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A PRELIMINARY STUDY OF THE DROUGHT MITIGATION PRACTICES OF AGRICULTURE SECTOR IN JAPAN

AND LOOKING FOR POSSIBILITIES TO APPLY BEST PRACTICES TO SRI LANKA

Research Report
for the Visiting Researcher Program (2011 A)
Asian Disaster Reduction Centre
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Background of the Research

What is Drought

- Drought can be simply defined as a situation where human demand for water exceeds the available supply.
- Droughts result from a combination of meteorological, physical and human factors.
- Four types of Droughts
  1. Meteorological drought - Lack of precipitation from normal ,over some period of time
  2. Hydrological drought - Deficiencies in surface and subsurface water supplies
  3. Agricultural drought – Lack of needed soil moisture of a particular crop at a particular time
  4. Socio-economic drought – Associating with supply of and demand for an economic good.

Objective of the Research

To study the Japanese drought mitigation practices and identify the best practices which can be applied in Sri Lanka.

Significance of the Research

- As a country mainly based on agriculture the Sri Lanka has to take the possible maximum production in agriculture, for that, should minimize the losses by droughts to keep the development targets, specially in economy.
- Therefore it needs to find solutions to mitigate droughts' effects in agriculture.
- This research is done to study the Japanese methods for drought mitigation.

Methodology

Data Collection

- Data collection was mainly done from websites.
- Some places where drought mitigation practices are going on, were visited and got some information.

Data Analysis

- Analyzed data in previous studies were mostly used.
- Descriptive method had to be applied, rather than any statistical or mathematical analyzing tools due to very limited period of time to complete the research.

Study Area

Agricultural areas, in Japan and in Sri Lanka, where droughts are occurred in time to time

Limitation of the Study

- Within a two weeks period of time I have to complete the research.
- Therefore only few research techniques were able to apply in the study.

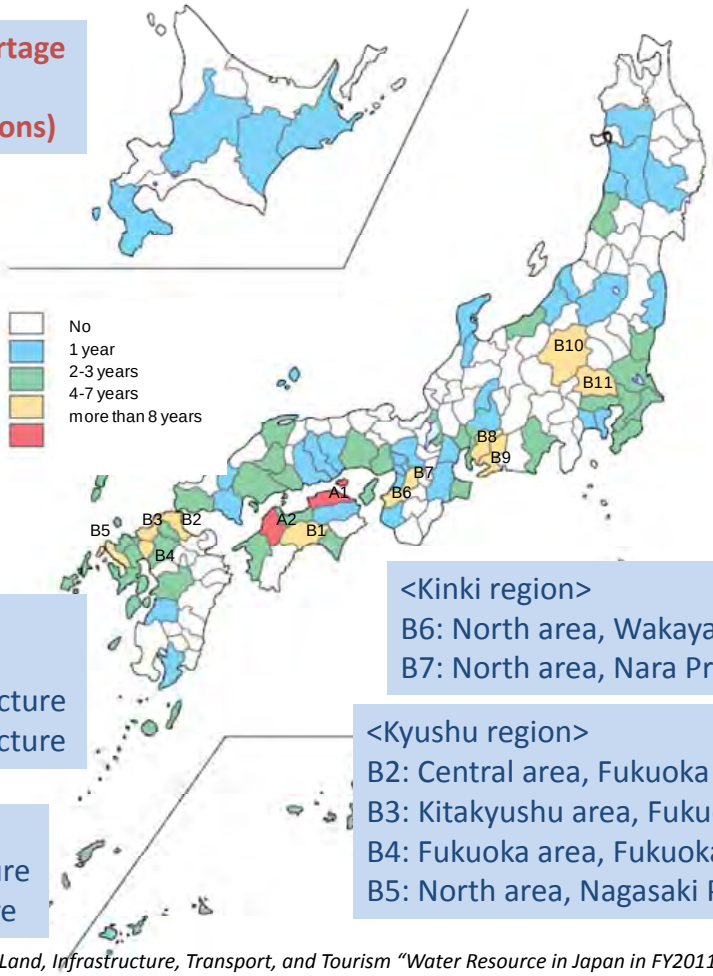
Droughts in Japan - 1

- Though Japan receives abundant precipitation, water shortages are frequent.
- Due to marked topographic differences, small river catchments and sudden drops in altitude, droughts are created.
- Total annual water use is approximately 85.2 billion m^3. 88 % of which is obtained from rivers. The agriculture sector uses more than 65 % of annual water abstraction while domestic – 20% and industrial – 15%

Droughts in Japan - 2

- Long-term trend of temperature change in Japan - Average annual surface air temperature has increased by approximately 1°C over the past 100 years.
- Years of low rainfall have become frequent since around 1970.
- Amount of precipitation was much below average in 1973, 1978, 1984, 1994, and 1996, and water shortages caused damage.
- 1994 water shortage covered almost all Japan. Approximately 16 million people were affected at least once by suspended or reduced water supply. Agricultural production losses - 140 billion yen.

