

CLIMATE CHANGE MITIGATION IN CAMBODIA

- The first attempt to evaluate GHG mitigation options in the energy, agriculture and forestry sectors was done under the Cambodia Climate Change Enabling Activity Project (CCEAP) in 2000 covered the period up to 2020.
- As a Party to the UNFCCC, many government activities and measures also contribute to the global effort to limit GHG emissions and develop GHG sinks including:
 - o The creation and management of 23 protected areas covering approximately 18% of the country's land area;
 - o Establishment of various legal instruments related to forest management, waste management and air pollution;
 - o Promotion of energy efficiency and development of renewable energy; and
 - o Current efforts to eliminate illegal logging.



I. IMPACT OF GREEN COVER AND CLIMATE CHANGE

- As is well known, the role of forests is immense by way to regulate and protect the environment and the climatic conditions and to clean up the environment.
- Deforestation either due to shifting cultivation, encroachment or change in land use practices leads to forest fragmentation, loss of biodiversity, soil erosion, floods, loss of live-stock, human life and property, etc.
- The reduction in green cover leads to reduction of photosynthetic cover which in-turn leads to reduce photosynthetic activity i.e. reduce CO₂ assimilation.
- Increase in atmospheric carbon due to burning and decomposition of biomass leading increased levels of atmospheric CO₂ contributing to the global warming.



- Unsustainable land use practices and changes in climate have potential to affect the geographic location of ecological systems and their ability to provide benefits on which societies depend for their continued existence.
- Moreover effects of climate change involve changes in soil characteristics, soil moisture in particular, disturbance regimes, fires, pests and diseases, which would favor some species over others and thus change the species composition of ecosystems.
- Increasing concentrations of greenhouse gases CO₂, NO₂, CH₄ and CFCs derive not only from industrial processes and the use of fossil-fuelled transport, but also from the daily activities of all of humankind: growing, harvesting, preserving, and cooking food; and heating and cooling homes, waste and workplaces.

