Group Exercise/Case Work:
Adaptive Delta Management and Adaptation Project Appraisal

CEGIS

Ahmmed Zulfiqar Rahaman
Hydrologist and Climate Change Expert

Learning Objectives

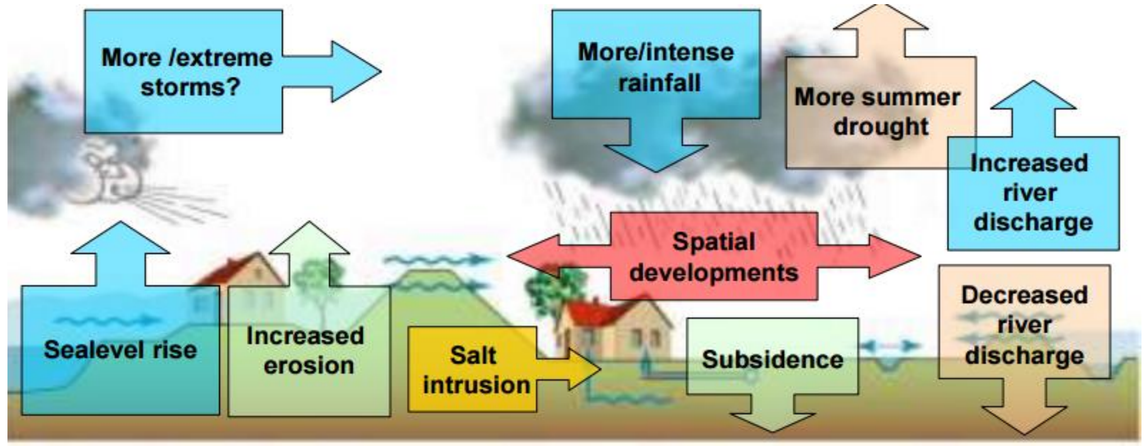
1. Concept of Adaptive Delta Management (ADM), Scenarios and Adaptation Pathways
2. Adaptation Project Appraisal Techniques
3. Superiority of ADM and Adaptation Pathways over Traditional Project Appraisal
4. Key Consideration of Adaptation Project Appraisal in ADM

Plan of Case Work

- **Based on Harvard Case Method: Role of Trainees are Key**
  - **20 Mins: Short Lecture on Concept of ADM and Adaptation Project Appraisal**
  - **5 Mins: Demonstration of Case Work**
  - **60 Mins: Group Exercise/Case Work**
  - **30 Mins: Group Presentation and Feedback**

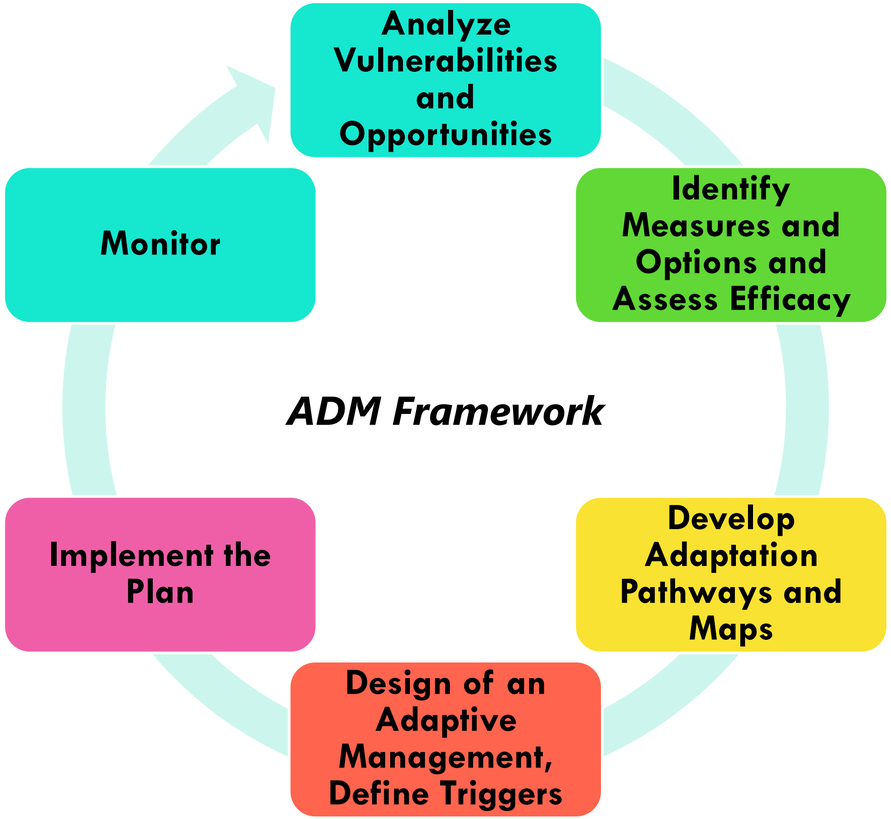
Concept of Adaptive Delta Management (ADM), Scenarios and Adaptation Project Appraisal

Adaptive Delta Management



- Complex dynamics of **delta and it's stressors** create serious challenges for governments and planning
- Need to make decisions about **long term sustainable and climate proof investments.**

- **Adaptive delta management** involves the selection of a strategy that can be **modified to achieve better performance** as one learns more about the **issues at hand and how the future is unfolding.**
- **Learning, experimenting and evaluation** are key elements of this approach and should be actively planned for in decision-making.



(adapted from Haasnoot et al, 2013)

Benefits of Adaptive Delta Management

Domestic

- Create Food, Water and Energy Security
- Develop Climate Change and Hazard Resilient Society
- Enhance Social Security and Economic Development
- Improved Life Expectancy, Quality of Life and Education
- Create Employment and Reduce Poverty
- Ensure Good Governance and Coordination
- Develop Sustainable Environment and Ecosystem
- Improve Communication and Networking
- Ensure Gender Balance

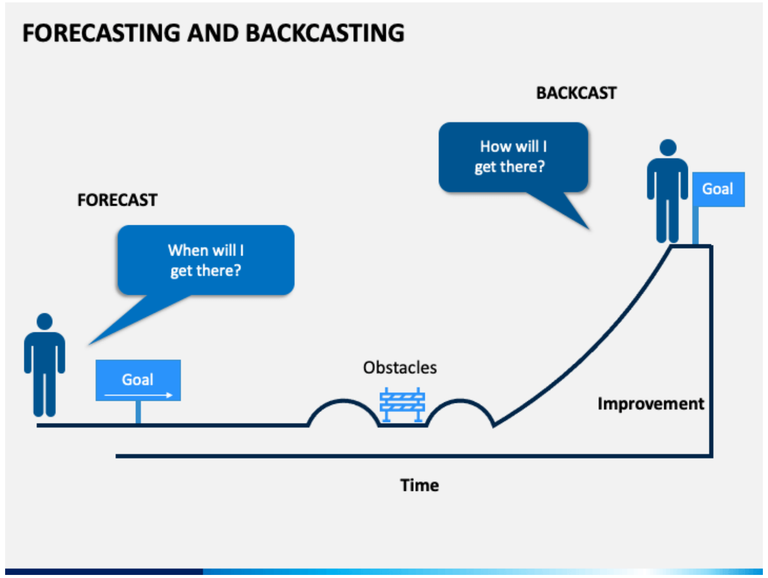
Regional

- Ensure Regional Cooperation and Co-ordination
- Create Economic Balance
- Conflict Resolution
- Establish and Maintain Knowledge Equilibrium
- Reduce Disparity of Development
- Promote Business Development and Communication

