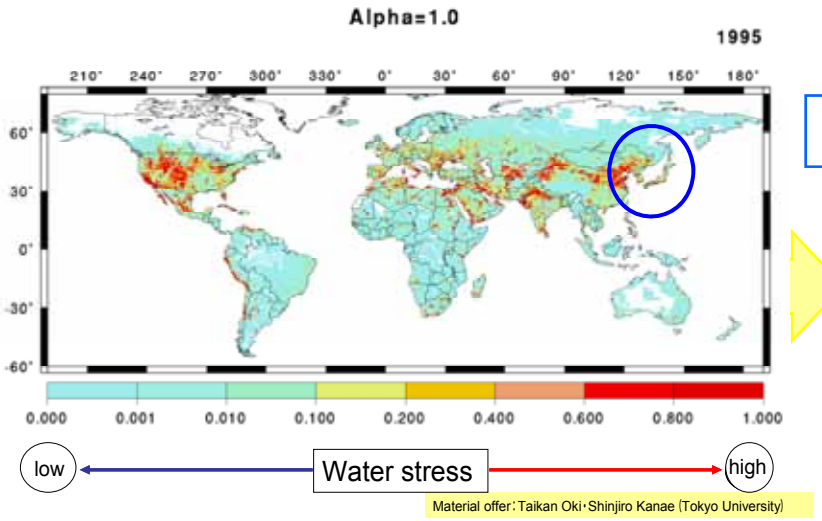


The method of evaluation about Water Stress Rate obtained by Water Stress Index

1st step

The variances exist in the water stress distribution in each country.

So, further classification is done according to the size of the distribution.



Simple Japan model

Japan has not only Red zone (high stress)
but also much Blue zone (low stress).

But

The maximum value of the water stress index is also a overt stress that Japan holds in fact.

So

Cannot assess the stress by simple average method.

Water Stress Rate

Rating by considering area factor

So

High

Middle

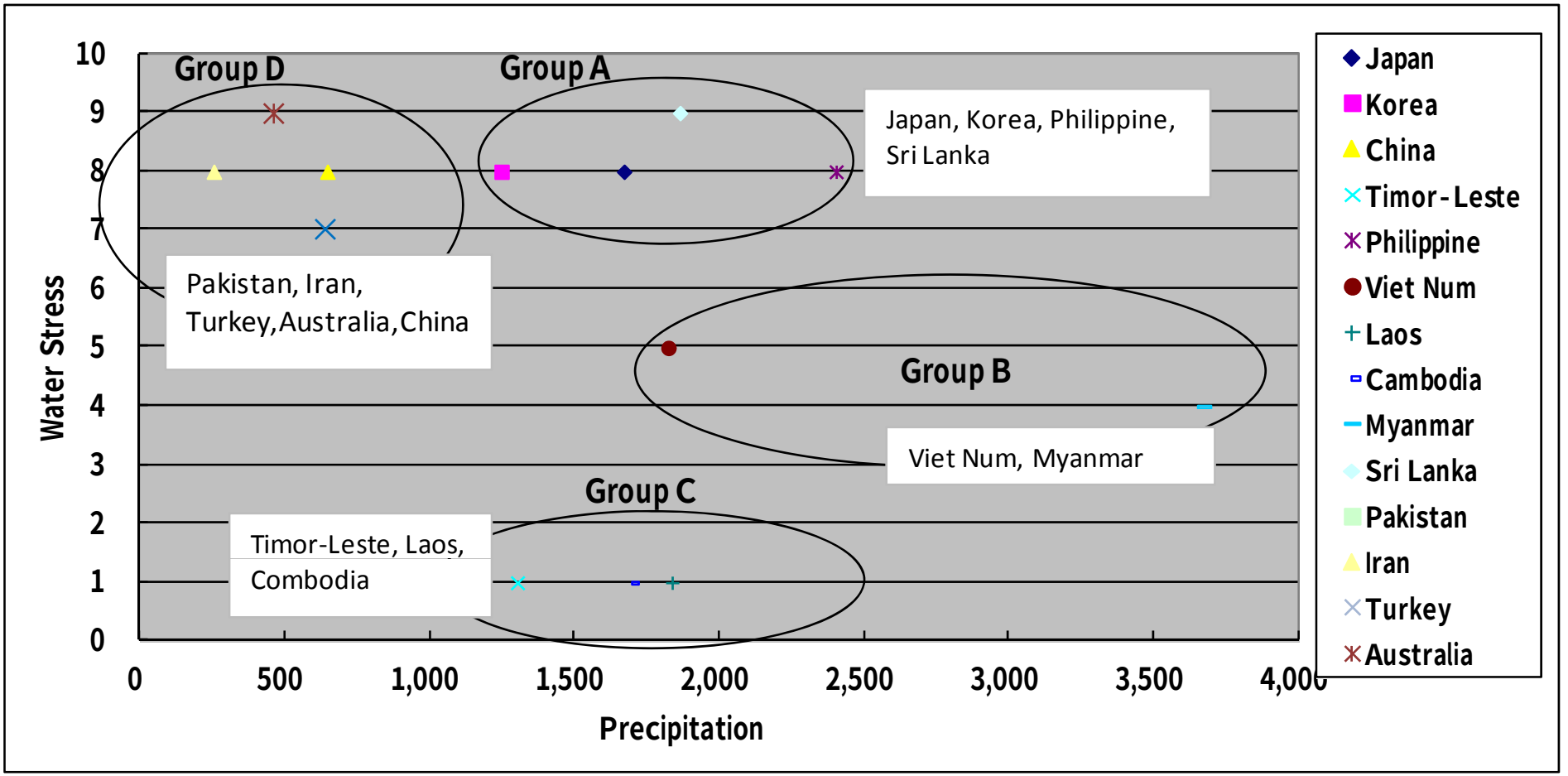
Low

9 Large Area (Red)
8
7
6
5
4
3
2
1 Small Area

1st step

The Current Water Policies of ASRWG Countries

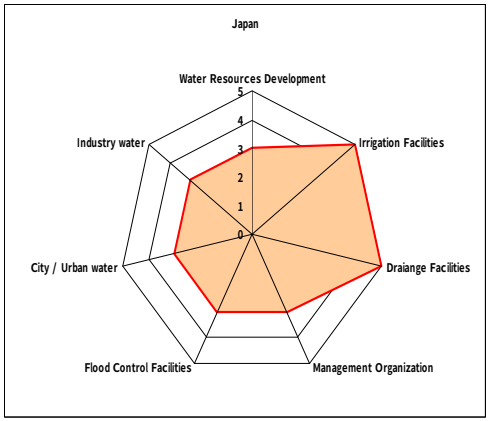
Categorized by Precipitation & Water Stress Rate



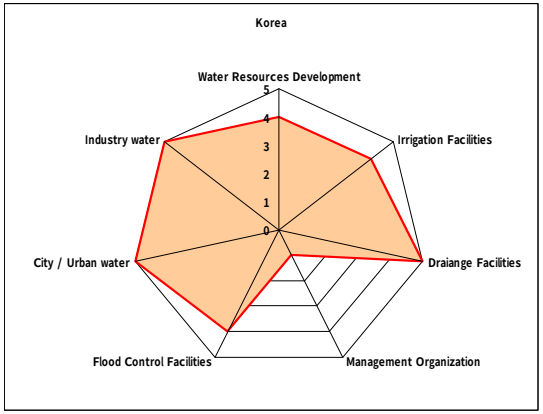
1st step

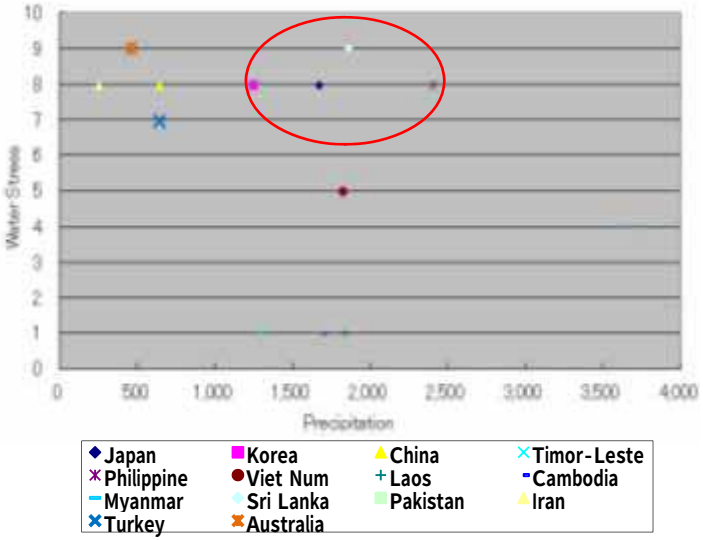
The Current Policies - Group A Countries

Japan



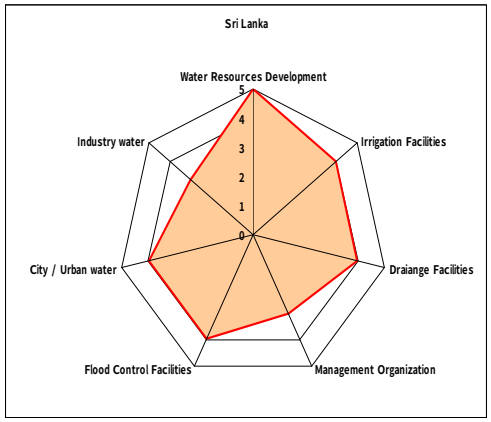
Korea



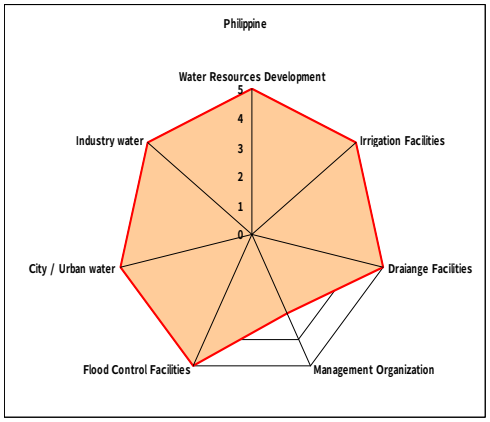


The Current Water Sector Condition

Sri Lanka



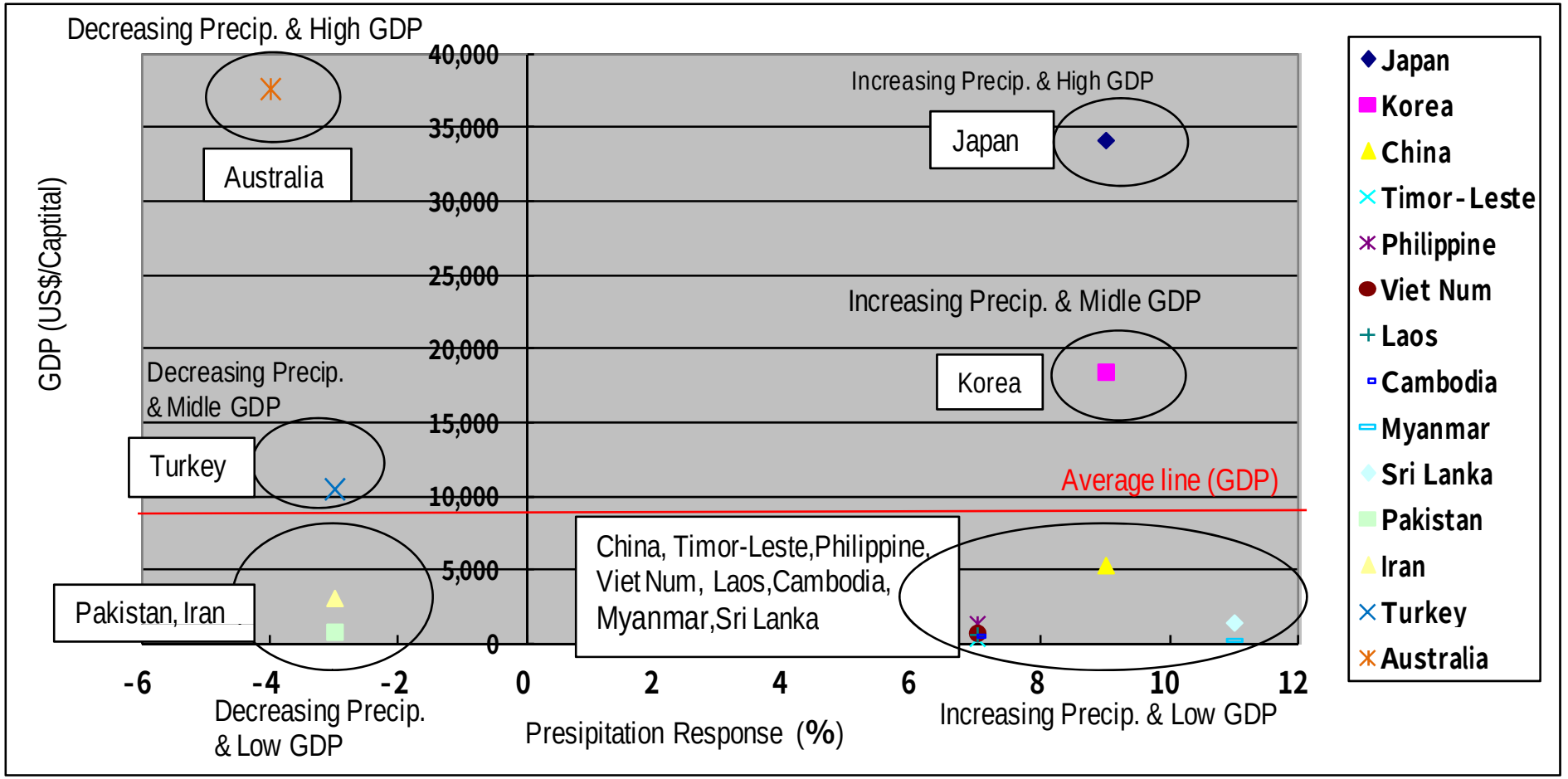
Philippines



1st step

Relation between GDP and Water Stress Rate

For Future Discussion About Counter & Adoption Measures on CC in ASRWG Countries



Case Study Format

2nd step

Case Study Format

Lessons from actual case

-Focused on sustainable agriculture and irrigation and drainage-

Group of Case Studies : **(please check one)**	☐"Science& Technology" ☐"Peoples Recognition or Social Movement" ☐"Governance" ☐"Local Practices" ☐"Others"
Field of Case Studies : **(please check one)**	(If you check "Science& Technology" in the Group) ☐"Strategy" ☐" Investigation" ☐"Research" ☐"Analysis"