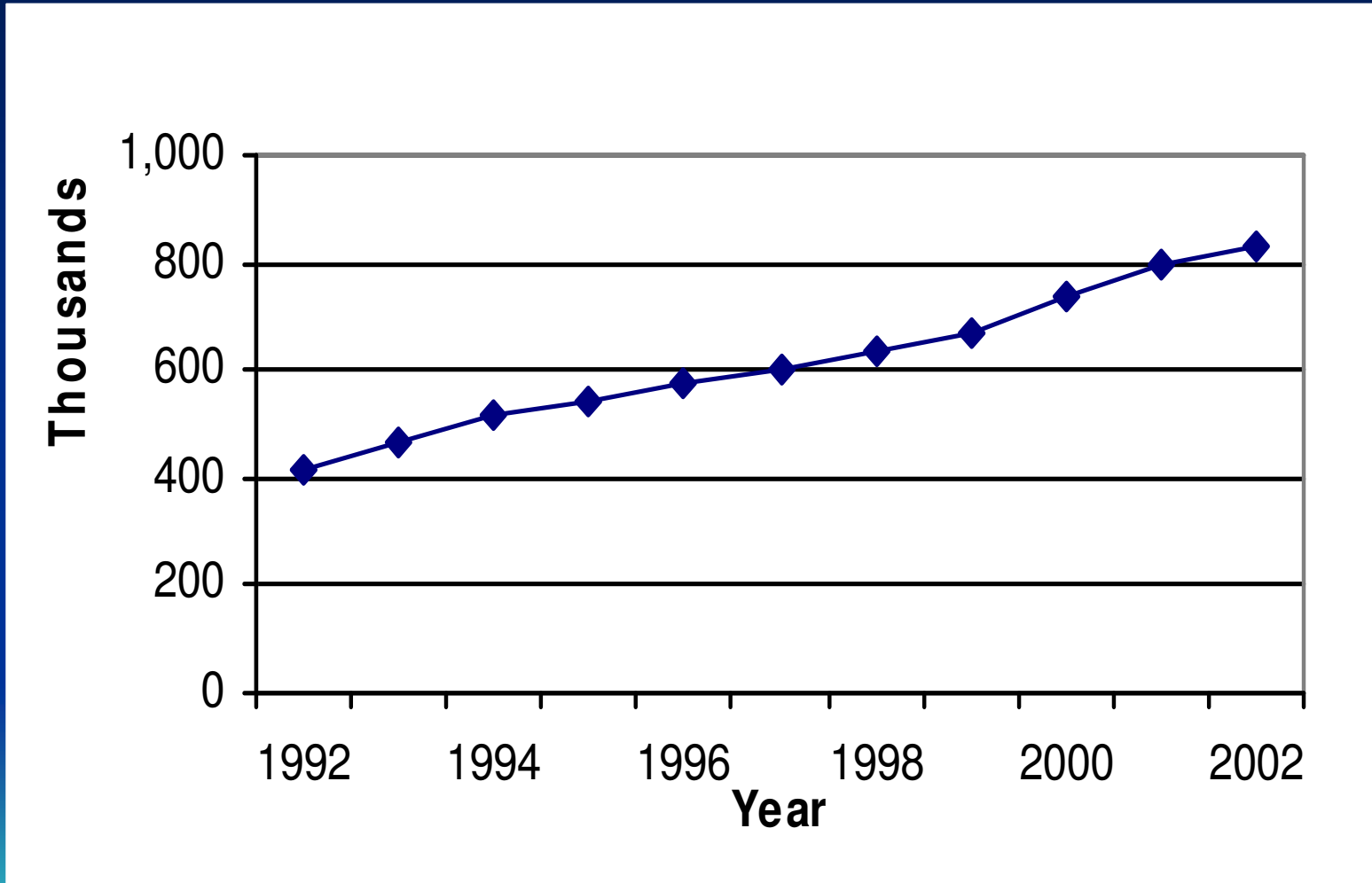


II. ENERGY SECTOR IN CAMBODIA

- There were 418,118 and 828,991 vehicles imported in 1992 and 2002, respectively, most of them are second-hand including:
 - Motorcycles account for 586,278 vehicles or 70.7%;
 - Cars, minibuses and pickups for 209,128 or 25.2%,
 - Trucks for 29,968 or 3.6%,
 - Buses for 3,196 or 0.4%, and
 - Other 421 special vehicles.
- The total of 200 and 219 registered vessels were operating on the river system and coastal water in 2002, respectively.



Estimated Number of Vehicles imported by year



III. AIR QUALITY MONITORING

- In 2002, an estimated 681,201 vehicles or 82.2% were registered or operating in Phnom Penh, with an estimated 147,990 vehicles or 17.8% in the provinces.
- Cambodia has no any air monitoring station; lighter pole is used for instalklation air monitoring equipment.
- Air Quality Monitoring activities were conducted in major cities or in target places only.
- Ambient air for CO, SO₂ and NO₂ was monotored using passive tupe as shown below;



Air Monitoring activities and Instruments for Ambient air for monitoring in Phnom Penh City



- From 2000-2002, The Air Pollution Control Office of Dept. C had cooperated with researcher Yokohama University to conducted a case study every 2 months each year;
- Ambient Air Pollution in Phnom Penh, by then, was Monitored;
- The results of this case study is as below:

Table 1

Parameter	2000		2001		2002	
	Min	Max	Min	Max	Min	Max
CO (ppm)	1.2	6.23	1.29	2.12	1.70	5.0
NO ₂ (ppm)	0.012	0.025	0.001	0.002	0.004	0.030
SO ₂ (ppm)	-	-	0.0003	0.003	0.001	0.005
TSP (mg/m ³)	-	-	0.507	0.844	0.067	1.00
PM ₁₀ (mg/m ³)	-	-	0.490	0.745	-	-

Air Quality Monitoring by Years

Table 2

Parameter	2002		2002		2003		2005	
	Min	Max	Min	Max	Min	Max	Min	Max
CO (ppm)	2.43	6.25	2.9	3.5	3.87	5.25	3.47	5.62
NO ₂ (ppm)	-	-	-	-	-	-	0.004	0.038
SO ₂ (ppm)	-	-	-	-	-	-	<0.004	0.083

IV. AIR QUALITY SITUATION

- Air quality status is still better;
- But the air pollution concern is still existed;
- Low taxes for import and export;
- Policy to use coal through local communities in order to reduce fuel wood requirement

- Factor deteriorates air quality : not only energy consumption, but also from suspended particulate matters;
- Second hand vehicles and generators : below 50%.

V. EMISSION INVENTORY

- Emission inventories in Cambodia is unavailable today.