Experiences of Water Shortage from 1991 to 2010 (10 Prefectures of 05 regions)



<Kanto Koshin region>
B10: Gunma Prefecture
B11: Saitama Prefecture

<Shikoku region>
A1: Kagawa Prefecture
A2: Chuyo area, Ehime Prefecture
B1: Central area, Kochi Prefecture

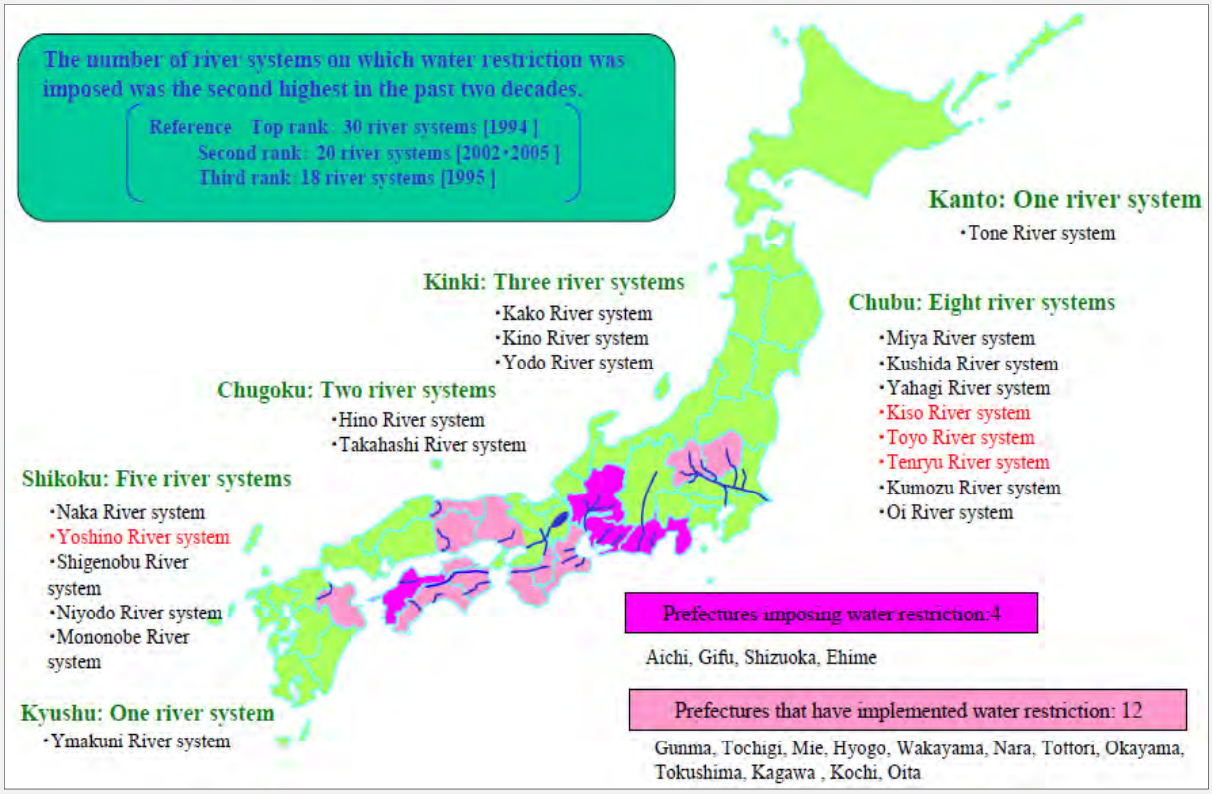
<Kinki region>
B6: North area, Wakayama Prefecture
B7: North area, Nara Prefecture

<Tokai region>
B8: West area, Aichi Prefecture
B9: East area, Aichi Prefecture

<Kyushu region>
B2: Central area, Fukuoka Prefecture
B3: Kitakyushu area, Fukuoka Prefecture
B4: Fukuoka area, Fukuoka Prefecture
B5: North area, Nagasaki Prefecture

Source: Ministry of Land, Infrastructure, Transport, and Tourism "Water Resource in Japan in FY2011" (August 2011) p.267

River systems and rivers affected by droughts in the year 2005



Source: Atsushi Kobayashi, River Bureau, Ministry of Land, Infrastructure, Transport, and Tourism, www.mlit.go.jp/river/trash_box/paper/pdf_english/36.pdf (Accessed on 2011/8/15)

Drought Management Measures in Japan

- Policy making (Acts, Plans)
- Devolution power (Central, Prefectural, Municipal, Community)
- Dam constructions to distribute water to vulnerable areas
- Community organization (Drought Conciliation Council)
- Using super technology
- Other methods

Community Response to Droughts

Water users first try voluntarily to adjust their water uses. They save water by means of

- Water-sharing (method of distributing water in accordance with designated times and turns)
- Intensification of repeated use
- Supplementary irrigation from underground water or water from ponds
- Irrigation by rotation

1.Irrigation by Rotation
Water management practices for water saving are as follows;
(1) Irrigated area is divided into smaller units and each unit receives water in turn
(2) Each field receives water by priority and with specified duration
(3) Water is withdrawn from the sources by the interval of several days.

