

**Kingdom of Cambodia
Ministry of Environment
Ministry of Agriculture, Forestry and Fisheries**

**Kingdom of Cambodia
The Project for
National and Sub-National Capacity
Development for Sustainable Natural
Resource Management (SNRM)**

Final Report

December 2024

Japan International Cooperation Agency

Asia Air Survey Co., Ltd.

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Project Site Map



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List of Abbreviations

AAS	Asia Air Survey Co., Ltd
AGB	Above Ground Biomass
AIP	Action and Investment Plan for implementation of the National REDD+ Strategy
APO	Annual Plan of Operation
APO2020-2021	APO for 2020 to 2021
APO2022	APO for 2022
APO2023	APO for 2023
APO2024	APO for 2024
BGB	Below Ground Biomass
CAM-REDD	Project for Facilitating the Implementation of REDD+ Strategy and Policy
CEMIS	Cambodia Environmental Management Information System
CF	Community Forestry
CI	Conservation International
CJCC	Cambodian-Japan Cooperation Center
COVID-19	Coronavirus disease 2019
CPA	Community Protected Area
DBH	Diameter at Breast Height
DFC	Department of Forest and Community Forest
DG	Director General
DGIS	Department of Geographical Information Service
DoA	Department of Agriculture, Forestry and Fisheries
DoE	Department of Environment
DP	Development Partners
DPS	Data Product Specifications
DSM	Digital Surface Model
DTM	Digital Terrain Model
EO	Earth Observation
EF	Emission Factor
FA	Forestry Administration
FAC	Forestry Administration Cantonment
FRL	Forest Reference Level
GCF	Green Climate Fund
GDANCP	General Directorate of Administration for Nature Conservation and Protection
GDEKI	General Directorate of Environmental Knowledge and Information
GDLC	General Directorate of Local Communities
GDNPA	General Directorate of Nature Protected Area
GIS	Geographical Information System
GNSS	Global Navigation Satellite System
GPL	Greening Prey Lang

GPS	Global Positioning System
HQ	Headquarters
JAXA	Japan Aerospace Exploration Agency
JCC	Joint Coordinating Committee
JCC1	The 1st JCC
JCC2	The 2nd JCC
JCC3	The 3rd JCC
JCC4	The 4th JCC
JCC5	The 5th JCC
JCM	Joint Crediting Mechanism
JICA	Japan International Cooperation Agency
JJ-FAST	JICA-JAXA Forest Early Warning System in the Tropics
LULC	Land Use and Land Cover
MAFF	Ministry of Agriculture, Forestry and Fisheries
ML	Machine Learning
MLMUPC	Ministry of Land Management, Urban Planning and Construction
M/M	Minutes of Meetings
MoE	Ministry of Environment
MRV	Measurement, Reporting and Verification
M&E	Monitoring and Evaluation
NDC	Nationally Determined Contribution
NFI	National Forest Inventory
NFMS	National Forest Monitoring System
NGO	Non-governmental Organization
NICFI	Norway's International Climate and Forest Initiative
NP	National Park
NPASMP	National Protected Area Strategic Management Plan
NRT	National REDD+ Taskforce
OVI	Objectively Verifiable Indicators
PaFF	Partnership for Forestry and Fisheries in Cambodia
PaFF3	PaFF Phase 3
PC	Personal Computer
PCA	Principal Component Analysis
PCM	Project Cycle Management
PDF	Portable Document Format
PDM	Project Design Matrix
PDOE	Provincial Department of Environment
PFSP	Production Forest Strategic Plan
PMU	Project Management Unit
PO	Plan of Operation
POI	Point of Interest
QA/QC	Quality Assurance / Quality Control

R/D	Record of Discussions
RECOFTC	The Regional Community Forestry Training Centre
REDD+	Reducing Emissions from Deforestation and Forest Degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries
RGC	Royal Government of Cambodia
RTS	REDD+ Taskforce Secretariat
RUA	Royal University of Agriculture
SATREPS	Science and Technology Research Partnership for Sustainable Development
SEA	Southeast Asia
SDC	Swiss Agency for Development and Cooperation
SEPAL	System for Earth Observation Data Access, Processing and Analysis for Land Monitoring
SLMS	Satellite Land Monitoring System
SNRM	The Project for National and Sub-National Capacity Development for Sustainable Natural Resource Management
SNS	Social Networking Service
tC	Ton of Carbon
tCO₂	Ton of Carbon dioxide
ToT	Training of Trainers
TWG-FR	Technical Working Group on Forestry Reform
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
UXO	Unexploded Ordnance
WB	World Bank
WG	Working Group
WS	Wildlife Sanctuary

Executive Summary

The Project for National and Sub-National Capacity Development for Sustainable Natural Resource Management (SNRM) has been implemented from October 2020 to October 2024 under the collaboration of Cambodian counterparts and Japanese experts. Japanese experts consist of long-term experts dispatched by JICA headquarters and short-term expert team formed by Asia Air Survey Co., Ltd. The short-term expert team is mainly responsible for the Output 1-3-2: Assist in enhancing the National Forest Monitoring System (NFMS) as well as Output 2-1-1: Develop and implement training plans for capacity enhancement of provincial staff.

In this report, activities, results and achievements mainly related with the Output 1-3-2 and Output 2-1-1 are reported. In these outputs, the short-term expert team conducted activities to enhance NFMS of Cambodia particularly on supporting development of deforestation alert function in the satellite land monitoring system (SLMS) of NFMS and contributing to enhance the information of measurement, reporting and verification (MRV) function of NFMS by providing forest inventory information of Stung Treng province by implementing provincial level forest inventory, as well as to enhance the capacities of central and provincial government staff to operate NFMS particularly on providing a series of training of trainers (ToT) program on collecting land use and land cover (LULC) information and analyzing its changes using satellite and drone imagery, conducting field verification of deforestation and forest degradation with drones and smartphone application as well as compilation of collected LULC information as maps and standardized geodatabase which promotes the implementation of duties of central and provincial governments including law enforcement and effective monitoring and management of protected areas and production forests.

I Basic Information of the Project and Component

1 Country

The Kingdom of Cambodia

2 Title of the Project

The Project for National and Sub-National Capacity Development for Sustainable Natural Resource Management (SNRM) (hereinafter referred to as “the Project”)

3 Duration of the Project (Planned and Actual)

Planned: 14 October 2020 – 13 October 2023 (3 years)*

*Originally the duration of the Project was 3 years but was extended officially to 4 years.

Actual: 14 October 2020 – 13 October 2024 (4 years)

4 Background (from Record of Discussions(R/D))

In Cambodia, approximately half of its territory is covered by various types of forests such as evergreen forest, deciduous forest, inland flooded forest, mangrove forest and so on. As habitats for rare and endangered species, carbon sinks contributing to the global warming mitigation and indispensable supply sources of foods and daily commodities for the life of local residents, the great value and the importance of the sustainable management of them has been widely recognized for many years.

However, compared to the neighboring countries in the Mekong region, Cambodia has recorded a worsen deforestation rate in recent years. The forest rate has been continuously reduced from 59% in 2009 to 47% in 2018 (Ministry of Environment, 2020). The major causes of deforestation are land use conversion for cash crop cultivation, illegal logging and unsustainable use of forest resources. The deforestation has resulted in increased soil erosion and reduced biodiversity bringing negative impacts to rural areas where 80% of the population live. Besides, seeing from a broader perspective, the deforestation and forest degradation would increase carbon emission and accelerate the global warming.

With the support of the international community, the Royal Government of Cambodia has continued significant efforts aimed at achieving a proper management of its valuable forest resources which have been put under the pressure of over exploitation and land use change. In the process, JICA has also play an important role as one of the major donor organizations for the forest sector in Cambodia. JICA has begun its support in this area by dispatching a policy advisor in 1999 followed by a ten-year technical cooperation project for the human resources development. In the next ten years from 2010, JICA mainly supported for the readiness phase of the REDD+ through providing equipment and implementing a technical cooperation project.

Utilizing the assets of JICA's previous cooperation, this project makes the national and sub-national government staff in charge of protected area management and sustainable forest management be equipped with necessary skills and knowledge for sustainable natural resource management through policy support at central level and sub-national implementation at provincial level, aiming that the related policies and key measures are formulated and implemented to reduce deforestation and forest

degradation in Cambodia.

5 Overall Goal and Project Purpose (from Record of Discussions(R/D))

The Project aims to contribute to the promotion of sustainable natural resource management towards reducing deforestation and forest degradation in Cambodia. In line with the background described in section 4, Table 1. 1 below shows the Project Purpose, Overall Goal, and Outputs, as amended during the mid-term review implemented in May 2022.

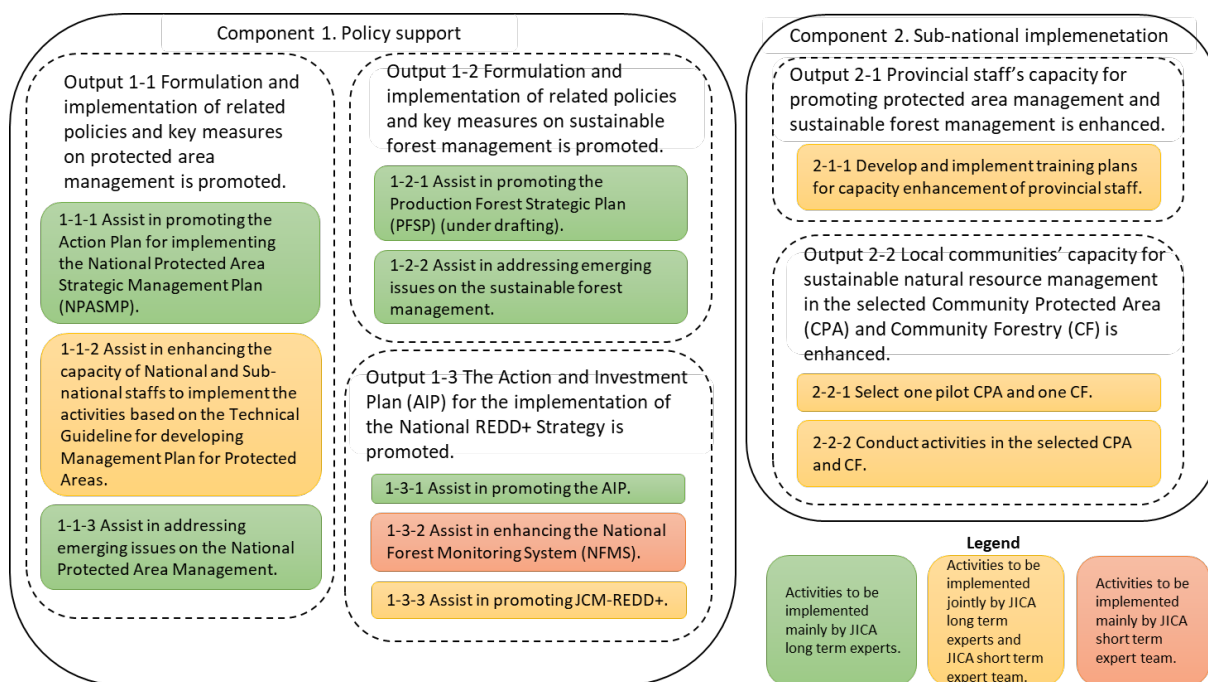
Table 1. 1 Outputs and Objectives of the Project

Overall Goal	Deforestation and forest degradation are reduced through formulation and implementation of related policies and key measures for strengthening protected area management and sustainable forest management.
Project Purpose	The national and sub-national government staff in charge of protected area management and sustainable forest management is equipped with necessary skills and knowledge for sustainable natural resource management.
Outputs	[Component 1: Policy support] 1-1. Formulation and implementation of related policies and key measures on protected area management is promoted. 1-2. Formulation and implementation of related policies and key measures on sustainable forest management is promoted. 1-3. The Action and Investment Plan for the Implementation of the National REDD+ Strategy is promoted. [Component 2: Subnational implementation] 2-1. Provincial staff's capacity for promoting protected area management and sustainable forest management is enhanced. 2-2. Local communities' capacity for sustainable natural resource management in the selected Community Forestry (CF) and provincial rangers' capacity for supporting local communities' sustainable natural resource management in Community Protected Areas (CPAs) are enhanced.

Source: SNRM Project

The Project is to be achieved through activities carried out by long-term experts and activities carried out by the short-term expert team (hereinafter referred to as “the Team”) together with the Cambodian Counterpart (C/P).

In the implementation of the Project, the Team mainly engaged in the activities of Output 1-3-2: Assist in enhancing the National Forest Monitoring System (NFMS) as well as Output 2-1-1: Develop and implement training plans for capacity enhancement of provincial staff as specified in Figure 1. 1. These outputs are hereinafter referred to as “the Component” and contents of the Component are described in this report.



Source: SNRM Project

Figure 1. 1 Outputs of the Project

6 Implementing Organization

General Directorate of Nature Protected Area (GDNPA), Ministry of Environment (MoE)
 Forestry Administration (FA), Ministry of Agriculture, Forestry and Fisheries (MAFF)
 Stung Treng Provincial Department of Environment (DoE)
 Stung Treng Provincial Department of Agriculture (FA cantonment)

II Results of the Component

1 Results of the Component

1.1 Input by the Japanese side (Planned and Actual)

1.1.1 Input of Short-Term Japanese Experts

The records of input of short-term Japanese experts are shown in Table 2. 1.

Table 2. 1 Input of short-term experts (December 2020 – October 2024)

Name	Expertise	Assignment month
Toru FURUYA	Team Leader / Forest Information Management	13.38
Toru INADA	Vice Team Leader / Forest Information Management	3.55
Asako TAKIMOTO	Institutional Coordination	1.77
Naoki MITSUZUKA	Forest Monitoring System (1)	4.42
Kenta YOSHINO / Miki ASAI	Forest Monitoring System (2) / Coordinator	6.20
Shiori TANIGUCHI	Forest Monitoring System (3)	4.33
Toru FURUYA	Forest Monitoring System (4)	6.50
Yoshihiko SATO	Forest Inventory Survey	4.68
Total		44.83

Source: SNRM Project

1.1.2 Input of Equipment and Materials

The record of input of equipment and materials is shown in Table 2. 2.

