

# 5

## PLANNING AND IMPLEMENTATION

Sub-category	Definition
Design guidelines (5.1)	Guidelines and standards incorporating disaster and climate risk are developed and used
Land-use and urban planning (5.2)	Land-use and urban plans are prepared by incorporating disaster and climate risk and with an assessment of ecosystem services
Disaster-resilient investments (5.3)	Public and private investments are channelled to strengthen resiliency of critical facilities, including schools, hospitals, evacuation facilities, roads and transport, river and coastal dykes, reservoirs and irrigation networks, forests and retardation areas, etc., and they are implemented in a stage-wise manner
Drought risk reduction (5.4)	Drought risk reduction measures including water saving and agricultural measures are implemented

### GP-5.1a: Design guidelines incorporating climate change, Department of Public Works and Highways (DPWH), the Philippines

**Description of practice:** The Department Order of DPWH “Upgrades on Flood Control and Road Drainage Standards” considering adaptation to climate change was issued in June 2011. This Department Order sets the minimum flood return periods to be used for the design of flood control and road drainage facilities. For rivers, it stipulates a) for principal and major rivers (40km<sup>2</sup> drainage area and above), shall be 50 year flood with sufficient freeboard to contain the 100 year flood, b) for small rivers (below 40km<sup>2</sup> drainage area), shall be 25 year flood with sufficient freeboard to contain the 50 year flood.

**Climate hazards addressed by the practice:** Floods

**DRR and CCA benefits:** Flood safety level can be improved by taking into consideration the climate change impacts.

**Scalability potential:** There is scalability potential. However, it is necessary to check whether the proposed flood control measures will be feasible in technical and economic points of view.

- **Social and political acceptability:** Acceptable and this can be one of the guidelines for planning and designing flood risk management facilities.
- **Economic viability and sustainability:** Necessary to design economical and sustainable flood control facilities. Additional finances may be necessary to accommodate the revised guidelines.
- **Institutional and policy needs:** The Philippine Government has a policy of considering climate change in their DRR. Hence, incorporating CCA into flood control is already among the high institutional and policy priorities of the Philippines

**Source/Contact:** Unified Project Management Office (UPMO) - Flood Control Management Cluster (FCMC), DPWH, the Philippines.

## GP-5.1b: Flood and storm resistant houses in Cambodia, Brunei, Viet Nam, and the Philippines



**Figure 28.** Elevated house beside the river (flood prone area with small flood velocity) (GP-5.1b)

Source: JICA Project Team

**Description of practice:** Flood and storm resistant houses can be found in many ASEAN countries. Many of them are historical practices such as elevated houses in the inundation areas in Mekong Delta in Cambodia. In Brunei, for building houses in flood prone areas where inundation from rivers with small velocity occurs, it is required as a practice like a regulation to build elevated houses. The requirement does not include additional height for water level rise by climate change. However, the elevated houses are also effective in cases of water level rise by climate change. Flood warning and evacuation assistance are also provided to the people living in the inundation areas from the government side in the case of bigger floods. This is one of the potential good practices against climate change impacts. In Danang, Viet Nam, Storm Resistant Houses were introduced in typhoon prone communities with the funding from the Rockefeller Foundation in 2011 and Women's Union was chosen to lead the project due to their good record of accomplishment on financial services and management of funds. In Singapore, PUB assists and advises building owners to humps and flood barriers to protect their basement levels from floodwaters. The water-level sensors in the basement car parks are linked to an alarm system to warn about flooding.

**Climate hazards addressed by the practice:**  
Floods and storms

**DRR and CCA benefits:** This practice will positively benefit people living in flood prone areas, because their houses are above the flood water level, stronger to resist storms or buildings with humps

and flood barriers to protect their basement levels from floodwaters. These houses will enable to conduct normal household operations during normal floods without causing much disturbance to social life and minimizing the evacuation needs. However, in case of bigger floods beyond normal scale, these houses will be also flooded. Therefore, combination with flood warning and evacuation systems is also very important.

**Scalability potential:** There is high scalability potential for applying this practice to flood prone areas with small flood velocity. Elevated housing architecture can be found in many ASEAN countries including Cambodia, Viet Nam, Indonesia and the Philippines.

- **Social and political acceptability:** This practice is acceptable by people who are living in flood prone areas with small flood levels or areas affected by storms.
- **Economic viability and sustainability:** This practice has economic viability to flood and storm prone areas with small population density and where flood mitigation infrastructures are too costly to be constructed. Moderately similar investment may be necessary for erecting houses on stilts compared to normal houses.
- **Institutional and policy needs:** Flood and storm warning and evacuation assistance are also necessary to be provided to people living in hazard prone areas.

**Source/Contact:** National Disaster Management Committee (NDMC), Brunei Darussalam; PUB Singapore, Women's Union Danang, Viet Nam.

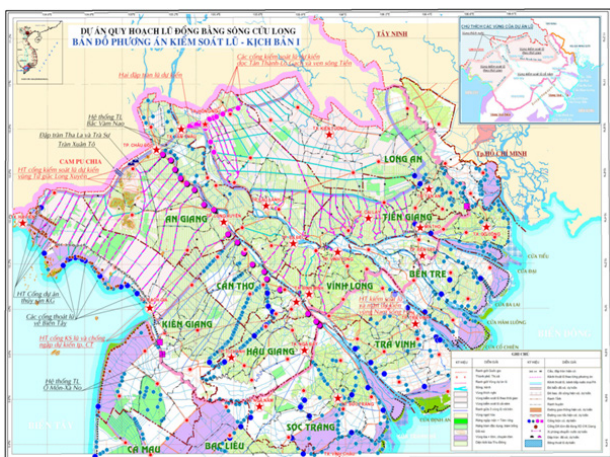
## GP-5.2a: Flood control planning in the Mekong delta by 2020, Vision to 2030, Viet Nam

**Description of practice:** Design flood is the 2000 year flood which with a 100-year return period. Sea water level rise by climate change is also considered. In order not to increase flood water level in the Cambodian border by constructing flood control structures in the Viet Nam side, introducing floodwater through sluice gates to inland delta area from the river for retention is proposed, so that the flood water level along the rivers will not raise (non structural measures).

**Climate hazards addressed by the practice:**  
Floods

**DRR and CCA benefits:** Flood damage to Autumn–Winter paddy fields will be reduced by implementing the flood control plan.

**Scalability potential:** Basic concept of not increasing flood water level by utilizing retarding







**Figure 31.** Bago River flood control and navigation canal system (Bago Sittaung Canal) (GP-5.2c)

Source: Map from IWUMD | Photos by: JICA Project Team

## GP-5.2c: Bago River flood control in Myanmar

**Description of practice:** This is a potential good practice for CCA integration by possible stage wise improvement against climate change impacts in the future. The Bago River Flood Control System is a complex system also affected by the floodwater from the Sittaung River and the system is important for water resources management in the area. Bago Sittaung canal is useful for retention of water for water transportation. Moe Yin Gyi Lake and Ramsal wetland site are used for retarding and water storage, and several flood control dams and water use dams were constructed for irrigation, etc. Bago Sittaung Canal and Moe Yin Gyi Lake were constructed about 140 years ago and there is an accumulation of experience of how these systems interacted with the climate change over these years.

**Climate hazards addressed by the practice:** Floods and droughts

**DRR and CCA benefits:** Floods have been mitigated to some extent. Some flooding problems remain while the drought and related water

scarcity were significantly reduced due to retention and distribution of water to places where it is needed.

**Scalability potential:** The above practice is for specific areas. Hence, there is a limited scalability potential.

- **Social and political acceptability:** The above practice has been highly accepted by people and political entities over the past 140 years.
- **Economic viability and sustainability:** These flood control systems have lasted for 140 years indicating their sustainability and viability. However, as the existing system is complex, reviewing the system and updating the integrated flood and drought risk management plan is necessary to be formulated for more effective implementation of flood prevention and mitigation in the area especially with climate change impacts.
- **Institutional and policy needs:** Meteorological observation system is very much insufficient and does not cover the upstream sub-river basins in the area. Hence, cooperation with other agencies especially

for strengthening the meteo-hydrological observation systems for covering the whole Bago River Basin as well as the related stretch of the Sittaung River is necessary.