Adaptive Delta Management

Functionality

- ADM deals with uncertainties in a transparent and sensible way to support decision making with regard to water policy, planning and infrastructural investments.
- It links current decision making to future scenarios or long term choices.
- Builds upon experiences of IWRM over the years
- Ensuring the solutions to be robust and flexible
- Having several strategies ready and being able to switch quickly in different pathways
- ADM enables putting in place incremental adaptation options, rather than undertaking large-scale adaptation
- Solutions are based on the analysis of multiple adaptation pathways instead of business-as-usual or worst-case scenarios

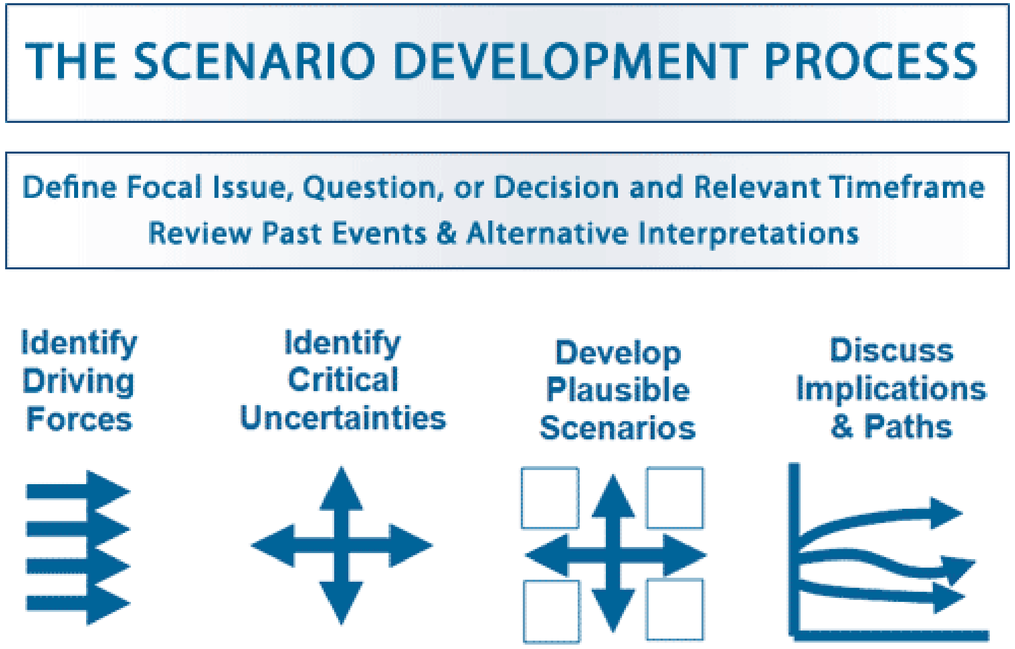


Key Terminologies

- **Scenarios:**

*"**consistent and coherent** descriptions of **alternative hypothetical futures** that reflect different perspectives on **past, present, and future developments**, which can serve as a **basis for action**"*

  - **Snapshots of possible futures**
  - **Tools for focusing thought, developing shared visions, and determining policy**
  - **Do not predict the future, but helps to decide what to do now in order to shape it**



- **Example:**
  - **Representative Concertation Pathways (RCPs)**
  - **Shared Socio-economic Pathways (SSPs)**
  - **Combination of Socio-Economic Development and External Factors like Climate Change**

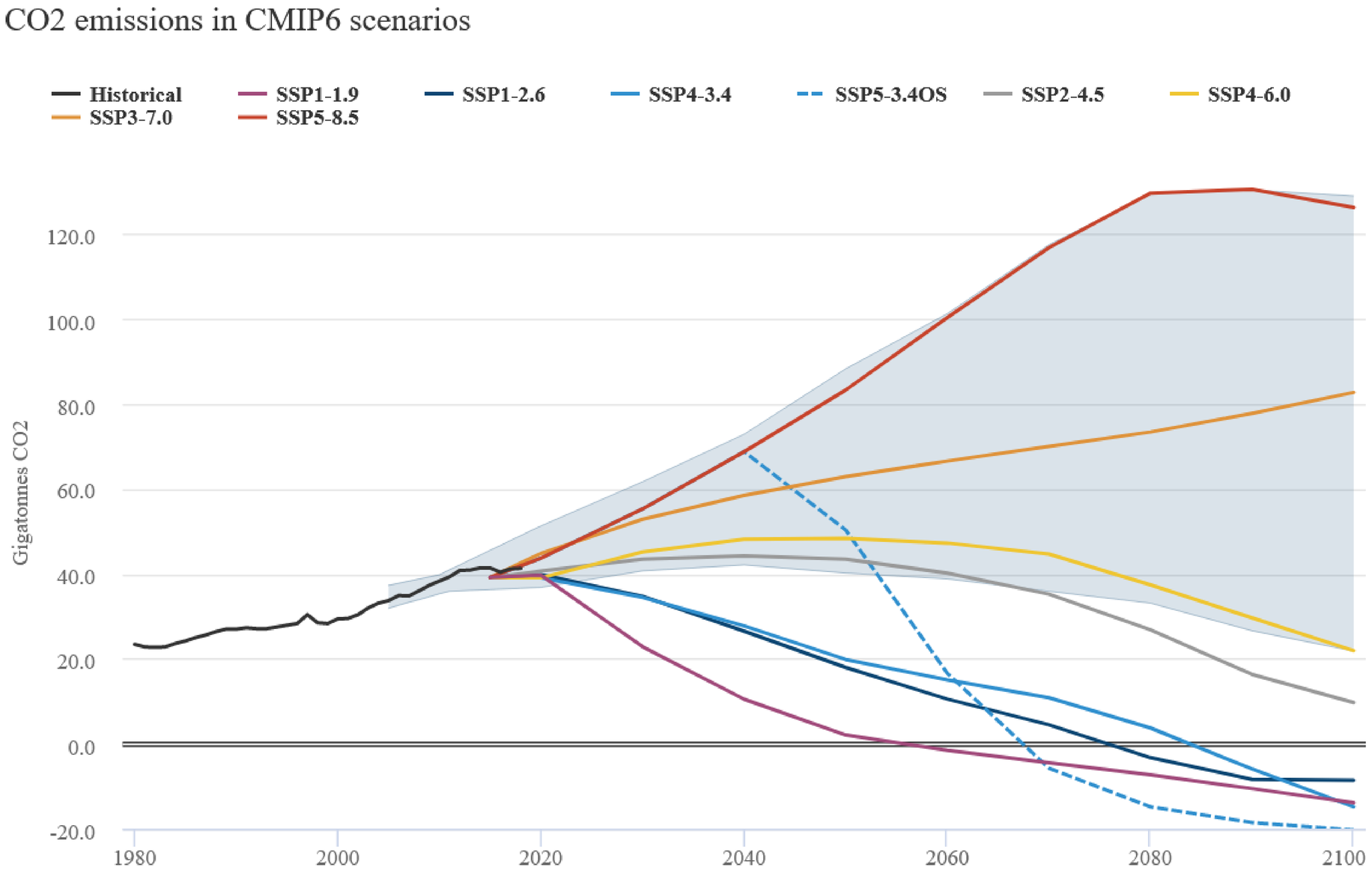
Concept of Representative Concentration Pathway