Table 2. 2 Input of equipment and materials

No.	Name of Equipment	Model	Q'ty	Date of inspection passed	Situation of handover at the completion of project
1	Measuring tape (50m)	Hayamaki 14 066-1281	12	2021/3/4	6 sets were handed over to MoE on 11th Oct. 2023. The other 6 sets were handed over to FA on 14th Dec. 2023.
2	Soil sampling cup	Stainless core	2	2021/3/4	1 set was handed over to MoE on 11th Oct. 2023. Another 1 set was handed over to FA on 14th Dec. 2023.
3	360 degree camera	Ricoh Theta SC2	6	2021/3/18	3 sets were handed over to MoE on 11th Oct. 2023. The other 3 sets were handed over to FA on 14th Dec. 2023.
4	Telescopic staff (8m)	AT-8	6	2021/3/4	3 sets were handed over to MoE on 11th Oct. 2023. The other 3 sets were handed over to FA on 14th Dec. 2023.
5	Diameter measuring tape (10m)	Million diameter D3M	12	2021/3/4	6 sets were handed over to MoE on 11th Oct. 2023. The other 6 sets were handed over to FA on 14th Dec. 2023.
6	Diameter measuring tape (2m)	F10-02DM	12	2021/3/4	6 sets were handed over to MoE on 11th Oct. 2023. The other 6 sets were handed over to FA on 14th Dec. 2023.
7	Clinometer with compass	SUUNTO Tandem	6	2021/6/29	2 sets were handed over to MoE on 11th Oct. 2023. The other 2 sets were handed over to FA on 14th Dec. 2023.

8	Hypsometer	Haglof Vertex Geo	4	2021/6/29	2 sets were handed over to MoE on 11th Oct. 2023. The other 2 sets were handed over to FA on 14th Dec. 2023.
9	GPS logger	Garmin GPSMAP 66s	4	2021/6/29	2 sets were handed over to MoE on 11th Oct. 2023. The other 2 sets were handed over to FA on 14th Dec. 2023.
10	Laptop PC	Dell Mobile Precision 7550	4	2021/10/4	A total of 2 sets were handed over to FA on 20th Sep. 2023 and 25th Sep. 2024, and 2 sets were handed over to MoE on 11th Oct. 2023 and 10th Oct. 2024.
11	Desktop PC	Desktop Dell Precision T7820	2	2021/10/4	1 set was handed over to Stung Treng PDoE on 26th Jun. 2023. Another 1 set was handed over to Stung Treng FAC on 20th Sep. 2024.
12	Workstation	Desktop Dell Precision T7810	3	2021/11/1	1 set was handed over to Stung Treng PDoE on 26th Jun. 2023, and a total of 2 sets was handed over to FA on 20th Sep. 2023 and 25th Sep. 2024.
13	Image processing software	Pix4D Mapper Pro	3	2021/11/5	1 licence was handed over to Stung Treng PDoE on 26th Jun. 2023, and a total of 2 sets was handed over to FA on 20th Sep. 2023 and 25th Sep. 2024.
14	Fixed-wing Drone and GPS equipment	eBee Geo	2	2021/11/24	1 set was handed over to MoE on 11th Oct. 2023. Another 1 set was handed over to FA on 25th Sep. 2024.

Source: SNRM Project

1.2 Input by the Cambodian side (Planned and Actual)

Counterparts from the Government of Cambodia are shown in Table 2. 3.

Table 2. 3 List of Counterpart of SNRM

No.	Name			Designation / Position	Remarks
1	H.E.	Srey	Sunleang	Director General, General Directorate of Natural Protected Area (GDNPA)	Project Director
2	Mr.	Chan	Ponika	Deputy Director General of Forestry Administration	
3	Mr.	Sou	Sontara	Deputy Director, Dept. of Inspection and Law Enforcement, GDNPA	Project Manager
4	Mr.	Long	Ratanakoma	Deputy Director, Dept. of Forest and Community Forestry	
5	H.E.	Chivin	Leng	Director General, General Directorate of Environmental Knowledge and Information (GDEKI)	
6	Mr.	Uy	Kamal	Deputy Director General, GDEKI	
7	Mr.	Kim	Sarin	Deputy Director, Dept. of Community Livelihood, General Directorate of Local Community (GDLC)	
8	Mr.	Sok	Vuthin	Chief of Office, Dept. of Terrestrial Protected Area Conservation (North of Tonlesap), GDNPA	
9	Mr.	Hour	Thanith	Chief of Office, Dept. of Fresh Water Wetland Area Conservation, GDNPA	
10	Mrs.	Huot	Naborey	Chief of Office, Dept. of Geographic	
11	Mr.	Menh	Khidorang	Vice Chief of Office, Dept. of Geographic Information Service, GDEKI	
12	Mr.	Net	Norint	Vice Chief of Office, Dept. of Geographic Information Service, GDEKI	
13	Mr.	Hean	Sereypheap	Vice Chief of Office, Dept. of Geographic Information Service, GDEKI	
14	Mr.	Mouerng	Sovan	Vice Chief of Office, Dept. of Administration, Planning and Finance, GDNPA	
15	Mr.	Tim	Yean	Vice Chief of Office, Dept. of Territorial Natural Protected Area Conservation (East of Mekong River), GDNPA	
16	Mr.	Tip	Sopheha	Vice Chief of Office, Dept. of Geographic Information Service, GDEKI	

17	Mr.	Nhong	Votey	Vice Chief of Office, Dept. of Geographic Information Service, GDEKI	Participant of Forest Inventory Survey
18	Mr.	Leng	Serey Odom	Officer, Dept. of Geographic Information Service, GDEKI	Trainee of Drone Training
19	Mr.	Mean	Naro	Deputy Chief of Dep. Terrestrial, Eastern Mekong-river Conservation, GDNPA	Trainee of GIS and Drone Training
20	Mr.	Song	Bonith	Deputy Chief Office Dep. Inspection and Strengthen of Law enforcement, GDNPA	
21	Mrs.	Chea	Sodaneth	Officer of Dep. Terrestrial, Eastern Mekong-river Conservation, GDNPA	
22	Mr.	Eng	Sereyvathana	Officer of Dep. Terrestrial, Eastern Mekong-river Conservation, GDNPA	
23	Mr.	Meng	Sokmean	Officer of Dep. Coastal and Marine Areas Conservation, GDNPA	
24	Mr.	Keth	Saren	Deputy Chief Office of Dep. Wetland and Freshwater Conservation, GDNPA	
25	Mr.	Koem	Nith	Officer of Dep. Administration Planning and Finance, GDNPA	
26	Mr.	Lay	Darith	Chief Office of Dep. Terrestrial, Eastern Mekong-river Conservation, GDNPA	
27	Mr.	Heng	Namyi	Officer of Dep. Terrestrial, Northern Tonlesap-river Conservation, GDNPA	
28	Mr.	Hean	Phanny	Officer of Dep. Terrestrial, Northern Tonlesap-river Conservation, GDNPA	
29	Mr.	Path	Sokunvath	Officer of Dep. Terrestrial, Southern Tonlesap-river Conservation, GDNPA	
30	Mr.	Ven	Bros	Officer of Dep. Inspection and Strengthen of Law enforcement, GDNPA	
31	Mr.	Tieng	Bunna	Deputy Office , Administration Planning and Finance, GDNPA	Trainee of Advanced GIS Training
32	Mr.	Oeun	Koemoun	Deputy Office , Southern Tonlesap, GDNPA	
33	Mr.	Sokha	Sophorn	Deputy Department , Administration Planning and Finance, GDNPA	
34	Mr.	Mom	Sethera	Volunteer Officer, Northern Tonlesap, GDNPA	
35	Mrs.	Eang	Phallis	Deputy Office, Wetland and Freshwater, GDNPA	
36	Mr.	Pin	Chanratana	Chief Office, Eastern Mekong, GDNPA	
37	Mr.	Tan	Thara	Chief Office, Eastern Mekong, GDNPA	
38	Mr.	Yub	Chanborey	Deputy Department, Law enforcement, GDNPA	
39	Mr.	Eng	Srereyathana	Deputy Office, Eastern Mekong, GDNPA	
40	Mr.	Than	Monokumrith	Deputy Office, Coastal, GDNPA	
41	Mr.	Yoeung	Visal	Deputy Office, Wetland, GDNPA	
42	Mrs.	Thao	Chanthearyradh	Officer, Dept. of Terrestrial Protected Area Conservation (South of Tonlesap), GDNPA	
43	Mr.	Sum	Dara	Deputy Chief Officer, Dept. of Marine & Coastal Area Conservation, GDNPA	
44	Mr.	Seng	Sopanha	Deputy Officer, Dept. of Administration, Planning and Finance, GDNPA	Trainee of Advanced GIS Training
45	Mr.	Chhun	Delux	Deputy Director, Dept. of Forest Industry and International Cooperation	
46	Mr.	Lim	Bunna	Deputy Director, Dept. of Administration, Planning, and Finance	
47	Mrs.	Im	Maredi	Chief of Community Forestry Office	
48	Mr.	Y	Chhaly	Official, Dept. of Forest Industry and International Cooperation	
49	Mrs.	Koh	Sotheavy	Vice Chief, Forest Demarcation, Registration and Forest Land use Office	Trainee of Drone Training
50	Mr.	Chheav	Sophoan	Vice Chief, Registration and Litigation Office	

51	Mr.	Pich	Sovathara	Vice Chief, Trade and Forest Certification	
52	Mr.	Hem	Senghong	Official, Forest Demarcation, Registration and Forest Land use Office	
53	Mr.	Chan	Ratana	Official, Registration and Litigation Office	
54	Mr.	As	Brosden	Official, Dept. of Forestry and Community Forestry	
55	Mrs.	Bun	Sokleng	Official of Community Forestry	
56	Mr.	Sreng	Cheaheng	Director of Stung Treng Department of Environment (DoE)	
57	Mr.	Lay	Laro	Deputy Director of DoE	
58	Mr.	Heng	Teklay	Chief of Wildlife Sanctuary Office, DoE	
59	Mr.	Sorn	Chanmonyphalla	Chief of Community Protected Area Office, DoE	
60	Mr.	Eng	Somatra	Officer, DoE	
61	Mr.	Pich	Putra	GIS Officer	
62	Mr.	Chhoung	Chhorn	Vice Chief of Ramsar Office	
63	Mr.	Ti	Tetsya	Ranger Officer	
64	Mr.	Sang	Rithsa	Vice Chief of Protected Area	
65	Mr.	Sang	Andy	Chief of Anlung Chrey Station	
66	Mr.	Kean	Kimsan	Vice Chief of Anlung Chrey Station	
67	Mr.	Orn	Chansocheat	Chief of Stung Treng FA Cantonment Office	
68	Mr.	Rey	Raksmey	Deputy Chief of Stung Treng FA Cantonment Office	Trainee of ToT Training
69	Mr.	Chhum	Monycheat	Deputy Chief of Stung Treng FA Division Office	Trainee of ToT Training
70	Mr.	Tith	Vy	Deputy Chief of Stung Treng FA Triage Office of Kbal Romes-Sre Kor	
71	Mr.	Hun	Samoeun	Deputy Chief of Stung Treng FA Triage Office of Oh Pongmoin	
72	Mr.	Thoeung	Linin	Official, Stung Treng FA Cantonment Office	
73	Mr.	Ly	Korn	Deputy Chief of Stung Treng FA Division Office	
74	Mr.	Va	Sokha	Deputy Chief of Stung Treng FA Division Office	
75	Mr.	Sok	Somnang	Deputy Chief of Stung Treng FA Division Office	

Source: SNRM Project

1.3 Activities (Planned and Actual)

1.3.1 Overall Activity

(1) Preparation of Work Plan

The draft Work Plan was prepared to clarify the basic concepts of the implementation of the Component of the Team at the beginning of the Project, and the draft Work Plan was finalized based on the comments from JICA. After dispatched to Cambodia, Work Plan meetings were held in MoE and FA to explain and discuss the contents of Work Plan with the Cambodian counterparts and the Work Plan was finalized in January 2021.



Source: SNRM Project

Figure 2. 1 Holding of Work Plan meetings in MoE and FA

In addition, Annual Plan of Operations (APO) were compiled under the collaboration with the Cambodian counterparts for every year of the project period and the APOs were approved in the Joint Coordinating Committees (JCC) of the Project.

Table 2. 4 Prepared Annual Plan of Operations

Year of APO	JCC to obtain approval of APO
2020 - 2021	JCC1 held in April 2021
2022	JCC2 held in February 2022
2023	JCC3 held in November 2022
2024	JCC4 held in September 2023

Source: SNRM Project



Source: SNRM Project

Figure 2. 2 Holding of Joint Coordinating Committees

(2) Meetings Held/Attended

The Team held and/or attended the JCCs, Project Management Unit (PMU) meetings, technical seminars and meetings with stakeholders to discuss and report the condition and progress of the activities. The held and/or attended meetings are listed in Table 2. 5.



Source: SNRM Project

Figure 2. 3 Holding of Technical Seminars

Table 2. 5 List of meetings held / attended

Date	Venue	Meeting held / attended
19th November, 2020	Online	Held meeting with MoE (DGIS) to discuss the Work Plan of the Team.
26th November, 2020	Online	Held meeting with GPL project to clarify the NFMS functions to be supported by the Project.
13th January, 2021	FA	Held meeting with FA PMU members to discuss the Work Plan of the Team.
15th January, 2021	FA	Held follow-up meeting with FA PMU members to discuss the Work Plan of the Team.
19th January, 2021	MoE	Held meeting with MoE PMU members to discuss the Work Plan of the Team.
21st January, 2021	FA	Held courtesy call to DG of FA with FA PMU members.
29th January, 2021	Online	Held meeting with GPL project and JCM REDD+ project to clarify the NFMS functions to be supported by the Project.
3 rd to 5 th February, 2021	Mayura Resort and Hotel, Kep province	Attended Planning the NFMS to Support the REDD+ Implementation Technical Retreat. Details in 2) Stakeholder's Workshop.
21st April, 2021	Online	Held the First Joint Coordinating Committee (JCC1) Meeting.
8th February, 2021	MoE	Attended a ceremony of the launching of "Cambodia's updated NDC".
16th February, 2021	FA	Attended TWG-FR.
26th February, 2021	Online	Attended a workshop on JCM-REDD+ and Nested REDD+ in Cambodia.
4th March, 2021	Online	Attended an online meeting on the Brief presentation on Sustainable Forest Financing Mechanism in Cambodia - focusing on CF.
16th March, 2021	Online	Held meeting on water resource management with the Project on Establishment of Environmental Conservation Platform of Tonle Sap Lake.
30th March, 2021	Online	Held meeting with JCM REDD+ project.
23rd June, 2021	Online	Held meeting with RTS on the progress of AIP.
15th July, 2021	Online	Attended the FRL allocation training hosted by UNDP.
19th July, 2021	Online	Held PMU joint monthly workshop.
13th August, 2021	FA and online	Held meeting on pilot CF selection.
19th August, 2021	Online	Attended a workshop of PaFF Phase 2 wrap-up and Phase 3.
27th August, 2021	Online	Held PMU joint monthly workshop.
17th September, 2021	Online	Held meeting with REDD Copernicus for information sharing of forest monitoring technology.
23rd September, 2021	Online	Attended a meeting of Geospatial technology for sustainable landscape management and REDD+ implementation in Cambodia.
11th October, 2021	Online	Held PMU joint monthly workshop.