**Source/Contact:** IWUMD, Myanmar.

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### GP-5.2d: Landslide disaster risk management in Banjarnegara municipality, Indonesia

**Description of practice:** The Banjarnegara municipality (Kabupaten) in Central Java Province is a mountainous area. About 70% of the municipal area belongs to the high-risk area of landslide. On December 14, 2014, a large deep landslide occurred at Sampang District due to heavy rain, causing more than 135 deaths. Currently, monitoring of rainfall and slope movement is being conducted. Also, land use management in the disaster areas is conducted so as not to build houses in the disaster area again. These measures are among the basic measures for landslide risk management (LRM), and will be also effective in the case with climate change impacts.

**Climate hazards addressed by the practice:**

Rain induced landslide

**DRR and CCA benefits:** It is rather difficult to link climate change impact on landslide phenomena. Therefore, it is important to provide non structural and structural measures against landslide even without climate change and such measures will benefits to the people by mitigating damage by landslides.

**Scalability potential:** There is a high scalability potential for areas with similar landslide problems. However, the combination of non structural measures such as land use management in the high-risk areas of landslide and structural measures such as check dams and sand retarding basin is necessary to be considered for mitigating damage by landslides.

- **Social and political acceptability:** There is high acceptability of the above measures against landslides, because land use management in high risk areas is commonly conducted in the areas with landslide problems.
- **Economic viability and sustainability:** The above land use management is viable from the economic point of view, and sustainable.
- **Institutional and policy needs:** There are many similar high-risk areas in Banjarnegara municipality. It is necessary to manage the high-risk areas of landslide including the restriction of land use such as not building houses in high-landslide risk areas and allow agricultural activities in normal time. For this, it is necessary to upgrade landslide hazard



**Figure 32.** Banjarnegara municipality landslide at Sampang district in Banjarnegara municipality in Central Java, Indonesia (GP-5.2d)

Source: BPBD

maps so that the hazard maps can show high-risk areas in detail based on more detail topographic maps.

**Source/Contact:** BPBD Banjarnegara Municipality, Indonesia.

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### GP-5.2e: Landslide disaster management in Guisauon in southern Leyte province, the Philippines

**Description of practice:** Large deep sliding of the mountain slope with debris flow occurred in Guisauon, Saint Bernard Municipality, Southern Leyte Province, on 17February 2006, due to the prolonged heavy rainfall, killing 1,100 people including 250 schoolchildren. The people of Barangay Guisauon and the surrounding 6 barangays were relocated. Land use management in dangerous areas including prohibition of building houses and only allowing farming such as rice cultivation has been conducted by the municipality.

**Climate hazards addressed by the practice:**

Rain induced landslide

**DRR and CCA benefits:** It is important to provide non-structural and structural measures against landslide even without climate change. These measures will benefit people by mitigating damage by landslides.

**Scalability potential:** There is high scalability potential for the areas with similar landslide problems. However, combination with non structural and structural measures is necessary to consider for mitigating damage by landslides.

- **Social and political acceptability:** There is high acceptability of the above measures against landslides.
- **Economic viability and sustainability:** The above land use management is viable from the economic point of view, and sustainable.





Deep sliding with debris flow on Feb 17, 2006 in and around Barangay Guisaugon

Source: San Bernard Municipality



Current Condition of the collapsed slope (Feb. 1, 2017)

Source: JICA Project Team

**Figure 33.** Landslide disaster area in Guisaugon, Saint Bernard Municipality, Leyte, the Philippines (GP-5.2e)

- **Institutional and policy needs:** It is necessary to manage the high-risk areas of landslide including restriction of land use based on detailed landslide hazard and risk maps as much as possible

**Source/Contact:** Saint Bernard Municipality in Southern Leyte Province, the Philippines.

### GP-5.2f: Integrated operation of Jatilhur dam in the Citarum river, Indonesia

**Description of practice:** Jatilhur Dam in the Citarum River is a multipurpose dam with gross storage of 3,000 Million Cubic Meters (MCM), supplies about 80% of water for drinking in Jakarta and other areas, and supplies a large amount of irrigation water. Integrated operation has been conducted with upstream hydropower dams like the Cirata Dam (gross storage: 2,165 MCM) and the Saguling Dam (gross storage: 881 MCM) for stable



**Figure 34.** Jatilhur Dam (Reservoir and Spillway) in Citarum River, Indonesia (GP-5.2f)

Source: JICA Project Team

water supply as well as flood control.

**Climate hazards addressed by the practice:** Floods and droughts.

**DRR and CCA benefits:** If CCA is incorporated in the integrated operation of the above dams, enough safety level against floods and drought to the downstream areas of Jatilfur Dam can be ensured even with climate change.

**Scalability potential:** The concept of integrated operation of dams has high scalability potential for application in dams in other river basins.

- **Social and political acceptability:** Acceptable without any major problem due to minimal impacts during the establishment of such dams. Integrated operation of dams will be effective for efficient water resources management and flood risk management in river basins.
- **Economic viability and sustainability:** Integrated operation of dams does not need huge investment and can produce additional benefits than the normal dam operation.
- **Institutional and policy needs:** In order to realize integrated operation of dams with different purposes in countries, institutional and policy set-up between different agencies responsible for dams for cooperation for the integrated operation of dams against floods and droughts are very much necessary.

**Source/Contact:** Jasa Tilta II, Indonesia.



Slit Dam in the Anilao River Upstream Reach

River Improvement in the Mid-stream to Downstream Reaches of the Anilao River

**Figure 35.** Flood control facilities in Ormoc City, Leyte Province, the Philippines (GP-5.3a)

Source: JICA Project Team

### GP-5.3a: Slit dam in the upstream of Anilao river, Ormoc City, the Philippines

**Description of practice:** In November 1991, severe damage including 4,922 deaths and 3,000 missing people occurred in Ormoc City due to the flash floods from Anilao River and Malbasag River caused by overflow from the rivers as well as clogging of bridges by floating logs and debris during Typhoon Uring. Three slit dams were constructed to capture floating logs and debris. River improvement was conducted in the mid stream to the downstream reaches of these rivers. Maintenance of the slit dams including removal of logs and debris and that of the improved river reaches including dredging and cutting vegetation have been conducted by Ormoc City through the Flood Management Committee (FMC). Under the FMC, easement zones (bank areas) along the rivers have been managed under cooperation by the community (barangay) people, so as not to build illegal houses in the bank areas.

Climate hazard addressed by the practice: Flash floods with floating debris

**DRR and CCA benefits:** These practices have benefited the people of Ormoc City by ensuring additional safety to people, assets and economy against floods. There is a need to assess the climate change adaptation potential of these interventions.

**Scalability potential:** This practice has high scalability potential to rivers with similar flash flood and floating log problems.

- **Social and political acceptability:** There is high acceptability, because the people of Ormoc City accepted the project and cooperated for maintaining the facilities including easement

zones (bank areas) of the improved stretches of the rivers.

- **Economic viability and sustainability:** This practice has economic viability and sustainability.
- **Institutional and policy needs:** A Flood Management Committee (FMC) has been established in Ormoc City, and it has maintained the slit dams and improved river reaches along the rivers for maintaining the easement zones with the cooperation of communities.