II. Keys for Success

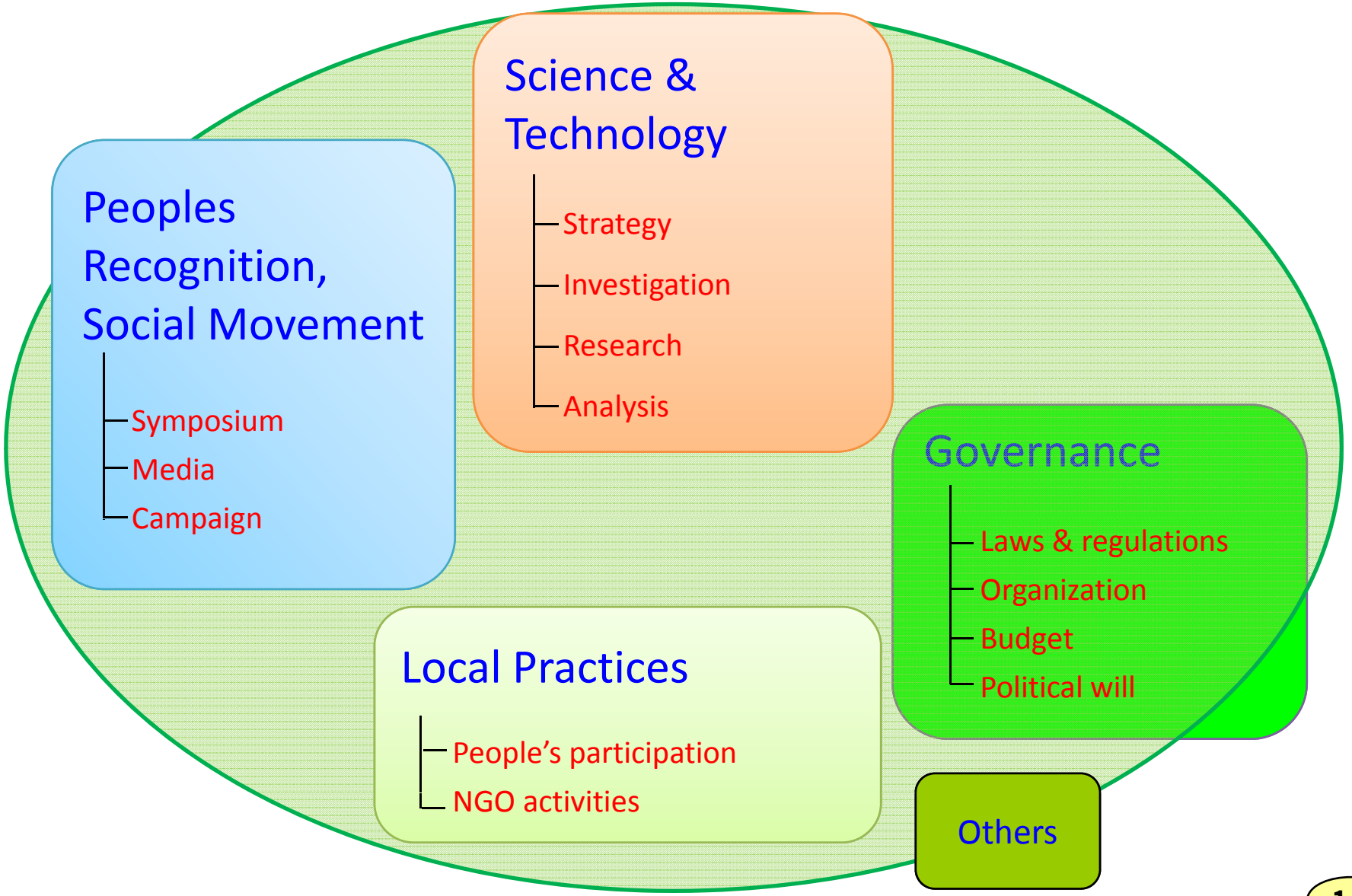
Experienced problem → How to overcome

I. Outline o

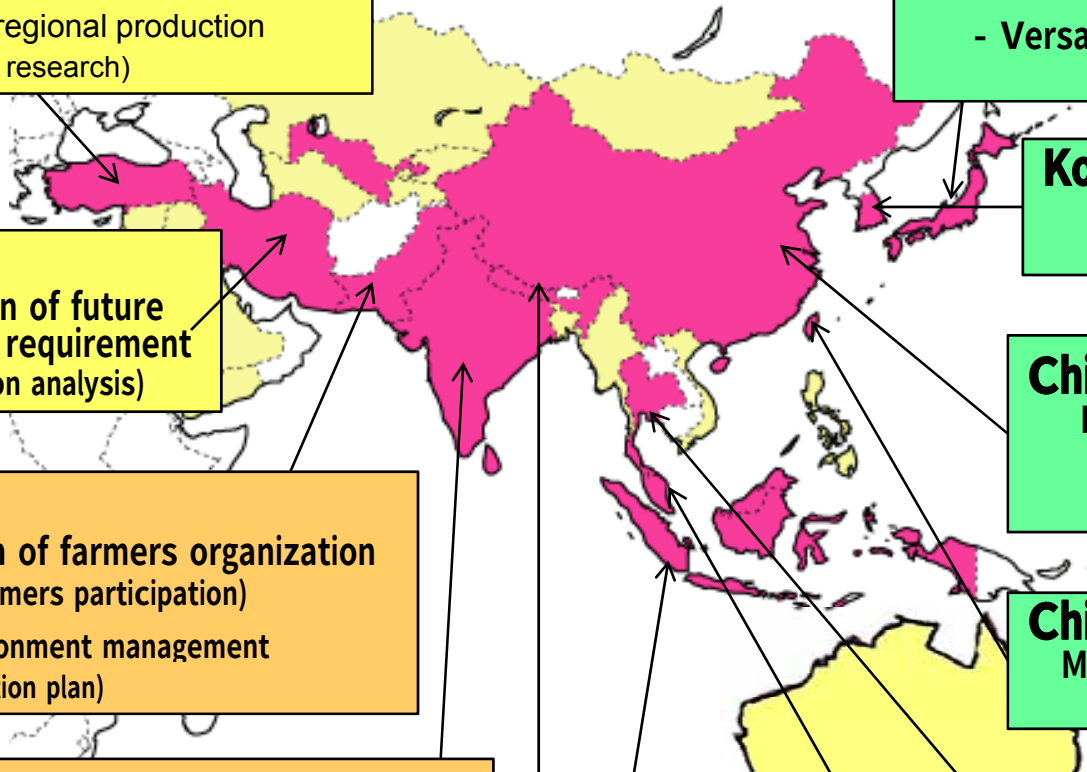
Title of Ca	
Implement	
Operating	
Active ter	
Contact pe	
Backgrou	
Purpose and Goal : Goal : Step 1 : , Step 2 : ,Step 3 : ・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・	
Present situation :	
Effect and Result :	

2nd step

Groups and Fields of Case Studies



Countries that sent Case Study



Turkey
- Public awareness
(Government campaign)
- Impact to regional production
(On-site research)

Japan
- Integrated program with priorities
(Research strategy)
- Versatile basin model development
(Simulation analysis)

Korea
Revision of design criterion
(Risk management)

Iran
Estimation of future crop water requirement
(Simulation analysis)

China
Readjustment of groundwater management
(Strategic research)

Pakistan
- Formation of farmers organization
(Farmers participation)
- Water environment management
(Action plan)

Chinese Taipei
Multi-functionality of paddy fields
(Public awareness)

India
Demonstrations of effective technologies
(Administrative campaign)

Thailand
Farmland as retained basins
(Win-win strategy)

Nepal
Formation of database
(Basin survey)

Indonesia
Establishment of systematic networks
(Strategic research)

Malaysia
Development of adaptation guideline
(Public involvement)

2nd step

Case Study Format (IRAN) - summary

Title: Climate change impacts on irrigation water requirement
- A case study in Zayandeh Rud Irrigation Scheme –

Group: Science &Technology **Field:** Analysis

I. Outline of the activity

Background: One of the most climate change impacts on agriculture is its effects on water requirement of agricultural crops. This impact should be taken into account in preparation of IWRM which is under development for water basins in Iran. Where, the sustainable water allocation to each sector will have to be determined.
Encouraged by the results of the preceding researches, and in line with the Iran's National Climate Change Policy , the Ministry of Energy of Iran took initiative to conduct researches to study impacts of climate change on water resources and agricultural water use and mitigation measures to cope with them for the reasonable agricultural water allocation in future. Where the Ministries of Energy and the Ministry of Agricultural Jihad are responsible for water supply and agricultural water use respectively.

Purpose and Goal:
Goal: To propose possible adaptation measures to deal with impacts of climate change on agricultural water sector in future in Zayandeh Rud River Basin in future.
Step 1: To investigate rainfall and temperature changes in three time period :2010-39, 2040-2069 and 2070-99.along with different climate change scenario.
Step 2: To predict the impacts of climate change on flow of the river up to the year 2080 in Zayandeh Rud River Basin.
Step 3: To predict water requirement of four crops up to the year 2080 in the basin.
Step 4: To consider possible adaptation measures for crop production.

Example of Filled-out Case Study Format (Iran)

2nd step

II. Keys for Success

i) Application of proper methodology

Experienced problem →How to overcome

○ In order to find out probable crop water requirement, possible risks should be taken into consideration and simulation analysis using yearly data was considered insufficient judged from the nature of crop growth. We had to seek a proper methodology.

→ Due to the uncertainty in using the AOGCM (Intergovernmental Panel on Climate Change) models, where we should use the probability of occurrence in the estimated climatological parameters by AOGCM, we decided to use the risk analysis issue to calculate the predicted crop water requirement and also use long-term monthly climatological data instead of yearly ones.

Key points or requirements for success

Use of the risk analysis issue and monthly data is one of the outstanding of this research compare with the others. Where the climatological parameters (average temperature, evaporation and evapo-transpiration) for future period has been calculated with a 50 and 75 percent probability of occurrence.

ii) Application of proper methodology 2

iii) Dissemination to other country/region

III. Key findings from failure

2nd step

Case Study Format (Korea) - summary

Title: Design criteria for emergency spillway to cope with extreme flood in the irrigation dam

Group: Science &Technology **Field:** Strategy & Research

I. Outline of the activity

Background: The rainfall pattern is often disturbed by heavy storms mainly caused by typhoon. Actually, we experienced such a heavy storms mainly caused by the typhoon Rusa from Aug.4 to Sept.1 and serious flood damages like collapse of embankment and spillway occurred on earth-fill dams in 2002. On the 31st August, the amount of 24 hours rainfall reached 870.5mm (and 100.5mm/hr) which is corresponding to the level of Probable Maximum Precipitation (PMP) in Gang-reung area. This amount of 24 hours rainfall is 2.24 bigger than the present design criterion of 200 years frequency rainfall 388.4mm.
Such heavy storms and floods were considered as phenomena of climate change.
Most of people watching the drastic moment of 0.5m freeboard of embankment left on the TV in real time on Aug. 31, 2002 in the Sung-ju dam were so scared that social consensus on the government's strategy was formed, even though huge amount of financial budget is required.
Therefore, in 2002, Ministry of Agriculture, Forestry, and Fishery (MAFF) decided to established necessary countermeasures to cope with the dams safety.

Purpose and Goal:
Goal: To take necessary measures to irrigation dams in order to correspond to the extreme flood.

Example of Filled-out Case Study Format (Korea)

2nd step

Phase1: To define the design criterion for earth-fill irrigation dam to be safe from the extreme flood like flood event on 31st Aug. 2002 in Gang-reung area.
Step 1: To organize the special research committee.
Step 2: To review the situations of design criterion and its problems.
Step 3: To define new design criterion applicable to the emergency spillway.