2. Reuse of Water
Upstream drainage water is dammed up and reuse for irrigation Purpose with pumps.

3. Supplementary Irrigation
When water shortage persists even after the rotational supply or reuse, supplementary water sources are utilized Such as under-ground water by digging temporary wells, dead water of ponds and reservoirs which are not normally Implemented, or water transferred from other uses.

4.Sacrificed Field
Due to the shortage of the volume of water, management practices such as the intensification of rotational supply and reuse do not work effectively. Under such conditions, water supply is cut off to some parts of paddy to save
Other parts.

The case of water reallocation during the drought of 1994

	the upper limit of water intake (percentage to the maximum)		Expenses against the drought by land improvement districts (relative to the expense of an average year)
	City water supply	Irrigation water	
Kiso river	35%	65%	3.5 times
Yoshino river	56%	80%	(Unknown)
Chikugo river	50%	79%	3.0 times

Source: Ministry of Agriculture, Forestry and Fisheries "Irrigation Water Use in Agriculture in Japan" pp.11-12

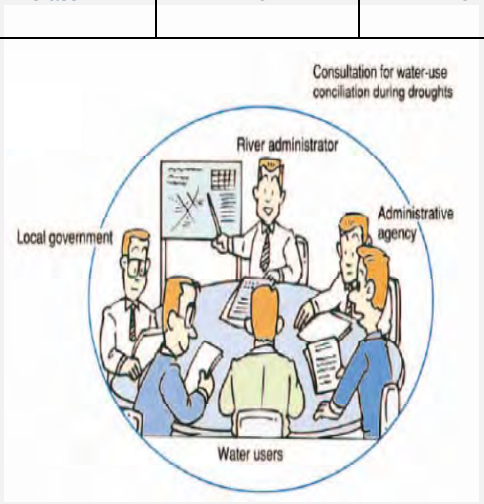
Drought Conciliation Council for Water Use Coordination

By the River Law, the provisions have been made

- Drought Conciliation Council's, composed of the river administrator, water users, local government, and other concerned agencies, have been established in a lot of river basins.
- This council has contributed to water use conciliation during droughts as a forum for mutual consultation among stakeholders.
- River administrators may make necessary intermediation or arbitration in case no agreement is reached in the consultation among water users.
- Government's intervention is the second measurement.

Drought water-use conciliation councils established (as of March 2002)

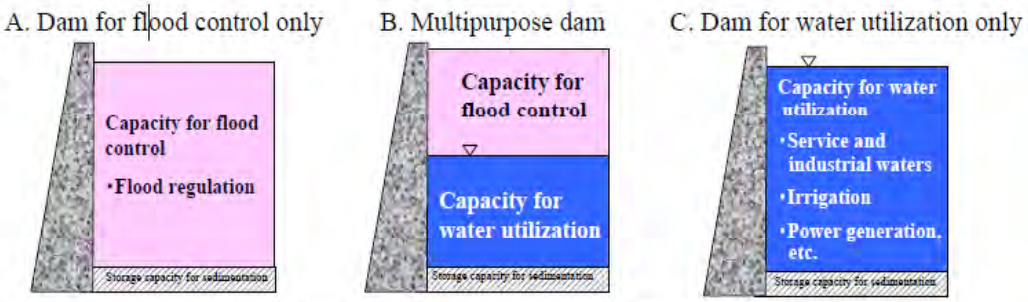
Types of River System	No. of Established River Systems	No. of Established Organizations
Class A	69	103
Class B	25	25



Source: Ministry of Land, Infrastructure, Transport, and Tourism "Rivers in Japan" (September 2006) p.52

Dam Constructions & Drought Mitigation in Japan

Objectives of dam



Number of dams

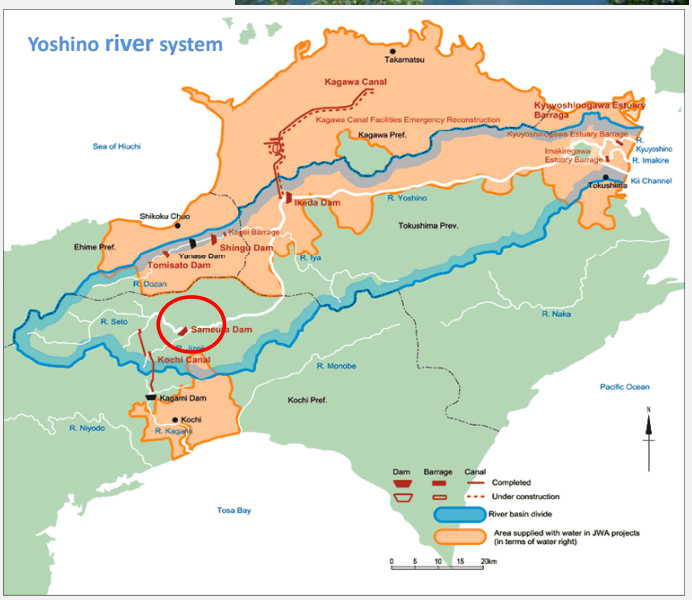
Class	Administrator	Category	No. of dams
Under control of the Ministry of Land, Infrastructure, and Transport	Under direct control of the Ministry	A,B	81
	Dam Division, Japan Water Agency	B	20
	Prefecture	A,B	338
	Subtotal		439
Under control of the Ministry of Agriculture, Forestry, and Fisheries	Under control of the Ministry	C	152
	Canal Division, Japan Water Agency	C	17
	Prefecture	C	1567
	Subtotal		1736
Others	Electric power suppliers	C	399
	Service and industrial waters (Enterprise Bureau, local authorities)	C	129
	Total		2703