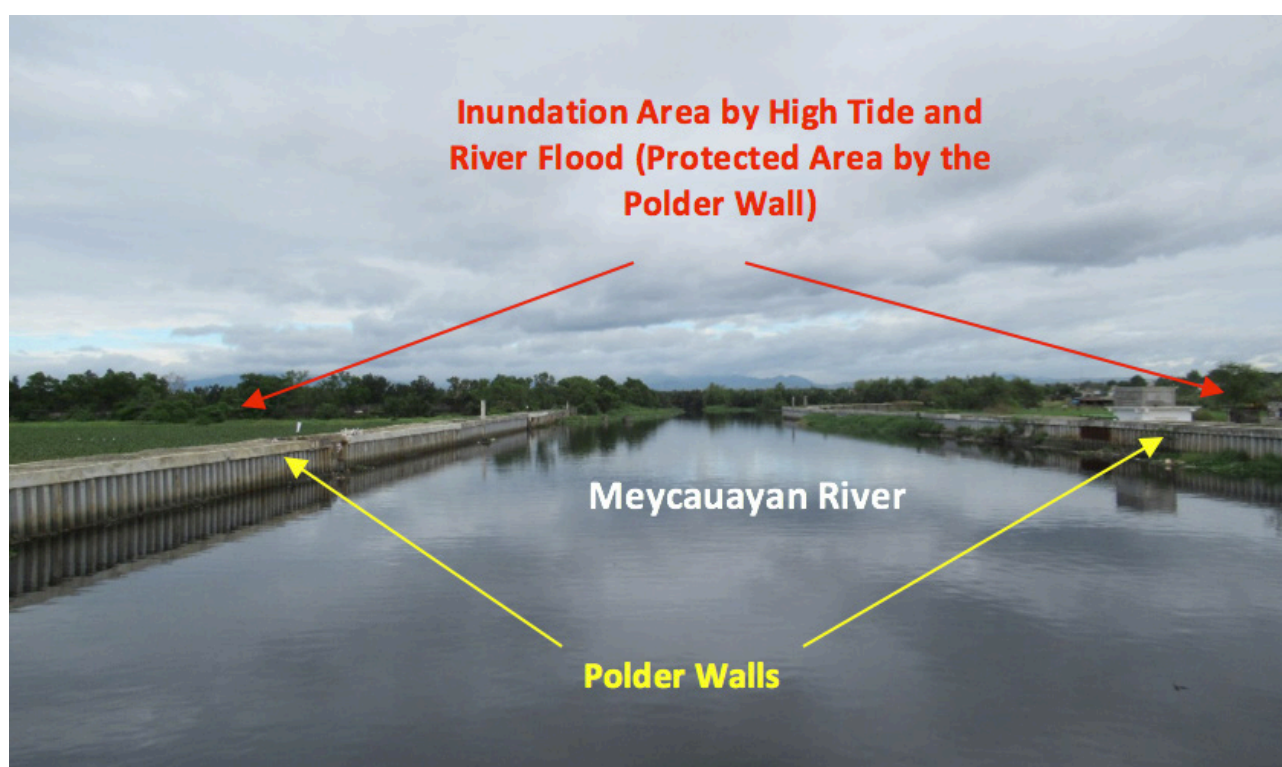
**Source/Contact:** Ormoc City Disaster Risk Reduction and Mitigation Office, Leyte, the Philippines.

### GP-5.3b: Polder wall for protecting Valenzuela–Obando–Meycauayan (VOM) area from inundation by high tide and river flood, Metro Manila, the Philippines

**Description of practice:** The VOM Area is a coastal wetland area and many houses in the low-lying area are affected by recurrent inundation during high tide and by floodwater from the Meycauayan River. The design highest water level (HWL) is set at the recorded maximum tide water level. The polder walls include additional 30cm for sea water level rise by climate change. Above the design high water level including sea water level rise of 30cm, 60cm of freeboard is added to set the top of the polder walls.

**Climate hazards addressed by the practice:** Sea water level rise and floods





**Figure 36.** Polder wall including height for sea water level rise in VOM Area, Metro Manila, the Philippines (GP-5.3b)  
Source: JICA Project Team

**DRR and CCA benefits:** This practice will provide several flood risk reduction benefits to the people, assets and economy in the inundation areas affected by high tide, sea water level rise and floods.

**Scalability potential:** This practice has scalability potential for the areas affected by sea water level rise and floods.

- **Social and political acceptability:** This practice has acceptability from social and political points of view. Drainage pumps are also necessary to be installed to drain rainwater for preventing inland floods.
- **Economic viability and sustainability:** Initial costs are high but benefits will outweigh in the end.
- **Institutional and policy needs:** Enough budget for maintaining the facility is necessary.

**Source/Contact:** Flood Control Management Cluster (FCMC), UPMO, DPWH, the Philippines

### GP-5.3c: Polder dike for protecting Ben Tre province, Viet Nam

**Description of practice:** Ben Tre Province is one of the provinces in Mekong Delta where floods and droughts are problems. Agriculture such as paddy and coconut plantation, as well fish culture, are widely conducted in the province. In order to

solve the flooding problems, coastal dikes with sluice gates are being constructed to form a polder system (ring dikes) for protecting the agricultural areas against floods by the government of Viet Nam and World Bank. The height of coastal dike is set considering sea level rise.

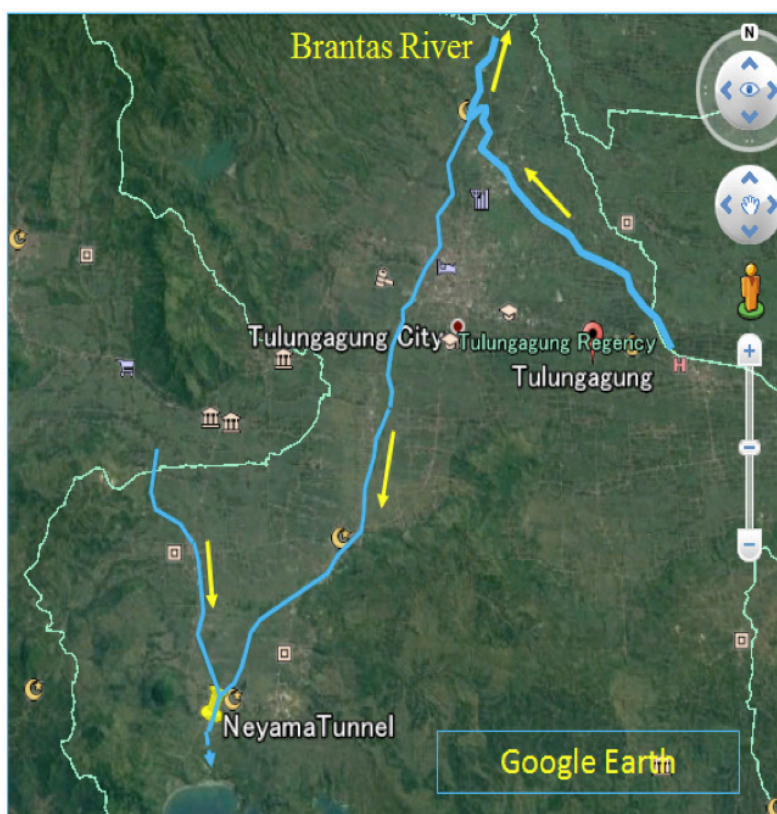
**Climate hazards addressed by the practice:** Sea level rise and floods

**DRR and CCA benefits:** This practice will benefit the areas affected by sea level rise and floods by mitigating floods.



**Figure 37.** Polder dike including height for sea water level rise for protecting delta area of the Mekong River in Ben Tre Province, Viet Nam (GP-5.3c)  
Source: JICA Project Team





Phase I tunnel (Right) and intake of power station (Left)



Phase II tunnel

**Figure 38.** Tulungagung Neyama Tunnel in the Brantas River Basin in East Java (GP-5.3d)

Source: JICA Project Team

**Scalability potential:** This practice has high scalability potential for the areas affected by sea level rise and floods.

- **Social and political acceptability:** This practice has acceptability from social and political points of view.
- **Economic viability and sustainability:** No information is available about its economic viability and sustainability.
- **Institutional and policy needs:** Enough budget for maintaining the dike is necessary.

**Source/Contact:** Ben Tre Provincial Government Office, Viet Nam.

### GP-5.3d: Floodway tunnel (Neyama tunnel) in the Brantas river basin, Indonesia

**Description of practice:** Tulungagung Area was originally a flood-prone marshland with floodwater coming from the Brantas River and its tributaries. To solve the flooding problem, a tunnel floodway called “Neyama Tunnel” was constructed with design discharge of 1,000m<sup>3</sup>/s to discharge floodwater to the Indian Ocean which solved the flood problem and improved the agriculture. This project does not include CCA, but it can be one of the potential good practices due to the possibility of installing an additional retention pond in the

upstream wide area along the inlet canal for not increasing flood peak discharge in case of climate change impacts.