Phase2: To apply the new design criterion to the existing and new irrigation dams in an appropriate manner.
Step1: To make engineers understand the new design criterion.
Step2: To select existing dams necessary for improvement according to the new criterion.
Step3: To improve the existing dams and to construct new dams according to the criterion.

II. Keys for Success

i) Initial design of activities

Experienced problem →How to overcome

○ The people took the event of collapse and damage of irrigation dams seriously. Therefore a government had to take the measures which do not cause dam collapsing.

→ MAFF came to the conclusion that revision of the design criterion is the basic and the most effective solution. The design criterion of PMF for dam crest and spillway was reinforced and approved by MAFF in 2003.

Key points or requirements for success

○ To ask advice from experts for revision of the design criterion and to keep transparency of the revision process, a committee was set up.

○ PMF(Probable Maximum Precipitation) was introduced to the irrigation reservoir instead of the design flood of 200 years frequency with storage capacity bigger than 5mil. m^3 and/or with watershed area larger than 2,500ha.

2nd step

ii) Dissemination

Experienced problem →How to overcome

○ Engineer should judge the design criterion to apply properly. Otherwise it is afraid that too much irrigation dam has the PMF capacity of spillway which is much higher than expected, in other words, over estimate and over design.
For this purpose, the new design criterion and its manual were, but only reading these written materials seemed not enough to lead proper judgment by engineers and officers.

→ The MAFF took various measures to supplement the information obtained from the written materials, which include meetings to explain the background/key points of the new criterion, workshops to apply the criterion to a virtual dam and organizing committee to give advice how to apply the criterion to a particular dam.

III. Key findings from failure

1. Safe but too expensive structure
2. Need to redefine the regulation from the view point of engineering economics.
3. No definition on the capacity of river bank in the up and down stream to be safe in case of such extreme flood.

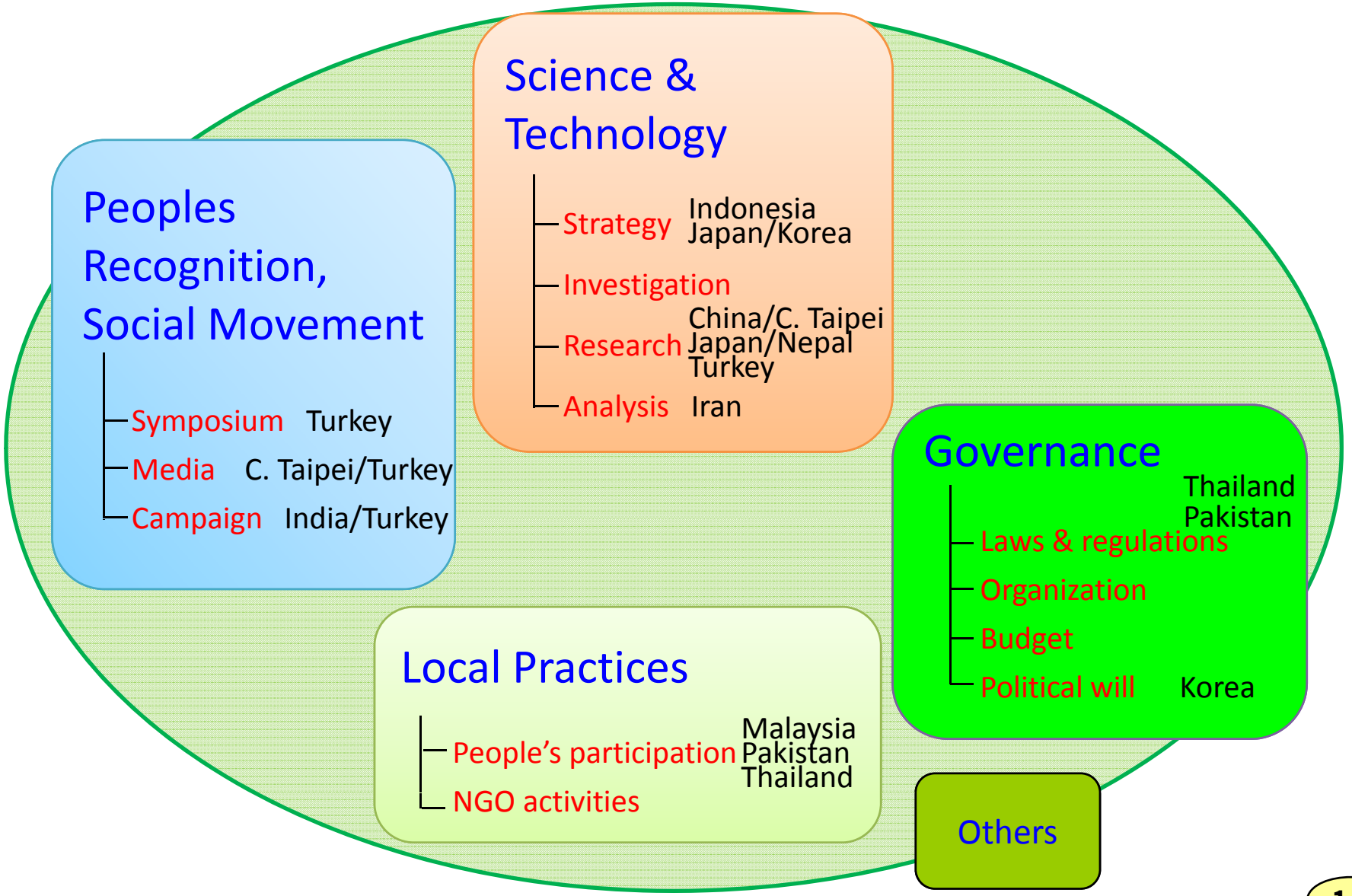
2nd step

List of Submitted Case Studies

Region	Country	Theme	Group	Field
Near East	Iran	Climate Change impacts on irrigation water requirement	Science & Technology	Analysis
	Turkey I	Increasing Public Awareness and Support for Climate Change	People's Recognition or Social Movement	Symposium, Media & Campaign
	Turkey II	Research of impact of Climate Change in Seyhan River in Turkey	Science & Technology	Research
Southt Asia	Nepal	Adaptation to Global Change in Agricultural Practices: A Case Study of Indrawati Basin	Science & Technology	Research
	Pakistan I	Lower Bari Doab Canal Improvement Project (LBDC)	Local Practices	People's participation
	Pakistan II	Water Sector Environmental Management Planning in Pakistan	Governance	Law & Regulation
	India	Farmers Participatory Action Research Programme (FPARP) – 1st Phase	People's Recognition or Social Movement	Campaign
Southeast Asia	Thailand	Study of Using Agricultural Land in the Chao Phraya Delta for Mitigating Flood caused by Climate Change.	Science & Technology	Strategy
	Malaysia	A Conceptual Framework for the Preparation of Guidelines for Climate Change Vulnerability and Adaptation Strategies	Local Practices	People's participation & NGO activities
	Indonesia	Impact of Climate Change on Water Availability Aspects In Java Island	Science & Technology	Strategy
East Asia	China	Managing Climate Change Effect on Groundwater through Monitoring Groundwater	Science & Technology	Research
	Chinese-Taipei	Study on Paddy Fields Multi-Functionality for Sustainable Environment and Climate Change in Taiwan (Chinese Taipei)	Science & Technology	Research
	Japan I	Formulation of strategy for enhancing research related to global environment established	Science & Technology	Strategy
	Japan II	Impact assessment of climate change on agriculture water use in Mekong River Basin and Seki River Basin	Science & Technology	Research
	Korea	Design criteria for emergency spillway to cope with extreme flood in the irrigation dam	Science & Technology	Strategy, Research

2nd step

Groups and Fields of Case Studies



2nd step

Grouping in view of novelty

Group 1:

The theme of the case has long been tackled with.

It has recently drawn attention in view of its importance to cope with climate change impacts.

(Chinese-Taipei, Indonesia, India, Pakistan-PIM)

Group 2:

The theme of the case has been recognized necessary to take action but has never been tackled with because of low priority.

It has recently been gotten down to as its importance has been recognized in order to cope with climate change impacts.

(China, Korea, Pakistan-EMS , Thailand)

Group 3:

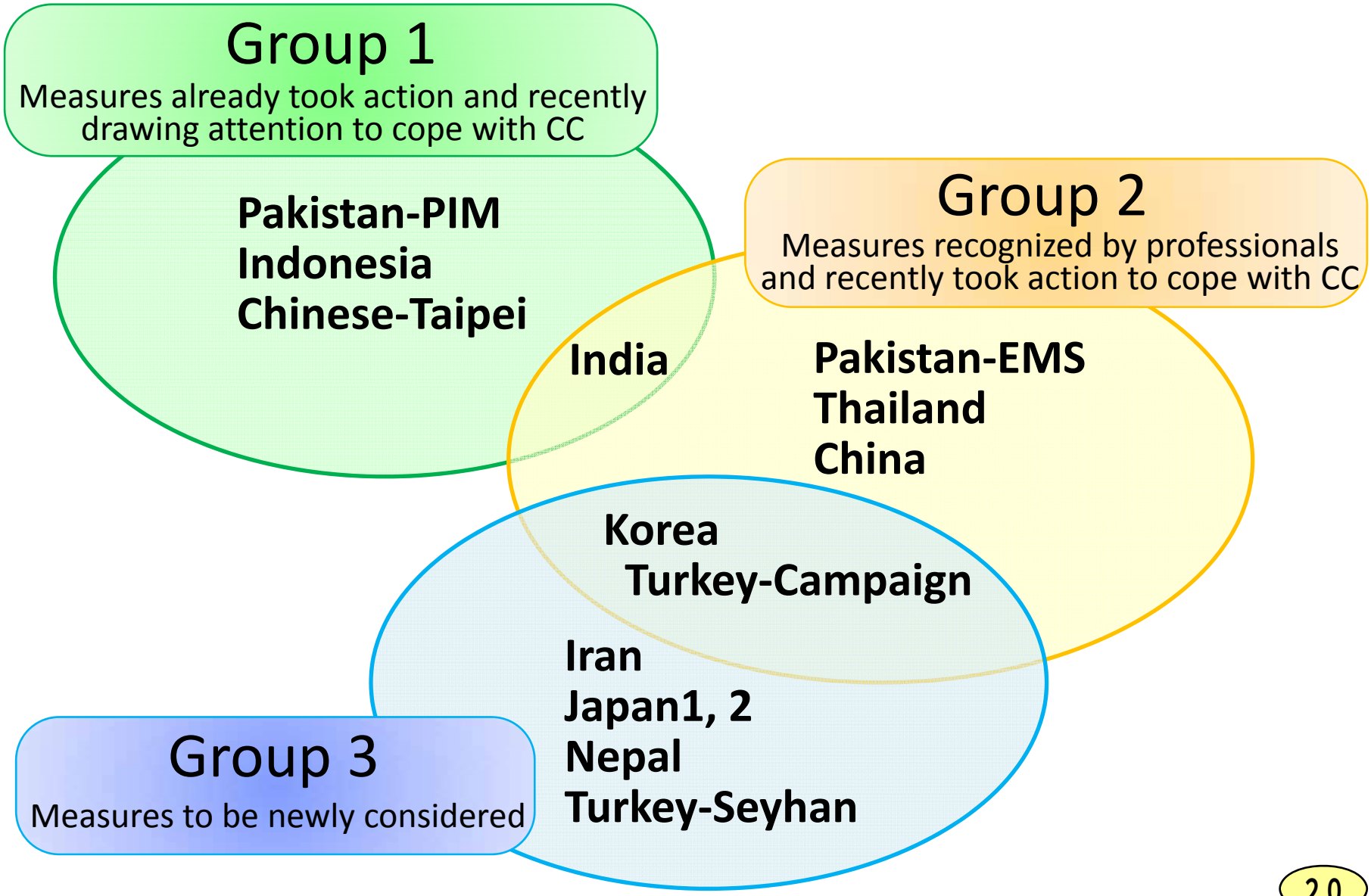
The theme of the case is newly recognized as caused by climate change.

It requires novel approach to solve.