RCP's

- RCP is a greenhouse gas concentration (not emissions) trajectory adopted by the IPCC in AR5 in 2014.
- It supersedes Special Report on Emissions Scenarios (SRES) projections published in 2000.
- Four pathways have been selected for climate modeling and research, which describe different climate futures, all of which are considered possible depending on how much greenhouse gases are emitted in the years to come.

Name	Radiative Forcing	Co2 Equivalent PPm	Median Temp Anomaly (C)	Pathway
RCP 8.5	8.5 wm2 in 2100	1370	4.6	Rising
RCP 6.0	6 wm2 in 2100	850	3	Stabilization without Overshoot
RCP 4.5	4.5 wm2 in 2100	650	2.6	Stabilization without Overshoot
RCP 2.6	3 wm2 in 2100	490	1.7	Peak and Decline

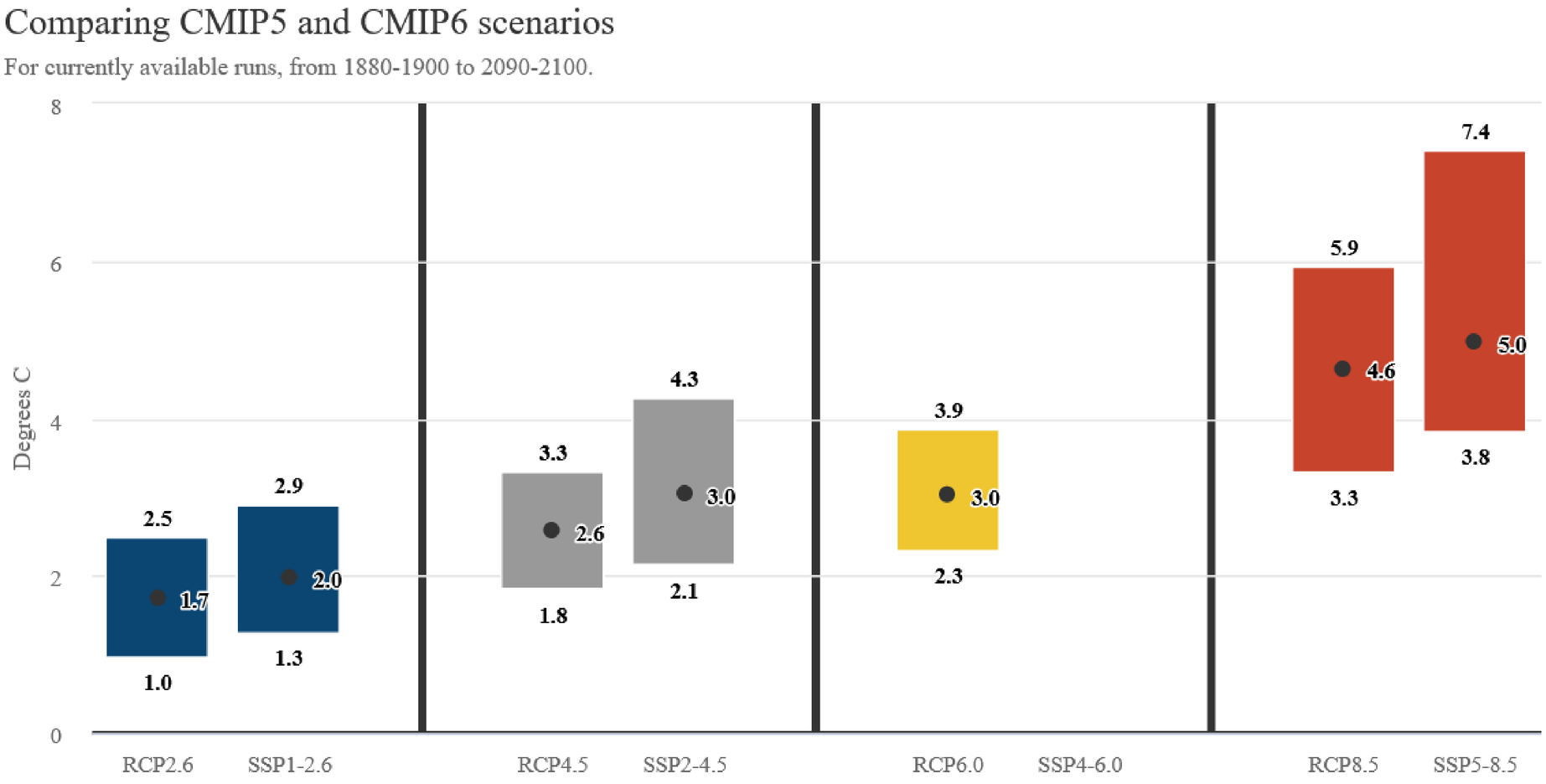
New Scenarios of CMIP6 to be Introduced in IPCC 6th Assessment Report