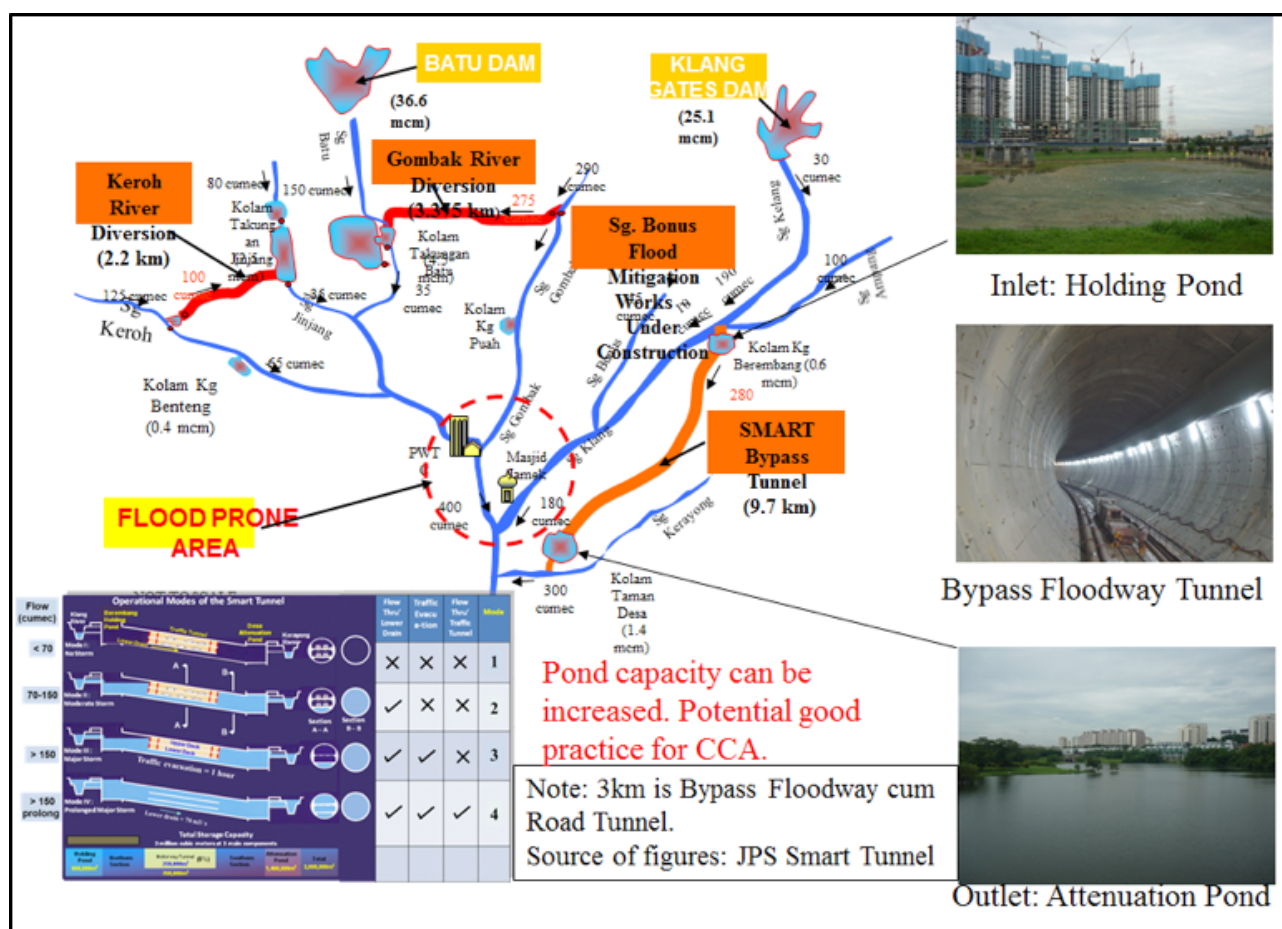
**Climate hazards addressed by the practice:** Floods

**DRR and CCA benefits:** This practice has made significant benefits to the people in the area for ensuring safety of people, physical assets and agricultural areas against floods. Furthermore, this practice has contributed development of the area by mitigating flood problems in the area.

**Scalability potential:** This practice has scalability potential for the possibility of adding CCA elements.

- **Social and political acceptability:** This practice has acceptability from social and political points of view due to the fact that the area has been developed since implementation of this practice.
- **Economic viability and sustainability:** This practice has economic viability due to large benefit to the areas for agricultural and socio-economic development in the areas.
- **Institutional and policy needs:** Enough budget for maintaining and operating the facilities is necessary.

**Source/Contact:** Jasa Tilta I, Indonesia



**Figure 39.** Smart Tunnel in Kelang River Basin, Kuala Lumpur, Malaysia (GP-5.3e)

Source: Smart Tunnel Management Office of JPS (DID) for schematic map, figures and photo of tunnel and JICA Project Team for photos of ponds

## GP-5.3e: Smart tunnel and retention ponds, Kuala Lumpur, Malaysia

**Description of the practice:** Smart Tunnel is one of the flood control facilities of integrated flood risk management (FRM) system in Kelang River to protect Kuala Lumpur (especially the central area) from floods. JPS (DID) has the responsibility of managing the Smart Tunnel. Smart Tunnel is a kind of floodway tunnel with retention ponds at the inlet and outlet of the Tunnel Floodway to minimize flood discharge from the Kelang River to the centre of Kuala Lumpur. The design discharge of 290m<sup>3</sup>/s in the Kelang River is divided into 280m<sup>3</sup>/s for the Smart Tunnel and 10m<sup>3</sup>/s for the downstream of the river. CCA elements are not included in this Project. However, retention capacities can be increased by enlarging the inlet and outlet retention ponds to some extent in case of additional climate change impacts. SMART Tunnel has been functioning well due to good management. This can be considered as a special example for mitigating floods in Kuala Lumpur, as an example of urban flood control facility.

### Climate hazards addressed by the practice:

Floods

**DRR and CCA benefits:** This practice has made significant benefits by mitigating floods in the central part of Kuala Lumpur.

**Scalability potential:** This practice has scalability potential for the possibility of adding CCA elements such as increasing capacity of retention ponds in the similar urban areas with flood problems. More suitable in flood prone and traffic congested areas.

- **Social and political acceptability:** This practice has acceptability from social and political points of view in very much developed urban areas such as metropolitan areas
- **Economic viability and sustainability:** This can be considered as a costly infrastructure. This practice has economic viability due to significant benefit to the areas. Sustainability is ensured with better operation and maintenance of the flood control facilities as well as utilization of bypass tunnel for transportation
- **Institutional and policy needs:** Enough budget and staff for maintaining and operating the facilities are necessary.

**Source/Contact:** Smart Tunnel Management Office of JPS (DID), .





**Figure 40.** A cyclone shelter in Ayeyarwady Delta in Myanmar (GP-5.3f)

Source: JICA Project Team

### GP-5.3f: Cyclone shelters in Ayeyarwady Delta, Myanmar

**Description of practice:** Disasters such as Cyclone Nargis with storm surge occurred in the Ayeyarwady delta in Myanmar killing about 140,000 people in 2008. For evacuation, cyclone shelters have been constructed in the Delta Area. The cyclone shelters may not fully address climate change impacts, although these will also be effective under climate change impacts. These kinds of cyclone shelters are multi-functional buildings, since they are used as school buildings etc. during normal time.

**Climate hazards addressed by the practice:** Storm surge

**DRR and CCA benefits:** This practice has provided significant benefits to people living in the delta area with high risk of storm surge so that people evacuated to these shelters are safe during storm surge. During the normal time, the cyclone shelter can provide space for operating a school.

**Scalability potential:** This practice has scalability

potential in similar risk areas of storm surge even with climate change.

- **Social and political acceptability:** This practice has acceptability from social and political points of view.
- **Economic viability and sustainability:** This practice has economic viability due to significant benefit to the affected communities. This practice has sustainability since this practice has been operated and maintained well and utilized as school during normal time.
- **Institutional and policy needs:** Enough budget for maintaining the facility is necessary. Community people are necessary to cooperate for maintaining the facility.