(Japan I & II, Nepal, Iran, Turkey-Campaign, -Seyhan)

Three groups of case studies in view of novelty

2nd step



2nd step

Experienced problem and How the problem was solved

kfs	Experienced problem	How the problem was solved
NEAR EAST		
Iran-kfs1	Proper estimation methodlogy considering possible risks and using suitable data should be found out.	To use risk analysis issue and monthly data instead of yealy presipitation was decided.
Iran-kfs2	Use of old method would lead to overestimation of crop water requirement.	The recent findings in other regions should beconformed.
Iran-kfs3	Less effort and finance are allocated to theresearch on vulnerable agriculture sector in such regions as South Asia and South Africa.	ICID should commit to those vulnerable areas in collecting and disseminate relevant information.
Turkey I-kfs1	The activities of the various governmental and other organizations were dispersed.	"Cordination Board on Climate Change" was established by the Prime Ministerial Circular.
Turkey I-kfs2	The intencity of climate change effects had not been clarified and the relevant information had not reached to the people.	The central government took initiative to clarify the future effects and ammended the law for active dissemination thru. education and media.
Turkey I-kfs3	Most of the farmars was reluctant to use new irrigation techniques useful for climate change.	The responsible ministry has been implementing various dissemination activites with the help of media.
Turkey I-kfs4	Introduction of pressuried irrigation system was hindared due to economic and technical reasons.	The government prepared subsidiary system for farmars and technical guidance to engineers etc.
TurkeyII-kfs1	Necessary budget and support by the government organizations were not smoothly obtained.	The study leaders negotiated the relevant National Council for budget and organizational support.
TurkeyII-kfs2	Each researcher's concern was limited in his own field and this hindared cooperation among reserchers.	Various meetings with different scale and interval were organaized in order to share the project aim.
SOUTH ASIA		
India-kfs1	Lack of irrigation water was severe problem especially for poor people to be solved immediately.	Various programmes have been carried out by the government under the political leadership.
India-kfs2	Many water saving methods developed by the reserchers were not used by the farmers because they did not have occasions to see the reserch outcomes.	The government implement the project to demonstrate the technologies available and issued an application guidelines to openly call for reserchers' participation.
India-kfs3	Reserchers recognized the conditions of experimental and demonstration farm were quite different.	The reserchers modified their method to be easily used by the farmers.
India-kfs4	Reserchers need occasion to share the farmers' field experience in order to modify the methods.	The government organized a congress for the reserchers to grasp the actual farmers' field conditions.
Nepal-kfs1	It became clear the original reserch team size was too small and data collection site/template were unsuitable.	Reserch team was strengthened and data collection plan was readjusted.
Nepal-kfs2	This reserch with complex and multi-disciplinary nature of the reserch made the analysis difficult.	The data were collected by integrated approach employing all possible methods and cross verified.
Pakistan I-kfs1	Difficulties in formulating substantial FOs were felt in the absence of any guidelines and other materials.	Positive/negative checklists were provided to show success/failure factors for formation of FOs.
Pakistan I-kfs2	Applying formal approach had some limitations especially in the case of election of FO management committee.	The formal and informal interaction process was introduced to make socially acceptable FO committee.
Pakistan I-kfs3	Newly organized FO members did neither shared practical objectives nor incentives at the initial stage.	Small scale projects were provided for the new FOs in order to increase the whole members' participation.
PakistanII-kfs1	In preparating Water Sector EMP, persistent weakness in Govent.'s technical/ logistical capability was recognized with people's low initiative for environmental awareness.	The local governments provided activities for environ-mental awareness in the rural area through education, media, community involvement, NGOs' activities, etc.
PakistanII-kfs2	The effective EMP implementation could only be done with a strong commitment from the relevant authorities.	Two Provinces established a special unit for EMP and the four-leveled institutional framework are functioning.
PakistanII-kfs3	A commitment from the federal government and cooperation among Indus River Basin Provinces are limited for implementation of EMP.	The federal government could prepare a platform on which the Units established c... communicate each other thru. Web.

Experienced problem and How the problem was solved

2nd step

kfs	Experienced problem		How the problem was solved
SOUTHEST ASIA			
Indonesia-kfs1	Systematic observation networks were inadequate due to lack of stations and lack of maintenance.		Cooperation and collaboration among country-wide research institutions concerned were established.
Indonesia-kfs2	Limited human resources of the RBOs hindered on-site implementation of measures to cope with climate change.		Ministry of Public Works had set up a working team for smooth cooperation among related divisions.
Malaysia-kfs1	Poor appreciation of risks such as biodiversity by many stakeholders hindered to prioritize areas of concern.		A session was held to explain risk management and to have a common agreement on prioritizing areas.
Malaysia-kfs2	Lack of data and understanding of "vulnerability" was a serious problem and good examples were needed.		A series of capacity building programme was done to mobilize knowledge centres and active professionals.
Thailand-kfs1	Increase of flood risks by climate change to both Metropolitan area and agricultural low lands in Chao Phraya basin will cause serious damage on the both areas.		The government proposed a project using the agricultural law lands as temporally retarding basins by making acceptable compensations.
Thailand-kfs2	Unless the Government grasps the farmers' concerns and clarify their questions, the project cannot be in success.		The Government prepared many occasions to explain the project, make hearing and answer the questions.
EAST ASIA			
China-kfs1	The complex situation of water utilization, water quality and depletion hindered to define the existing problems.		Integrated approach was taken including model simulation, on-site investigation and questionnaires.
China-kfs2	Good result cannot be expected unless different technical levels of technitians in different areas will be improved.		The project team provides the field technical support and holds the different trainings and workshops.
China-kfs3	As the data to be collected are related to different sectors, various problems are foreseen.		The project team cooperates with other sectors to acquire the necessary data.
C. Taipei-kfs1	Unless the effects of multi-functionality of paddy fields had been proved scientifically or numerically, it would be hard to enhance the relevant knowledge among people.		The government decided to start the project to preserve eco-environmental functions of paddy fields and groundwater recharge and has been supporting this.
C. Taipei-kfs2	People's understanding about the multi-functionality of paddy fields and its relations to climate change was not sufficient to promote the paddy field preservation policy.		The government has made efforts to transmit the research results to the people with the variety of methods including on-site demonstration and web.
Japan I-kfs1	It was recognized the original menbers and project duration might not cover the wide range of the issue.		The academic society decided to select additional members and to extend the project duration.
Japan I-kfs2	The outcomes of the committee needed to be known to the society members, but there were limited occasions.		The achievements were presented at the society's annual meeting and the special issue was published.
JapanII-kfs1	The necessary data shoud be collected from various sources and often have to be purchased to obtain or do not exist.		The data was obtained taking advantage of establishied human network aupplemented by direct measurement.
JapanII-kfs2	It was needed to obtain a common/ simplel model applicable for other basins making use of existing information on irrigation facilities.		Larger mesh size had been aopted and a modification method of non-desitalized information was developed.
JapanII-kfs3	The existing budget was not sufficient to undertake the wide range of research.		The researcher applied for Grant-in-Aid for Scientific Research by appealing the importance of the research.
Korea-kfs1	Responding to the dam collapsing by flood the government had to take the measures to convince the people.		The government decided to revise the design criterion which was studied by the committee by specialists.
korea-kfs2	Proper application of revised design criterion is necessary in order to alleviate over design by engineers infamiliar to the new criterion.		The responsible ministry supplemented the written materials with meetings and workshops and organized a committee to give advice to the engineers.

Some interesting "Problem" and "Solution"

2nd step

	Experienced problem	How the problem was solved
Turkey I -kfs4	Introduction of pressurized irrigation system was hindered due to economic and technical reasons.	The government prepared subsidiary system for farmers and technical guidance to engineers etc.
Pakistan I -kfs1	Difficulties in formulating substantial FOs were felt in the absence of any guidelines and other materials.	Positive/negative checklists were provided to show success/failure factors for formation of FOs.
Thailand -kfs1	Increase of flood risks by climate change to both Metropolitan area and agricultural low lands in Chao Phraya basin will cause serious damage on the both areas.	The government proposed a project using the agricultural law lands as temporally retarding basins by making acceptable compensations.
Korea -kfs1	Responding to the dam collapse by flood the government had to take the measures to convince the people.	The government decided to revise the design criterion which was studied by the committee by specialists.

Nature of Problem

2nd step

No. of kfs	Experienced problem	Nature of trouble: political judgement	proper system	people's awareness	effective approach	How the faced problem was solved
NEAR EAST						
Iran-kfs1	Proper estimation methodlogy considering possible risks and using suitable data should be found out.				○	To use risk analysis issue and monthly data instead of yealy presipitation was decided.
Iran-kfs2	Use of old method would lead to overestimation of crop water requirement.				○	The recent findings in other regions should beconformed.
Iran-kfs3	Less effort and finance are allocated to theresearch on vulnerable agriculture sector in such regions as South Asia and South Africa.	○				ICID should commit to those vulnerable areas in collecting and disseminate relevant information.
Turkey I-kfs1	The activities of the various governmental and other organizations were dispersed.		○			"Cordination Board on Climate Change" was established by the Prime Ministerial Circular.
Turkey I-kfs2	The intencity of climate change effects had not been clarified and the relevant information had not reached to the people.			○		The central government took initiative to clarify the future effects and ammended the law for active dissemination thru. education and media.
Turkey I-kfs3	Most of the farmars was reluctant to use new irrigation techniques useful for climate change.			○		The responsible ministry has been implementing various dissemination activites with the help of media.
Turkey I-kfs4	Introduction of pressuried irrigation system was hindared due to economic and technical reasons.				○	The government prepared subsidiary system for farmars and technical guidance to engineers etc.
TurkeyII-kfs1	Necessary budget and support by the government organizations were not smoothly obtained.		○			The study leaders negotiated the relevant National Council for budget and organizational support.
TurkeyII-kfs2	Each researcher's concern was limited in his own field and this hindared cooperation among reserchers.				○	Various meetings with different scale and interval were organaized in order to share the project aim.
SOUTH ASIA						
India-kfs1	Lack of irrigation water was severe problem especially for poor people to be solved immediately.	○				Various programmes have been carried out by the government under the political leadership.
India-kfs2	Many water saving methods developed by the reserchers were not used by the farmers because they did not have occasions to see the reserch outcomes.				○	The government implement the project to demonstrate the technologies available and issued an application guidelines to openly call for reserchers' participation.
India-kfs3	Reserchers recognized the conditions of experimental and demonstration farm were quite different.				○	The reserchers modified their method to be easily used by the farmers.
India-kfs4	Reserchers need occasion to share the farmers' field experience in order to modify the methods.				○	The government organized a congress for the reserchers to grasp the actual farmers' field conditions.
Nepal-kfs1	It became clear the original reserch team size was too small and data collection site/template were unsuitable.				○	Reserch team was strengthened and data collection plan was readjusted.
Nepal-kfs2	This reserch with complex and multi-disciplinary nature of the reserch made the analysis difficult.				○	The data were collected by integrated approach employing all possible methods and cross verified.
Pakistan I-kfs1	Difficulties in formulating substantial FOs were felt in the absence of any guidelines and other materials.				○	Positive/negative checklists were provided to show success/failure factors for formation of FOs.
Pakistan I-kfs2	Applying formal approach had some limitations especially in the case of election of FO management committee.				○	The formal and informal interaction process was introduced to make socially acceptable FO committee.
Pakistan I-kfs3	Newly organized FO members did neither shared practical objectives nor incentives at the initial stage.				○	Small scale projects were provided for the new FOs in order to increase the whole members' participation.
PakistanII-kfs1	In preparating Water Sector EMP, persistent weakness in Govent.'s technical/ logistical capability was recognized with people's low initiative for environmental awareness.			○		The local governments provided activities for environ-mental awareness in the rural area through education, media, community involvement, NGOs' activities, etc.
PakistanII-kfs2	The effective EMP implementation could only be done with a strong commitment from the relevant authorities.		○			Two Provinces established a special unit for EMP and the four-leveled institutional framework are functioning.
PakistanII-kfs3	A commitment from the federal government and cooperation among Indus River Basin Provinces are limited for implementation of EMP.		○			The federal government could prepare a platform on which the Units established could communicate each other thru. Web.
SOUTHEST ASIA						
Indonesia-kfs1	Systematic observation networks were inadequate due to lack of stations and lack of maintenance.		○			Cooperation and collaboration among country-wide research institutions concerned were established.
Indonesia-kfs2	Limited human resources of the RBOs hindered on-site implementation of measures to cope with climate change.		○			Ministry of Public Works had set up a working team for smooth cooperation among related divisions.
Malaysia-kfs1	Poor appreciation of risks such as biodiversity by many stakeholders hindered to prioritize areas of concern		○			A session was held to explain risk management and to have a common agreement on

Nature of problem (enlarged view)

2nd step

No. of kfs	Experienced problem	Nature of problem			
		political judgment	proper system	people's awareness	effective approach
Near East					
Iran-kfs1	Proper estimation methodology considering possible risks and using suitable data should be found out.				●
Iran-kfs2	Use of old method would lead to overestimation of crop water requirement.				●
Iran-kfs3	Less effort and finance are allocated to the research on vulnerable agriculture sector in such regions as South Asia and South Africa.	●			
Turkey I-kfs1	The activities of the various governmental and other organizations were dispersed.		●		
Turkey I-kfs2	The intensity of climate change effects had not been clarified and the relevant information had not reached to the people.			●	
Turkey I-kfs3	Most of the farmers was reluctant to use new irrigation techniques useful for climate change.			●	
Turkey I-kfs4	Introduction of pressuried irrigation system was hindered due to economic and technical reasons.				●
TurkeyII-kfs1	Necessary budget and support by the government organizations were not smoothly obtained.		●		
TurkeyII-kfs2	Each researcher's concern was limited in his own field and this hindered cooperation among researchers.				●