8 new CO2 emission scenarios introduced combined with previous 4 RCPs and SSPs

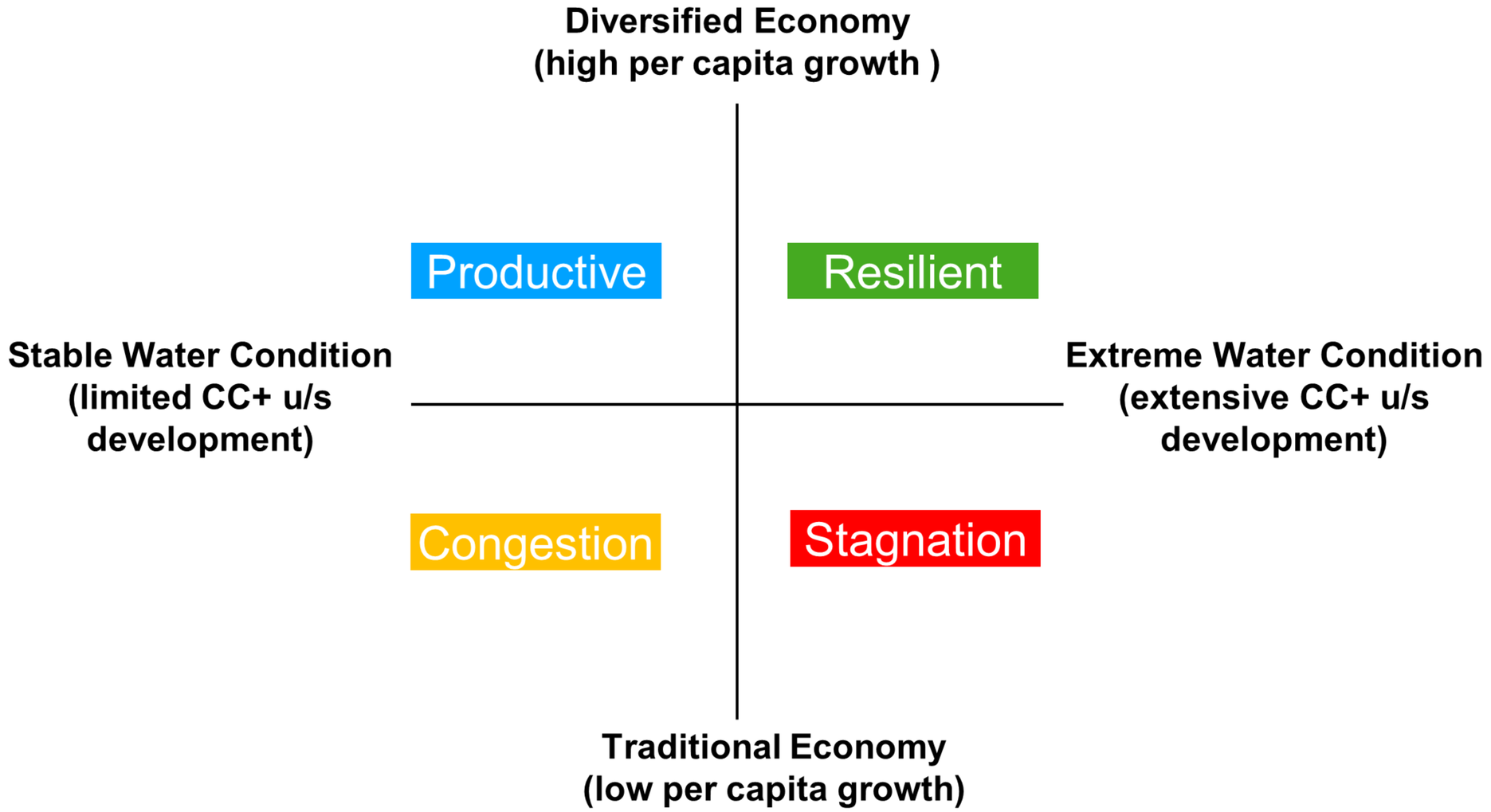
Simulation of almost 100 GCMs from 49 modeling groups

New Scenarios of CMIP6 to be Introduced in IPCC 6th Assessment Report



New Projections Giving Signal of More Rapid Rise of Temperature

BDP2100 Scenarios



Combination of socio-economic driver and uncertainties

Key Terminologies

- **Uncertainties:**

*"state of **incomplete knowledge** that can result from a lack of information or from disagreement about what is known or even knowable, which **raise lack of confidence in making a specific decision**"*

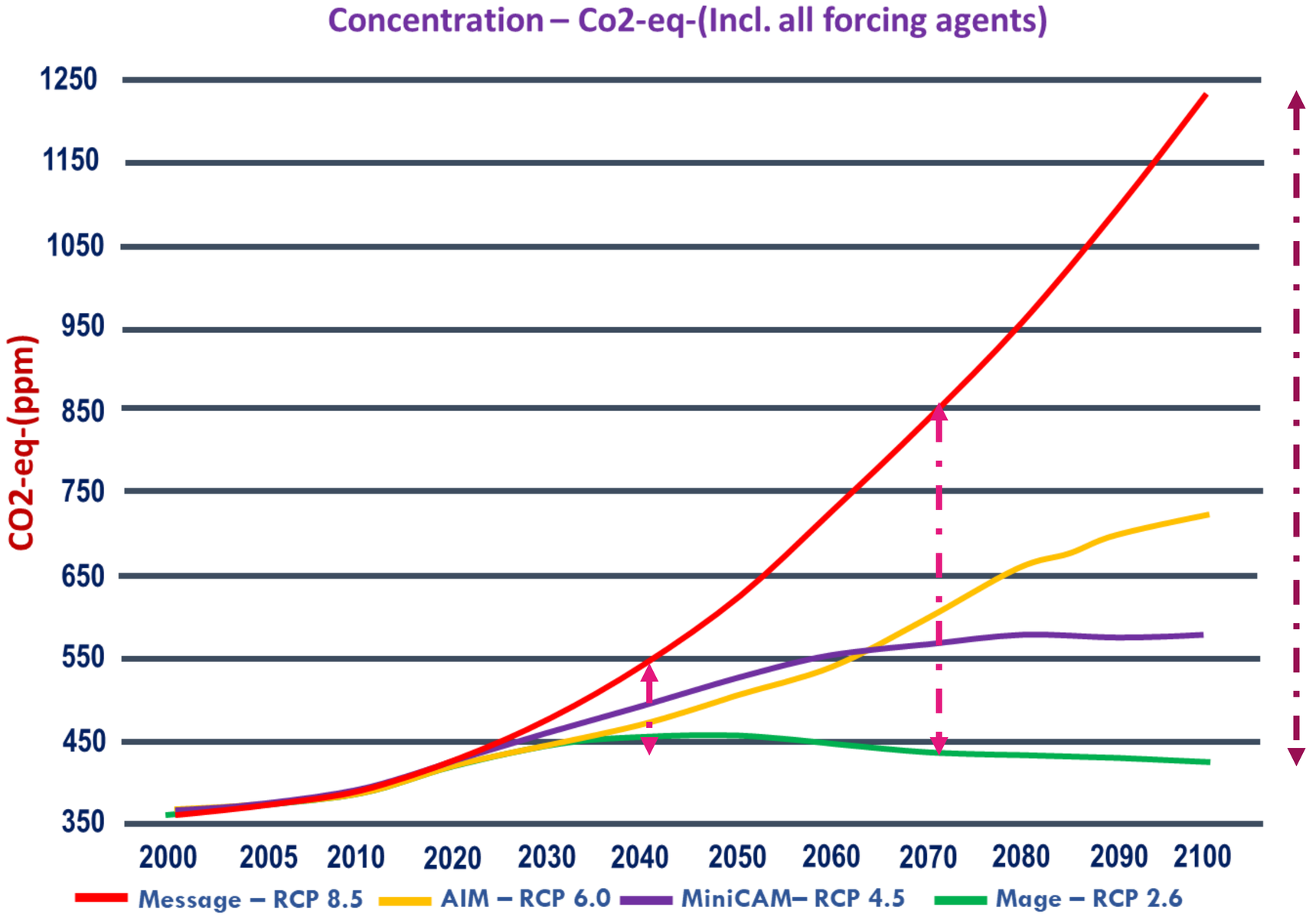
Potential Sources of Uncertainties

- **Measurement errors or aggregation errors**
- **Natural variability resulting from unpredictable natural processes within the climate system**
- **Limited resolution and capacity of physical process simulation by models**
- **Dependency of Future emissions trajectories on demographic, economic and technological development**
- **Future development of non-climatic factors**
- **Future changes in societal preferences and political priorities**

Why to Consider Uncertainties in Decision Making?