22nd December, 2021	MoE	Attended CEMIS stakeholder consultation event.
13th January, 2022	Stung Treng province	Held a meeting of pre-inventory survey with Stung Treng Provincial DoE and FAC.
14th January, 2022	MoE	Attended a consultation workshop on CEMIS.
27th January, 2022	Stung Treng province	Held meeting with JCM REDD+ project on the forest monitoring technique.
7th February, 2022	Online	Held the Second Joint Coordinating Committee (JCC2) Meeting.
25th March, 2022	FA	Held a seminar on the mid-term reporting of the forest inventory survey in Stung Treng province.
31st March, 2022	Online	Held PMU joint monthly workshop.
1st April, 2022	MoE	Held meeting with CEMIS project team.
29 th June, 2022	Cambodia-Japan Cooperation Center (CJCC), Angkor Meas Hotel and online	Held the first technical seminar. Details in 1) Technical Seminar.
3rd August, 2022	Online	Held PMU joint monthly workshop.
1st September, 2022	Online	Held PMU joint monthly workshop.
25th November, 2022	Himawari Hotel	Held the Third Joint Coordinating Committee (JCC3) Meeting.
26th December, 2022	Online	Held meeting with a Japanese start-up company and JICA HQ on the smart phone application of patrolling.
18 th January, 2023	Stung Treng Provincial DoE	Held workshop on forest inventory of Stung Treng province for Stung Treng provincial government.
23 rd January, 2023	MoE and online	Held workshop on forest inventory of Stung Treng province for the Central government and stakeholders.
26th January, 2023	FAO Cambodia	Held meeting with FAO expert to discuss the future NFI implementation in Cambodia.
27th January, 2023	MoE	Held meeting with RTS to discuss the recommendation for future NFI implementation in Cambodia.
2nd February, 2023	MoE, FA, RTS	Held meeting with MoE, FA, RTS and JICA HQ mission for the mid-term review of the Project.
22nd May, 2023	Himawari Hotel	Attended a consultation workshop of SERVIR SEA.
24th May, 2023	Phnom Penh Hotel	Attended a closing seminar of PaFF3: Ten years of partnership for forestry and fisheries communities in Cambodia: experiences, lessons, and innovations.
2nd June, 2023	MoE	Attended a consultation workshop on designing spatial data infrastructure (SDI) in CEMIS.
6th July, 2023	Online	Held PMU joint monthly workshop.
14th August, 2023	Online	Held PMU joint monthly workshop.
15th September, 2023	Hotel Sunway Phnom Penh	Held the Fourth Joint Coordinating Committee (JCC4) Meeting.
21st September, 2023	MoE	Attended courtesy call to the Minister of MoE.
9th October, 2023	Phnom Penh	Held meeting with RECOFTC for the progress report of the Project.
10th October, 2023	Phnom Penh	Held meeting with SDC and CI for the progress report of the Project.
29th February, 2024	Online	Held meeting with Kyushu University for possible assistance on the future SATREPS project in Cambodia.
22 nd to 25 th April, 2024	Hotel Sunway Phnom Penh	Attended Workshop on Geospatial Technology for Sustainable Landscape Management and Information Dissemination in Cambodia And Training on Geospatial Application for Crop Mapping. Details in 2) Stakeholder's Workshop.
20 th to 24 th May, 2024	Paulo Wai Hotel & Apartments	Attended Technical Workshop on Comparing State-of-the-Art Methods and Artificial Intelligence for Mapping Deforestation and Estimating Forest Degradation. Details in 2) Stakeholder's Workshop.
10th July, 2024	Online	Attended the action plan presentation of the Training of Remote Sensing of Forest Resources 2024.
28 th August, 2024	Cambodia-Japan Cooperation Center (CJCC), Angkor Meas Hotel and online	Held the second technical seminar. Details in 1) Technical Seminar.
16th October, 2024	Himawari Hotel	Held the Fifth Joint Coordinating Committee (JCC5) Meeting.

Source: SNRM Project

1) Technical Seminar

Date	29 th June, 2022	Place	Cambodia-Japan Cooperation Center (CJCC), Angkor Meas Hotel and online
Name of Meeting	The first technical seminar	Organizing or Participating	Organized by the short term expert team of SNRM
Participants	56 persons including PMU members, Stakeholders and JICA members		
Contents	• Outline of the SNRM Project • Report on the result of forest inventory implemented in Stung Treng province • Report on the progress of drone operation for forest management and monitoring • Discussion		
Results	This seminar presented the progress of two major project activities to enhance the National Forest Monitoring System (NFMS): the forest inventory implemented in Stung Treng province and trial operations of drone for forest management and monitoring. Following the presentations, all the participants were invited to discuss how the outputs of those project activities can contribute to missions of the central and provincial governments and relevant projects and stakeholders for the enhancement of sustainable natural resource management. In the discussion session, all the participants of the seminar were invited to discuss two major issues of the Project. The issues and the comments from the participants are as follows. Issue 1: Implementation of NFI in the future: how, when and who to implement? ➤ Who: There are two main actors (FA and MoE). However, Academia, Research Institute, NGO and Development Partners plus other relevant stakeholders are also welcome. ➤ When: Between 4-5 years as FAO guideline. However, timeframe might vary based on geographical and weather condition. Thus we need to be flexible. ➤ How: Developing the proposal for NFI full implementation that include all actors and their responsibilities plus planning budget. More importantly, we need to ensure the capacity of the data collectors and data analysts. Issue 2: Future use of drone: which application should be prioritized? ➤ There are eight applications of drone for SNRM of Cambodia as follows: Create or update LULC map & forest cover map; Monitor illegal logging and forest encroachment; Boundary demarcation for protected areas (PAs) and production forests; Zoning of PAs; Land use planning; Understand forest condition such as canopy cover, canopy height and canopy density; Fauna study (wildlife inventory/research/tracking, etc.); and Flora study (forest inventory, forest disease (pathology), etc.).		

Date	28 th August, 2024	Place	Cambodia-Japan Cooperation Center (CJCC), Angkor Meas Hotel and online
Name of Meeting	The second technical seminar	Organizing or Participating	Organized by the short term expert team of SNRM
Participants	50 persons including PMU members, Stakeholders and JICA members		
Contents	• Outline of the SNRM Project and activities of enhancing the NFMS and capacity enhancement of central and provincial staff • Introduction of a training package for capacity enhancement of central and provincial staff • Report on the achievement of GIS trainings, and utilization of training outputs for the management of protected areas • Report on the achievement of drone operation and drone data processing trainings and utilization of training outputs for the production forest management • Report on the achievement of a series of trainings and utilization of training outputs for the management of community forests • Report on the achievement of a series of trainings and utilization of training outputs for the management of protected areas • Discussion		
Results	This seminar presented the outline of a training package developed and used in the forest monitoring related trainings, as well as reporting from the central and provincial government staff on the achievement of trainings and utilization of training outputs for their duties. Following the presentations, all the participants were invited to discuss how the outputs of SNRM can be contributed to the missions of the central and provincial governments as well as needs for future assistance on the sustainable natural resource management. In the discussion session, all the participants of the seminar were invited to discuss how to utilize the outputs of the Project. The issues and the comments from the participants are as follows. Theme 1: How the outputs of SNRM can be effectively utilized or integrated into various missions of the central and provincial governments?		

	➤ The following eleven points were raised from the participants on the utilization of outputs of SNRM: ensure data accuracy; more efficient PA, CPA, CF management planning; Monitoring and evaluation of CPA and CF; Knowledge improvement for national and sub-national staff; Data collection and ground truth; Field survey and research; Sharing knowledge to provincial staff; Assist with Management and natural conservation based on acquiring knowledge GIS and Remote; Remote sensing to produce the Zoning in PA and Management plan; Produce maps of wildlife distribution and others; To help law enforcement more effectively; and Produce land use and land cover maps for Protected Areas. Theme 2: Needs for the future assistances on SNRM. ➤ Eleven needs were raised from the participants as follows: Provide new method to download satellite image with less size; More training courses related with SNRM; Short term training in Japan and Cambodia; Establish monitoring platform of LULC; Prepare technical documents in English and Khmer with video materials; Establish data portal; Carbon stock inventory; Protected area management technique; Exchange program to Japan on forest/protected area management; Forest or natural crime investigation; and Watershed and landscape management in PA.
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2) Stakeholder's Workshop

Date	3 rd - 5 th February, 2021	Place	Mayura Resort and Hotel, KEP province
Name of Meeting	Planning the NFMS to Support the REDD+ Implementation Technical Retreat	Organizing or Participating	Organized by UNDP and funded by Forest Carbon Partnership Facility II
Participants	MRV/FRL technical team, REDD+ Secretariat, FCPF-II project, DPs and INGOs involved in REDD+		
Contents	Analyze the technical, institutional and financial requirements of the REDD+ implementation at multiple scales and to set a new vision of the NFMS.		
Results	Discussions were held with the participants of the workshop on; ➤ Making a capacity gap assessment based on the current and future requirements of the MRV technical team; ➤ Revising the institutional arrangements and the roles and responsibilities in the MRV team; and ➤ Developing an NFMS road map for the REDD+ implementation.		

Date	22 nd - 25 th April, 2024	Place	Sunway Hotel
Name of Meeting	Workshop on Geospatial Technology for Sustainable Landscape Management and Information Dissemination in Cambodia And Training on Geospatial Application for Crop Mapping	Organizing or Participating	Organized by SERVIR SEA
Participants	NGOs, Government agencies of Cambodia, Open Development Cambodia, USAID project, Development partners in Cambodia		
Contents	SERVIR SEA presented its initiative in Cambodia and held discussions with the participants how to collaborate on the implementation of the following activities: ➤ To upgrade and expand the existing Protected Area Alerts System to other areas in Cambodia; ➤ To develop crop-mapping tools to regularly capture and update maps of six key crops including Cashew, mango, rubber, pepper, rice, and cassava; and ➤ To release and disseminate an annual biophysical condition evaluation report to key stakeholders to support decision making.		
Results	The following outputs were obtained though the workshop: ➤ Increased awareness and understanding of the Cambodia Biophysical M&E Dashboard; ➤ Enhanced stakeholder engagement and collaboration; ➤ Improved utilization of geospatial data for sustainable development; and ➤ Action plan for continued development and utilization of the dashboard.		

Date	20 th - 24 th May, 2024	Place	Poulo Wai Hotel & Apartment
Name of meeting	Technical Workshop on Comparing State-of-the-Art Methods and Artificial Intelligence for Mapping Deforestation and Estimating Forest Degradation	Organizing or participating	Organized by UNDP
Participants	Government agencies of Cambodia including MoE, MAFF, MLMUPC and Development partners in Cambodia		
Contents	The primary objective of this workshop is to equip participants with the knowledge and skills required to implement advanced modeling techniques for deforestation monitoring. Specifically, the workshop aims		

	to: ➤ Explore various modeling options for deforestation monitoring, evaluating their strengths and applicability; ➤ Critically review the current land use/cover change mapping methods utilized by the Cambodian government and identify areas for improvement; ➤ Engage participants in hands-on exercises to deepen their understanding of machine learning (ML) algorithms and their application in environmental monitoring; and ➤ Facilitate discussions on the selection of appropriate models for initial testing, considering the available data and contexts for deforestation and forest degradation mapping.
Results	Upon completion of the workshop, the following outcomes were obtained: ➤ A comprehensive understanding of different modeling techniques for deforestation monitoring and their practical application; ➤ Identified improvements for existing mapping methods and a strategic plan for integrating more advanced models; ➤ Selection of three candidate models for deforestation and forest degradation for initial implementation based on detailed discussions and analysis of the available data, respectively; and ➤ Potential field site selections based on different forest ecological types for testing the performance of selected models for deforestation and forest degradation mapping.

(3) Monitoring

Based on the JICA's working guidance, monitoring of the Project were conducted with the counterparts in every six months by use of monitoring sheet. A total of eight monitoring sheets were prepared in the Project and these monitoring sheets were submitted to JICA. Table 2. 6 shows the period covered by each monitoring sheet.

Table 2. 6 Version and period of monitoring sheet

Version	Date of sign	Period
Ver.1	7 th May 2021	November 2020 – April 2021
Ver.2	7 th February 2022	May 2021 – October 2021
Ver.3	30 th May 2022	November 2021 – April 2022
Ver.4	20 th December 2022	May 2022 – October 2022
Ver.5	31 st May 2023	November 2022 – April 2023
Ver.6	31 st October 2024	May 2023 – October 2023
Ver.7	30 th April 2024	November 2023 – April 2024
Ver.8	14 th October 2024	May 2024 – October 2024

Source: SNRM Project

(4) Equipment Procurement

In this project, the equipment and materials shown in Table 2. 2 were procured based on the “Procurement and Management Guideline for the Equipment in the outsource contract (2017 June)” as well as “Internal Regulations for Local Procurement Cambodia Office, Japan International Cooperation Agency (2016 February)”. At the confirmation of the current status of the counterparts in advance, the component considered the compatibility and affinity with the related equipment used by the C/P, as well as the ease of maintenance and sustainability of the equipment. The confirmed draft of equipment list was submitted to JICA, and it was confirmed based on discussion with JICA. The procurement tender document, draft of contract and purchase order, equipment specification and estimation for budget with

reference quotation were prepared, and evaluation of the proposal in tender and inspection of procured goods were conducted.

(5) Activity of Public Relations

The activities of the Team were reported in the project news on the website of JICA in order to promote awareness of the sustainable natural resource management in Cambodia. In addition, the outline of the project and activities on the enhancement of NFMS were reported in the Japanese Journal of International Forest and Forestry.