**Source/Contact:** Ayeyarwady Region, Myanmar

### GP-5.3g: Riverbank protection using the Soda method, Lao PDR

**Description of practice:** This is a low-cost and sustainable riverbank protection technology from Japan introduced under a JICA project. Most of the riverbank protection works adopted by Lao PDR used Gabion Work, which are high in cost due to the use of gabion wire and difficulty in procuring materials (steel wire) and equipment. In Soda method, wooden branches are bundled as “rensai” (tie-beam of soda), and assembled as 3 layers of lattice structure with hurdle work on the top. The mattress is submerged by putting rubble stones on it to place on the river bottom to protect riverbed against scoring. Soda mattress acts well as foot protection work and creates harmonious riverine environment. Materials used are mainly broadleaf trees, which are readily available locally, hard and tough wood such as chestnut, oak, live oak, and sawtooth oak as well as flexible and sticky wood such as Japanese snow bell, Japanese rowan.



**Figure 41.** Riverbank protection using the Soda method, Lao PDR (GP-5.3g)

Source: JICA<sup>5</sup>

<sup>5</sup> <https://www.jica.go.jp/project/english/laos/003>



**Climate hazards addressed by the practice:**  
Floods

**DRR and CCA benefits:** It complements implementation of both DRR and CCA benefits due to protection of riverbanks from erosion and future floods.

**Scalability potential:** The technology has a high scalability potential to areas wherever suitable materials are available

- **Social and political acceptability:** Since the method uses locally available materials, there is direct involvement of the local people in its construction and maintenance.
- **Economic viability and sustainability:** Its main attraction is low-cost and environmentally friendly. The Soda mattress is flexible and durable in water, suitable to sandy riverbed as foot protection and a good habitat for aquatic animals.
- **Institutional and policy needs:** Coordination between forestry agency and Department of Waterways, Ministry of Public Works and Transport is necessary

**Source/Contact:** 1) JICA. 2014. JICA Project on Riverbank Protection Works Phase II. Tokyo, Japan: Japan International Cooperation Agency. Available at <https://www.jica.go.jp/project/english/laos/003/outline/index.html>. 2) NARBO. 2009. IWRM Guidelines at River Basin Level – Part 2-2: The Guidelines for Flood Management. UNESCO, World Water and NARBO. Available at <http://unesdoc.unesco.org/images/0018/001864/186420e.pdf>.

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### GP-5.3h Hanging fertigation, Malaysia

**Description of practice:** In this technique, vegetables are grown in a bag with soil media that is hung to a pole so that the crops remain unaffected during the period of inundation. This



**Figure 42.** Fertigation for gourds (GP-5.3h)

Source : MOA, Malaysia

technique is used in flood-prone areas to prevent crop damage and loss of fertility with floods.

**DRR and CCA benefits:** It complements both DRR and CCA as the technique is also water efficient as it employs fertigation by drips connected to each bag, making fertilization possible even during floods. The technique has been found advantageous to control pest infestation, extend harvesting period, better exposure to sunlight and higher yield.

**Climate hazards addressed by the practice:**  
Floods

**Scalability potential:** Effective in areas prone to inundation and could be easily adapted by individual farmer. MOA is considering it as a potential approach in flood prone areas.

- **Social and political acceptability:** The practice is highly acceptable due to income generation even during floods.
- **Economic viability and sustainability:** The approach is profitable and reduced risk of crop damage. Labour intensive (including need for uniformly tall labour), need higher cost and risk of structure collapsing are some of the disadvantages
- **Institutional and policy needs:** Government could provide suitable incentives in terms of financial subsidy and capacity building of farmers about the know-how and provision of materials (poles, drip irrigation, fertigation and crop types), to promote this practice both under DRR and CCA interventions.

**Source/Contact:** Ministry of Agriculture (MOA), Malaysia.

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### GP-5.3i: Improved forest management in various ASEAN countries

**Description of the practice:** Forest Management is actively conducted in general in Myanmar, Thailand and Viet Nam. This can be said as a good practice for DRR and CCA as a non-structural measure against floods, landslides and water resources management for reducing the surface runoff, reducing sediment production from upper river basins and for storing water by natural storage function in forest areas.

**Climate hazards addressed by the practice:**  
Rainfall runoff, floods, landslide and drought

**DRR and CCA benefits:** This practice has provided significant benefits to the river basins with flood, landslide or drought problems by not increasing flood discharge and sediment production from the upper river basins and storing water in the mountainous areas and maintaining base flow in the rivers. As a non-structural



Ba Vi National Park, Viet Nam

Source: Viet Nam Administration of Forestry



Myanmar: Private Teak Plantation

Source: Forest Department, Myanmar



Thailand: Community Forest Reforestation Activity

Source: Royal Forest Department



Mangrove Forest Rehabilitation in Thailand to protect coastal erosion by waves and currents

Source: JICA Project Team

**Figure 43.** Diverse forest management practices in ASEAN countries (GP-5.3i)

measure, forest ecosystem has important role in regulating flows, controlling erosion and landslides and retarding rainfall flows and reducing runoff intensity.

**Scalability potential:** These practices are highly scalable to other river basins in the ASEAN region.

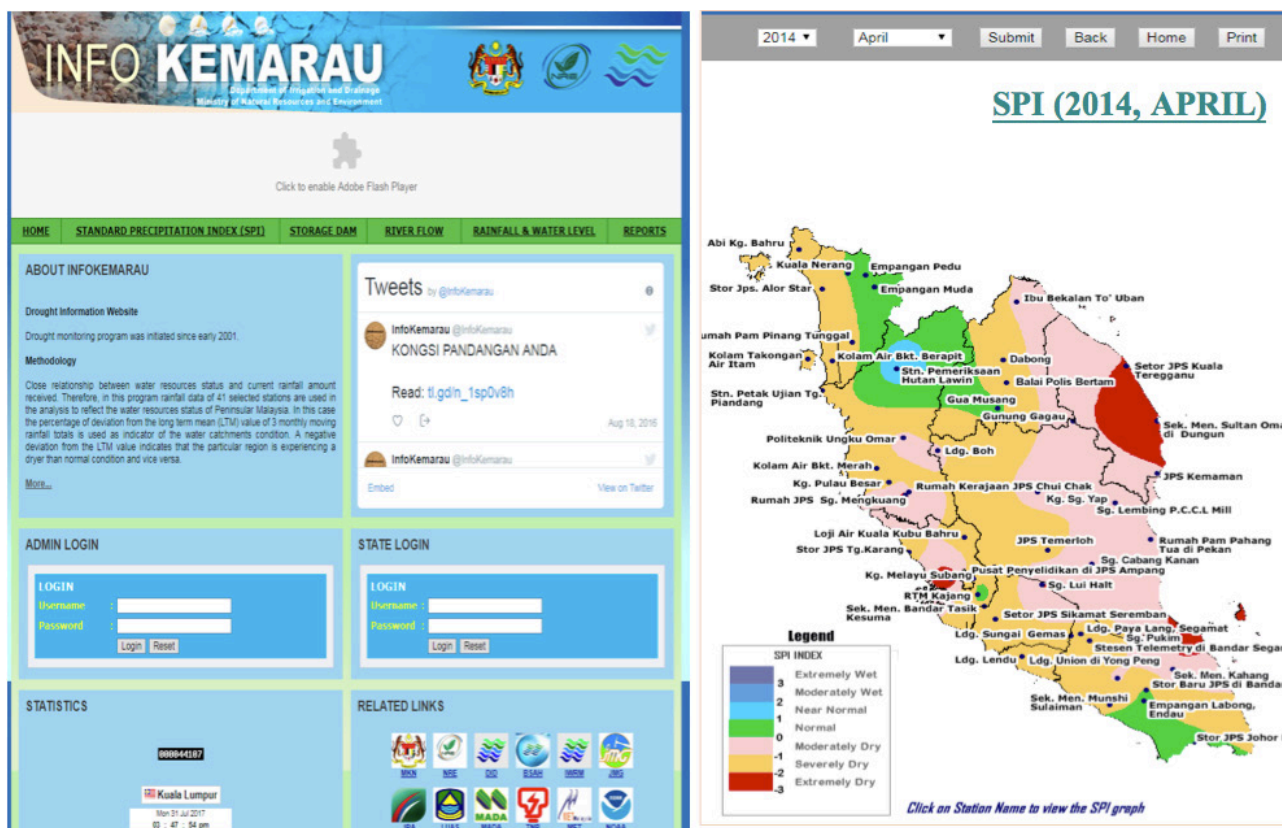
- **Social and political acceptability:** These practices are acceptable from social and political points of view and also from environmental point of view.
- **Economic viability and sustainability:** These practices are economically viable and sustainable for the reason of not increasing flood and landslide disaster risks and increasing water resources potential in the river basins. Effective if implemented through community participation. Mobilization of international financing such as REDD+ and use of other payment for ecosystem services schemes could also contribute sustainable forest management.