- **Uncertainty is inherent**
- **More relevant and robust decision-making**
- **Minimise the potential for maladaptation**
- **Ignoring uncertainty conceals risks.**

Range of Uncertainties



Uncertainties increases in long term planning horizon

Key Terminologies

- **Adaptation** refers to **adjustments in environmental, social or economic systems in response to impacts posed by different climatic or non-climatic stressors**.
- It refers to changes in processes, practices, and structures to moderate potential damages or to **increase benefit from opportunities associated with climate change**
- Adaptation measures may be related to **policy and legal framework, capacity development, technical interventions and research**

Types of Adaptation

Protect

- Dykes, Levees, Floodwalls
- Floodgates, Tidal Barriers
- Detached Breakwaters
- Wetland Restoration
- Afforestation

Accommodation

- Emergency Planning
- Insurance
- Improved Drainage
- New Techniques of Crop Cultivation
- Alternate Livelihood

Retreat

- Establish Retreat Zone
- Relocate Threatened Area
- Erosion Control Easement
- Upland Buffers

Based on Response Nature

- ❑ **Autonomous adaptation or reactive adaptation** tends to be what people and systems do as impacts of climate change become apparent
- ❑ **Anticipatory or proactive adaptation** are measures taken to reduce potential risks of future climate changes

Based on Minimizing Implementation Challenges

- ❑ **No/Low or Limited Regret**
- ❑ **Win-win**
- ❑ **Delay Action**

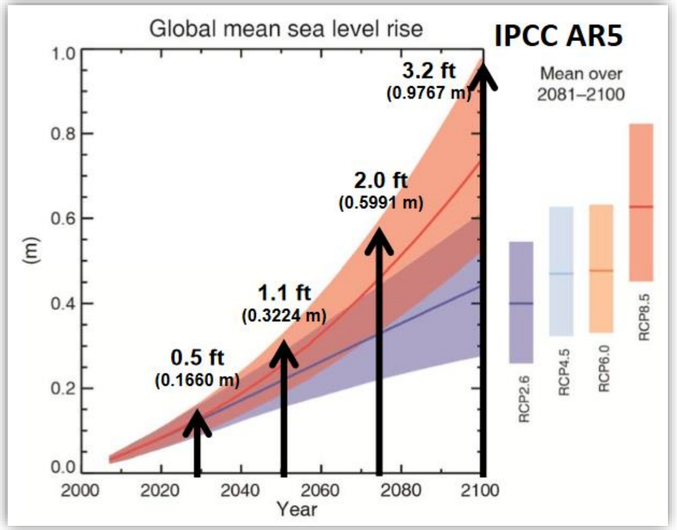
Key Terminologies

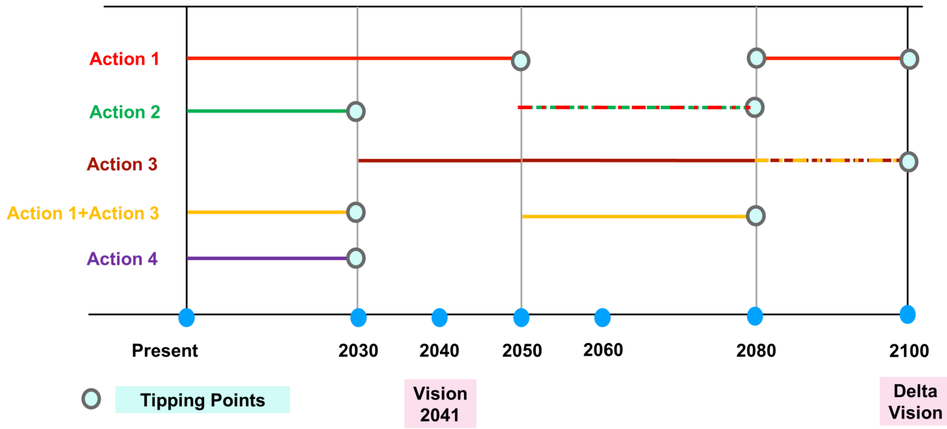
Dynamic Adaptive Policy Pathways (DAPP):

- A wide array of paths or trajectories (consisting of a series of measures) through which policy objectives are achieved under changing climate and socio-economic conditions

Adaptation Tipping Points:

- Central to adaptation pathways are adaptation tipping points under which an action no longer meets clearly a-priori specified objectives.
- After reaching a tipping point, additional measures are needed to reach the objectives.



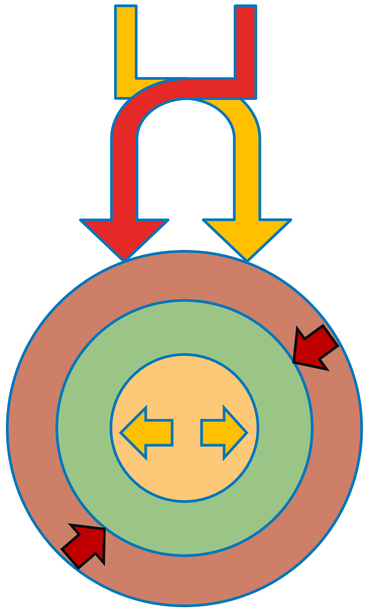


The new measure **may be sequential based on learning from predecessor** or **may be adhoc** or **combination of measures**

Climate Adaptive Pathway

(A) Present

Multiple Stressors Including Climate Change



Biophysical Stressors

Resilience Space

Social Stressors

(B) Opportunity Space

(E) Climate Resilient Pathways

Embankment

Embankment Strengthening (1 in 50 Year)

Embankment Strengthening (1 in 100 Year)

Tipping point

Tipping point

Living With Floods

Tipping point

Living With Floods

Salinity Intrusion

Salinity Tolerant Rice

Tipping point

Marine Agriculture (e.g. Seaweed)