Character of Solution

2nd step

	Experienced problem	Nature of trouble: political judgement	proper system	people's awareness	effective approach	How the faced problem was solved	Character of solution: Commitment by the government	Information sharing	agreement among stakeholders	doable strategic approach
NEAR EAST										
Iran-kfs1	Proper estimation methodlogy considering possible risks and using suitable data should be found out.				○	To use risk analysis issue and monthly data instead of yealy presipitation was decided.				○
Iran-kfs2	Use of old method would lead to overestimation of crop water requirement.				○	The recent findings in other regions should beconformed.		○		○
Iran-kfs3	Less effort and finance are allocated to theresearch on vulnerable agriculture sector in such regions as South Asia and South Africa.	○				ICID should commit to those vulnerable areas in collecting and disseminate relevant information.	○			
Turkey I-kfs1	The activities of the various governmental and other organizations were dispersed.		○			"Cordination Board on Climate Change" was established by the Prime Ministerial Circular.	○			
Turkey I-kfs2	The intencity of climate change effects had not been clarified and the relevant information had not reached to the people.			○		The central government took initiative to clarify the future effects and ammended the law for active dissemination thru. education and media.	○			○
Turkey I-kfs3	Most of the farmars was reluctant to use new irrigation techniques useful for climate change.			○		The responsible ministry has been implementing various dissemination activites with the help of media.		○	○	
Turkey I-kfs4	Introduction of pressuried irrigation system was hindared due to economic and technical reasons.				○	The government prepared subsidiary system for farmars and technical guidance to engineers etc.	○			○
TurkeyII-kfs1	Necessary budget and support by the government organizations were not smoothly obtained.		○			The study leaders negotiated the relevant National Council for budget and organizational support.	○		○	
TurkeyII-kfs2	Each researcher's concern was limited in his own field and this hindared cooperation among reserchers.				○	Various meetings with different scale and interval were organaized in order to share the project aim.		○	○	○
SOUTH ASIA										
India-kfs1	Lack of irrigation water was severe problem especially for poor people to be solved immediately.	○				Various programmes have been carried out by the government under the political leadership.	○			
India-kfs2	Many water saving methods developed by the reserchers were not used by the farmers because they did not have occasions to see the reserch outcomes.				○	The government implement the project to demonstrate the technologies available and issued an application guidelines to openly call for reserchers' participation.			○	○
India-kfs3	Reserchers recognized the conditions of experimental and demonstration farm were quite different.				○	The reserchers modified their method to be easily used by the farmers.				○
India-kfs4	Reserchers need occasion to share the farmers' field experience in order to modify the methods.				○	The government organized a congress for the reserchers to grasp the actual farmers' field conditions.		○		○
Nepal-kfs1	It became clear the original reserch team size was too small and data collection site/template were unsuitable.				○	Reserch team was strengthened and data collection plan was readjusted.				○
Nepal-kfs2	This reserch with complex and multi-disciplinary nature of the reserch made the analysis difficult.				○	The data were collected by integrated approach employing all possible methods and cross verified.				○
Pakistan I-kfs1	Difficulties in formulating substantial FOs were felt in the absence of any guidelines and other materials.				○	Positive/negative checklists were provided to show success/failure factors for formation of FOs.		○		○
Pakistan I-kfs2	Applying formal approach had some limitations especially in the case of election of FO management committee.				○	The formal and informal interaction process was introduced to make socially acceptable FO committee.			○	○
Pakistan I-kfs3	Newly organized FO members did neither shared practical objectives nor incentives at the initial stage.				○	Small scale projects were provided for the new FOs in order to increase the whole members' participation.			○	○
PakistanII-kfs1	In preparating Water Sector EMP, persistent weakness in Govent.'s technical/ logistical capability was recognized with people's low initiative for environmental awareness.			○		The local governments provided activities for environ-mental awareness in the rural area through education, media, community involvement, NGOs' activities, etc.		○		
PakistanII-kfs2	The effective EMP implementation could only be done with a strong commitment from the relevant authorities.		○			Two Provinces established a special unit for EMP and the four-leveled institutional framework are functioning.	○			
PakistanII-kfs3	A commitment from the federal government and cooperation among Indus River Basin Provinces are limited for implementation of EMP.		○			The federal government could prepare a platform on which the Units established could communicate each other thru. Web.		○		
SOUTHEST ASIA										
Indonesia-kfs1	Systematic observation networks were inadequate due to lack of stations and lack of maintenance.		○			Cooperation and collaboration among country-wide research institutions concerned were established.		○		○
Indonesia-kfs2	Limited human resources of the RBOs hindered on-site implementation of measures to cope with climate change.		○			Ministry of Public Works had set up a working team for smooth cooperation among related divisions.		○		○
Malaysia-kfs1	Poor appreciation of risks such as biodiversity by many stakeholders hindered to prioritize areas of concern.		○			A session was held to explain risk management and to have a common agreement on prioritizing areas.		○		
Malaysia-kfs2	Lack of data and understanding of "vulnerability" was a serious problem and good examples were needed.				○	A series of capacity building programme was done to mobilize knowledge centres and active professionals.				○
Thailand-kfs1	Increase of flood risks by climate change to both Metropolitan area and agricultural low lands in Chao Phraya basin will cause serious damage on the both areas.	○				The government proposed a project using the agricultural law lands as temporally retarding basins by making acceptable compensations.	○		○	
Thailand-kfs2	Unless the Government grasps the farmers' concerns and clarify their questions, the project cannot be in success.				○	The Government prepared many occasions to explain the project, make hearing and answer the questions.		○	○	
EAST ASIA										
China-kfs1	The complex situation of water utilization, water quality and depletion hindered to define the existing problems.				○	Integrated approach was taken including model simulation, on-site investigation and questionnaires.				○
China-kfs2	Good result cannot be expected unless different technical levels of technitians in different areas will be improved.				○	The project team provides the field technical support and holds the different trainings and workshops.				○
China-kfs3	As the data to be collected are related to different sectors, various problems are foreseen.				○	The project team cooperates with other sectors to acquire the necessary data.				○
C. Taipei-kfs1	Unless the effects of multi-functionality of paddy fields had been proved scientifically or numerically, it would be hard to enhance the relevant knowledge among people.	○				The government decided to start the project to preserve eco-environmental functions of paddy fields and groundwater recharge and has been supporting this.	○			○
	People's understanding about the multi-functionality of paddy fields and its relations to [illegible] change was not suff[illegible]servation policy.			○		The government has made efforts to transmit the research results to the people with the [illegible] including on-site demo[illegible]			○	

Character of Solution (enlarged view)

2nd step

No. of kfs	How the faced problem was solved	Character of solution			
		Commitment by the government	Information sharing	Agreement among stakeholders	Doable strategic approach
NEAR EAST					
Iran-kfs1	To use risk analysis issue and monthly data instead of yearly precipitation was decided.				●
Iran-kfs2	The recent findings in other regions should be conformed.		●		●
Iran-kfs3	ICID should commit to those vulnerable areas in collecting and disseminate relevant information.	●			
Turkey I-kfs1	"Coordination Board on Climate Change" was established by the Prime Ministerial Circular.	●			
Turkey I-kfs2	The central government took initiative to clarify the future effects and amended the law for active dissemination thru. education and media.	●			●
Turkey I-kfs3	The responsible ministry has been implementing various dissemination activities with the help of media.		●	●	

Examination of Solution - what was done/what the action means

2nd step

KSF Name	Code name	Nature of problem	Character of Solution			
			Commitment by the government (to show political will)	Information sharing (to adjust way to deliver information)	agreement among stakeholders (to consider people's acceptability)	doable strategic approach (to employ proper methodology)
SOUTHEAST ASIA						
Indonesia-kfs1	INA1-1	Proper System		To establish systematic observation network (Common network)		To involve country-wide research institutions (Cooperative approach)
Indonesia-kfs2	INA1-2	Proper System		To supply necessary C. C. information by research institutions to RBOs (Through working team)		To set up working team by related devisions (Cooperating approach)
Malaysia-kfs1	MAS-1	People's Awareness		To establish common agreement through discussion (Holding session)		
Malaysia-kfs2	MAS-2	Effective Approach				To mobilise Knowledge centers and active professionals (Capacity building)
Thailand-kfs1	THA-1	Political Judgment	To enact a special law for inundation project (Enacting a law for implementation)		To prepare compensation for farmers (Win- win strategy)	
Thailand-kfs2	THA-2	Effective Approach		To explain the project (Holding briefing sessions)	To hear farmers demand and to answers, there questions (Deepening farmers' understanding)	
EAST ASIA						
China-kfs1	CHN-1	Effective Approach				To employ model simulation, on-site investigation, etc (Integrated approach)
China-kfs2	CHN-2	Effective Approach				To give technical support and hold training the workshop (Capacity building/ Supportive approach)
China-kfs3	CHN-3	Effective Approach				To cooperate with other sectors (Cooperative approach)
C.Taipei-kfs1	TPE-1	Political Judgment	To carry out the project at the expense of the government (Financial support by the government)			
		Effective Approach				To study all possible effects of paddy fields (Integrated approach)
C.Taopei-kfs2	TPE-2	People's Awareness		To disseminate research results to the peop (Through media, Internet, Newspaper, etc)	To carry out on-site demonstration (Stirring People's motivation for conservation)	
JapanI-kfs1	JPN1-1	Effective Approach				To adjust the project members and study duration after preliminary discussions (Flexible approach)
JapanI-kfs2	JPN1-2	Effective Approach		To disseminate obtained information to the society members (Holding regular conference/ Through special issue of journal)		
JapanII-kfs1	JPN2-1	Effective Approach			To collect voluminous data from various sources (Effective use of human network)	
JapanII-kfs2	JPN2-2	Effective Approach				To modify original model easily applicable to other basins (Rational approach)
JapanII-kfs3	JPN2-3	Political Judgment	To prepare Grant-in-Aid system for research promotion (Financial support by the government)			
		Effective Approach				To apply for grant-in-Aid by appealing outcomes (Persuading support)
Korea-kfs1	KOR-1	Political Judgment	To revise the existing criterion (Revision of design criterion)			To appeal in outcome and to the effect (Integration approach)
		Effective Approach			To establish special committee for discussion on division (Integration approach)	
Korea-kfs2	KOR-2	Effective Approach			To train technicians by workshops and to support technical guidance	(Capacity building/ Supportive appr

Solutions of the case of Thailand

Solutions of the case of Korea

Examination of Solution - what was done/what the action means (enlarged view/Iran)

2nd step

KFS Name	Code Name	Nature of Problem	Character of solution			
			Commitment by the government (*to show political will*)	Information sharing (*to adjust way to deliver information*)	Agreement among stakeholders (*to consider people's acceptability*)	Doable strategic approach (*to employ proper methodology*)
Thailand -kfs1	THA-1	Political Judgment	**To enact a special law for inundation project** (***Enacting a law for implementation***)		**To prepare compensation for farmers** (***Win-win strategy***)	
Thailand -kfs2	THA-2	Effective Approach		**To explain the project to the farmers** (***By holding briefing sessions***)	**To hear farmers' demand and to answer their questions** (***Deepening farmers' understanding***)	

Examination of Solution - what was done/what the action means (enlarged view/Korea)

2nd step

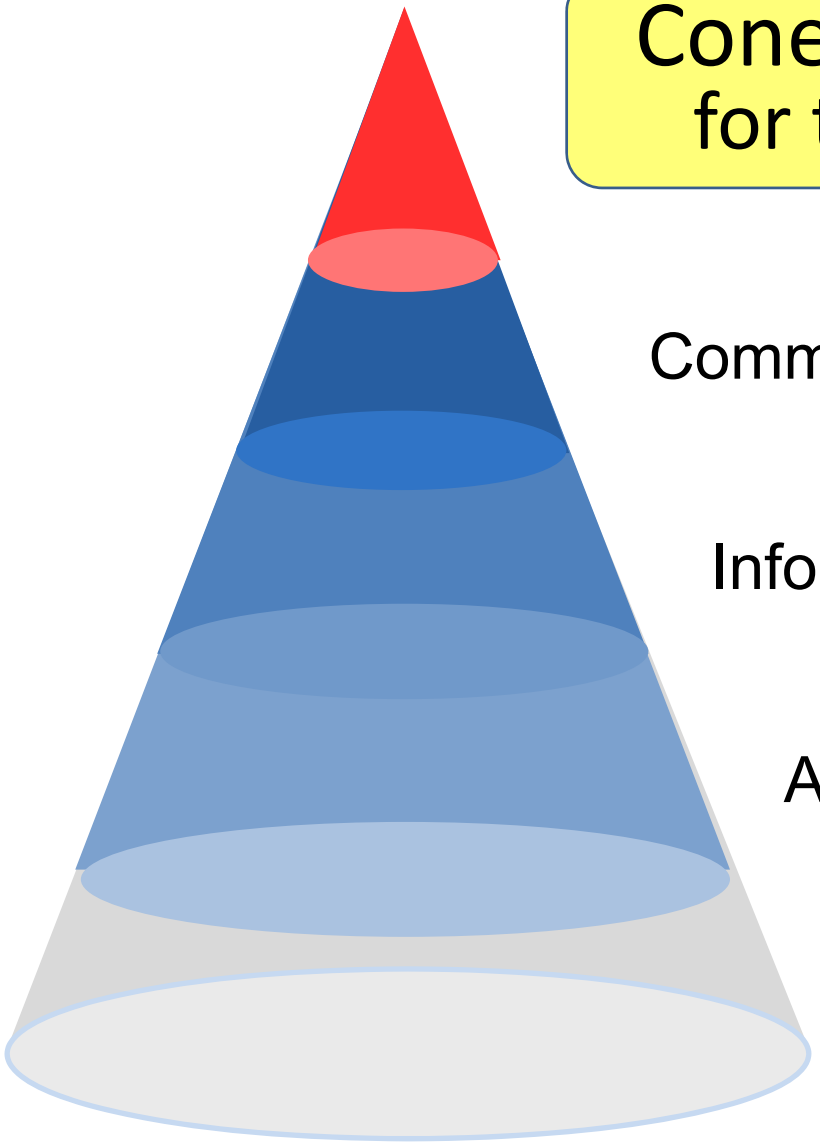
KFS Name	Code Name	Nature of Problem	Character of solution			
			Commitment by the government (*to show political will*)	Information sharing (*to adjust way to deliver information*)	Agreement among stakeholders (*to consider people's acceptability*)	Doable strategic approach (*to employ proper methodology*)
Korea -kfs1	KOR-1	Political Judgment	**To revise the existing design criterion** (***Revision of design criterion***)			**To appeal its outcome and effect** (***Integrated approach***)
		Effective Approach				**To establish special committee for revision** (***Integrated approach***)
Korea -kfs2	KOR-2	Effective Approach				**To train technicians and to support them by technical guidance** (***Capa-buil/ Supportive***)