**Source/Contact:** Forestry Department (FD), Ministry of Resources and Environmental Conservation (MOREC), Myanmar; Royal Forest Department, Thailand; Viet Nam Forest Administration Office, Ministry of Agriculture and Rural Development (MARD).

### GP-5.4a Drought information platform in Malaysia and Thailand

**Description of practice:** Malaysia and Thailand have established web-based platform for sharing drought information. Department of Irrigation and Drainage (DID), Malaysia has initiated drought monitoring program in 2001. The characteristics of InfoKemarU are based on an approach of 'Non-Structural Measures' such as map of high risk areas for drought, adaption of droughts, and awareness raising/capacity building and drought warning system. InfoKemarU shares information on Standard Precipitation Index (SPI), dam water level and river flow to prepare monthly drought reports. Thailand Drought Monitoring Center reports





**Figure 44.** An example of web-based drought information platform in Thailand (GP-5.4a)

Source: DID Malaysia

various information relevant to drought. It shares information about distribution of rice grown areas, satellite based indices for vegetation (NDVI) and wetness (NDWI), and monthly reporting of drought affected low humidity areas.

**Climate hazards addressed by the practice:** Drought

**DRR and CCA benefits:** Information shared by these platforms could be used for both DRR and CCA related decision making.

**Scalability potential:** This kind of platform could be relevant mainly in drought prone areas

- **Social and political acceptability:** Could be very useful to farmers if information could be shared via mobile phones.
- **Economic viability and sustainability:** For economic viability, such platform could be mainly targeted at drought prone areas and a cost sharing mechanism could be developed with the provider of crop insurance services.
- **Institutional and policy needs:** Government funding and human resource capacity is vital.

**Source/Contact:** Department of Irrigation and Drainage (DID), Malaysia, Geo-Informatics & Space Technology Development Agency (Public Organization), Thailand.

## GP-5.4b: Water user associations, Cambodia

**Description of practice:** Water user associations (WUAs) are the groups of farmers who come together to organize themselves in a systematic manner so that the financial, technical and physical resources are used efficiently to manage the limited water resources among the members of the association and to ensure equitable distribution of water even during the time of disaster such as drought. Promoting a form of participatory water management, the WUAs manage the tertiary irrigation infrastructure and schedule irrigations among the farmers depending on the crop needs. These water user associations were established with ADB support in 2011. Members pay 20000 riel per ha per crop to association.

**Climate hazards addressed by the practice:**

Water user associations help manage both droughts and floods by operating canals in such a way that the water do not stagnate in the fields or do not lead to excessively deficit.

**DRR and CCA benefits:** WUAs have helped enhance the water use efficiency in water scarce regions. Increased the area under irrigation by 50% at Krouch Saeuch alone through saving water in the upstream areas (1,000 ha irrigated) and





**Figure 45.** Office of a water user association in Cambodia (GP-5.4b)

Source: JICA Project Team

diverting it to the further deeper downstream areas (500 ha). As a result, yields increased by 1-2 tons/ha, living standards of farmers increased and they are able to cultivate three crops in a year.

**Scalability potential:** Water user associations are highly scalable and it is evident from many other ASEAN countries where such associations are thriving as in case of Malaysia, Indonesia, Viet Nam, Lao PDR and the Philippines.

- **Social and political acceptability:** The success and fast spreading of WAUs in Cambodia and elsewhere indicate that they are fairly well accepted both socially and politically but also depends on the active participation of the community and good governance on cost and benefit sharing.
- **Economic viability and sustainability:** These associations have thrived with no or limited failure. However, they need to be provided with the technical and financial management capacity.
- **Institutional and policy needs:** Institutional support for technical and financial management capacity as well as formalization of the WUA can help to improve the performance of WAUs and a policy support for their formulation and proper function

**Source/Contact:** Ministry of Agriculture, Forestry, and Fisheries, Cambodia.

### GP-5.4c: Sprinkler irrigation in drought prone areas, Viet Nam

**Description of practice:** Sprinkler irrigation consist of piped-distribution of water to the point of delivery and application through an array of sprinklers, reducing the amount of water used while obtaining the same or more yield per unit



**Figure 46.** Sprinkler irrigation in the asparagus field (GP-5.4c)

Source: JICA Project Team

area. Traditionally, farmers grow vegetables using flood and furrow irrigation practices that are low in irrigation water use efficiency, leading to high water use and low productivity, which is detrimental to agriculture production in the drought-prone areas.

**Climate hazards addressed by the practice:** Drought

**DRR and CCA benefits:** Reduced water use (>60% compared to conventional methods), high crop productivity (>15% compared to traditional practice) and quality produce, reduced energy and fertilizer use (up to 30% reduction), better income, reduced crop loss, better integration with surface and sub-surface water sources, integration with the renewable energy use. Up to 60% of migrated farmers shifted to agriculture in the Tuan-Tu village after introduction of the sprinkler irrigation.

**Scalability potential:** Highly scalable to all drought prone areas with limited water supply including sandy soils where other forms of irrigation provide least efficiency. Sprinkler irrigation is rapidly expanding in several ASEAN countries.

- **Social and political acceptability:** Initial training is necessary for installation, operation and maintenance of irrigation systems. Highly acceptable, no known issues.
- **Economic viability and sustainability:** Initial subsidies are necessary for poor farmers and promoting local entrepreneurs can reduce the long-term costs. Profits sustain the higher adoption rate.
- **Institutional and policy needs:** subsidies targeting the poor farmers, training of extension agents on new irrigation and related agronomic practices.

**Source/Contact:** Implementation Unit for Capacity Development and ODA Water Resources Projects, Phan Rang, Ninh Thuận province, Viet Nam.

#### GP-5.4d: Recycled water for supplementary irrigation in water-scarce areas of Perlis, Malaysia

**Description of practice:** Recycling irrigation water constitutes circulating the drainage water from one part of the irrigation command area to irrigate additional cropped area by mixing it with fresh water so that the overall area under irrigation can be expanded without compromising the crop yields and soil health. Reuse the drainage water from the irrigated paddy fields of Muda Agriculture Development Agency (MADA) area for irrigating the paddy fields outside the MADA region, either mixing with the normal irrigation water from Timah-Tasoh or to use as such during the drought spells. The recycled water project has been in place since 2007.

#### Climate hazards addressed by the practice:

Largely targets the droughts and related water scarcity

**DRR and CCA benefits:** The recycled water provided three full days of irrigation to more than 6000 ha in the April month of 2016 during the 2015-16 drought. As a result, farmers in this area were saved from crop loss while others outside this irrigated area were severely impacted by drought and lost their crop. Saving of crop during the drought had spill over impacts in terms of employment generation during the drought period sustaining the livelihoods of thousands of farm workers and farmers.

**Scalability potential:** Water recycling is scalable in areas where water can be diverted to mix with the fresh water and use in the downstream.

- **Social and political acceptability:** Initial acceptance could be a challenge due to fears of poor quality water impacting soils and possible disease and pest transmission.
- **Economic viability and sustainability:** Once fears of pest and disease infestations are addressed, the system is highly viable with its

advantages clearly visible during the water scarce years.

- **Institutional and policy needs:** Capacity building of farmers for healthy management of fields, water and soil testing facilities for monitoring and policy support for infrastructure and coordination.

**Source/Contact:** Muda Agriculture Development Agency (MADA), Kedah, Malaysia.

#### GP-5.4e: Salinity intrusion monitoring, Viet Nam

**Description of practice:** ISET worked with city and local administrations in establishing a real-time salinity monitoring system that provides real-time data to different sectors in Can Tho city and send SMS alerts to water management authorities to operate the gates on rivers and canals arresting the saline water intrusion. Eight monitoring stations were established to monitor the salinity levels. The results persuaded the Cai Rang district to construct Dat Set dam for salinity control.