As of December 2005
Surveyed by
the Water Management office,
the Ministry of Land,
Infrastructure, and Transport

Source: Atsushi Kobayashi, River Bureau, Ministry of Land, Infrastructure, Transport, and Tourism, www.mlit.go.jp/river/trash_box/paper/pdf_english/36.pdf (Accessed on 2011/8/15)

Sameura Dam

- Having faced to the drought condition in 2004, Japanese government decided to build the Sameura Dam in Yoshino River in Shikoku region as solution to control the future impacts.
- Yoshino river basin is a one of the biggest river basin in Japan including a catchment area of 3750 km^2
- Length of the river is 194 km and 20% of the land area of Shikoku island included to the Yoshino River basin
- Both the floods and droughts are experience in this basin
- The major construction of this project was the Sameura Dam which was built with four purposes that are as, flood control in Yoshino River, maintenance of normal function the river water, water supply to Shikoku four prefectures for irrigation and power generation

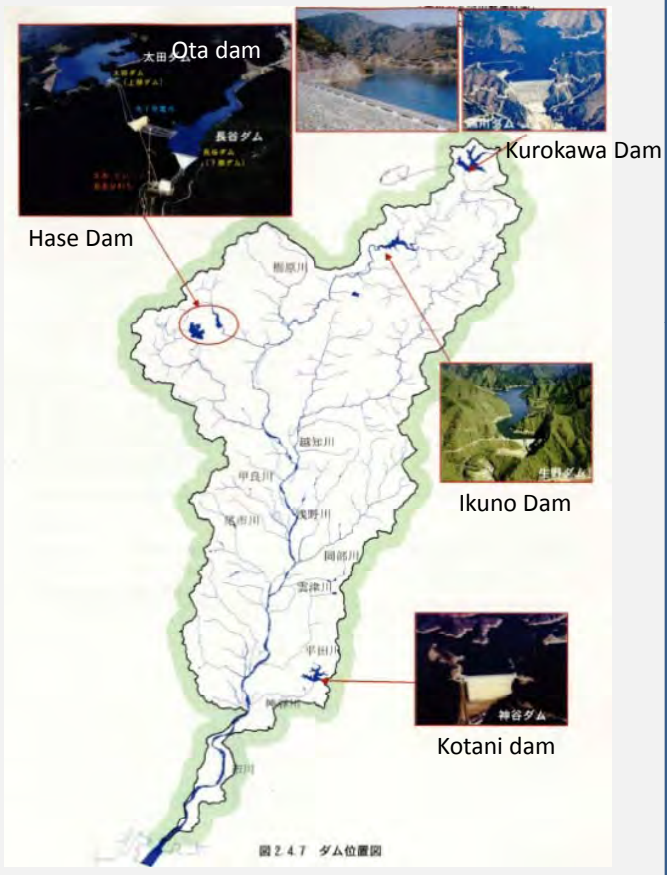


Donto Dam

- Donto dam in Kako River system in Miki City area, has been constructed under the Toban-Yosui Irrigation Project.
- The objectives of the project are to Irrigation water supplying to the paddy fields and tap water supplying to the urban areas. For four cities and one town in Hyogo prefecture
- Ancient water diversion works under the Donto dam at Inami plateau
- Ponds have been constructed to supply water to paddy lands at Inami plateau