(D) Decision Point

New Crop More Salinity Tolerant

Tipping point

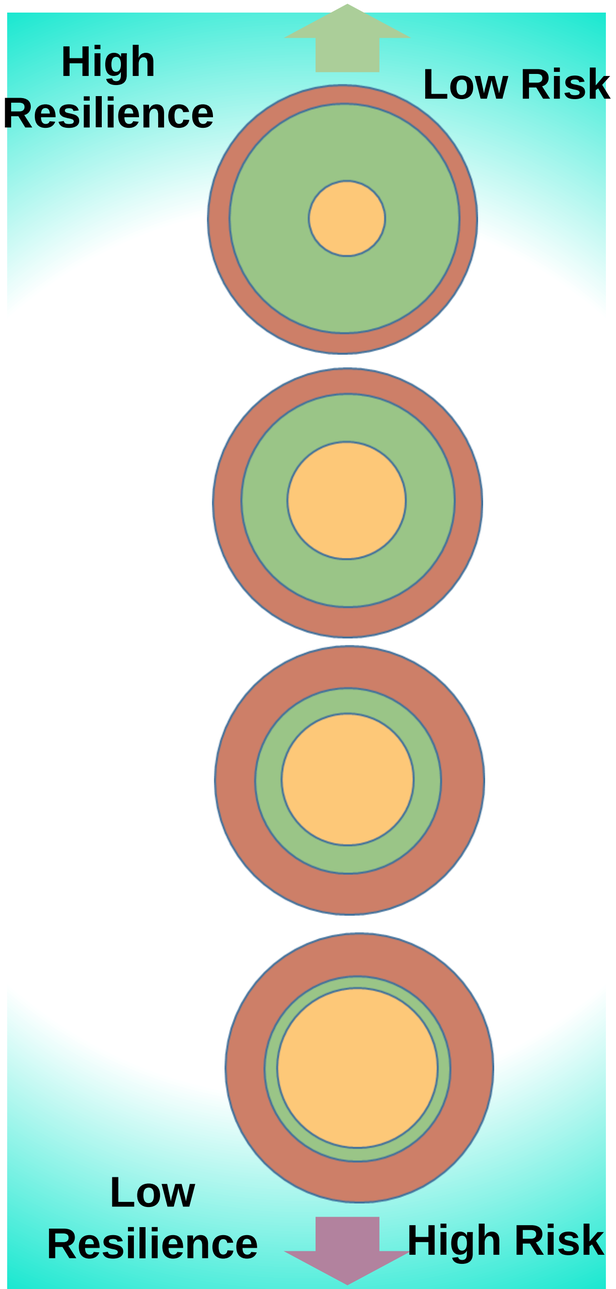
2030

2041

2050

Climate Adaptive Pathway Development

(C) Possible Futures



Adaptation Project Appraisal Techniques

Traditional Practice

- **Technical Feasibility**
- **Economic Viability**
- **Social Acceptability**
- **Environmental Soundness**
- **Operational Sustainability**

ADM Follows

- **Robustness analysis –** performance under different scenarios and extreme events
- **Cost- benefit analysis –** societal costs and benefits
- **Multi criteria analysis –** including non-tangible effects by local and experts' panels
- **Implementation analysis –** institutional and socio-cultural barriers for implementation.

Qualitative or Quantitative

Key Considerations for Project Appraisal

1. Ultimate Goal and Vision like Delta Vision
2. Interim Development Agenda like SDG2030, Vision 2041
3. Future Uncertainties and Sudden Shock
4. Robustness and Flexibility of Adaptation and Measures
5. Additional Opportunities Attributed from Adaptation

"If Plan Does Not Work, Change the Plan not the Vision"

Demonstration of Case Work

Key Tasks to Be Performed: Task 1

Adaptation Options	Effectiveness	Costs	Benefits	Consequences of Interventions	Total MCA Score
Small scale dredging	3	-1	2	0	4
Big-scale River dredging	3	-3	3	-1	2
Introduce stress tolerant (heat, cold, salinity) crop Varieties	…	…	…	…	…
Introduce Short Duration Crop Varieties	…	…	…	..	…
Small Ships					
Large Ships					
Strengthening Embankment up to Certain Height					
Strengthened Early Warning for Flash Floods and Lightening					
Afforestation and Green belt development					
Increased Transboundary cooperation and sign treaty					
Changing Cropping Pattern					
Promote Eco-tourism					
Introduce Low Cost Desalination Techniques					
Promote Surface Water irrigation					
GW recharge					
Reservoir and Rainwater harvesting					
Floating Agriculture					
Elevated House or Flood Proof House					
Construction of Multi-purpose Cyclone Shelter					
Awareness Building Program and Training for Alternative Livelihood Generation					
Institutional Capacity Building for O&M and Financing					
Wise Harness of Resources from Ocean and Expand Blue Economy					
Integrated Fisheries Management					

Step 1.1: Brainstorm Each Group and Identify Best 6 Adaptation Options for Building Present Condition based on Given Problem Statement

Step 1.2: Scoring (+3 to -3) of Individual Adaptation and Estimate Total Score Against Multi-Criteria, Draw Table in Flip Chart

Duration: 15 minutes

You can add more rationale adaptation options to address your problems

Clarifications on Multi-Criteria

You need to consider following 5 criteria:

1. **Effectiveness:** How long a measure perform effectively to address problem and when it fails (tipping points)
2. **Flexibility:** How easily you can switch to another or start
3. **Costs:** Tangible cost of a measure
4. **Benefits:** Tangible benefits of a measure
5. **Consequences of Interventions:** Impacts of interventions on environment, society and opportunities

Key Tasks to Be Performed: Task 1

Present

Adaptation Options	Effectiveness	Costs	Benefits	Consequences of Interventions	Total MCA Score
Small scale dredging	3	-1	2	0	4
Big-scale River dredging	3	-3	3	-1	2
Introduce stress tolerant (heat, cold, salinity) crop Varieties	…	…	…	…	…
Introduce Short Duration Crop Varieties	…	…	…	..	…
Small Ships					
Large Ships					
Strengthening Embankment up to Certain Height					
Strengthened Early Warning for Flash Floods and Lightening					
Afforestation and Green belt development					
Increased Transboundary cooperation and sign treaty					
Changing Cropping Pattern					
Promote Eco-tourism					
Introduce Low Cost Desalination Techniques					
Promote Surface Water irrigation					
GW recharge					
Reservoir and Rainwater harvesting					
Floating Agriculture					
Elevated House or Flood Proof House					
Construction of Multi-purpose Cyclone Shelter					
Awareness Building Program and Training for Alternative Livelihood Generation					
Institutional Capacity Building for O&M and Financing					
Wise Harness of Resources from Ocean and Expand Blue Economy					
Integrated Fisheries Management					

2030

Adaptation Options	Effectiveness	Costs	Benefits	Consequences of Interventions	Total MCA Score
Small scale dredging	3	-1	2	0	4
Big-scale River dredging	3	-3	3	-1	2
Introduce stress tolerant (heat, cold, salinity) crop Varieties	…	…	…	…	…
Introduce Short Duration Crop Varieties	…	…	…	..	…
Small Ships					
Large Ships					
Strengthening Embankment up to Certain Height					
Strengthened Early Warning for Flash Floods and Lightening					
Afforestation and Green belt development					
Increased Transboundary cooperation and sign treaty					
Changing Cropping Pattern					
Promote Eco-tourism					
Introduce Low Cost Desalination Techniques					
Promote Surface Water irrigation					
GW recharge					
Reservoir and Rainwater harvesting					
Floating Agriculture					
Elevated House or Flood Proof House					
Construction of Multi-purpose Cyclone Shelter					
Awareness Building Program and Training for Alternative Livelihood Generation					
Institutional Capacity Building for O&M and Financing					
Wise Harness of Resources from Ocean and Expand Blue Economy					
Integrated Fisheries Management					