Project news: <https://www.jica.go.jp/Resource/project/english/cambodia/031/news/index.html>

- ✓ Forest Inventory in Stung Treng is going on, April 2022
- ✓ Fixed-wing drone training in Stung Treng, May 2022
- ✓ The first technical seminar, July 2022

Japanese Journal of International Forest and Forestry:

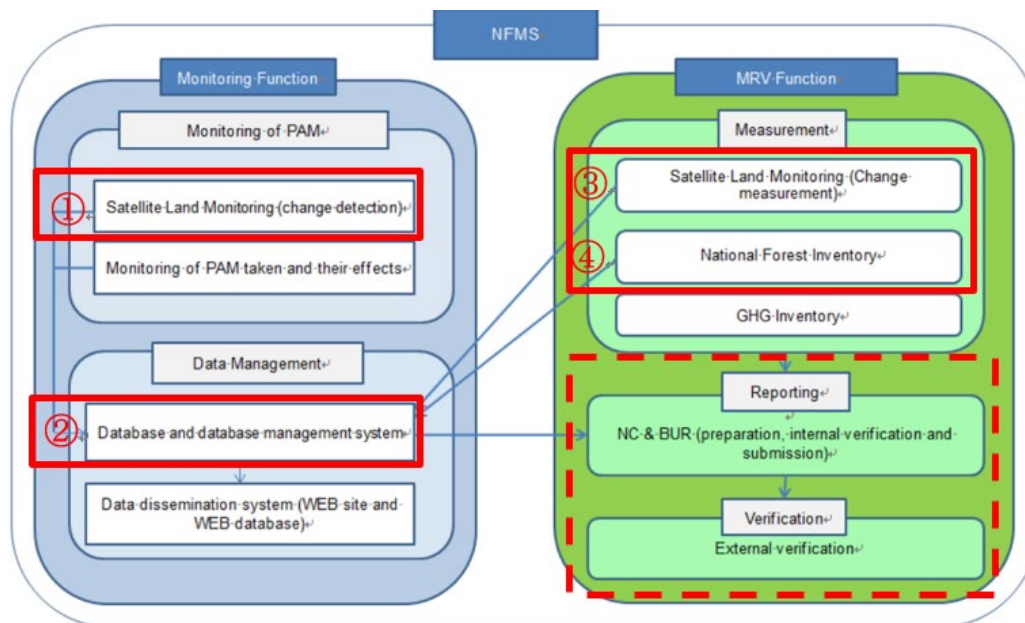
https://www.jstage.jst.go.jp/article/jjjiff/120/0/120_8/article/-char/en

- ✓ Situation of Utilizing Remote Sensing for Forest Monitoring in Cambodia, For the Operation of National Forest Monitoring System, July 2024

1.3.2 Activity on Output 1-3-2-1: Assist in operating the NFMS with due consideration of the respective roles and responsibilities of the central and provincial government

(1) Clarification of NFMS functions to be supported by the Project

At the beginning of activities for enhancing NFMS, the functions and components of NFMS to be supported by the Project were clarified based on the overall framework of Cambodia NFMS (Figure 2. 4) through holding discussions with the counterparts. Finally, the Team confirmed that there were needs from the Cambodian Government on the technical supports for the NFMS components specified as ① Satellite Land Monitoring (change detection), ② Database and database management system, ③ Satellite Land Monitoring (change measurement), and ④ National Forest Inventory in Figure 2. 4. In the Reporting and Verification components specified as a dotted rectangle, the Team provided technical supports as necessary.



Source: SNRM Project

Figure 2. 4 NFMS of Cambodia

(2) Study of the institutional coordination among the different organizations

In the operation of NFMS, information sharing and transmission among the related organizations are indispensable. In this task, a study of the institutional coordination was conducted for enhancing the information sharing and transmission particularly for the following four types of coordination: 1. between the central and provincial governments, 2. among the different ministries in the central government, 3. among the different departments in the provincial government, and 4. between the government and related projects. From January to February 2021, a baseline survey was conducted for the Stung Treng provincial government. During this period, basic information was collected regarding the organizations and personnel, duties, and patrol information collection and sharing systems in MoE, FA, Stung Treng Provincial DoE and FAC, ranger stations of protected areas and Ramsar Wetlands office.

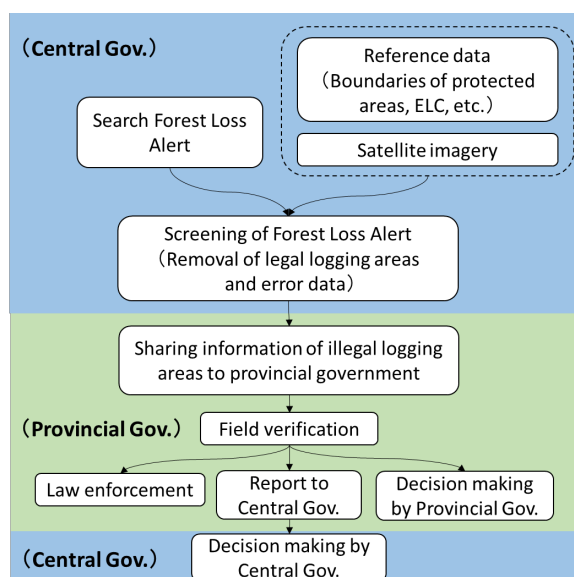


Source: SNRM Project

Figure 2. 5 Holding of baseline survey in Ramsar Wetlands office

(3) Baseline study of Satellite Land Monitoring (change detection) function of NFMS

Figure 2. 6 shows the conceptual diagram of the operation of SLMS (change detection) based on the coordination between the central and provincial governments. In the central government, it is required to build a structure (setting a mandate and a team) to implement the screening of forest loss alert as a standard operation of the central government, and share the extracted reliable forest loss alert with the provincial government, while in the provincial government, it is required to build a structure to conduct field verification using the shared forest loss alert, compile the result of the field verification and feedback to the central government as a standard operation of the provincial government.



Source: SNRM Project

Figure 2. 6 Conceptual diagram on the operation of SLMS (change detection)

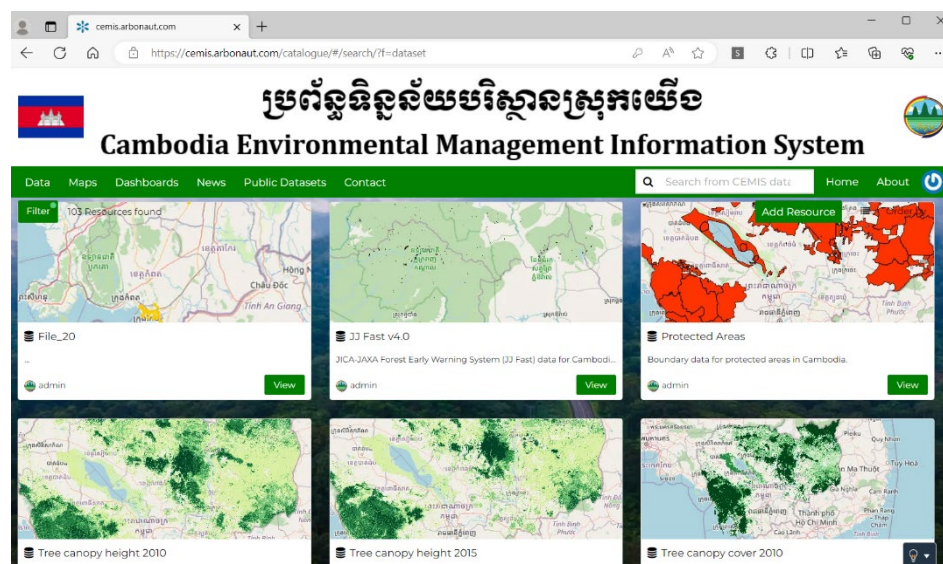
The Team conducted baseline study of Satellite Land Monitoring (change detection) function of NFMS by participating in the Cambodia Environmental Management Information System (CEMIS) Stakeholder Meeting hosted by UNDP on 22nd December 2021, as well as holding meetings with DGIS in MoE, UNDP MRV experts, SERVIR Southeast Asia (SEA) project and USAID Greening Pray Lang (GPL) project.

Figure 2. 7 shows the framework of CEMIS. CEMIS has been developed in MoE since December 2021 by Cambodia Sustainable Landscape and Ecotourism Project under the support of World Bank and UNDP. CEMIS is composed of two main pillars: GIS Services (GIS analysis, database and portal functions) and Decision Support Systems with NFMS to be integrated as one of the functions. In May 2023, CEMIS Ver. 1.0 (Figure 2. 8) was released. CEMIS Ver. 1.0 includes data management functions such as data upload/download capabilities and a dashboard used for data viewing. Furthermore, CEMIS Ver. 1.0 is equipped with an automatic upload feature for JICA-JAXA Forest Early Warning System in the Tropics (JJ-FAST) data as a forest alert function, enabling users to search and download JJ-FAST data using CEMIS.



Source: SNRM Project

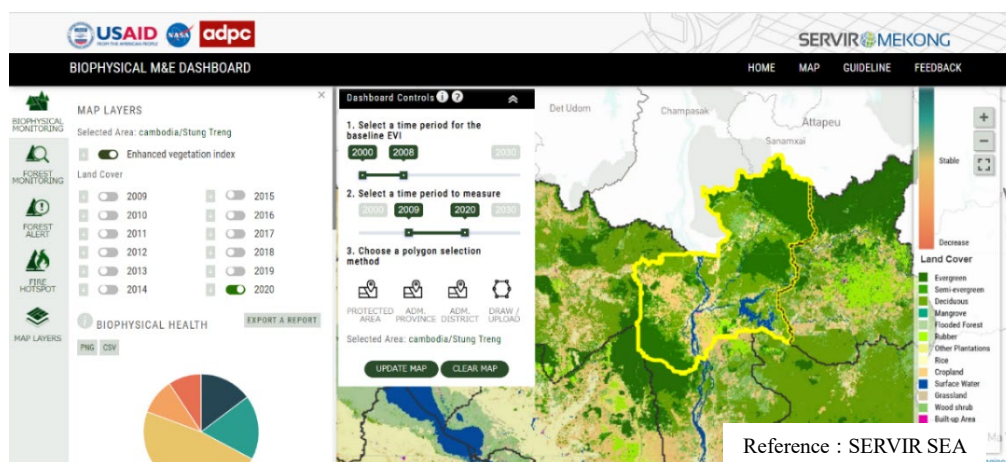
Figure 2. 7 Framework of CEMIS



Source: SNRM Project

Figure 2. 8 Interface of CEMIS Version 1.0

Regarding the satellite land monitoring (land use and land cover change detection) function of NFMS, online systems shown in Figure 2. 9 and Figure 2. 10 have already been established by the SERVIR SEA project. Additionally, Conservation International (CI), which is responsible for the field activities of the JCM-REDD+ project, and many other NGOs that support the management of protected areas are operating SMART as a tool for collecting information on illegal loggings and for creating forms and reports (Figure 2. 11). It is planned that CEMIS will be operated in coordination with these existing systems.



Source: SNRM Project

Figure 2. 9 Online system to monitor and evaluate the condition of forest cover developed by SERVIR SEA project



Source: SNRM Project

Figure 2. 10 Forest loss alert system developed by SERVIR SEA project



Source: CI

Figure 2. 11 SMART system supported by CI to operate in JCM-REDD+ project

In the JCM-REDD+ project, aerial photographs of deforested areas were taken using small multi-copter

drones and used as materials to show the on-site situation in patrol reports. However, orthophotos, which enable clarification of deforested area boundaries and the delineation of land parcels by overlaying with maps and satellite images, had not been produced.

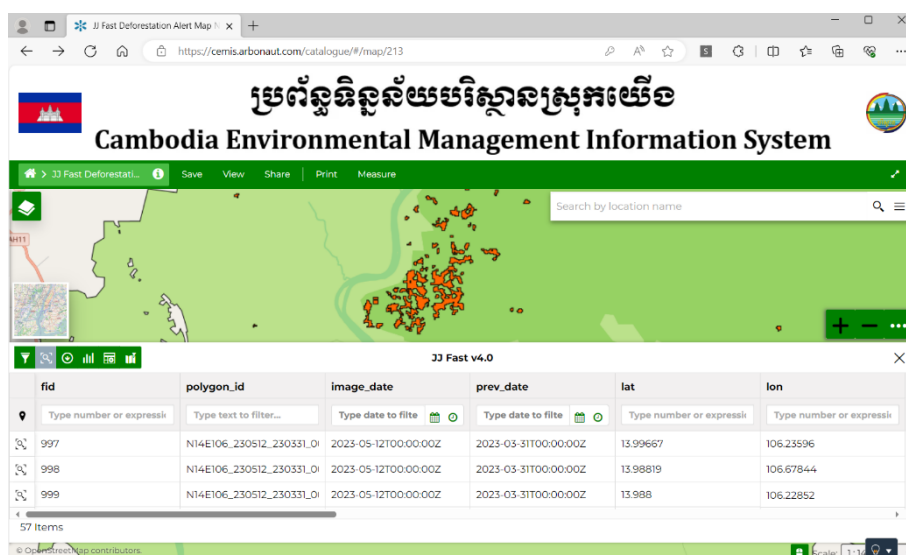


Source: CI

Figure 2. 12 Field verification of deforested areas using drones in JCM-REDD+ project

(4) Clarification of assistance and compilation of assistance and training plans related to the operation of Satellite Land Monitoring System (change detection)

Based on the results of the baseline study of Satellite Land Monitoring (change detection) function of NFMS, needs for incorporating forest alert data into NFMS were confirmed. Therefore, it was decided to support the incorporation of JJ-FAST data into CEMIS in collaboration with UNDP. The Team provided technical information of JJ-FAST to UNDP for the development of JJ-FAST function of CEMIS. CEMIS Ver. 1.0, released in May 2023, has been equipped with a function that automatically uploads JJ-FAST data to CEMIS. This allows for viewing JJ-FAST data using CEMIS, extracting data through query functions using date and boundary data, and downloading the extracted data.



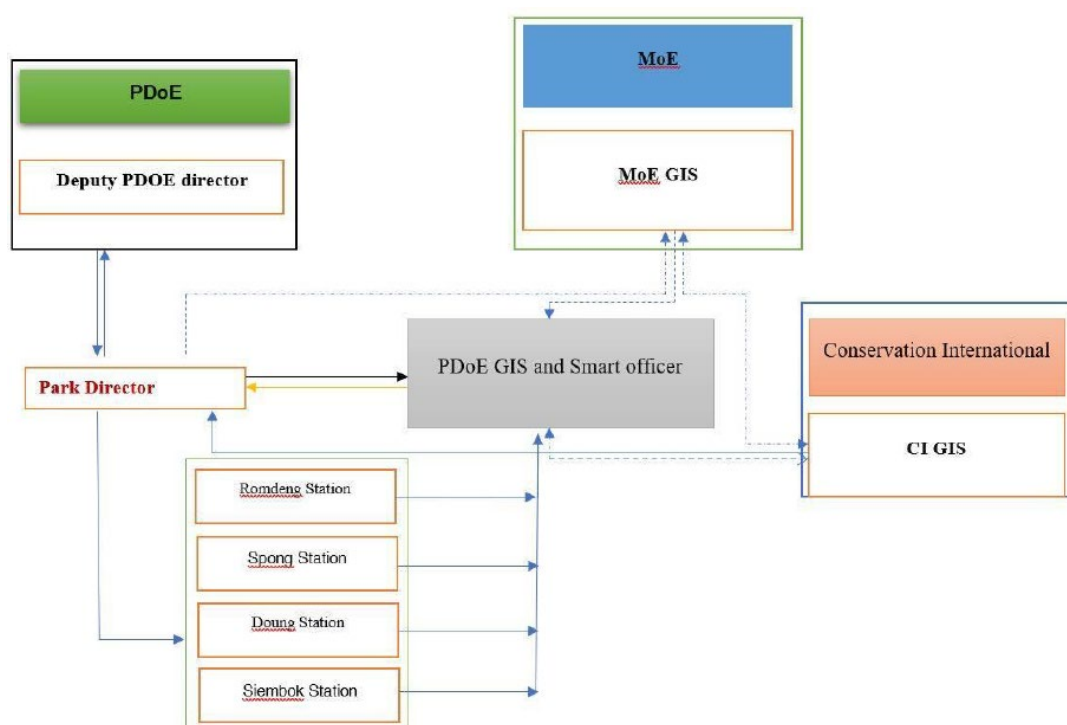
Source: SNRM Project

Figure 2. 13 JJ-FAST forest alert function of CEMIS

(5) Baseline study on the information sharing

Baseline study on the information sharing was conducted from January to February 2021, and the Team studied the current condition on the information sharing between the central and provincial governments. Figure 2. 14 shows the information-sharing system among MoE, Provincial DoE, ranger stations and CI, which are responsible for the field activities in the JCM-REDD+ project.