VI. AIR QUALITY MANAGEMENT

- Sub-decree on Air Pollution Control and Noise Disturbance was developed and adopted for the prevention and reduction of the pollution impacts on public health and environmental quality through monitoring, curbing and mitigating activities.
- It consists of eight annexes included Emission Standard for Mobile Sources and Standard of Pollution Substance for stationary Sources in Ambient Air .

Conclusion

- According to the result in the table 1 :NO₂, CO, and SO₂ is lower than ambient air standard of Cambodia;
- Base on the result in the table the table 2 : Air quality in Phnom Penh City in general is still good, but except total suspend particulate (TSP) concentration;
- TSP :from soil, unpaved roads and the roads under construction;
- Health effect were concerned : residents and working people a long roadside of heavy traffic



VII. FORESTRY SECTOR IN CAMBODIA

- Before 1960, the forest area covered 73% (13.23 million ha) of the country total land area, of which, the inundated forest in the Tonle Sap covered about 1 million ha and the mangrove forest in the coastal areas covered about 83,700 ha.

Cambodia Forest Cover, 2002		
Forest Types	Area (ha)	Percentage
Evergreen Forest	3,720,506	20.49
Semi-evergreen forest	1,455,190	8.01
Deciduous forest	4,833,861	26.62
Other forest	1,094,726	6.03
<i>Sub-total</i>	<i>11,104,283</i>	<i>61.15</i>
Non-forest	7,056,388	38.85
Total	18,160,671	100

- The 23 protected areas, designated in 1993 by the Royal Decree, share 18.08 percent (3,273,200 ha) of the total country's area including 7 national parks, 10 wildlife sanctuaries, 3 protected landscapes and 3 multiple use areas

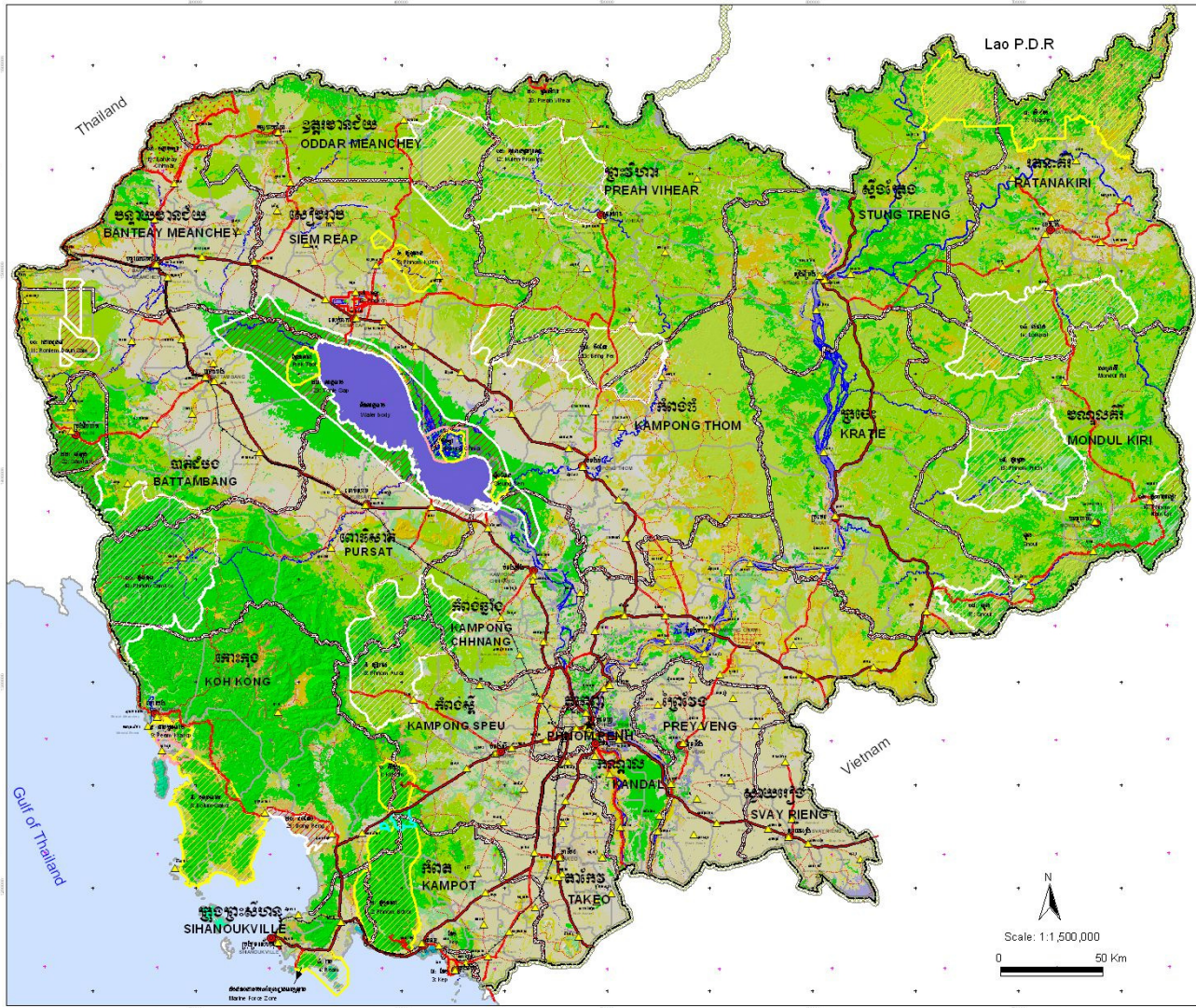
Protected Areas of Cambodia			
Protected areas	No.	Hectares	% of Total Land Area
National park	7	742,250	4.1
Wildlife Sanctuary	10	2,030,000	11.21
Protected Landscapes	3	97,000	0.54
Multiple Use Areas	3	403,950	2.23
Total	23	3,273,200	18.08