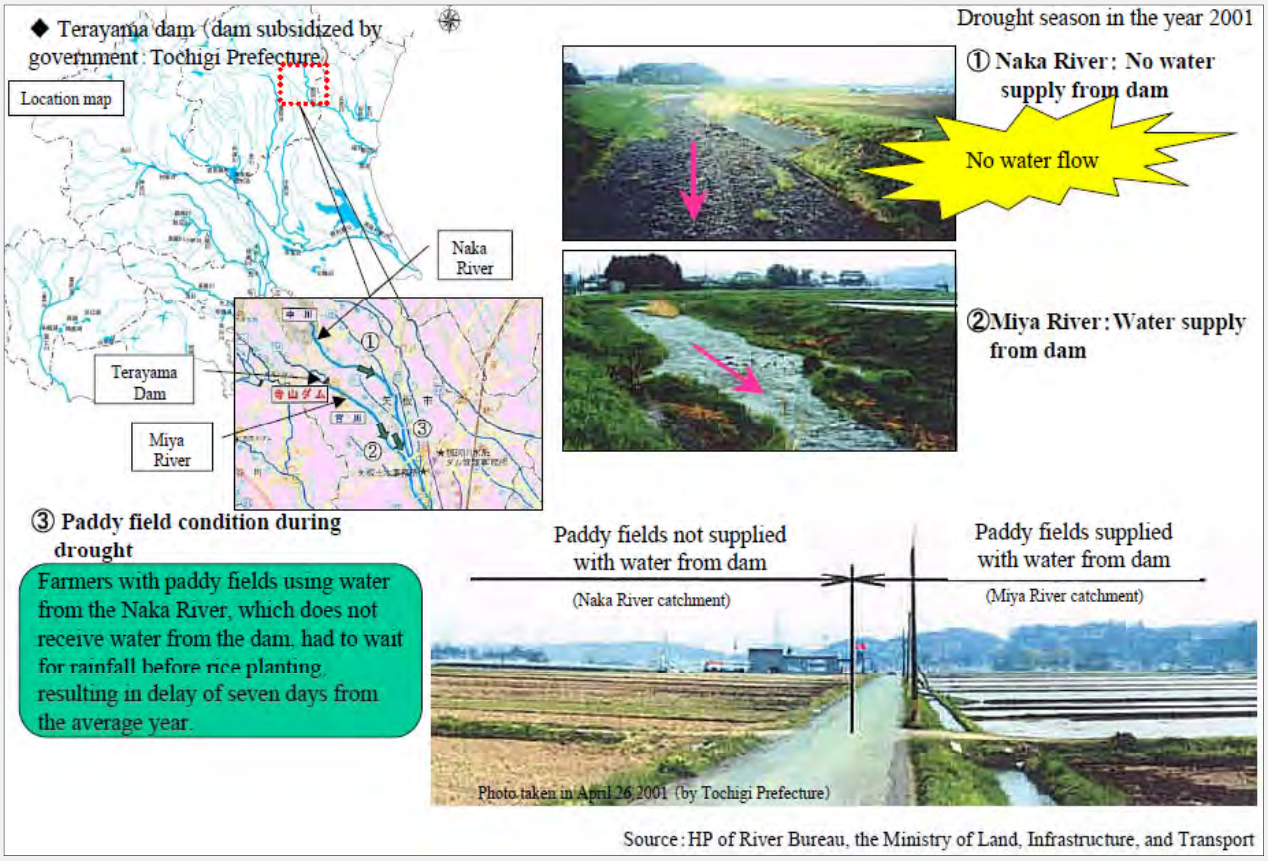
Ichikawa River System and Drought Management

Name of Dam (Year)	Managed by	Purpose	Capacity (Effective)
Kurokawa Dam (1974)	Kansai Electric Power Co. Inc.	Industrial Use, Irrigation, Tap Water, and Power Generation	21.36 million m^3
Ikuno Dam (1972)	Hyogo Prefecture	Flood Control, Industrial Use, Irrigation and Tap Water	17.0 million m^3
Hase Dam & Ota Dam (1995)	Kansai Electric Power Co. Inc.	Power Generation	8.26 million m^3 and 8.66 million m^3
Kotani Dam (2001)	Hyogo Prefecture	Tap Water and Irrigation	16.1 million m^3



Source: Himeji Public Works Office, Hyogo Prefectural Government

Effects of dams in drought condition



Source: Atsushi Kobayashi, River Bureau, Ministry of Land, Infrastructure, Transport, and Tourism, www.mlit.go.jp/river/trash_box/paper/pdf_english/36.pdf (Accessed on 2011/8/15)