2050

Adaptation Options	Effectiveness	Costs	Benefits	Consequences of Interventions	Total MCA Score
Small scale dredging	3	-1	2	0	4
Big-scale River dredging	3	-3	3	-1	2
Introduce stress tolerant (heat, cold, salinity) crop Varieties	…	…	…	…	…
Introduce Short Duration Crop Varieties	…	…	…	..	…
Small Ships					
Large Ships					
Strengthening Embankment up to Certain Height					
Strengthened Early Warning for Flash Floods and Lightening					
Afforestation and Green belt development					
Increased Transboundary cooperation and sign treaty					
Changing Cropping Pattern					
Promote Eco-tourism					
Introduce Low Cost Desalination Techniques					
Promote Surface Water irrigation					
GW recharge					
Reservoir and Rainwater harvesting					
Floating Agriculture					
Elevated House or Flood Proof House					
Construction of Multi-purpose Cyclone Shelter					
Awareness Building Program and Training for Alternative Livelihood Generation					
Institutional Capacity Building for O&M and Financing					
Wise Harness of Resources from Ocean and Expand Blue Economy					
Integrated Fisheries Management					

Step 2 and 3. Perform Step 1 again for Given Future Scenarios in 2030 and 2050 to achieve the Delta Vision by 2100

Duration: 15+15=30 minutes

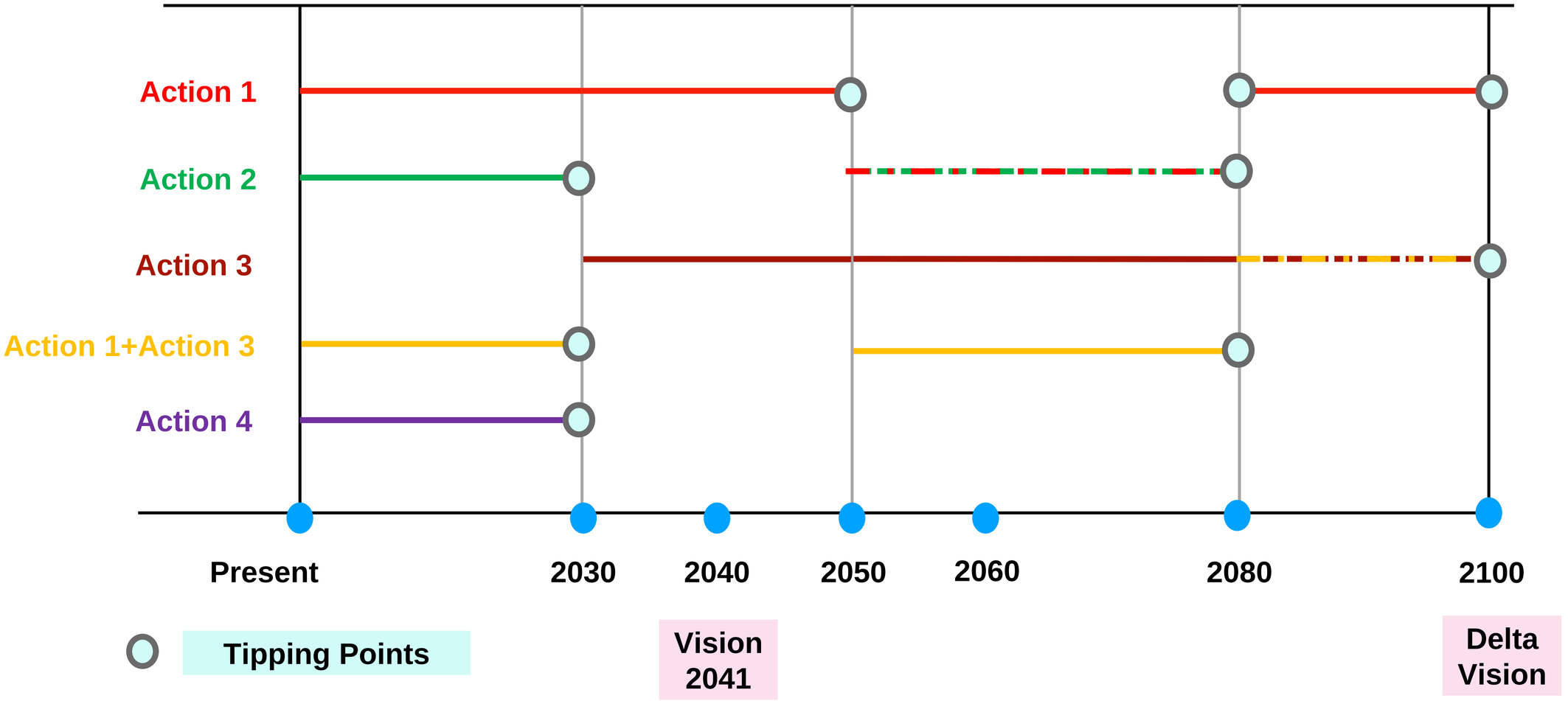
Draw in Flip Chart for Task 1

Brainstorm in a Flip Chart

SL	Present							2030							2050						
	Adaptation	E	F	C	B	I	T.S	Adaptation	E	F	C	B	I	T.S	Adaptation	E	F	C	B	I	T.S
1																					
2																					
3																					
4																					
5																					
6																					

Draw in a Separate Flip Chart

Key Tasks to Be Performed: Task 2



Step 4. Construct Adaptation Pathways in Flip Chart like Above

Duration: 15 minutes

Case Work

Key Facts: Present Condition

Coastal Region

- Sea facing coastal area, downstream region
- Extreme Cyclone in every 5 year, sea level rise, salinity intrusion
- Storm surge height in extreme 4.8m
- Crop production contributes 30% of food security
- SW salinity 3 ppt,
- Cyclone shelter density 1 for 100000
- Population 2 crore (30% of country)
- Financial condition good, poverty 30%
- GDP contribution 35% the region
- Coastal embankment coverage 80% with avg height 5m, 20% in breached condition
- Some Opportunities: marine fisheries and aquaculture, mangrove world heritage, blue economy
- Trans-boundary cooperation: Good
- Gap in freshwater availability and demand: 6 out of 10
- Irrigation demand: 7 out of 10 (70% from GW, 30% from SW)

Barind Region

- Downstream region
- Extreme Drought in every 3 year, sea level rise, salinity intrusion
- Storm surge height in extreme 4.8m
- Crop production contributes 20% of food security
- Irrigation demand: 7 out of 10 (90% from GW, 10% from SW)
- GW depletion rate: 2 m/year
- Waterbody and Wetlands: 30% of the region
- Population 2 crore (30% of country)
- Financial condition good, poverty 30%
- GDP contribution 25% the region
- 90% of total mango production from the region
- Trans-boundary cooperation: Average
- Gap in freshwater availability and demand: 5 out of 10
- Some Opportunities: Fruit like mango, melon, dragon fruits etc, pulses, oil seed cultivation, fisheries