Cambodia Protected Areas and Land Use/Cover



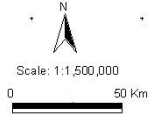
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Prepared by Department of Natural Resources Assessment
and Environmental Data Management,
Ministry of Environment

Data Source:
- Royal Decree on Creation and Designation
of Protected Areas, 1993.
- Land Use/Cover: MPWT and JICA, 2002.
- Administrative Boundary: Department of Geography,
MLMU/PC (Delineation of International Boundaries
must not be considered authoritative).



LEGEND

- Administration**
- ▲ District
 - Provincial Capital
 - ⚡ Railway
 - ⚡ National Road
 - ⚡ Provincial Road
 - ⚡ Main Road
 - ⚡ District Boundary
 - ⚡ Main River
 - ⚡ Water
 - ⚡ Provincial Boundary
 - ⚡ Province-buffer strip
 - ⚡ International Boundary
 - ⚡ Buffer of International Boundary
- PAs and PFs**
- Biosphere Reserve
 - Multiple Use Area
 - National Park
 - Protected Landscape
 - Ramsar Site
 - Wildlife Crossing Area
 - Wildlife Sanctuary
- Landuse, Land Cover**
- Abandoned field
 - Bamboo and Secondary forests
 - Bamboo dominated secondary formations
 - Barren land
 - Coniferous forest
 - Deciduous forests
 - Dryland crops
 - Estuarine areas
 - Flooded forests
 - Flooded grasslands
 - Flooded shrublands
 - Forest plantation
 - Infrastructure (Airfield, playground, cemetery, etc.)
 - Island evergreen forest
 - Island grasslands
 - Island shrublands
 - Lakes
 - Lowland dry evergreen forests
 - Lowland grasslands
 - Lowland moist evergreen forests
 - Lowland semi-evergreen forests
 - Lowland shrublands
 - Mangrove forests
 - Marsh and swamp
 - Orchard
 - Other Water (Lake, river, etc.)
 - Paddy field
 - Rear mangrove forests
 - Receding and Flooding rice fields
 - Reservoir
 - Riparian forests
 - Rock outcrop
 - Rubber plantation
 - Sand bank
 - Settlement
 - Shrimp/fish farming and Salt pan
 - Submontane dry evergreen forest
 - Submontane grasslands
 - Submontane moist evergreen forests
 - Submontane semi-evergreen forests
 - Submontane shrublands
 - Swidden agriculture
 - Tree dominated secondary formations