Droughts in Sri Lanka

Geography

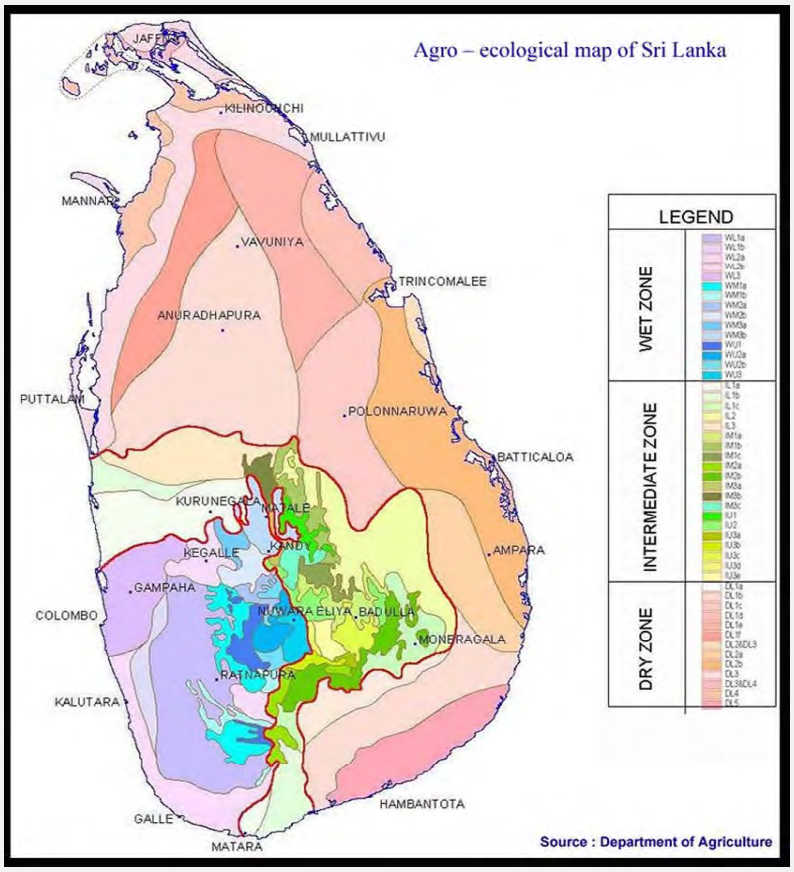
- Sri Lanka is an Island
- Location
  Indian ocean, Indian sub continent
  Latitudes $5^0.55'$-$9^0.55$ N
  Longitudes $79^0.42'$-$81^0.52'$ E
- Land area : 65,610 km^2
- Maximum Length : 445 km
- Maximum Breadth : 225 km

Climate

- Due to the location of Sri Lanka, the climate could be characterized as tropical.
- Sri Lanka lies on Inter Tropical Convergent Zone (ITCZ).
- The topographical features strongly affect the spatial patterns of winds, seasonal rainfall, temperature, relative humidity and other climatic elements, particularly during the monsoon season.
- Rainfall in Sri Lanka has multiple origins. Monsoonal, Convectional and expressional
- The mean annual rainfall varies from 900mm to 5000mm.

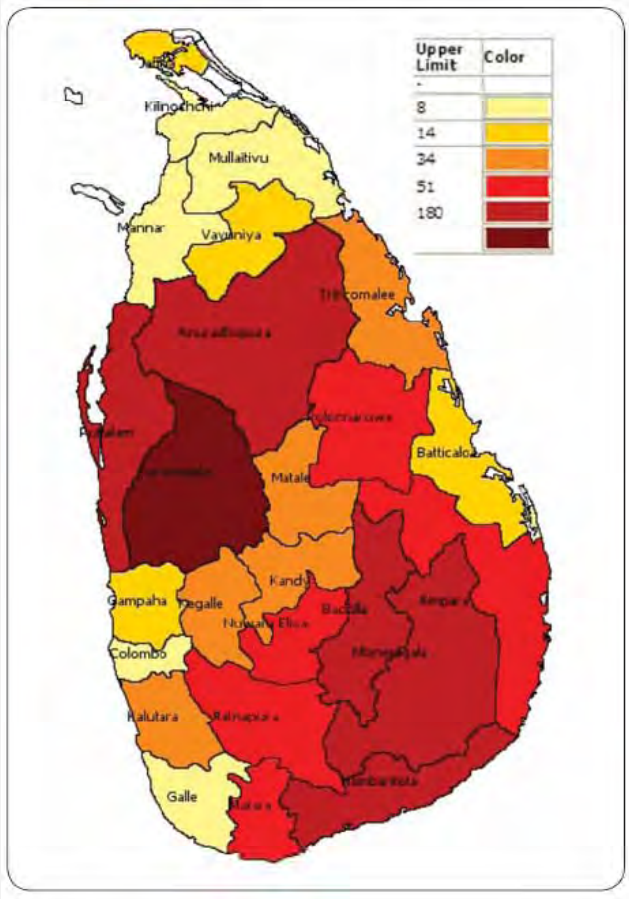
- The mean annual temperature varies from 16^0c to 27^0c.
- Climate experienced during 12 months period in Sri Lanka can be characterized in to 4 climate seasons
  - First Inter-monsoon Season – March-April
  - Southwest monsoon season – May-September
  - Second Inter-monsoon season – October-November
  - Northeast Monsoon season - December – February
- Three Agro ecological zones based on climatic conditions.
  - Wet zone
  - Inter mediate zone
  - Dry zone