At the Stung Treng Provincial DoE (PDoE GIS and Smart officer in the figure), EarthRanger system introduced by the GPL project was used to regularly check forest change alerts. Based on this, the Provincial DoE staff identified areas with high probability of illegal logging that require on-site verification and instructs the ranger stations responsible for those areas through the Park Director. Ranger stations used SMART Mobile (smartphone application of SMART) to collect on-site information about deforested areas and sent the data to the Provincial DoE. Upon receiving the data from the ranger stations, Provincial DoE used the desktop version of SMART to create patrol reports and submit those to GDNPA in MoE and Provincial DoE through the Park Director. All of these information sharing were conducted using Telegram SNS application.



Source: CI

Figure 2. 14 Diagram of information sharing system among MoE, provincial DoE, ranger stations and CI in JCM-REDD+ project

(6) Technical assistance on National Land Use and Land Cover mapping

From May to September 2022, the methodology for creating the 2022 forest cover map, which was being undertaken by FA, was reviewed. Subsequently, technical support was provided for the creation of national mosaic images of LANDSAT 8 and 9 images and Sentinel-2 images using FAO SEPAL, as well as for the download of NICFI Planet satellite images and utilization of the Global Forest Canopy Height 2019 data.

(7) Forest inventory survey (Forest stratification)

Needs on the technical supports for National Forest Inventory (NFI) were confirmed in 1.3.2 (1) Clarification of NFMS functions to be supported by the Project. A survey was planned and conducted in the pilot province of Stung Treng based on the current NFI setting and manuals.

In January 2021, forest stratification was carried out together with the counterparts of MoE following the procedures shown in Table 2. 7, with reference to the National Forest Inventory Field Manual created by FA with the support of FAO in 2018 (FAO (2018): Field Manual for the National Forest Inventory of Cambodia) and the supplementary manual created by CAM-REDD in 2015 (Working Paper #15_Supplementary_NFI-manual).

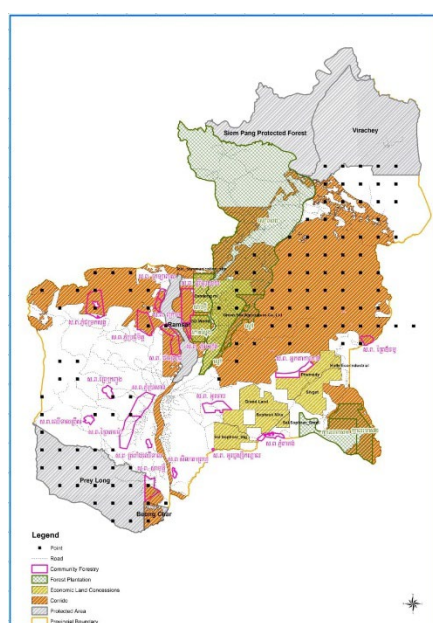
Table 2. 7 Procedure of forest stratification

Pre-processing	• Associate NFI points with the 2018 National Land Use and Cover Map data (created by MoE) and the 2019 Tree Canopy Cover data (created by the SERVIR SEA project). • Exclude NFI points that might have been deforested or converted to agricultural lands using the NICFI Planet satellite images of December 2020.
Stratification 1	• Extract NFI points that fall in the main forest types: Evergreen forest, Semi-evergreen forest and Deciduous forest.
Stratification 2	• Exclude NFI points with tree canopy cover of 10% or less using the 2019 Tree Canopy Cover data. • Stratify NFI points into three ranges of tree canopy cover using the 2019 Canopy Cover data: sparse (10% - 40%), moderate (40% - 70%) and dense (70% - 100%).

Source: SNRM Project

(8) Forest inventory survey (Setting of survey plots)

In February 2021, through consultations with MoE and FA, NFI points located in areas with high safety risks such as landmine and UXO contaminated areas and areas near the border were excluded. Furthermore, considering the result of forest stratification, a total of 120 clusters and 360 survey plots were established.

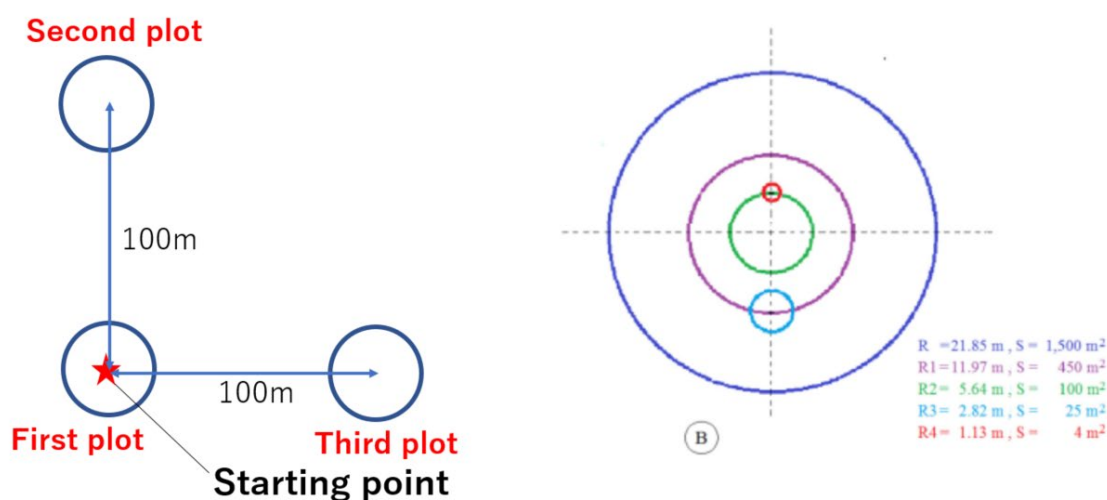


Source: SNRM Project

Figure 2. 15 Allocation of survey plots of forest inventory survey

Additionally, through consultations with FAO experts, it was decided to adopt a circular shape for the

plot, with each cluster containing three circular plots.



Source: SNRM Project

Figure 2. 16 Setting of survey plots

(9) Forest inventory survey (Selection of subcontractor)

From February to March 2021, a bidding process had been conducted in Cambodia, and a local subcontracting agreement for the implementation of the forest inventory survey was signed with the selected Royal University of Agriculture (RUA) on 26th March 2021.

(10) Implementation of forest inventory survey

In March 2021, an online training session on forest inventory survey methods was conducted. The training was aimed at the central government staff responsible for forest inventory at MoE and FA. The session covered an overview of the forest inventory survey methods to be implemented in Stung Treng and instructions on how to use the equipment. The lecture materials referenced the National Forest Inventory Field Manual developed by FAO (FAO (2018): Field Manual for the National Forest Inventory of Cambodia). A FAO expert was invited to this training, during which the details of the survey methods were reviewed, and a lecture on QA/QC methods was conducted by the FAO expert.

In January 2022, a pre-inventory survey was conducted at one of the survey plots in Stung Treng with all the relevant organizations (MoE, FA, RUA survey team and the Team). During this survey, the survey methods and the use of measurement instruments were verified on the site.

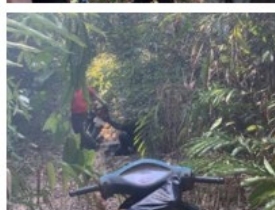


Source: SNRM Project

Figure 2. 17 Implementation of pre-inventory survey

Subsequently field survey had been implemented from January to March 2022, and a total of 360 plots were surveyed.

Field survey training in RUA



Inaccessible clusters in Virak Chey on 13 Feb 22

Team 1 collected litter fall on 19 Jan 22



Team 1&4 traveled to cluster in Virak Chey 8 Feb 2022



Team 1&2 traveled to Chantou on 29 Jan 22

Source: SNRM Project

Figure 2. 18 Implementation of field survey

After the field survey, biomass measurements and forest carbon stock analysis had been conducted from April to June 2022. The results were compiled, and the Final Report of Forest Inventory Survey in Stung Treng Province of Cambodia (Appendix 1) was prepared in June 2022.

The final report shows that the forest inventory surveyed all of five forest carbon pools including above ground biomass (AGB), below ground biomass (BGB), deadwood, litter and soil organic carbon (SOC). The result shows that the total carbon stock density of evergreen forest (234.53 tC/ha) was higher than that of semi-evergreen forest (159.97 tC/ha), deciduous forest (115.39 tC/ha) and non-forest (61.30 tC/ha), as listed in Table 2. 8.

Table 2. 8 The amount of forest biomass and carbon stock in five carbon pools

Forest Types	AGB (tC/ha)	BGB (tC/ha)	Deadwood (tC/ha)	Litter (tC/ha)	Soil (tC/ha)	Total (tC/ha)	Total CO ₂ (t/ha)
Evergreen forest	114.88	42.51	6.91	1.74	68.49	234.53	859.94
Semi-evergreen forest	71.97	14.40	8.89	0.94	63.77	159.97	586.56
Deciduous forest	37.29	7.46	4.36	1.04	65.24	115.39	423.10
Non forest	4.35	0.87	1.76	1.03	61.30	69.31	254.14

Source: SNRM Project

In the setting of Cambodia's Second Forest Reference Level (FRL) in 2021, the carbon pools of forest biomass are targeted as AGB (Above Ground Biomass) and BGB (Below Ground Biomass) and are calculated in terms of CO₂ amount. Therefore, when calculating the FRL from the results of the forest inventory survey in Stung Treng, the biomass amounts of litter, deadwood, and soil were excluded. Based on the survey results in Stung Treng, the CO₂ amounts for each forest type (the total of AGB and BGB) were 577.10 tCO₂/ha for Evergreen forest, 316.69 tCO₂/ha for Semi-evergreen forest, and 164.08 tCO₂/ha for Deciduous forest, indicating that Evergreen forest had the highest value. On the other hand, the Second FRL showed that Semi-evergreen forest had the highest value, followed by Evergreen forest and Deciduous forest, which is different from the survey results in Stung Treng.

Table 2. 9 The amount of forest biomass and carbon stock in AGB and BGB to compare with the National FRL

Forest Types	#Plot	AGB (t/ha)	BGB (t/ha)	Total Biomass (t/ha)	Total Carbon (t/ha)	Total CO ₂ (t/ha)	(95% CI)
Evergreen forest	117	244.42	90.44	334.86	157.39	577.10	12%
Semi-evergreen forest	90	153.13	30.63	183.76	86.37	316.69	13%
Deciduous forest	108	79.35	15.87	95.22	44.75	164.08	13%
Non forest	45	9.25	1.85	11.10	5.22	19.14	103-196%

Source: SNRM Project

Finally, based on the experiences of the forest inventory of Stung Treng, the following recommendations were derived:

1. A method to measure parts of illegally harvested timber left should be integrated into the field manual;
2. The result of AGBs for each forest types in Stung Treng showed a different trend from the national FRL data. Whole scale NFI and/or additional inventory should be conducted to support and verify the national FRL data;
3. The data of forest inventory in Stung Treng can be used for improvement of the national FRL accuracy, and also should be contributed to sustainable forest management based on the accurate understanding of forest resources;

4. Continuous Implementation of forest inventory should also encourage academia to continue their studies and research to build human resources, and the data could be made available for academic purposes; and
5. The results of the study should contribute to the GHG inventory in Cambodia, along with the national GHG monitoring and BUR.

(11) Review of NFI design documents

Based on the experiences and challenges derived through the forest inventory in Stung Treng, a proposal for the future NFI implementation was compiled through consultations with the national REDD+ Taskforce, FAO, UNDP and RUA in September 2023.



Source: SNRM Project

Figure 2. 19 Holding of consultation meeting to compile proposal for future NFI implementation

The proposal includes reviews of NFI sampling design and emission factor (EF) calculation method, as well as lessons learned as follows.

(a) NFI sampling design

[Discussion Point] Review of the required number of samples for NFI implementation

The current required sample size for NFI is significant and it has been difficult to conduct the whole scale of NFI field survey at once. Methods of deriving the statistically required sampling number in Stung Treng based on the forest inventory results in Stung Treng and the current NFI sampling plan were compared and examined.

- ✓ **Current required sampling number:** Table 2. 10 shows the current NFI sampling design described in the National Forest Monitoring System of Cambodia (2015). The required number of samples in Stung Treng was estimated at approximately 600 plots (200 clusters) based on the area proportion of Stung Treng to the total area of Cambodia (at Uplands stratum).

$11,000/152,000 \text{ km}^2 \text{ (in Uplands)} * 2,751 \text{ clusters} = \text{approximately } \mathbf{200 \text{ clusters} (* 3 \text{ plots} = 600 \text{ plots})}$

Table 2. 10 Number of samples proposed for NFI in 2014

Stratum	Area (km ²)	Number of sampling clusters expected in forest or other wood lands (2 nd phase)
Uplands	152,751.3	2,751
Wetlands	27,742.0	322
Mangrove	1,207.6	97
Total	181,700.9	3,170

Source: SNRM Project

- ✓ **Statically required sampling number based on the result of forest inventory in Stung Treng :**
The statistically required sampling number was calculated based on the tolerance confidence intervals and target error rates (Equation 1). The required number of samples in Stung Treng was calculated based on the results of forest inventory data of Stung Treng for standard deviation and mean biomass value per hectare in two classification system, which were described in the stratification in NFMS (Table 2. 11) and the land use / cover classification in FRL (Table 2. 12).

$$n = \left(\frac{t_{0.05} * C_v}{e} \right)^2 \quad \text{Equation 1}$$

n = the minimum required number of plots for a stratum

$t_{0.05}$ = Critical value from a two tail-test with $n-1$ degrees of freedom, based on confidence interval of 95% (=1.96)

C_v = Coefficient of variation which is the standard deviation divided by the mean biomass value per hectare in a stratum.

e = Target error rate (=10%)

In this case, the target error rate was set at 10% and the confidence interval was set at 95% for the calculation.