List of Specific Solutions - in Character of Solution

2nd step

Character of solution	Key point of solution	Specific solution
Commitment by the government	to show political will	Enacting a law for people's awareness/implementation Commitment by the prime minister Financial support by the government Preparing national program Revision of design criterion Organizational support by the government Establishing new organization Possible commitment by ICID
Information sharing	to adjust way to deliver information	Through mass media and IT By reference materials/special issue of journal By congress/conference/session Through meetings By Information platform/common network Through working team By training visit/community involvement
Agreement among stakeholders	to consider people's acceptability	Stirring motivation of people involved Deepening stakeholders' understanding Win-win strategy Respecting traditional rule Effective use of human network
Doable Strategic approach	to employ proper methodology	Integrated approach Rational approach Logistic approach Cooperative approach Supportive approach Appropriate scheduling Field approach Feed back approach Participatory approach Incentive approach Persuading approach Capacity building

2nd step



Cone
for the successful solutions

Commitment by the government

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Information sharing

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Agreement among stakeholders

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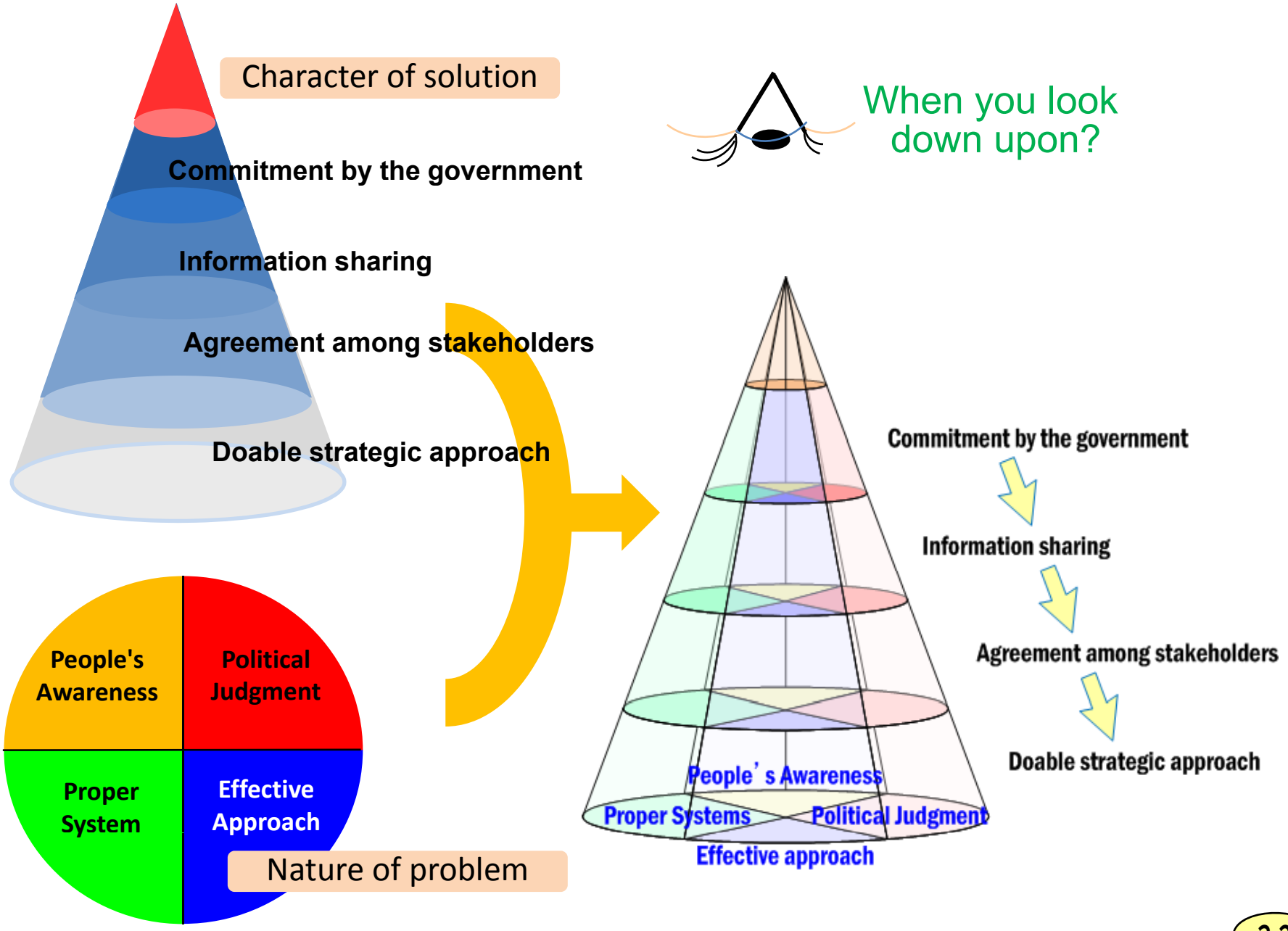
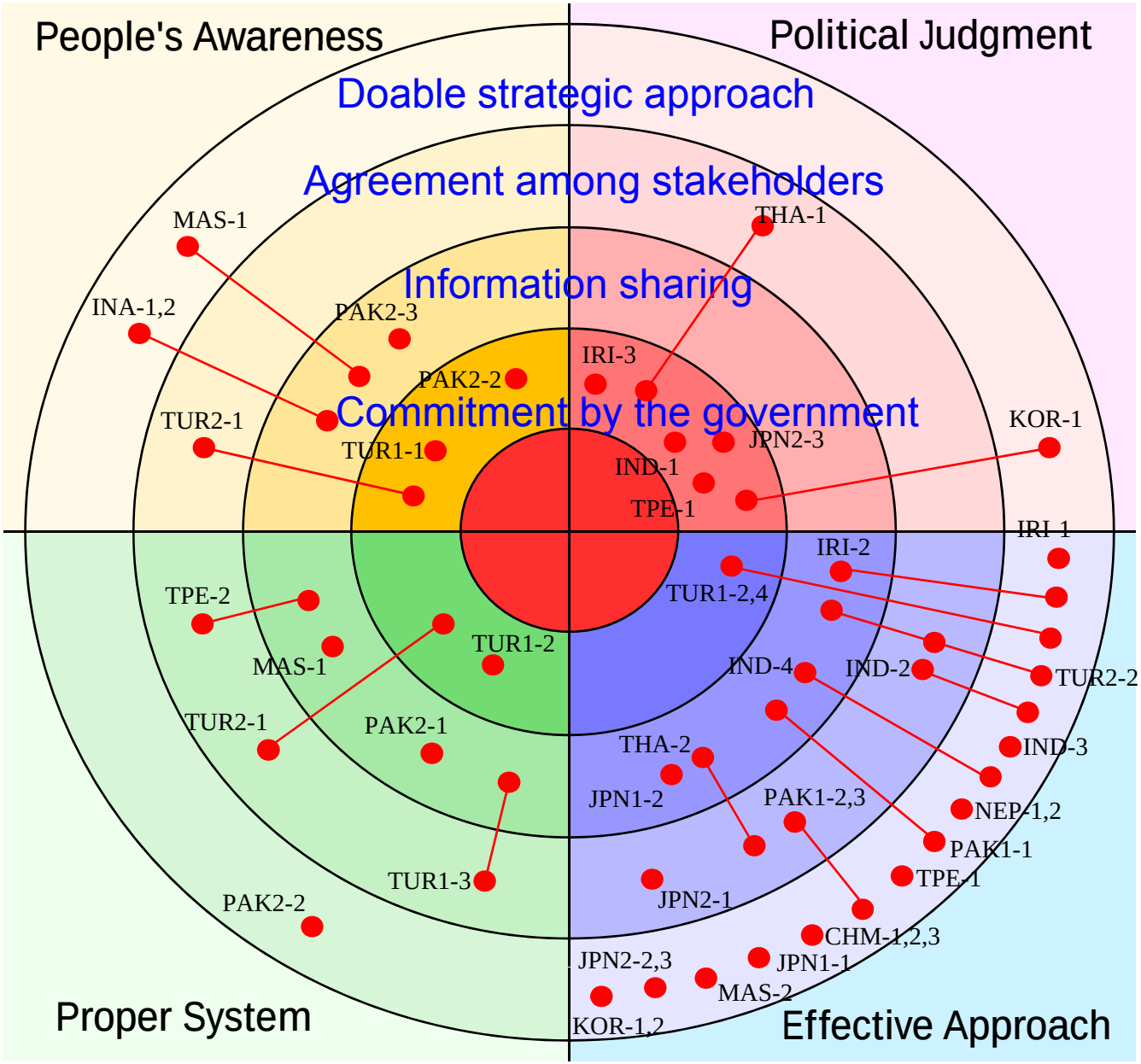
Doable strategic approach

Relation between experience problem and character of solution



Keys for Success on “problem and Solution Diagram”

2nd step



How to make use of the Study Result

	When applicable	Possible entrance	Main goal
General approach	Your problem not identified yet	The whole text + jump into cases	Wherever you want
"Country" approach	When you consider what to be done as a country	Ref. 11 Country position chart related to climate/economy	Country strategy
"Case" approach	When you have specific theme	Ref. 17 List of submitted case studies	Case to be referred
"Problem" approach	When you face a specific trouble	Ref. 33 Problem & Solution Diagram	Keys to solve your trouble + related hints/ideas
"Solution" approach	When you have possible solutions in mind	Ref. 33 30 Problem & Solution Diagram + List of Specific Solutions	Verification of your idea + other ideas

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How to make use of the Study Result

	When applicable	Possible entrance	Main goal
General approach	Your problem not identified yet	The whole text + jump into cases	Wherever you want
"Country" approach	When you consider what to be done as a country	Ref. 11 Country position chart related to climate/economy	Country strategy
"Case" approach	When you have specific theme	Ref. 17 List of submitted case studies	Case to be referred
"Problem" approach	When you face a specific trouble	Ref. 33 Problem & Solution Diagram	Keys to solve your trouble + related hints/ideas
"Solution" approach	When you have possible solutions in mind	Ref. 33 30 Problem & Solution Diagram + List of Specific Solutions	Verification of your idea + other ideas