Map data source: Geographical State File 2002

VIII. CAMBODIA CLIMATE CHANGE PROJECTION

- **The state of the Cambodia climate is closely linked to the management of forest, agriculture, water and natural resources of the countries and the global climate.**
 - **Cambodia's contribution to greenhouse gas emissions using Global Warming Potential showed that Cambodia could offset of CO₂ emission of global GHG emissions in 1994.**
 - **Results from projection analysis of greenhouse gas emissions and removals by sectors indicated that in 2000 Cambodia was already a net emitter of GHGs and would increase to 2020.**
 - **Among the sectors, Land Use Change and Forestry (LUCF) would be the main source of GHG emissions.**
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Year	1994		2000		2010		2020	
Emissions	Gg	%	Gg	%	Gg	%	Gg	%
CO ₂	54,587	80	58,345	79	59,698	74	67,304	69
CH ₄	9,472	14	10,908	15	14,882	18	20,813	21
N ₂ O	3,844	6	4,109	6	6,040	8	9,500	10
Total CO ₂ - eqv.	67,902	100	73,362	100	80,620	100	97,617	100

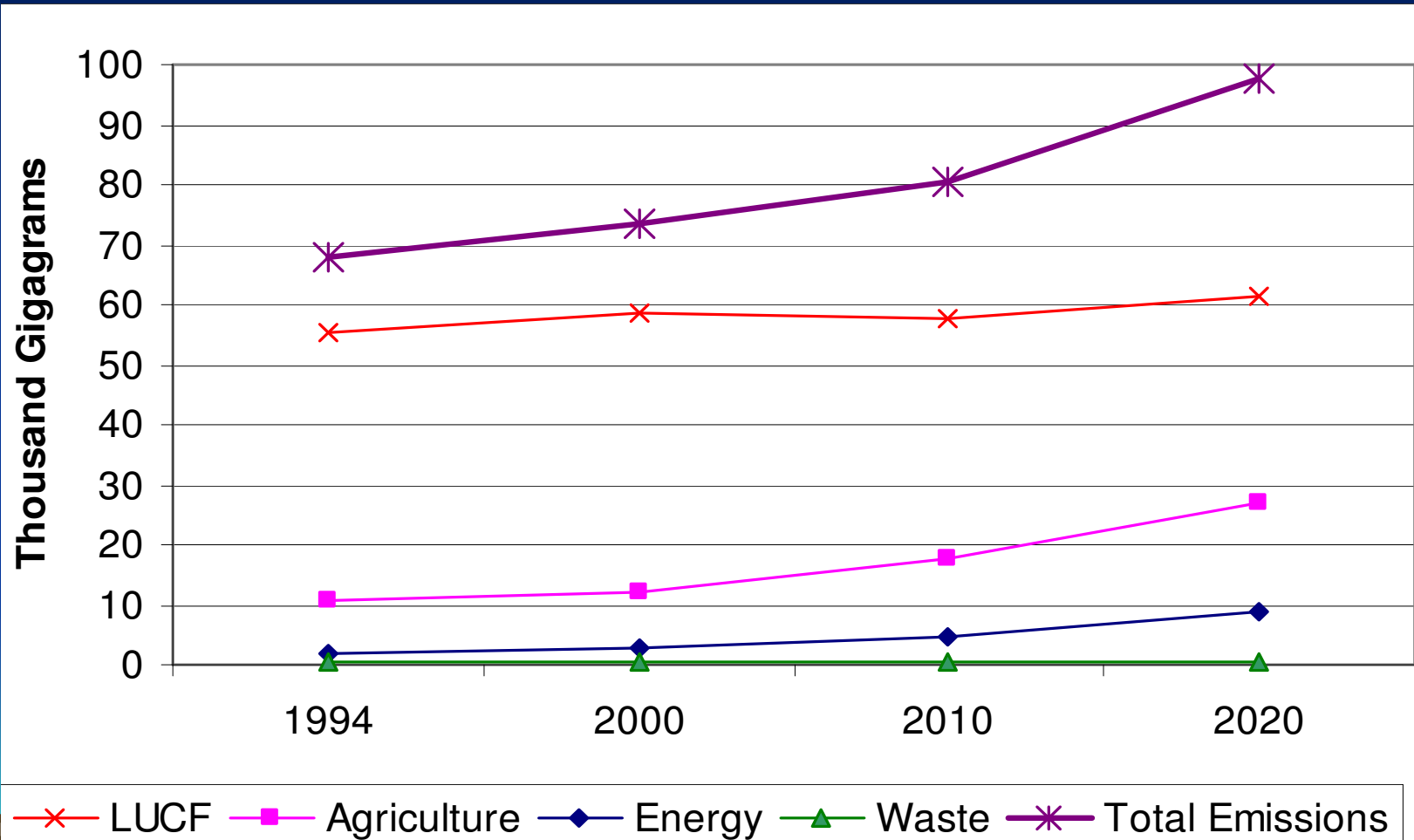
- The carbon dioxide emissions were about 80% of total CO₂-equivalents, followed by methane were about 14% and nitrous oxide were about 4%.
- Table below shown that the main source of carbon dioxide emission contributed from the LUCF sector.