Agro-ecological Zone Map of Sri Lanka



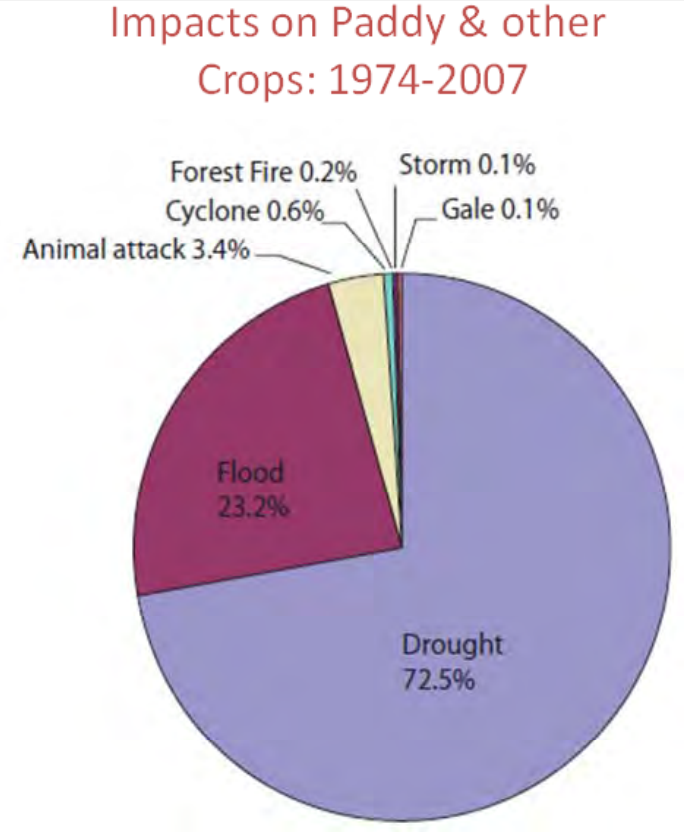
Droughts in Sri Lanka

- Low rainfall during monsoons is the cause for droughts in south-eastern, north-central and north-western areas of Sri Lanka
- Drought of serious nature occur once in about 3-4 years
- Severe drought of nationally significant in about 10 years also impacting hydro-power generation
- Major droughts have experienced during the years 1935-37, 1947-49, 1953-56, 1974-77, 1981-83, 1993-94, 2000-01 and 2003-04 (DMC 2005)



Drought affected areas in Sri Lanka, 1974 - 2007

Impact of Droughts in Sri Lanka



Trend Line of occurrence of Droughts in Sri Lanka

Drought Mitigation Measures in Sri Lanka

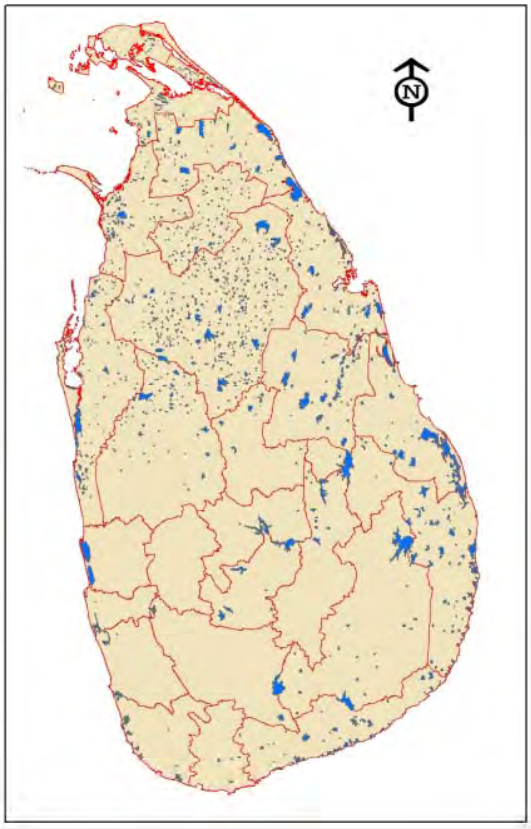
Construction of large reservoirs and small tanks to store water

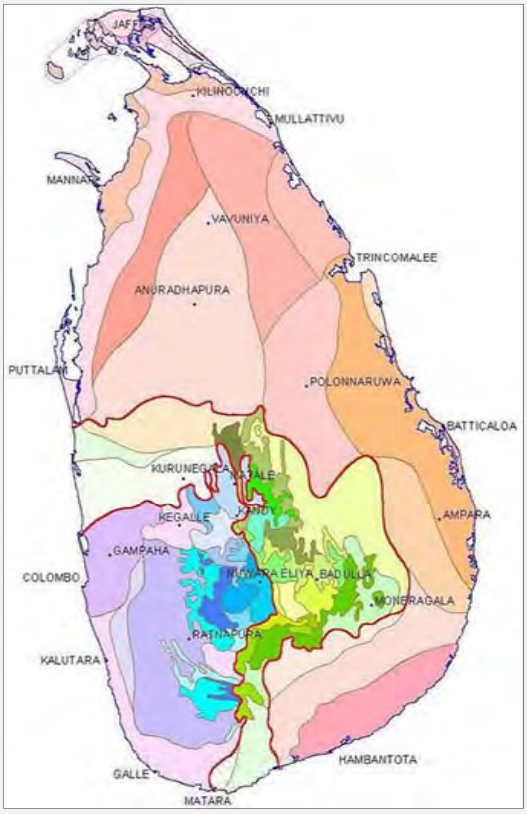
- Irrigation systems of ancient Sri Lanka consist of a large number of village tanks, gigantic reservoirs and a intrinsic network of water channels connecting these tanks while supplying water to farming land.
- There are about 30,000 tanks in Sri Lanka of which the majority was built form 3rd century BC to 12th century.