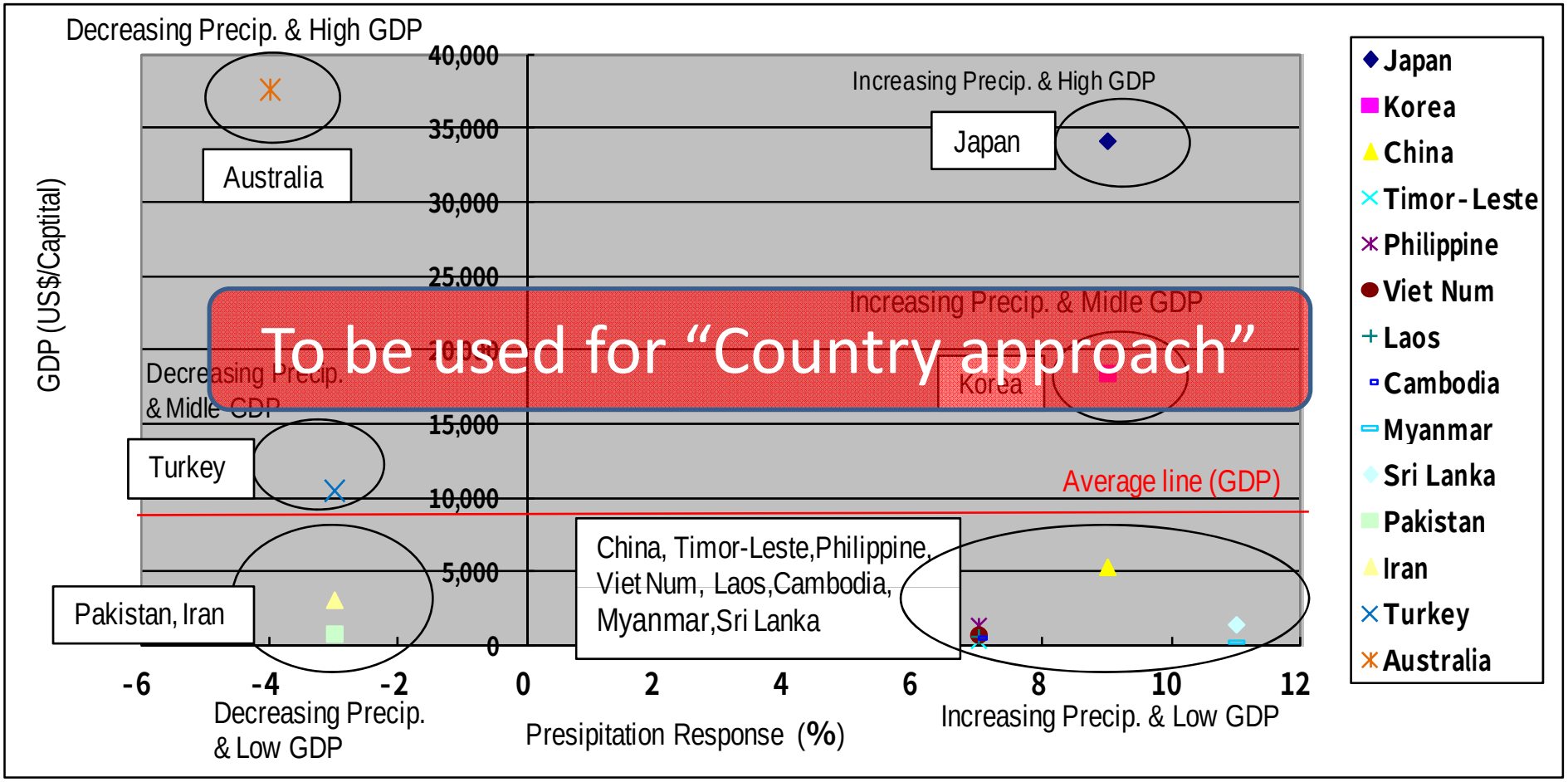
How to make use of the Study Result

	When applicable	Possible entrance	Main goal
General approach	Your problem not identified yet	The whole text + jump into cases	Wherever you want
"Country" approach	When you consider what to be done as a country	Ref. 11 Country position chart related to climate/economy	Country strategy
"Case" approach	When you have specific theme	Ref. 17 List of submitted case studies	Case to be referred
"Problem" approach	When you face a specific trouble	Ref. 33 Problem & Solution Diagram	Keys to solve your trouble + related hints/ideas
"Solution" approach	When you have possible solutions in mind	Ref. 33 30 Problem & Solution Diagram + List of Specific Solutions	Verification of your idea + other ideas

1st step

Relation between GDP and Water Stress Rate

For Future Discussion About Counter & Adoption Measures on CC in ASRWG Countries



To be used for “Country approach”

How to make use of the Study Result

	When applicable	Possible entrance	Main goal
General approach	Your problem not identified yet	The whole text + jump into cases	Wherever you want
"Country" approach	When you consider what to be done as a country	Ref. 11 Country position chart related to climate/economy	Country strategy
"Case" approach	When you have specific theme	Ref. 17 List of submitted case studies	Case to be referred
"Problem" approach	When you face a specific trouble	Ref. 33 Problem & Solution Diagram	Keys to solve your trouble + related hints/ideas
"Solution" approach	When you have possible solutions in mind	Ref. 33 30 Problem & Solution Diagram + List of Specific Solutions	Verification of your idea + other ideas

2nd step

List of Submitted Case Studies

Region	Country	Theme	Group	Field
Near East	Iran	Climate Change impacts on irrigation water requirement	Science & Technology	Analysis
	Turkey I	Increasing Public Awareness and Support for Climate Change	Peoples Recognition or Social Movement	Symposium, Media and
	Turkey II	Research of impact of Climate Change in Seyhan River in Turkey	Science & Technology	Research
Southt Asia	Nepal	Adaptation to Global Change in Agricultural Practices: A Case Study of Indrawati Basin	Science & Technology	Research
	Pakistan I	Lower Bari Doab Canal Improvement Project (LBDC)	Local Practices	People participant
	Pakistan II	Water Sector Environmental Management Planning in Pakistan	Governance	Law & Regulation
	India	Farmers Participatory Action Research Programme (FPARP) – 1st Phase	Peoples Recognition or Social Movement	Campaign
Southeast Asia	Thailand	Study of Using Agricultural Land in the Chao Phraya Delta for Mitigating Flood caused by Climate Change.	Science & Technology	Strategy
	Malaysia	A Conceptual Framework for the Preparation of Guidelines for Climate Change Vulnerability and Adaptation Strategies	Local Practices	People participant and NGO activities
	Indonesia	Impact of Climate Change on Water Availability Aspects In Java Island	Science & Technology	Strategy
East Asia	Chinese Taipei	Study on Paddy Fields Multi-Functionality for Sustainable Environment and Climate Change in Taiwan (Chinese Taipei)	Science & Technology	Research
	China	Managing Climate Change Effect on Groundwater through Monitoring Groundwater	Science & Technology	Research
	Japan I	Formulation of strategy for enhancing research related to global environment established	Science & Technology	Strategy
	Japan II	Impact assessment of climate change on agriculture water use in Mekong River Basin and Seki River Basin	Science & Technology	Research
	Korea	Design criteria for emergency spillway to cope with extreme flood in the irrigation dam	Science & Technology	Strategy and Research

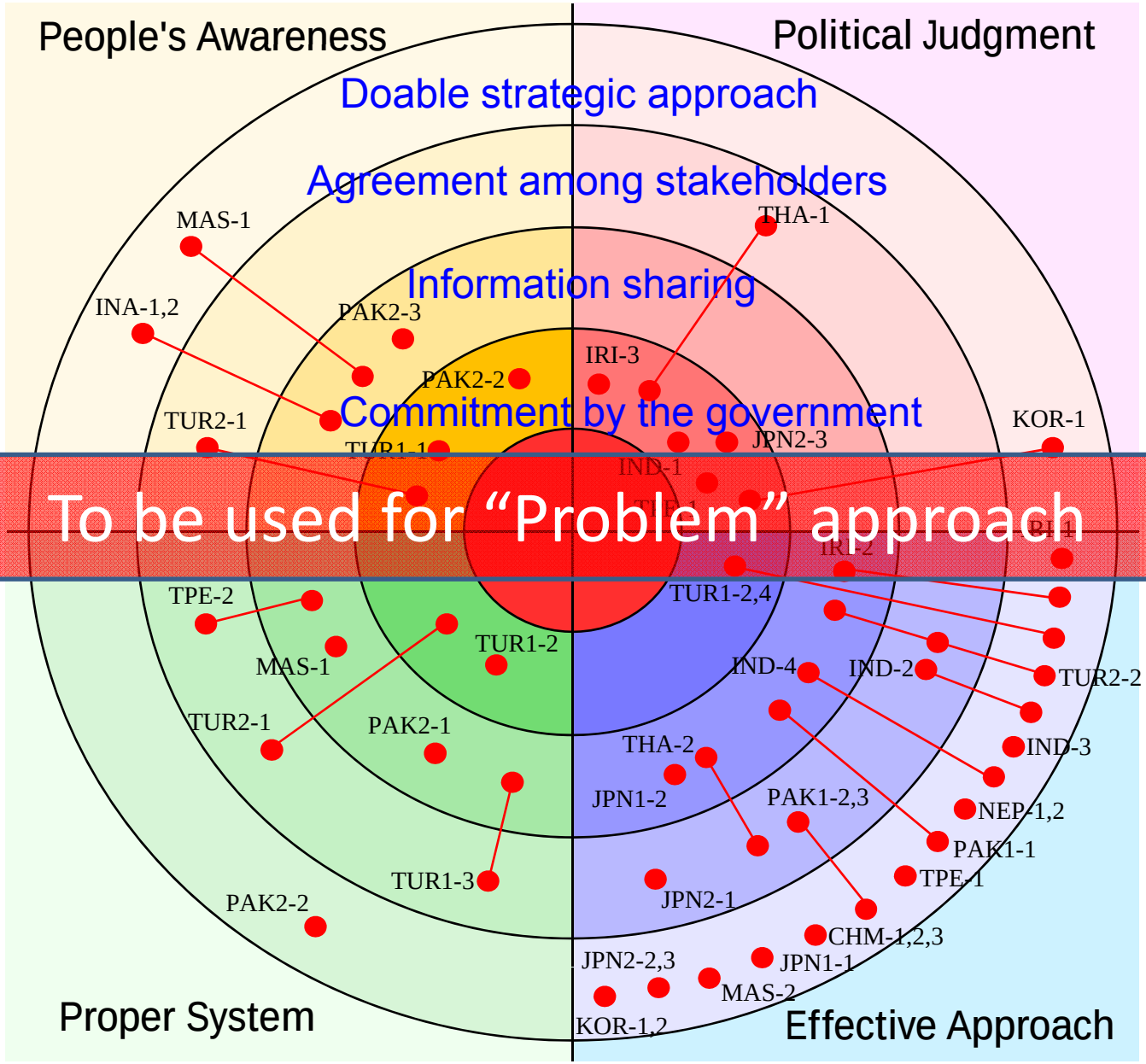
To be used for "Case" approach

How to make use of the Study Result

	When applicable	Possible entrance	Main goal
General approach	Your problem not identified yet	The whole text + jump into cases	Wherever you want
"Country" approach	When you consider what to be done as a country	Ref. 11 Country position chart related to climate/economy	Country strategy
"Case" approach	When you have specific theme	Ref. 17 List of submitted case studies	Case to be referred
"Problem" approach	When you face a specific trouble	Ref. 33 Problem & Solution Diagram	Keys to solve your trouble + related hints/ideas
"Solution" approach	When you have possible solutions in mind	Ref. 33 30 Problem & Solution Diagram + List of Specific Solutions	Verification of your idea + other ideas

Keys for Success on “Problem and Solution Diagram”

2nd step



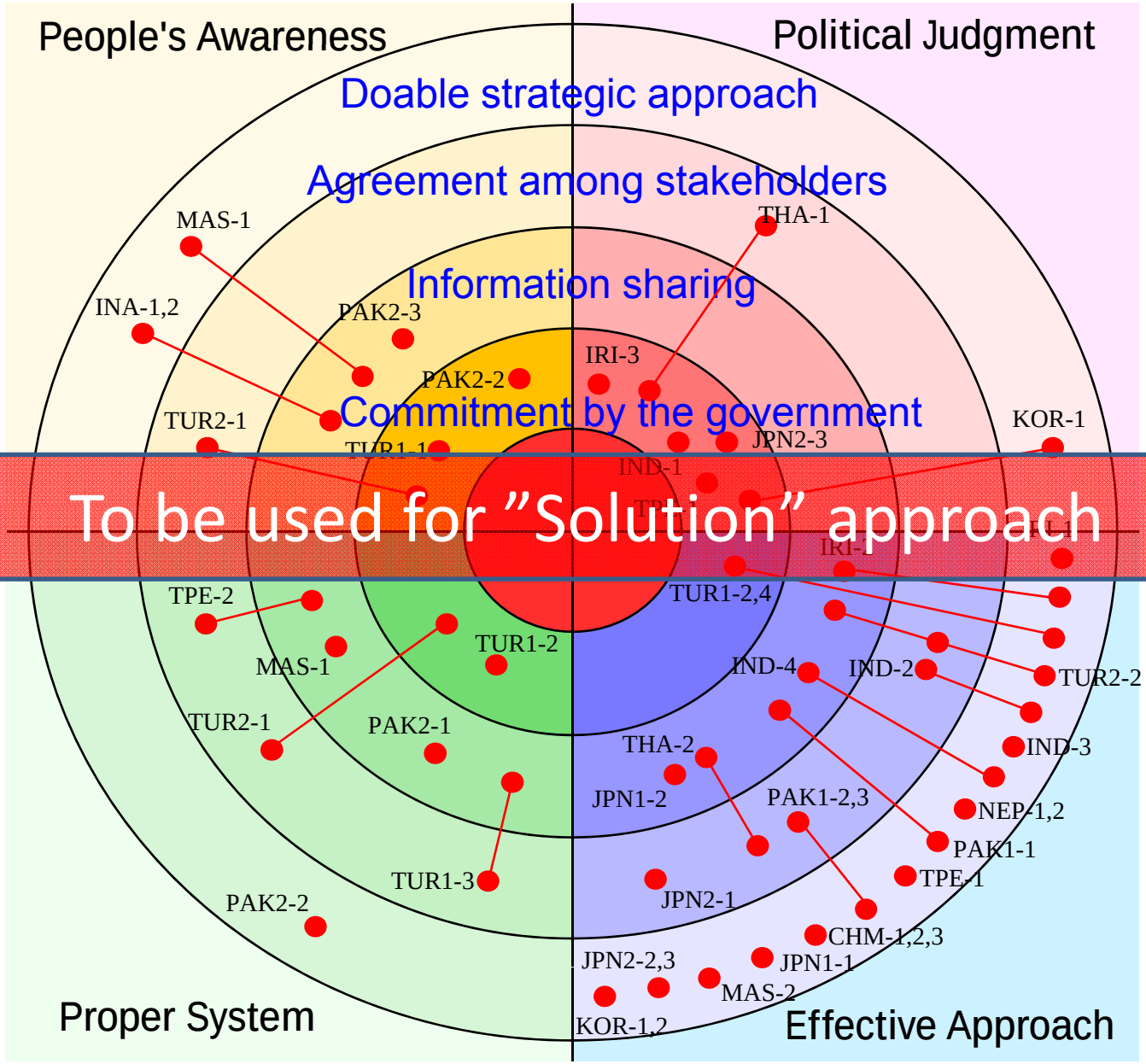
How to make use of the Study Result

	When applicable	Possible entrance	Main goal
General approach	Your problem not identified yet	The whole text + jump into cases	Wherever you want
"Country" approach	When you consider what to be done as a country	Ref. 11 Country position chart related to climate/economy	Country strategy
"Case" approach	When you have specific theme	Ref. 17 List of submitted case studies	Case to be referred
"Problem" approach	When you face a specific trouble	Ref. 33 Problem & Solution Diagram	Keys to solve your trouble + related hints/ideas
"Solution" approach	When you have possible solutions in mind	Ref. 33 30 Problem & Solution Diagram + List of Specific Solutions	Verification of your idea + other ideas