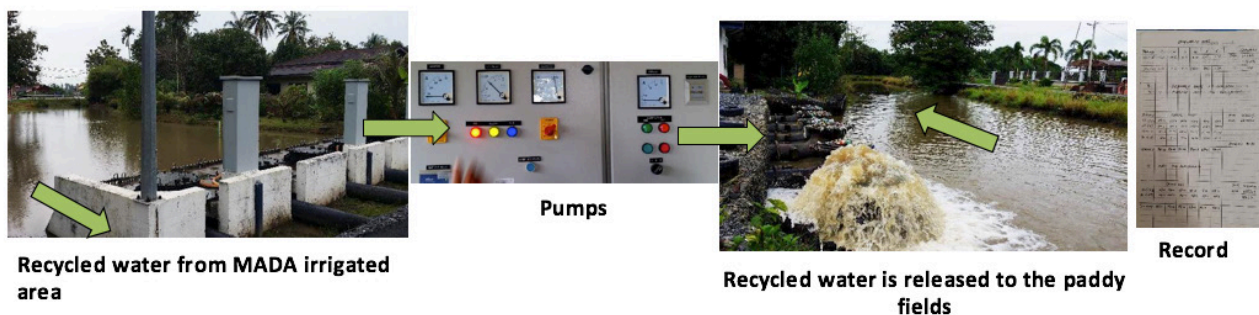
#### Climate hazards addressed by the practice:

Drought and related saline water intrusion in coastal areas

**DRR and CCA benefits:** The SMS alerts are helping water resource management authorities to operate the gates in time controlling the saline water intrusion. Stronger sea tide and saline intrusion are worsening the water scarcity problems in many of the coastal areas in Viet Nam and this system is helping ameliorate the problem. The data generated from the system is helping the decision making at the local and policy level and improved understanding of key salinity thresholds level.

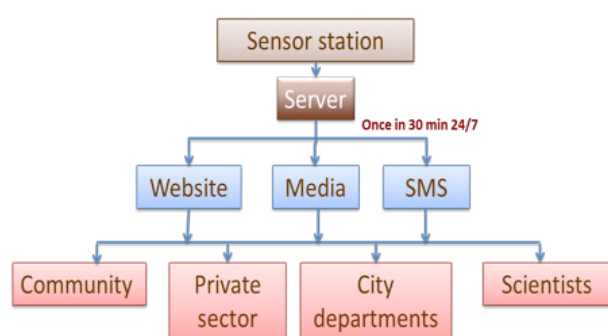
**Scalability potential:** There is a high potential to scale up this system to the entire Mekong region where salinity intrusion is worsening.

- **Social and political acceptability:** Highly acceptable
- **Economic viability and sustainability:** Initial



**Figure 47.** Infrastructure including pumps for operating the water recycling facility (GP-5.4d)

Source: JICA Project Team



**Figure 48.** Model for transferring salinity data to various users (GP-5.4e)

Source: ISET, Viet Nam

costs are not exorbitant, require limited maintenance and is highly compatible with the existing physical infrastructure.

- **Institutional and policy needs:** Capacity building of existing staff in operating the system and converting the salinity level data into usable information for different stakeholders

**Source/Contact:** ISET, Viet Nam.

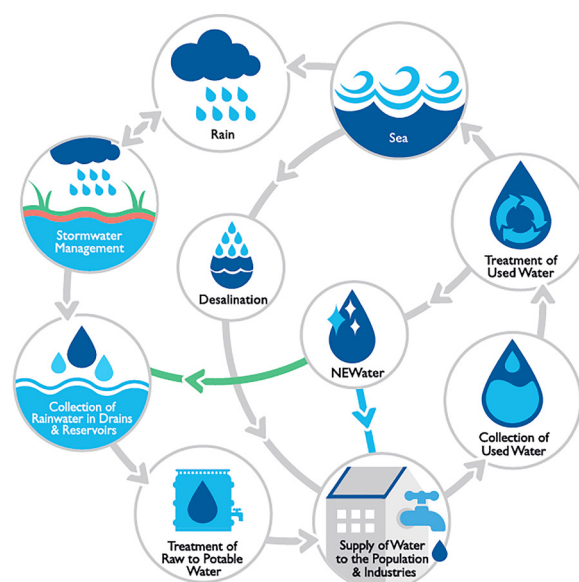
## GP-5.4f: Water resources management in Singapore

**Description of practice:** Singapore has achieved a high level of water security by adopting a holistic approach of water resources management. Its National Water Agency (PUB) is a pioneer in diversifying water services through the philosophy of 'closing the water loop'. Singapore has adopted the "Source-Pathway-Receptor" approach for flood and storm water management. Flood management is carried out a) along pathway, e.g., through widening and deepening of drains and canals; b) at the source, e.g., through on-site detention; and c) through receptor at flood prone areas, e.g., through platform levels, crest protection and flood barriers. Singapore is transforming a large part (currently 2/3rd) of the country into water catchments for large scale harvesting of rainwater through a network of rivers, canals and drains and finally channeling to 17 reservoirs.

**Climate hazards addressed by the practice:** Flood and drought (water scarcity)

**DRR and CCA benefits:** highly relevant for DRR and CCA integration that involve city-wide coordinated resource management

**Scalability potential:** High potential but needs longer time



**Figure 49.** Philosophy of 'closing the water loop' in Singapore (GP-5.4f)

Source: PUB Singapore

- **Social and political acceptability:** Community awareness and participation is vital for social and political acceptability
- **Economic viability and sustainability:** Needs long-term investment and effective implementation is crucial for the sustainability
- **Institutional and policy needs:** Government support and integrated policies are necessary condition for such as approach to become successful

**Source/Contact:** Public Utilities Board (PUB), Singapore.

## GP-5.4g: Conservation farming, Indonesia

**Description of practice:** Conservation farming refers to a range of methods of growing crops aiming at conservation of natural resources with minimal or no disturbance to soil and external inputs. FAO and Indonesia's Ministry of Agriculture are promoting conservation farming in East and West Nusa Tenggara that are highly drought prone regions in Indonesia. So far, the program is able to expand the conservation farming to 6,000 farmers in two years.

**Climate hazards addressed by the practice:** Mostly droughts

**DRR and CCA benefits:** Conservation farming provides needed buffer from short to medium dry spells in rainfall, improves and conserves the soil especially from the erosion in the undulated topographies as seen in Indonesia and provides





**Figure 50.** Conservation farming in the East Nusa Tenggara island, Indonesia (GP-5.4g)

Source: JICA Project Team

climate mitigation benefits due to soil carbon sequestration, reduced fertilizer consumption and need to pump groundwater. Conservation fields are reporting 36 times better yields than the traditional corn fields during the drought of 2015 (conservation farms gave 18 kg corn per 100 sqm while the traditional farms gave 0.5 kg per 100 sqm; interview with farmers). All these benefits tantamount to improved economic resilience, better nutrition (two crops in a year) and better soil conservation.

**Scalability potential:** Highly scalable depending on the nature of crops to which the method has been developed.

- **Social and political acceptability:** Initial acceptance is low due to cultural mindset among farmers but can take off rapidly with sufficient exposure to the practice
- **Economic viability and sustainability:** Highly viable due to reduced off-farm inputs and promotes sustainable use of natural resources including soil conservation.
- **Institutional and policy needs:** Capacity building of farmers is needed with initial on-farm trials to persuade farmers, developing suitable agro-techniques by local agricultural research stations is necessary with necessary financial and technical capacities.