Names of some large reservoirs

- Badagiriya Wewa - Pallemalala
- Basawak Kulama (Abaya) Tank
- Bathalagoda Tank -
- Debera Wewa - Tissamaharamaya
- Girithale Tank
- Mahagala Wewa - Hambantota
- Minneriya Tank
- Nachchaduwa Reservoir - Anuradhapura
- Nuwara Wewa - Anuradhapura
- Nuwara Wewa (Kandy Lake) - Kandy
- Panda Wewa - Panduwasnuwara
- Parakrama Samudraya (Ocean of Parakrama) - Pollonnaruwa
- Siyambalagamuwa Reservoir
- Sorabora Weva - Mahiyangana
- Thabbowa Tank - Puttalama
- Thuruwila Irregation Tank - Anuradhapura
- Tissa Wewa - Anuradhapura
- Tissa Wewa - Tissamaharamaya
- Vavunikulama Reservoir - Vavunia
- Weerawila Wewa - Wellawaya
- Yoda Wewa - Mannar District
- Yoda Wewa - Tissamaharamaya

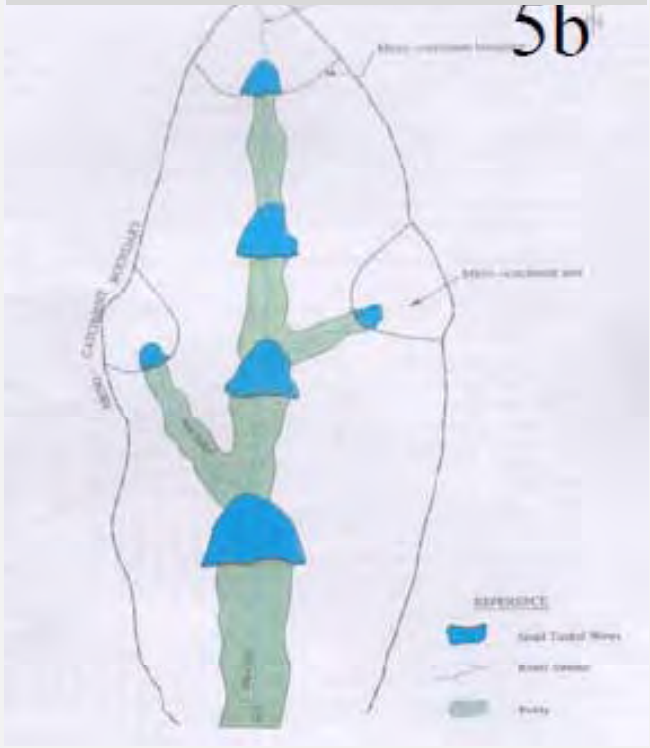
Distribution of large reservoirs and small tanks

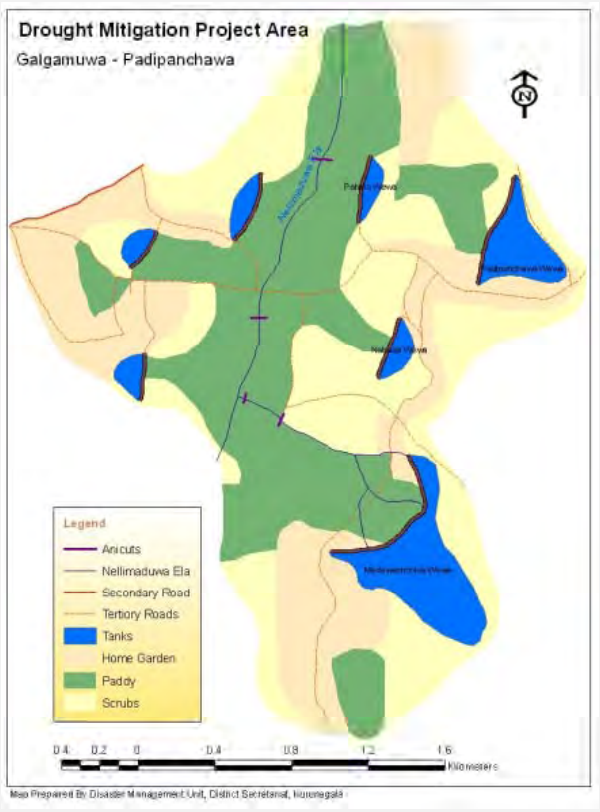




Renovation of small tank cascades for Drought Mitigation

Village Tank Cascade System





Application of Japanese methods in Sri Lanka

- Policies making (Acts, Plans)
- Devolution power (Central, Provincial, Local)
- Large reservoirs & small tanks constructions to store water for drought season
- Community organization (Farmer organizations)
- Lack of capital & technology
- Other methods (deep wells, tube wells, drip irrigation, new varieties of crops)

- Policy making (Acts, Plans)
- Devolution power (Central, Prefectural, Municipal, Community)
- Dam constructions to distribute water to vulnerable areas
- Community organization (Drought Conciliation Council)
- Using super technology
- Other methods

Thank You