Year	1994		2000		2010		2020	
Emissions	Gg	%	Gg	%	Gg	%	Gg	%
Energy	1,853	2.8	2,622	3.6	4,780	5.9	8,761	9
Industry	50	0.1	-		-		-	
Agriculture	10,560	15.5	12,030	16.4	17,789	22.1	26,821	27.5
Waste	273	0.4	331	0.4	425	0.5	523	0.5
LUCF	55,216	81.2	58,379	79.6	57,627	71.5	61,512	63
Total Emissions	67,952	100	73,362	100	80,621	100	97,617	100
Removal by LUCF	-73,122		-67,118		-61,090		-53,769	
Net Emissions	-5,170		6,244		19,531		43,848	



Among the sectors, LUCF would be the main source of GHG emissions (63%), followed by agriculture (28%).



IX. CLIMATE CHANGE MODELING AND DPREDICTIONS

- Vulnerability of various ecosystems needs to be assessed with respect to possible climate change. Regional climate predictions are needed to determine climate change-related threats to forests/biodiversity.
- The simplest method begins with maps of existing assemblages of species (e.g., plant species as described on vegetation maps).
- Satellite data is being used for biome and landscape level mapping to characterize the biodiversity richness and distribution.
- Vegetation maps and their constituent species are being enumerated for species abundance, frequency, density etc. By incorporating a range of climatic variables, together with actual climatic data sets, and GIS, etc. will be useful for modeling biodiversity distribution and area estimation in Geographic information domain.



X. THE NEED FOR CAPACITY BUILDING IN APPLICATION OF REMOTE SENSING IN CLIMATE CHANGE MITIGATION

- **Dept. D (Department of Natural Resource Assessment and Environmental Data Management) is one of the six other Departments of MoE with the mandate to:**
 - **Develop programs, monitor and assess natural resources and environment;**
 - **Determine conditions and changing trends of natural resources, environmental quality and socio-economy involved;**
 - **Provide comments and assess environmental impacts caused by investment in order to develop policies and strategic plans on socio-economy and environment;**
 - **Prepare state of environmental reports for the Kingdom of Cambodia and other reports necessary for the government to fulfill its obligations and responsibilities;**
 - **Contact and co-operate with countries in the region and the world to ensure cooperation, exchange of experience, knowledge, information and data on environmental conditions in the region and the world; etc.**
- **Anyways, the capacity of Dept. D staff to produce such modeling is still limited. Therefore staff capacity building in application of Remote Sensing in Climate Change is indeed needed.**

On-job Training Activities of Dept. D Staff in Management Information System (MIST), Supported by World Bank



The training of GIS/RS application in climate change should be focused on:

- ***Land cover change detection:*** It is necessary for updating land cover maps and the management of natural resources. The change is usually detected by comparison between two multi-date images, or sometimes between an old map and an updated remote sensing image.
- ***Monitoring of Atmospheric Constituents:*** Density of Each atmospheric constituent molecules can be monitored by measuring the spectral energy transmits from the sun, moon or the stars, the scattering energy from the atmosphere or the clouds , the reflected energy from the earth surface and/or the thermal radiation emitted from the atmosphere and the earth surface.
- ***Evapotranspiration (ET):*** The calculation use inputs of land cover, leaves area index meteorological data and soil texture.



Conclusion

- ➔ So far, the application of GIS/RS was so far used by Dept. D staff mainly for the purpose of Natural Resources Management and Conservation in the Protected Areas.
- Then, the application of GIS/RS for Landcover Change Detection, Monitoring of Atmospheric Constituents, Evapotranspiration (ET), etc. are the new topics/methodologies that Dept D staff should be trained and provided related equipments under the technical and financial support from relevant international institution.
- Meanwhile, Dept D should be given the access to Remote Sensing Data such as satellite images and up-to-date software since those items are so costly that the Dept. D could not afford by it own.