Table 2. 11 The required number of samples based on the stratification scheme in NFMS

Stratum	#Plot	Sum (t)	Ave. (t/ha)	SD	SE	e	e (%)	Coefficient of variation (SD/Ave.)	Required sampling no. (10%)
Uplands	315	50,949.06	161.74	135.68	7.64	14.98	9%	0.84	270
Wetlands	-	-	-	-	-	-	-	-	-
Mangrove	-	-	-	-	-	-	-	-	-
	315	50,949.06							270

Source: SNRM Project

Table 2. 12 Required number of samples based on land use classification system in FRL

Forest Type	#Plot	Sum (t)	Ave. (t/ha)	SD	SE	e	e (%)	Coefficient of variation (SD/Ave.)	Required sampling no. (10%)
Evergreen forest	117	28,597.33	244.42	161.75	14.95	29.31	12%	0.66	168
Semi-evergreen forest	90	13,781.65	153.13	98.91	10.43	20.43	13%	0.65	160
Deciduous forest	108	8,570.07	79.35	55.97	5.39	10.56	13%	0.71	191
Other forest	-	-	-	-	-	-	-	-	-
	315	50,949.06							519

Source: SNRM Project

- ✓ The statistically required number of samples based on two classification system (270 plots in NFMS and 519 plots in FRL setting) was assumed to be smaller than the quantities of current NFI design (600 plots).

[Recommendation]

- ✓ Statistical method suggested the possibility to reduce the required sampling number for NFI. Furthermore, since the statistics required sampling number is calculated with the target error rate, it is expected to contribute to improve the accuracy of FRL in the future.
- ✓ In the examination of the required sample size, it is important to consider both the reliability of inventory data to be obtained, and the costs associated with conducting the NFI.
- ✓ It is advisable to add supplementary samples (clusters) with the statistically required minimum number of samples as a precaution. Actual field conditions may be different from the assumption in the plan. Some identified clusters were quite difficult to access due to terrain, barriers, water bodies or any other reasons in the forest inventory in Stung Treng. Therefore, to prepare for such cases, adding the supplementary samples before starting the field surveys, i.e. 20% of the minimum required sampling number for each forest stratum, is proposed. In the case that the survey team is unable to access the originally intended survey sampling point, the supplementary samples will be used to supplement the required sample size.

(b) EF and AGB calculation method and lessons learned from field survey

[Discussion Point] EF and AGB calculation and lessons learned from field survey

In the FRL report and its reference documents, detailed information on the EF (Emission Factor)

calculation method and approach are not provided particularly on. Several issues and challenges on the method of field survey and data calculation were identified through the implementation of inventory survey in Stung Treng.

- ✓ It is unclear how to aggregate AGB when multiple Land Use Vegetation types exist within a single plot, and how to calculate and combine AGBs of shrubs and vines.
- ✓ The calculation of AGB for individual bamboo species in the EF calculation in the FRL is unclear.
- ✓ The measurement method of trees with unique form is unclear in the field manual (Figure 2. 20).



Source: SNRM Project

Figure 2. 20 Tree species with unique form: ex. *Ficus tribe*

[Recommendation]

- ✓ Creating a manual for the EF calculation method is considered effective to ensure the reproducibility and transparency of biomass calculations.
- ✓ It is needed to develop AGB allometric equations specific to bamboo in Cambodia. Until allometric equations for bamboo within Cambodia are developed, it is advisable to apply AGB calculation formulas developed in the neighboring countries.

Examples of allometric equation of bamboo are as follows.

Allometric Equations for Estimating the Aboveground Biomass of a 14-Year=Old Bamboo Plantation at Moeswe Research Station, Myanmar, 2019, Ladqwan p., et al.

A Manual for Bamboo Forest Biomass and Carbon Assessment, The International Bamboo and Rattan Organisation (INBAR), 2019

- ✓ Since the survey team are sometimes put in jeopardy such as armed illegal loggers, ground mines and UXOs, it is important to ensure the communication means of the survey teams in the field, establish a communication system, and prepare the necessary equipment.

- ✓ It should be recommendable to use satellite phones in the future NFI because forest canopy interferes the transmission of radio waves. When using transceivers for a long-distance communication in the forest, it is advisable to extend the antennas to heights above the forest canopy using antenna extension cables or other methods.

1.3.3 Activity on Output 1-3-2-2: Assist in developing the training materials in operating NFMS

Figure 2. 21 shows a basic concept on the development of training materials to operate NFMS. The training materials to be developed should contribute to enhance capacities of the central government staff to carry out the major components of NFMS including forest monitoring and monitoring of sustainable natural resource management activities as well as Measurement, Reporting and Verification (MRV).



Source: SNRM Project

Figure 2. 21 Basic concept on the development of training materials to operate NFMS

The team held a series of consultation meetings with MoE and FA on the development of training materials and finally a total of five training materials listed in Table 2. 13 were developed.

Table 2. 13 Training materials to operate NFMS by the central government staff

Training material	Contents	Remarks
1. GIS Training Material (Basic)	Training material on the outline of map and GIS data as well as guidance on making map and GIS data	In Khmer (Appendix 3)
2. GIS Training Material (Intermediate to Advanced)	Training material on the outline of data standardization as well as guidance on creating Geodatabase and data product specifications, and setting topology, relation, guideline and rule for data standardization	In English (Appendix 4)
3. Fixed-wing Drone Training Material	Training material on the functions of fixed-wing drone (Sensefly eBee Geo), flight preparation, flight procedure and data download	In Khmer (Appendix 6)
4. eLearning material	eLearning material on the functions of fixed-wing drone	In Khmer

on fixed-wing drone operation	(Sensefly eBee Geo), flight preparation, flight procedure and data download.  eMotion software will assign image geo-location  https://www.youtube.com/playlist?list=PLrH1jDKShKr01MgOH89DfYXdORb6Kpw	with English subtitles
5. Satellite Image Processing and Interpretation Training Material	Training material on searching and downloading satellite data, land cover change analysis using satellite data, interpretation of satellite imagery to extract land use and land cover information, and drone image processing	In Khmer and English (Appendix 7)

Source: SNRM Project

1.3.4 Activity on Output 1-3-2-3: Conduct training for the relevant government staff (mainly for National gov staff) to operate NFMS

NFMS related training were conducted for the central government staff of MoE (GDNPA and DGIS) and FA to enhance the capacity of collecting LULC information and forest inventory data as well as compilation of collected information as a standardized GIS database and creation of maps. Considering the efficiency and safety of forest monitoring activities due to dangers of landmines and UXOs, fixed-wing drone operation trainings were conducted for wide-area forest monitoring from safe locations. The trainings were conducted multiple times according to the proficiency levels of central government staff. Additionally, a series of training sessions on drone data processing, operation of forest inventory data calculation program, basic and intermediate to advanced GIS trainings, and satellite image processing and interpretation were also conducted.

Table 2. 14 List of trainings for central government staff to operate NFMS

Training	Objective	Target organization	Period
1. Fixed-wing drone operation training	To develop the capacity of conducting safe and effective forest monitoring by using fixed wing drones.	MoE (DGIS)	1 st : 27 th to 29 th December, 2021 2 nd : 20 th to 21 st April, 2022 3 rd : 27 th August, 2022
		FA	1 st : 27 th to 29 th December, 2021 2 nd : 26 th to 27 th April, 2022 3 rd : 14 th to 16 th June, 2022 4 th : 17 th to 20 th April, 2023 5 th : 16 th to 19 th September, 2024
2. Drone data processing training	To develop capacity of drone data processing for mapping.	FA	1 st : 4 th May, 2022 2 nd : 19 th June, 2023

3. Training of forest inventory data calculation program	To develop capacity of compiling forest inventory data and biomass and carbon stock calculation	MoE (DGIS)	5 th April, 2023
		FA	7 th April, 2023
4. GIS training (Basic and Intermediate to Advanced)	To develop capacity of GIS data standardization	MoE (GDNPA)	<Basic> 23 rd to 26 th April, 2024 <Intermediate to Advanced> 1 st : 15 th to 19 th July, 2024 2 nd : 19 th to 23 rd August, 2024
5. Satellite image processing and interpretation training	To develop the capacity of using satellite imagery to identify LULC and its changes	MoE (GDNPA)	4 th to 5 th September, 2024
		FA	2 nd to 3 rd September, 2024

Source: SNRM Project

(1) Fixed-wing drone operation training

Table 2. 15 shows the contents of fixed-wing drone operation training.

Table 2. 15 Contents of fixed-wing drone operation training

Training	Contents of the training
Fixed-wing drone operation training	➤ Operation of Sensefly eBee Geo (take-off and landing) ➤ Set up of GeoBase (GNSS base station) ➤ Flight planning and simulation ➤ Data downloading ➤ Data quality checking

Source: SNRM Project

In the preparation of fixed-wing drone operation training, fixed-wing drones and GNSS devices were procured in Cambodia. Additionally, computer equipment necessary for programming drone flight plans and processing drone photographs were also procured.



Source: SNRM Project

Figure 2. 22 Receiving inspection of fixed-wing drone

Fixed-wing drone operation training was conducted multiple times from 2021 to 2024 for the central government staff in charge of forest monitoring depending on the level of understanding of the participants of the training.



Source: SNRM Project

Figure 2. 23 Holding of fixed-wing drone operation training for MoE (DGIS)



Source: SNRM Project

Figure 2. 24 Holding of fixed-wing drone operation training for FA

Through the implementation of fixed-wing drone operation training, the capability to efficiently acquire wide-area aerial photographs using drones has been developed in MoE and FA. In the future, it is expected that drones will be utilized for boundary demarcation and zoning in PAs and CFs, the creation of CF management plans, as well as for understanding the current situation of illegal logging and land

encroachment. Additionally, drones are expected to be used for forest monitoring in areas that pose significant risks to land and forest management in Cambodia, such as mine and UXO contaminated areas, as well as in regions that are difficult to access like flooded forests and wetlands.

(2) Drone data processing training

Table 2. 16 shows the contents of drone data processing training.

Table 2. 16 Contents of drone data processing training

Training	Contents of the training
Drone data processing training	➤ Creation of data quality report, ortho-mosaics, digital surface model (DSM), digital terrain model (DTM) and contour line data using Pix4Dmapper software ➤ Overlaying with GIS data and making map layout

Source: SNRM Project

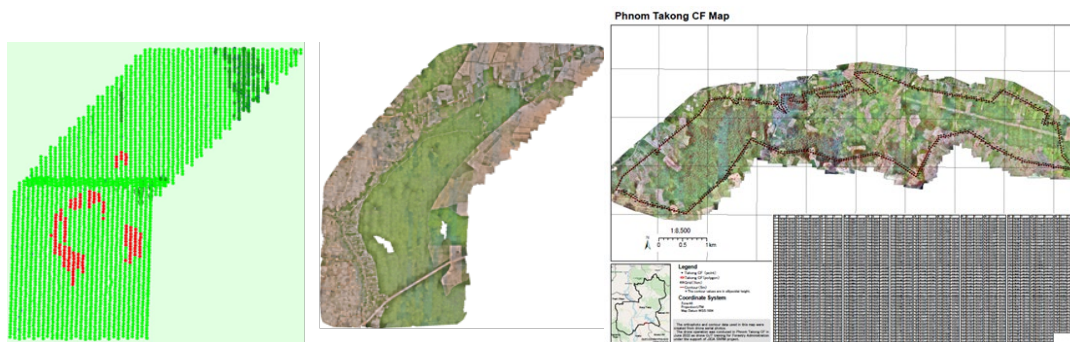
Drone data processing trainings were conducted in FA in 2023 and 2024.



Source: SNRM Project

Figure 2. 25 Holding of drone data processing training for FA

In the training, drone data quality report, ortho-mosaics, DSM, DTM and contour line data were generated using Pix4Dmapper software, and these data were used to make maps of CF using GIS software. The created maps were exported to Geo-PDF files and these files were used for forest management activities of CF.



Source: SNRM Project

Figure 2. 26 Outputs of drone data processing training

Through the drone data processing training, the capability to create orthophotos, terrain data, and orthophoto maps from drone data has been developed in FA. In the future, effective forest management through the expedited creation of CF management plans using orthophotos and terrain data in FA is expected.

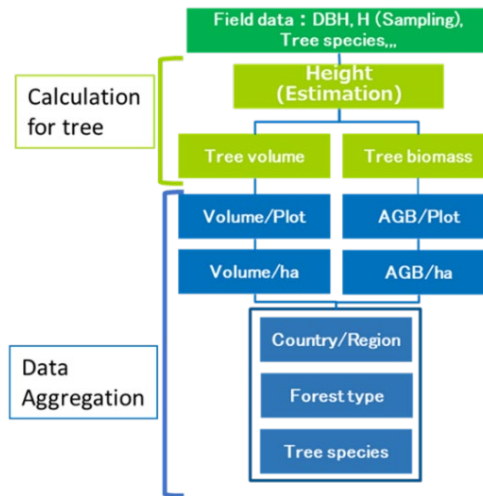
(3) Training of forest inventory data calculation program

Table 2. 17 shows the contents of training of forest inventory data calculation program.

Table 2. 17 Contents of training of forest inventory data calculation program

Training	Contents of the training
Training of forest inventory data calculation program	➤ How to calculate biomass/volume based on the methodology of National Forest Inventory (NFI) manual ➤ Operation of forest biomass calculation program using Visual Basic for Applications (VBA)

Source: SNRM Project



Source: SNRM Project

Figure 2. 27 Steps of forest biomass calculation

Trainings of forest inventory data calculation program were conducted in MoE (DGIS) and FA in 2023.



Source: SNRM Project

Figure 2. 28 Holding of training of forest inventory data calculation program for MoE (DGIS) and FA

Through the implementation of the forest inventory data calculation program training, MoE and FA have developed the ability to efficiently calculate forest biomass from forest inventory data in accordance with the NFI methodology. Additionally, by reviewing the entire calculation process, understanding has been promoted regarding the coefficient settings used in the EF calculation methods of the NFI methodology and the potential issues in each process. Utilizing these abilities, MoE and FA are expected to take the lead in further promoting forest inventories and implementing the future NFI.

(4) GIS training (Basic and Intermediate to Advanced)

Table 2. 18 shows the contents of GIS training of basic and intermediate to advanced levels.