34

Keys for Success on “Problem and Solution Diagram”

2nd step



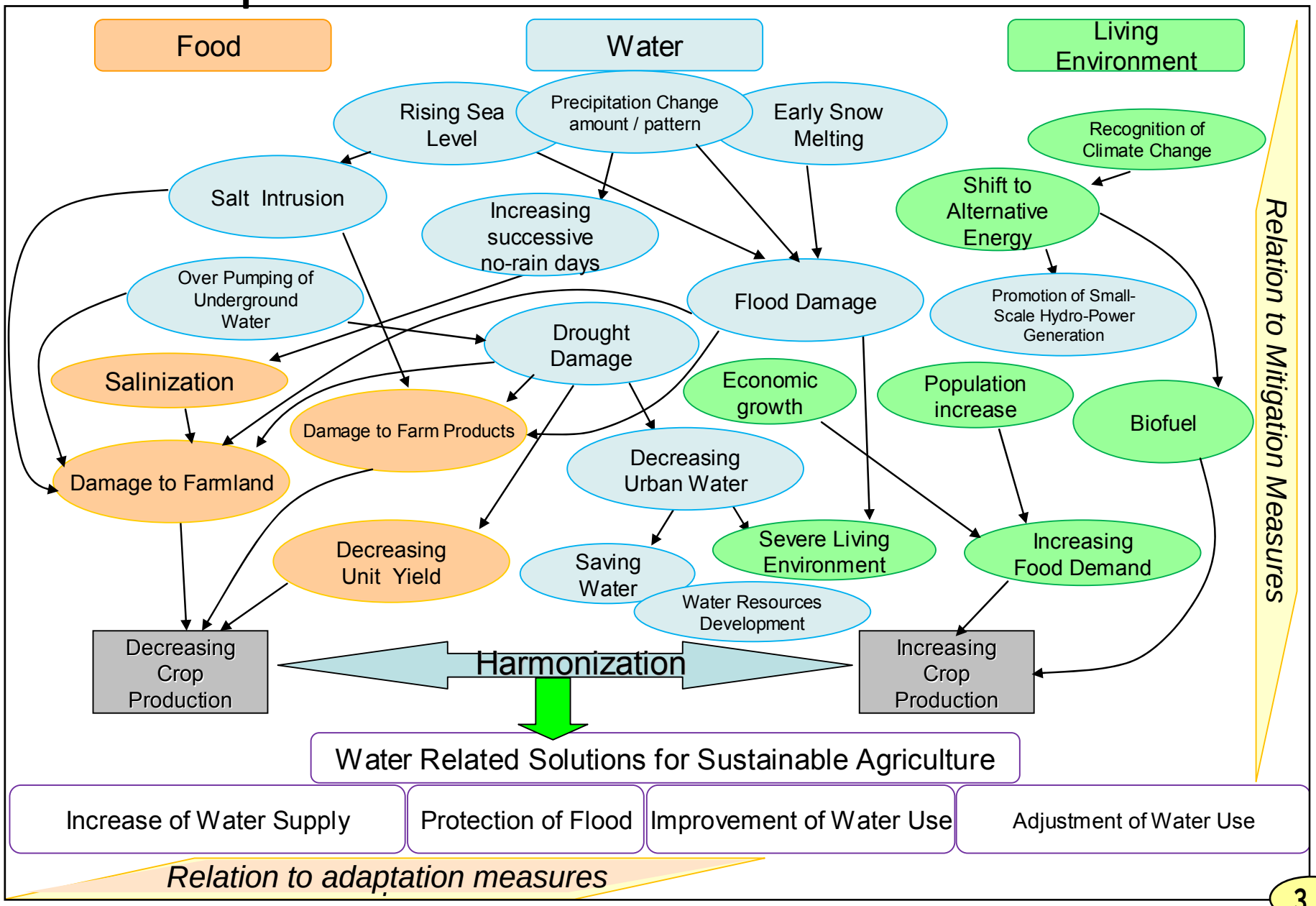
List of Specific Solutions - in Character of Solution

2nd step

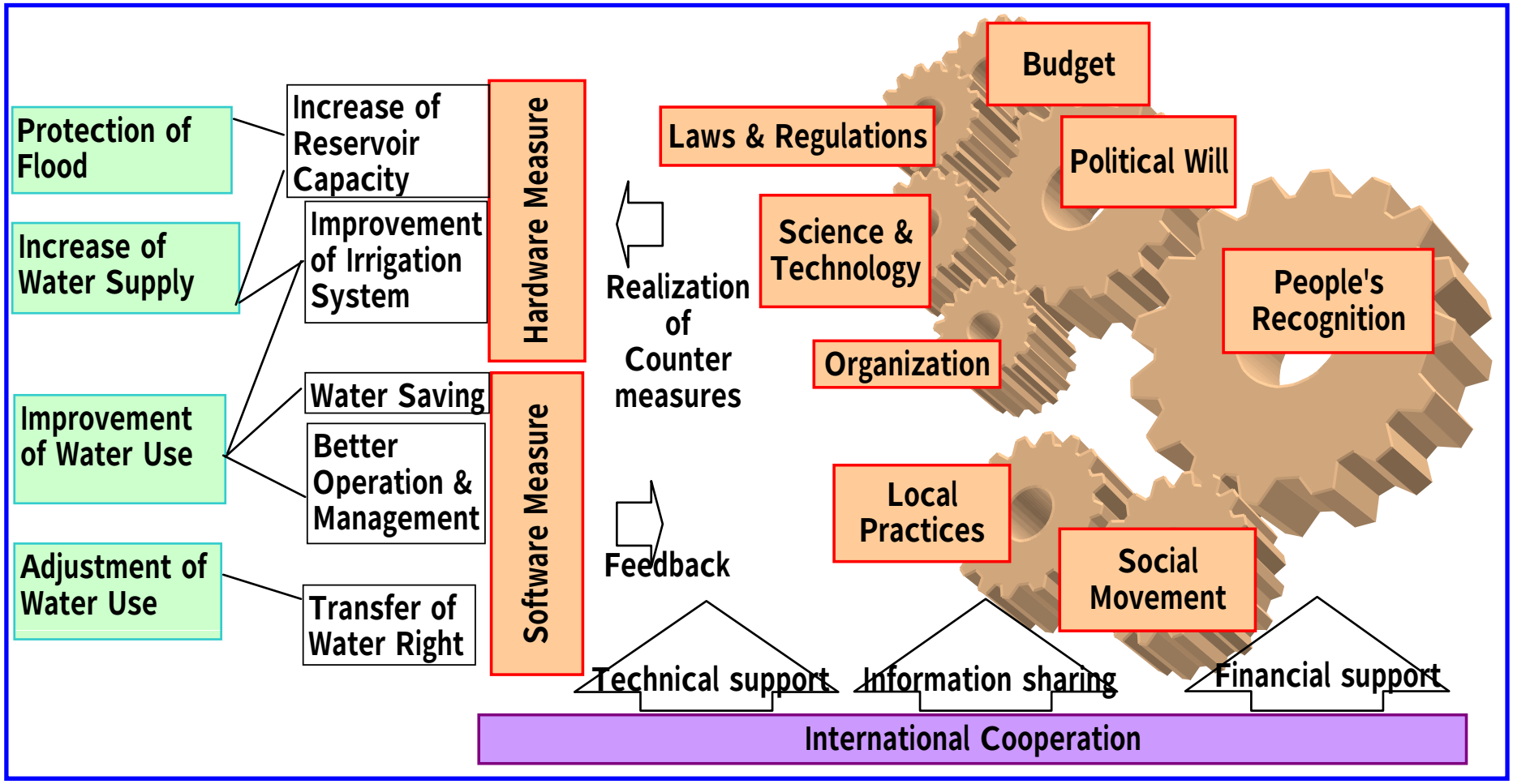
Character of solution	Key point of solution	Specific solution
Commitment by the government	to show political will	Enacting a law for people's awareness/implementation Commitment by the prime minister Financial support by the government Preparing national program Revision of design criterion Organizational support by the government Establishing new organization Possible commitment by ICID
Information sharing	to adjust way to deliver information	Through mass media and IT By reference materials/special issue of journal By congress/conference/session Through meetings By information platform/common network Through working team By training visit/community involvement
Agreement among stakeholders	to consider people's acceptability	Stirring motivation of people involved Deepening stakeholders' understanding Win-win strategy Respecting traditional rule Effective use of human network
Doable Strategic approach	to employ proper methodology	Integrated approach Rational approach Logistic approach Cooperative approach Supportive approach Appropriate scheduling Field approach Feed back approach Participatory approach Incentive approach Persuading approach Capacity building

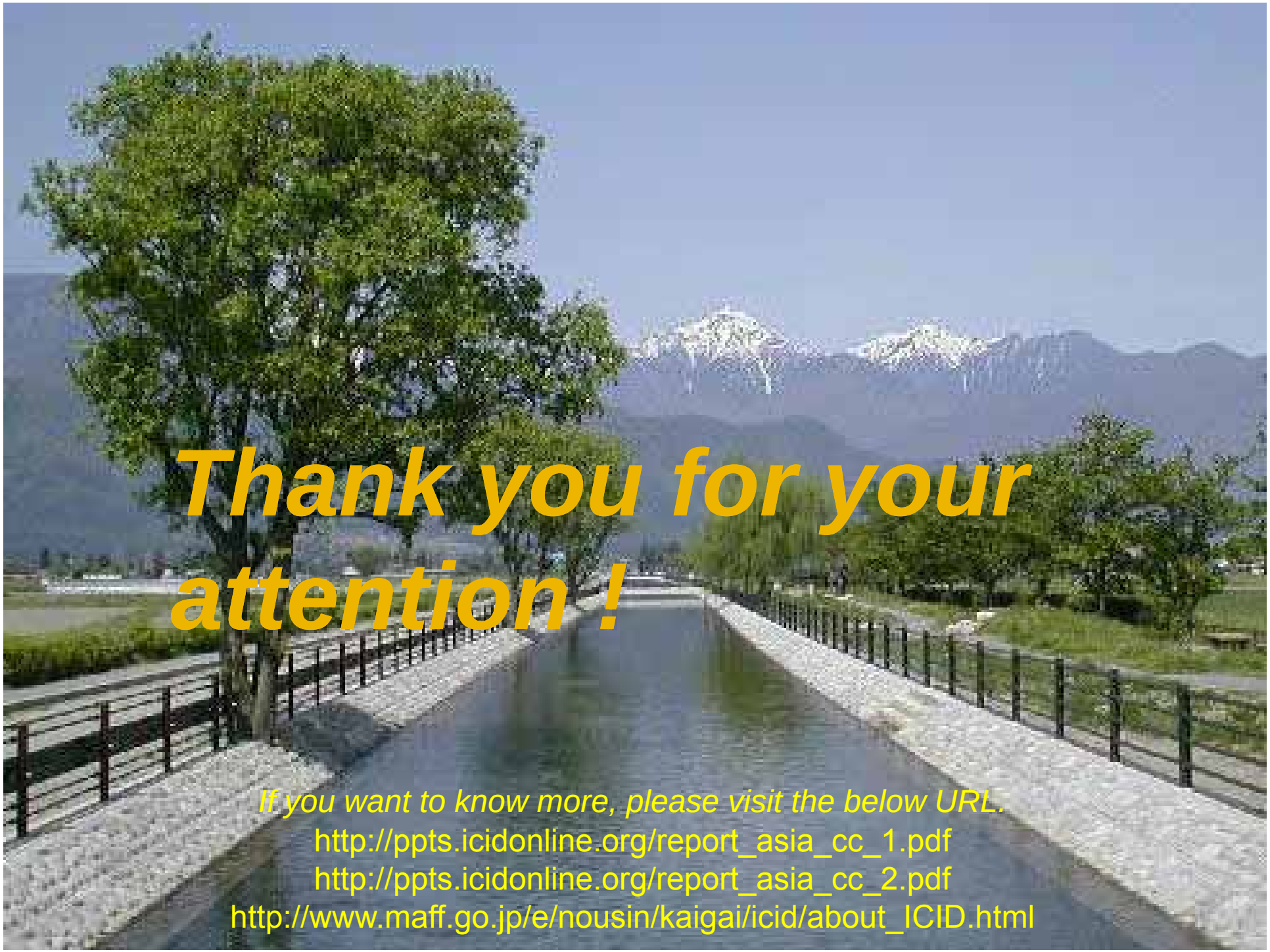
To be used for "Solution" approach

Implication of Factors related to C.C.



Overview of Components in tackling C.C.

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