**Source/Contact:** FAO, Indonesia.

## GP-5.4h: Small water impounding for flood water use during dry season

**Description of practice:** The complex geography and climatological features of the ASEAN region means that the countries in the region face repeated cycles of floods and droughts and the ASEAN countries are able to convert this bane into boon by putting in place co-management

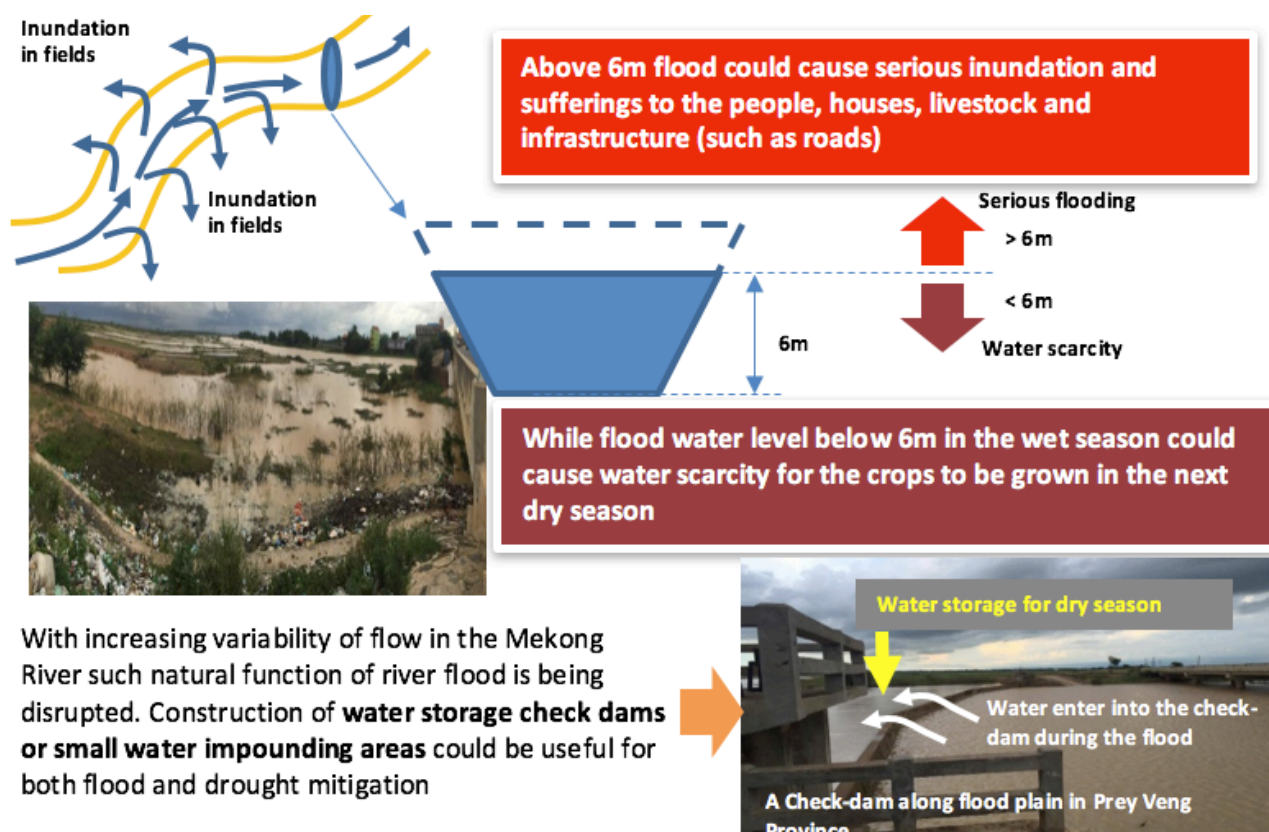
measures. Farmers along the Mekong River floodplain rely on natural flood water inundation which is vital for growing crops in the dry season as long as such inundation is not in excess or below the normal. For instance, average 6m river water level is found ideal for inundation in fields in the case of Prey Veng Province of Cambodia. Recognizing these flood inundation areas for their water supply utility during the dry season risk mitigation, several countries and institutional stakeholders in the ASEAN region including Cambodia, Indonesia and the Philippines are promoting small water impounding projects.

**Climate hazards addressed by the practice:** Drought and floods

**DRR and CCA benefits:** Complementary use of excess flood waters during dry seasons will have win-win benefits for both flood and drought risk reduction. During flood season, the inundation areas act as buffers to store excess flood water thereby reducing the flood risks for agriculture fields and communities and help in recharging the groundwater reservoirs. Since the flood water is stored in abandoned and uncultivated fields, this water can be retained for use during the dry season since many areas in ASEAN countries suffer from severe dry-season water shortage even after a satisfactory wet season due to unfavorable soil and vegetation conditions. As a consequence, the dry season crop production could be substantially improved benefiting communities economically and micro-environmentally i.e. through cooling down the micro-climate in the vicinity of small water impounding areas benefiting the local vegetation.

**Scalability potential:** The concept of small water impounding areas are highly scalable to all the ASEAN region wherever land is available for impounding the flood season water. This concept has already been known to be extensively used in Indonesia and the Philippines.

- **Social and political acceptability:** The uptake of this practice by national government and development partners indicates that the practice has gained social and political acceptance in many countries.
- **Economic viability and sustainability:** The small water impounding projects often use natural depressions and those areas with minimal modification of topography and hence are not costly compared to conventional water storage tanks that need extensive earthmoving. These measures also require minimal maintenance and hence can serve the purpose for several years.
- **Institutional and policy needs:** Several countries in ASEAN region including Indonesia and the Philippines have national level



**Figure 51.** Small water impounding projects are on the rise in various ASEAN countries providing win-win benefits for flood and drought risk reduction (GP-5.4h)

Source: JICA Project Team

programs for promoting the implementation of small water impounding projects and hence the required policy conditions are met in these countries.

**Source/Contact:** Department of Agriculture, the Philippines

#### GP-5.4i: Groundwater irrigation for drought mitigation and climate smart agriculture in several ASEAN countries

**Description of practice:** ASEAN countries are increasingly facing drought due to occurrence of El Nino. Government in almost all countries have promoted use of groundwater for drought mitigation as well as to ward off temporary dry spells caused by change in rainfall pattern during the rainy season. One of the common approaches taken by countries is to install groundwater pumping stations at drought affected areas for irrigation or drinking water. In case of irrigation, the main intent is supplementary purpose during the time of temporal water deficits. Indonesia's Ministry of Public Works (PU) support farmers to irrigate fields during temporary water scarcity. The PU drilled the well and gave training to farmers on its operation and management. Well is 200 m deep, use diesel generator to run pump, yields 40 lit/sec and can irrigate 40-50 ha. 156 farmers

formed community water user group to irrigate a total of 38 ha. The facility is not a main source of irrigation; used only when there is shortage of water for few days. Farmers collect Rp.25,000-50,000/2,500 m<sup>2</sup> block to cover operation and maintenance cost. In Malaysia, there are over 280 tube-wells and 1700 mobile pumps in use for agricultural purpose in water scarce areas. Groundwater irrigation has been also promoted in by drought prone areas of Mindanao region in the Philippines, Prey Veng Province in Cambodia, and northeast part of Thailand.

**Climate hazards addressed by the practice:** Drought

**DRR and CCA benefits:** Groundwater acts as a natural buffer storage during the time of drought and thus could be a cost-effective and convenient option for both DRR and CCA due to ease for abstraction and its slow response to external climatic condition.

**Scalability potential:** Groundwater irrigation is highly scalable due to easy access and relatively lower investment for development. However, proper care should be taken to prevent over reliance of groundwater and limit the use explicitly for drought mitigation. .

- **Social and political acceptability:** Due to its ubiquitous and affordable access,



**Figure 52.** Groundwater bore wells for supplementary irrigation in rice field in Indonesia (GP-5.4i)

Source: JICA Project Team

groundwater is usually the primary choice during the time of droughts. .

- **Economic viability and sustainability:** Unless used for very large scale irrigation and abstraction did not exceed the sustainable yield, groundwater is a cost-effective and reliable option for supplementary irrigation and for drinking water supplies. Over abstraction of groundwater could threaten resource sustainability.
- **Institutional and policy needs:** Strong institutional, regulatory and policy measures are necessary condition for sustainable development of groundwater. In case of DRR and CCA, groundwater should be prioritized as a strategic resources and strong regulatory mechanism should be in place to control over uses.

**Source/Contact:** MOA and DID in Malaysia, DGR in Thailand, Ministry of Public Works in Indonesia, IWUMD, Myanmar, DWRM and Ministry of Rural Development in Cambodia, National Irrigation Authority (NIA), the Philippines.