Table 2. 18 GIS training of basic and intermediate to advanced levels

Training	Contents of the training
GIS training (Basic)	➤ Understanding basics of GIS and common GIS tools ➤ GIS data creation and GIS data downloading ➤ GIS data editing and data preparation for mapping ➤ Clipping vector data and masking raster data ➤ Topographic analysis and applying GIS symbols ➤ Map layout, export to Geo-PDF and import to smart phone application (Avenza Maps)
GIS training (Intermediate to Advanced)	➤ Understanding data standardization ➤ How to create and update geodatabase (setting of subtype and domain, data integration, data revision) using GIS software and Microsoft Excel ➤ Creation of Data Product Specification (DPS) ➤ Creation of geodatabase for protected area management

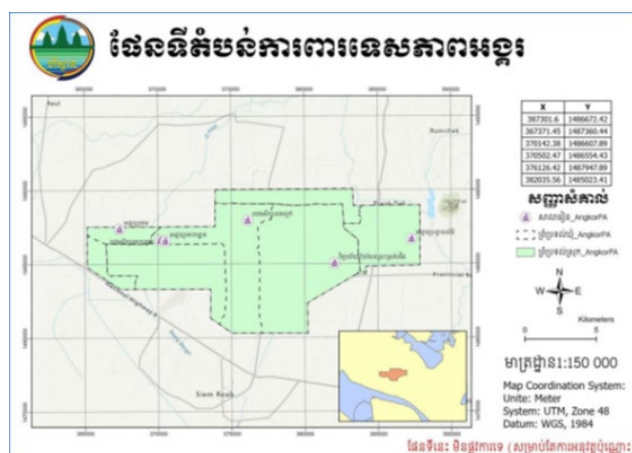
Source: SNRM Project

GIS trainings of basic and intermediate to advanced levels were conducted in MoE (GDNPA) in 2024.



Source: SNRM Project

Figure 2. 29 Holding of GIS training (Basic and Intermediate to Advanced) for MoE (GDNPA)



Source: SNRM Project

Figure 2. 30 Thematic map of Angkor Wat created in the GIS training (Basic)

Through the implementation of the GIS training (Basic), MoE has developed the ability to create thematic maps and location maps by combining field information collected in PAs with publicly available GIS data. Additionally, through the implementation of the GIS training (Intermediate to Advanced), basic knowledge on data standardization and the ability to utilize GIS tools for standardization were developed. Moving forward, with a focus on smooth data sharing and data utilization within MoE, data maintenance will be carried out with an awareness of data standardization. By visualizing the field information collected in each PA as maps, it will be possible to analyze issues related to PA management, leading to more effective PA management.

(5) Satellite image processing and interpretation training

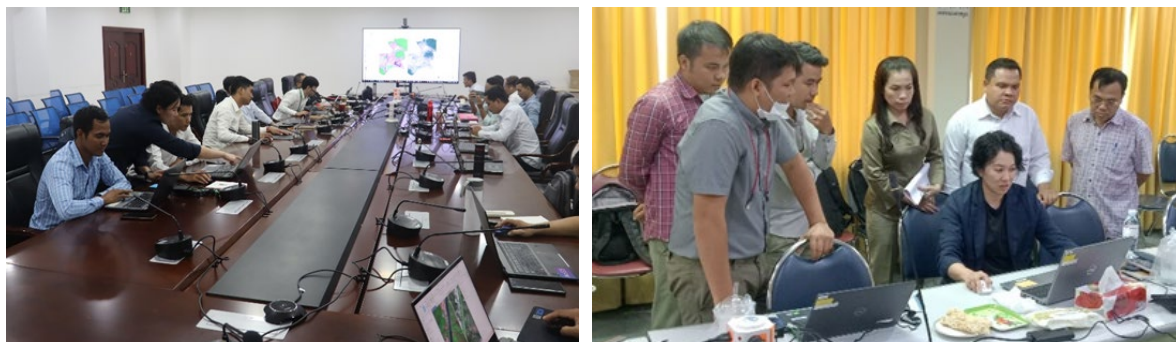
Table 2. 19 shows the contents of satellite image processing and interpretation training.

Table 2. 19 Satellite image processing and interpretation training

Training	Contents of the training
Satellite image processing and interpretation training	➤ Understanding of Earth Observation (EO) satellites ➤ Application of EO data to natural resources management ➤ Elements of satellite image interpretation ➤ Understanding satellite image classification and change detection ➤ Downloading EO data using Sepal and Planet Add-in for ArcGIS Pro ➤ Practice1: LULC classification using supervised image classification ➤ Practice2: LULC change detection using Principal Component Analysis (PCA)

Source: SNRM Project

Satellite image processing and interpretation trainings were conducted in MoE (GDNPA) and FA in September 2024.



Source: SNRM Project

Figure 2. 31 Holding of satellite image processing and interpretation trainings for MoE (GDNPA) and FA

Through the satellite image processing and interpretation training, the capability to assess wide-area land use and land cover conditions using satellite images, as well as to extract areas of land use and land cover changes, including deforestation and forest degradation, has been developed in MoE and FA. In the future, it is expected that MoE and FA will lead forest monitoring using satellite images of PAs and CFs nationwide on a regular basis, and promote the establishment of a system for conducting field verification of the extracted areas of deforestation and forest degradation in collaboration with the provincial governments.

1.3.5 Activity on Output 2-1-1-1: Develop training plans which include NFMS related training.

In the beginning of developing training plans, workshops were held in Stung Treng Provincial DoE and FAC in January 2021 to identify duties of these organizations and any challenges in the implementation of the duties, as well as to consider possible solutions for the identified challenges.



Source: SNRM Project

Figure 2. 32 Holding of workshops in Stung Treng Provincial DoE and FAC

The identified challenges in the implementation of duties of these organizations and possible solutions for the challenges are summarized in Table 2. 20.

Table 2. 20 Identified challenges in the implementation of duties of Stung Treng provincial government and possible solutions

Organization	Identified challenges in implementation of duties	Possible solutions
Stung Treng Provincial DoE	1. Lack of capacity of making map 2. Lack of equipment to create map 3. Lack of capacity in using drone, only taking pictures and no capacity of using drone for mapping 4. Lack of budget (organize workshop, etc.) 5. Available drones can be used only in particular project area 6. Data from rangers sometimes contain errors 7. Lack of capacity of identifying and monitoring biodiversity	1. Hold training about making maps integrated with GIS, remote sensing and drone 2. Hold training about SMART (desktop and mobile) 3. Training about utilizing maps
Stung Treng FAC	1. Lack of capacity of making maps 2. Lack of capacity of using drone 3. Lack of equipment for office 4. Lack of equipment for patrolling 5. Lack of equipment for transportation 6. Lack of officer 7. Lack of budget 8. Wildlife illegal hunting 9. Illegal logging 10. Land encroachment 11. Lack of drone for patrolling 12. Those who commit crime do not afraid law	1. Hold training about making maps 2. Hold training about writing reports (monthly report, criminal record, etc.)

Source: SNRM Project

After identified possible solutions for the challenges, further discussions were held to identify the needs of trainings. After identified the needs of the training (see Table 2. 21), training programs consisting of Map utilization training, Multi-copter drone training and Satellite image processing training were proposed from the Team and finally agreed with the Stung Treng Provincial government.

Table 2. 21 Identified needs of training and proposed training program

Identified needs of training	Proposed training program
1. Using maps	Map utilization training

2. Map reading (angle, map scale, symbol, distance and height) 3. Using map in the field 4. Making maps 5. Downloading freely available satellite image and GIS data 6. Georeferencing paper maps 7. Importing downloaded satellite image, GIS data and georeferenced maps to GIS software 8. Digitizing points, lines and polygons of topographic features 9. Editing attribute table 10. Compiling a field survey map and export to PDF map 11. Importing PDF map to smartphone application 12. Collecting field data (e.g., boundary and POI) using smartphone application 13. Importing collected field data to GIS software 14. Transmission of collected field data using SNS (Telegram)	
15. Automatic operation of multi-copter drone 16. Processing of drone aerial photo to make ortho-mosaics	Multi-copter drone training
17. Land use/cover classification of using drone ortho-mosaics and satellite image	Satellite image processing training

Source: SNRM Project

1.3.6 Activity on Output 2-1-1-2: Prepare training materials

Training materials listed in Table 2. 22 were developed for the training programs of provincial government staff.

Table 2. 22 Training materials for the training programs of provincial government staff

Training material	Contents	Remarks
1. Map Utilization Training Material	Training material on reading and using maps including scale, azimuth, map symbols and contour lines as well as contents and specifications of 1:100,000 scale topographic map of Cambodia	In Khmer (Appendix 2)
2. Multi-copter Drone Training Material	Training material on operating multi-copter drone and processing of drone data	In Khmer (Appendix 5)
3. Satellite Image Processing Training Material	Training material on searching and downloading satellite data, land cover change analysis using satellite data and drone image processing	In Khmer (Appendix 7)

Source: SNRM Project

1.3.7 Activity on Output 2-1-1-3: Conduct trainings

A series of training programs listed in Table 2. 23 were conducted for the provincial government staff

of Stung Treng Provincial DoE and FAC from August 2022 to January 2024 to enhance the capacity of forest monitoring by using multi-copter drones, utilizing maps for forest monitoring including field verification, as well as using satellite imagery to identify LULC and its changes. The trainings were held as a style of training of trainers (ToTs). The basic concept behind the ToT is to train trainers during the Project and the raised trainers will transfer the knowledge to untrained staff in the Stung Treng provincial government after the Project.

Table 2. 23 List of trainings for provincial government staff to operate NFMS

Training	Objective	Target organization	Period
1. Multi-copter drone operation training	To develop the capacity of safe and effective forest monitoring by using multi-copter drones	Stung Treng Provincial DoE	1 st : 22 nd to 24 th August 2022 2 nd : 7 th to 8 th February 2023 3 rd : 28 th to 30 th March 2023 4 th : 24 th to 26 th January 2024
		Stung Treng FAC	1 st : 10 th to 12 th October 2022 2 nd : 9 th to 11 th February 2023 3 rd : 22 nd to 24 th March 2023 4 th : 18 th to 23 rd January 2024
2. Map utilization training	To develop the capacity of utilizing maps for forest monitoring including field verification	Stung Treng Provincial DoE	1 st : 7 th to 8 th December 2022 2 nd : 19 th to 20 th December 2022
		Stung Treng FAC	1 st : 6 th to 7 th December 2022 2 nd : 21 st to 22 nd December 2022 3 rd : 26 th May 2023
3. Satellite image processing training	To develop the capacity of using satellite imagery to identify LULC and its changes	Stung Treng Provincial DoE	22 nd November 2023
		Stung Treng FAC	21 st November 2023

Source: SNRM Project

(1) Multi-copter drone operation training

Table 2. 24 shows the contents of fixed-wing drone operation training.

Table 2. 24 Contents of multi-copter drone operation training

Training	Contents of the training
Multi-copter drone operation training	➤ Manual and automatic operation of multi-copter drones (DJI Phantom 4 Pro and DJI Mavic 3 Pro) ➤ Flight planning and simulation ➤ Data download

Source: SNRM Project

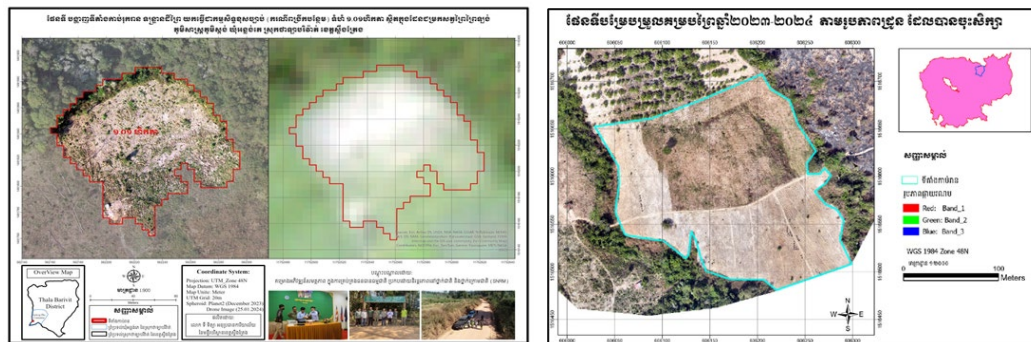
Multi-copter drone operation trainings were conducted for the provincial government staff from August 2022 to January 2024 for multiple times depending on the level of understanding of the participants of the training.



Source: SNRM Project

Figure 2. 33 Holding of multi-copter drone operation training for Stung Treng Provincial DoE and FAC

After the drone operation and acquired aerial photos were processed and ortho-mosaics were created. The created ortho-mosaics were used to identify the condition and area of deforestation. Finally maps of deforestation were created as outputs of the training.



Source: SNRM Project

Figure 2. 34 Outputs of multi-copter drone operation training

Through the multi-copter drone operation training, the capability to take aerial photographs using drones and to conduct detailed verification of land use and land cover conditions, as well as measure land areas, has been developed in the Stung Treng Provincial DoE and FAC. In the future, utilizing this capability to collect detailed information on illegal logging and land encroachment using drones is expected to enable the incorporation of detailed information into the reports necessary for law enforcement, thereby promoting appropriate forest management.

(2) Map utilization training

Table 2. 25 shows the contents of map utilization training.

Table 2. 25 Contents of map utilization training

Training	Contents of the training
Map utilization training	➤ How to interpret topographic maps (topographic description, contour line, map scale, azimuth, coordinate system, and map symbol) ➤ Field practices of using compass and paper maps ➤ Smartphone map application (Avenza Maps)

Source: SNRM Project

Map utilization trainings were conducted for the provincial government staff from December 2022 to May 2023.



Source: SNRM Project

Figure 2. 35 Holding of map utilization trainings for Stung Treng Provincial DoE and FAC

Through the implementation of the map utilization training, the capability to read topographic maps and use map applications on smartphones has been developed in the Stung Treng Provincial DoE and FAC. Currently, there are cases that rangers and forest officers get lost in the forest, so in the future, it is expected that they will safely conduct forest patrols by using topographic maps and map applications to understand the route, distance, and terrain conditions to their destinations.

(3) Satellite image processing training

Table 2. 26 shows the contents of satellite image processing training.

Table 2. 26 Contents of satellite image processing training

Training	Contents of the training
Satellite image processing training	➤ Downloading LANDSAT and Sentinel-2 satellite images using SEPAL ➤ Downloading NICFI Planet satellite images ➤ LULC change detection using Principal Component Analysis (PCA)

Source: SNRM Project

Satellite image processing trainings were conducted for the provincial government staff in November 2023.



Source: SNRM Project

Figure 2. 36 Holding of satellite image processing trainings for Stung Treng Provincial DoE and FAC

Through satellite image processing training, the capability to assess wide-area forest cover conditions and to extract potential areas of deforestation and forest degradation using satellite images has been developed in the Stung Treng Provincial DoE and FAC. In the future, it is expected that the Stung Treng Provincial DoE and FAC will lead forest monitoring using satellite images on a regular basis in PAs and CFs within Stung Treng Province. For the extracted potential areas of deforestation and forest degradation, it is anticipated that screening for illegal logging will be conducted, and efficient on-site verification will be carried out for areas with a high likelihood of illegal logging.

1.3.8 Activity on Output 2-1-1-4: Compile the result and impact of the trainings

In the end of ToT trainings, workshops were held in September 2024 in Stung Treng Provincial DoE and FAC to compile the result and impact of the trainings.



Source: SNRM Project

Figure 2. 37 Holding of workshops to compile the result and impact of the trainings in Stung Treng Provincial DoE and FAC

In the workshops, questionnaire survey was held to evaluate how much the capacities to implement the

duties of Stung Treng provincial government have been enhanced through implementation of ToT trainings. Summary of the survey is listed in Table 2. 27.