Haor Region

- NE Region, remains under water 6-7 months, downstream region, Resided in just foothill of Meghalaya, the Highest rainfall region
- Extreme Early Flash Floods 1 in every 5 year (20 year return period flood), Normal flash floods every year
- Early flash floods come usually in 1st week of April
- Wave action and river flow capacity reduced due to huge sedimentation in river bed
- Waterbody and Wetlands: 80% of the region, Perennial beels decreasing
- Submergible embankment coverage 60%, design for 10 year return flood, rest all weather road cum embankment
- Crop production contributes 50% of food security, 20% boro production, 20% fish production
- Irrigation demand: 7 out of 10 (60% from SW, 40% from GW)
- Population 2 crore (30% of country)
- Financial condition bad, poverty 55%
- GDP contribution 30% from the region
- Reach ecosystem and biodiversity including Tanguar Haor, RAMSAR site
- Some Opportunities: Fish production, eco-tourism, transboundary trading
- Trans-boundary cooperation: Good
- Gap in freshwater availability and demand: 3 out of 10, accessibility not good although

Ideas of Adaptation

Adaptation Options	Effectiveness	Costs	Benefits	Consequences of Interventions	Total MCA Score
Small scale dredging	3	-1	2	0	4
Big-scale River dredging	3	-3	3	-1	2
Introduce stress tolerant (heat, cold, salinity) crop Varieties	…	…	…	…	…
Introduce Short Duration Crop Varieties	…	…	…	..	…
Small Ships					
Large Ships					
Strengthening Embankment up to Certain Height					
Strengthened Early Warning for Flash Floods and Lightening					
Afforestation and Green belt development					
Increased Transboundary cooperation and sign treaty					
Changing Cropping Pattern					
Promote Eco-tourism					
Introduce Low Cost Desalination Techniques					
Promote Surface Water irrigation					
GW recharge					
Reservoir and Rainwater harvesting					
Floating Agriculture					
Elevated House or Flood Proof House					
Construction of Multi-purpose Cyclone Shelter					
Awareness Building Program and Training for Alternative Livelihood Generation					
Institutional Capacity Building for O&M and Financing					
Wise Harness of Resources from Ocean and Expand Blue Economy					
Integrated Fisheries Management					

Key Facts: 2030

Coastal Region

- Extreme cyclone 1 in 3 years
- Sudden Super Cyclone, Storm surge height 7m, Damage to GDP Contribution 50%
- Salinity increases to 5 ppt due to Sea level Rise, progress towards north additional 50 km
- Financial Crisis, Poverty 45%
- Population 3 crore (35% of country)
- Political Turmoil, Social Demand: 100% embankment protection
- GDP Contribution needs: 40% from the region
- Food security needs 40% contribution from the region
- Livelihood Protection from Damage to Extreme Disaster
- Trans-boundary cooperation: Average
- Irrigation demand: 9 out of 10

Barind Region

- Extreme drought 1 in 3 years
- Sudden Very Severe Drought, Damage to GDP Contribution 50%
- Crop damage 50%, Hunger Crisis
- Mango production contribution drops to 70%
- Political Turmoil, Social Demand: Ensure food and water for all and urbanization
- Waterbody and Wetlands: 25% of the region
- GDP Contribution needs: 30% from the region
- Food security needs 30% contribution from the region
- GW depletion rate 1m/year
- Financial Crisis, Poverty 45%
- Population 3 crore (35% of country)
- Livelihood Protection from Damage to Extreme Disaster
- Trans-boundary cooperation: Good
- Irrigation demand: 9 out of 10

Haor Region

- Extreme Early Flash Floods 1 in every 5 year (20 year return period), Normal flash floods every year
- Wave action and river flow capacity increased due to huge sedimentation in river bed
- Lightening increased with death tool
- Submersible embankment not adequate, needs strengthening to protect crop in early April,
- Perennial beels decreasing
- Waterbody and Wetlands: 60% of the region
- Crop production contributes needs additional 10% for food security
- Fish production contribution needs 40%
- Irrigation demand: 8 out of 10
- Population 3 crore (40% of country)
- Financial condition good, poverty 45%
- GDP contribution needs 40% from the region
- Social demand: Disaster risk reduction, alternative livelihood generation , urbanization
- Trans-boundary cooperation: Good
- Gap in freshwater availability and demand: 3 out of 10, accessibility slightly better
- Trans-boundary trade and eco-tourism flourishes

Key Facts: 2050

Coastal Region

- Extreme Cyclone in every 3 year, sea level rise, salinity intrusion
- GDP contribution needs 45% from the region
- Food security contribution needs 40% from the region
- Salinity increases to 10 ppt due to Sea level Rise, progress towards north additional 10 km
- Financial Condition Fair, Poverty 25%
- Population 4.5 crore (40% of country)
- Freshwater demand increases
- Political Stability
- Trans-boundary Cooperation: Poor
- Mangrove damaged 30% due to urbanization and industrialization
- Irrigation demand: 9 out of 10

Barind Region

- Extreme drought 1 in 2 years
- Sudden 2 Very Severe Drought, Damage to GDP Contribution 70%
- Crop damage 80%, Severe Hunger Crisis
- Mango production contribution drops to 40%
- Political Turmoil, Social Demand: Ensure food and water for all
- Waterbody and Wetlands: 25% of the region
- GDP Contribution needs: 25% from the region
- Food security needs 30% contribution from the region
- GW depletion rate 1m/year
- Financial Crisis, Poverty 50%
- Population 4 crore (40% of country)
- Livelihood Protection from Damage to Extreme Disaster
- Trans-boundary cooperation: Poor
- Irrigation demand: 9 out of 10

Haor Region

- Extreme Early Flash Floods 1 in every 2 year (50 year return period), Normal flash floods every year
- Early flash floods come in 1st week of March!
- Submergible embankments fails to protect crop harvest in early march
- Lightening increased with death tool
- Wave action increased and river flow capacity decreased again due to huge sedimentation in river bed
- Perennial beels reviving
- Waterbody and Wetlands: 70% of the region
- Crop production contributes needs 60% for food security
- Fish production contribution needs 50%
- Irrigation demand: 9 out of 10
- Population 3.5 crore (45% of country)
- Financial crisis, poverty 50%
- GDP contribution needs 40% from the region
- Social trend: displacement, urbanization.
- Social demand: Control pollution from eco tourism and trans boundary trade
- Political turmoil
- Trans-boundary cooperation: Poor
- Gap in freshwater availability and demand: 5 out of 10, accessibility slightly better
- Transboundary Trade and shipping expansion require substantially

Group Presentation and Feedback Session

(30 mins)

Thank You