Table 2. 27 Capacity of Stung Treng provincial government before and after ToT trainings

Organization	Identified challenges in implementation of duties	Capacity before ToT (Level 1-5)	Capacity after ToT (Level 1-5)
Stung Treng Provincial DoE	1. Lack of capacity of making map	1	4
	2. Lack of equipment to create map	1	4
	3. Lack of capacity in using drone, only taking pictures and no capacity of using drone for mapping	2	4
	4. Lack of budget (organize workshop, etc.)	2	5
	5. Available drones can be used only in the project area	2	5
	6. Data from rangers sometimes contain errors	2	4
	7. Lack of capacity of identifying and monitoring biodiversity	2	3
Stung Treng FAC	1. Lack of capacity of making maps	1	3
	2. Lack of capacity of using drone	1	3
	3. Lack of equipment for office	1	4
	4. Lack of equipment for patrolling	1	4
	5. Lack of equipment for transportation	1	1
	6. Lack of officer	1	1
	7. Lack of budget	1	1
	8. Wildlife illegal hunting	2	2
	9. Illegal logging	2	3
	10. Land encroachment	2	3
	11. Lack of drone for patrolling	1	3
	12. Those who commit crime do not afraid law	1	3

Source: SNRM Project

2 Output and Indicators

The performance of the Component was evaluated based on the achievement of indicators based on four ratings: very high, high, moderately low, and low.

2.1 Outputs and indicators

2.1.1 Indicator 3-2 (The NFMS is enhanced in terms of forest monitoring and Measurement, Reporting and Verification.)

<Achievement Level: High>

The NFMS has been enhanced in terms of forest monitoring and Measurement, Reporting and Verification (MRV) considering that in forest monitoring, capacity of field data collection and compilation has been enhanced through holding a series of trainings consisting of drone, GIS and satellite image interpretation trainings as well as introduced JJ-FAST function in CEMIS, and in MRV, the first provincial level forest inventory has been implemented and capacity of implementing future NFI has been enhanced by accumulating experiences and lessons learned from the inventory.

2.1.2 Indicator 4-1 (The capacity to operate NFMS for protected area management and sustainable forest management of Stung Treng Provincial staff is enhanced.)

<Achievement Level: High>

The capacity to operate NFMS for protected area management and sustainable forest management of Stung Treng Provincial staff has been enhanced considering that the capacity to identify potential deforestation and forest degradation as well as field verification for the identified deforestation and forest degradation has been enhanced through holding a series of ToT trainings consisting of satellite image processing training, map utilization training and multi-copter drone operation training.

2.2 Project Purpose and indicators

Project Purpose: The national and sub-national government staff in charge of protected area management and sustainable forest management is equipped with necessary skills and knowledge for sustainable natural resource management.

2.2.1 Indicator 1-1 (The skills and knowledge of MoE and DoE's staffs of Stung Treng Province for protected area management is improved.)

<Achievement Level: Moderately Low>

The improvement of the skills and knowledge of certain parts of MoE and DoE's staffs has been conducted and some achievements have been observed, and particularly on NFMS, skills and knowledge on forest monitoring and MRV have been improved.

2.2.2 Indicator 1-2 (The skills and knowledge of FA and FA cantonment's staffs of Stung Treng Province for sustainable forest management is improved.)

<Achievement Level: Moderately Low>

The improvement of the skills and knowledge of certain parts of FA and FAC staffs has been conducted and some achievements have been observed, and particularly on NFMS, skills and knowledge on forest monitoring have been improved.

3 History of PDM Modification

Since some of the original objectively verifiable indicators in the PDM were considered insufficient to

evaluate the achievements, revision of indicators in the PDM were recommended through the mid-term review in February 2023, and the Project followed the recommendations. The revised indicators were reflected in the PDM version 3 signed in June 2023.

Table 2. 28 Modification of indicators and reason for the change

Narrative Summary	Objectively Verifiable Indicators	Modified Indicators	Reason for the change
Overall Goal Deforestation and forest degradation are reduced through formulation and implementation of related policies and key measures for strengthening protected area management and sustainable forest management.	The rate of deforestation is reduced by half compared to the rate during 2006-2014	1-1. The rate of deforestation is reduced by half compared to the rate during 2006-2014 by 2026. 1-2. The target set by the NPASMP (2026 Target), the PFSP (2 nd phase Milestone) and the Action and Investment Plan is achieved.	1-1: As the target year was not specified, 2026 was added. 1-2: While 1-1 is an appropriate indicator for the Overall Goal of reducing deforestation, it cannot be achieved solely through the outcomes of this project. Additionally, the Overall Goal includes the statement: through formulation and implementation of related policies and key measures for strengthening protected area management and sustainable forest management. Therefore, we have set indicators related to the implementation status of NPASMP, PFSP and AIP after the project's completion as 1-2.
Project Purpose The national and sub-national government staff in charge of protected area management and sustainable forest management is equipped with necessary skills and knowledge for sustainable natural resource management.	The target set by the NPASMP and the PFSP is achieved respectively.	1-1. The skills and knowledge of MoE and DoE's staffs of Stung Treng Province for protected area management is improved. 1-2. The skills and knowledge of FA and FA cantonment's staffs of Stung Treng Province for sustainable forest management is improved.	The actual activities of the project do not significantly contribute to achieving NPASMP or PFSP. The project purpose is for national and sub-national government staff to equip with necessary skills and knowledge for sustainable natural resource management, and it does not require the implementation of policies and measures. Therefore, as indicators that better measure the project purpose and activities, indicators was set to evaluate the "acquisition of skills and knowledge" for MoE and FA.

Outputs [Component 1: Policy support component] 1-1. Formulation and implementation of related policies and key measures on protected area management is promoted.	1. The target set by the Action Plan for NPASMP (2018-2022) is achieved.	1-1. The proposal for updating the NPASMP is submitted. 1-2. The capacity of national and sub-national staffs for developing management plan for protected areas is improved.	Indicator 1-1 and 1-2: The actual activities of the project do not contribute to the overall achievement of NPASMP. Instead, they focus on monitoring the progress of the NPASMP action plan, compiling the results, reviewing and updating the NPASMP based on these results, and capacity building to achieve the "formulation of protected area management plans," which is only a part of the NPASMP and its action plan. Therefore, indicator 1-1 was set to evaluate activity 1-1-1-4, "Support the updating of the NPASMP," and indicator 1-2 was set to evaluate the capacity enhancement support for the formulation of protected area management plans under activity 1-1-2.
1-2. Formulation and implementation of related policies and key measures on sustainable forest management is promoted.	2. The target set by PFSP First Phase (2018-2022) is achieved.	2. The draft of PFSP is finalized.	Indicator 2: The actual activities of the project do not contribute to the overall achievement of the PFSP but focus on the finalization and promotion of understanding of the PFSP. Therefore, indicator 2 was set to evaluate the finalization of the PFSP.
1-3. The Action and Investment Plan for the Implementation of the National REDD+ Strategy is promoted.	3. The target set by the Action and Investment Plan for the Implementation of the National REDD+ Strategy for this project period is achieved.	3-1. The progress of the Action and Investment Plan for the Implementation of the National REDD+ Strategy is monitored regularly for the promotion. 3-2. The NFMS is enhanced in terms of forest monitoring and MRV.	Indicator 3-1 and 3-2: The actual activities of the project do not contribute to the overall achievement of the REDD+ Action and Investment Plan, but rather support its implementation and monitor its progress, and are focused on the enhancement of the NFMS, which is a part of the plan. Therefore, Indicator 3-1 was established to evaluate the support for the implementation of the REDD+ Action and Investment Plan, and Indicator 3-2 was established to evaluate the support for the enhancement of the NFMS.
[Component 2: Subnational]	4. The rate of deforestation and forest	4-1. The capacity to operate NFMS for protected area	The actual activities of the project do not aim to halt

implementation] 2-1. Provincial staff's capacity for promoting protected area management and sustainable forest management is enhanced. 2-2. Local communities' capacity for sustainable natural resource management in the selected Community Forestry (CF) and provincial rangers' capacity for supporting local communities' sustainable natural resource management in Community Protected Areas (CPAs) are enhanced.	degradation in Stung Treng Province is reduced by ? %.	management and sustainable forest management of Stung Treng Provincial staff is enhanced. 4-2. The sustainable natural resource management in CF and CPA are enhanced by staffs of Stung Treng FA Cantonment and rangers of DoE whose the capacity are built by the Project.	forest degradation and deforestation across Stung Treng Province, but rather focus on providing NFMS related trainings to the provincial government and enhancing the capabilities of local communities for sustainable natural resource management in the counterparts, as well as improving the capabilities of provincial rangers to support local communities for sustainable natural resource management in CPA. Therefore, Indicator 4-1 was established to evaluate the support for capacity building of provincial staff through NFMS-related training, and Indicator 4-2 was established to evaluate the support for the implementation of natural resource management in CF and CPA.
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Source: SNRM Project

4 Others

4.1 Results of Environmental and Social Considerations (if applicable)

No specific matters should be considered: category C under JICA's indicator.

4.2 Results of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

Since gender should be considered in implementation of the Project (category C under JICA's gender indicator), their involvement/participation was facilitated. For example, in the discussion with pilot CF committee members on the venue of the training conducted by the Project in August 2022, the Project well considered opinions of women and selected a Pagoda in the village, instead of inviting them to provincial capital. Finally, it resulted in the high ratio of women's participation in the training, 14 out of 26 participants were women. In addition, the Project included 3 women out of 5 participants in the training of village animal volunteers conducted in February 2023.

III Results of Joint Review

1 Results of Review based on DAC Evaluation Criteria

Since “Results of the Review based on the Development Assistance Committee (DAC) Evaluation Criteria” are assessed in the project completion report of the Project, please refer the report.

2 Key Factors Affecting Implementation and Outcomes

1) GDNPA, FA and Stung Treng Provincial government deploy sufficient officers and allocates necessary budget

Sufficient officers have been deployed, but almost all the necessary budgets have been covered by JICA side, thus implementation of some activities was forced to be canceled because of the financial constraints.

2) No significant change in the national policy on protected area management and sustainable forest management

The sustainable management of natural resources have continuously been appeared in the national policy as included in the Pentagon 4 of the latest Pentagonal Strategy of the RGC.

3) No significant change in the national policy related to REDD+

Ensuring environmental sustainability and readiness for responding to climate change continuously been appeared in the national policy as included in the Pentagon 4 of the latest Pentagonal Strategy of the RGC.

IV For the Achievement of Overall Goals after the Project Completion

1 Prospects to achieve Overall Goal

Overall Goal: Deforestation and forest degradation are reduced through formulation and implementation of related policies and key measures for strengthening protected area management and sustainable forest management.

OVI 1-1. The rate of deforestation is reduced by half compared to the rate during 2006-2014 by 2026

OVI 1-2. The target set by the NPASMP (2026 Target), the PFSP (2nd phase Milestone) and the Action and Investment Plan is achieved.

OVI 1-1 couldn't be achieved by the results of the project alone, therefore OVI 1-2 was added. Since the progress is limited against 2021 targets of NPASMP, according to the review of NPASMP based on the compiled result of the current Action Plan for Implementing NPASMP by the Project, the New Action Plan should be prepared to realize 2031 targets of NPASMP through ensuring to reach the 2026 targets. If it is possible, NPASMP itself should be modified to set the reasonable 2031 targets under the latest sub-national, national, and international situation and goals and the 2026 targets as the achievable milestones to ensure to reach the modified 2031 targets. The 2026 Target of NPASMP would be achieved

if the New Action Plan could be prepared by GDNPA and fully implemented.

Regarding the PFSP, it has not finalized yet and therefore the “2nd phase Milestone” is still in the draft, since PFSP WG of FA has not been activated. Therefore, FA shall activate PFSP WG and finalize the PFSP, utilizing the results of the related training of JICA through the trainees participated from FA. Then, the drafted 2nd phase (2023-2027) Milestone of the intended PFSP would be achieved if the Plan of Action of it could be fully implemented.

In the case of the Action and Investment Plan, currently there are the institutional and financial constraints, but it is expected that institution and funds will be available by completing reorganizing procedure of RTS and being approved the SAP application by GCF. Therefore, to achieve the Action and Investment Plan, RTS shall facilitate the implementation and monitor the progress of the Action and Investment Plan through substantial measures, such as holding annual planning and reviewing workshop involving all the responsible Ministries and developing partners, after reorganization of RTS by issuing joint decision of MoE and MAFF, as well as disbursement of GCF fund applied by the Government of Cambodia and development partners.

In addition, the sustainability of the Project results to realize the Overall Goals is one of the risks, and the transformative change for financial and capacity sustainability was proposed and recognized by both JICA and Cambodian sides.

Through the implementation of the Project, regarding the national and sub-national capacity development for sustainable natural resource management, certain changes have been observed that may contribute to sustain the impacts of the Project. Therefore, the Overall Goal would be achieved if such momentum could be maintained to make sure the transformative change that may not reverse from the path.

2 Plan of Operation and Implementation Structure of the Cambodian side to achieve Overall Goal

The intended 2nd Action Plan for implementing NPASMP, the draft PFSP, and the Action & Investment Plan for the implementation of the National REDD+ Strategy of Cambodia are the plans of the Cambodian government towards the achievement of the Overall Goal and the implementation structures are included in these plans, such as NRT including RTS, GDNPA, GDLC, and GDEKI of MoE, FA of MAFF, as well as Provincial DoE and FAC in all over the country.

GDNPA of MoE and FA of MAFF has formulated and shared plans in the final JCC held on 16th October 2024 to achieve the Overall Goals in three years after the end of the Project.

Table 4. 1 shows the Plan of Operation to achieve the Overall Goal in GDNPA, which includes implementation of activities for both Component 1: Policy Support and Component 2: Sub-national implementation.

Table 4. 1 Plan of operation to achieve the Overall Goal in GDNPA

Component	Output	Outcome	Activities		
			2025	2026	2027
Component 1: Policy Support	1-1. Enhancing the capacity of National and Sub-national staff to implement the activities based on the Technical Guidelines for Developing Management Plans for Protected Areas	Protected Area Management Plans have been developed according to the technical Guideline.	Training workshop on orientation of preparing and implementing the management plan for PA (1 time)	Training workshop on orientation of preparing and implementing the management plan for PA (1 time)	Training workshop on orientation of preparing and implementing the management plan for PA (1 time)
Component 2: Sub-national implementation	1-2. Providing training on law enforcement and Regulations related to protected area management to PDOE staff and rangers.	PDOE staff and Ranger to have knowledge of the Code of Environment and Natural Resources and supported regulations and are able to record or file natural resources crime to the court.	Provide training on standard operating procedures on money laundering related to natural resources offenses (1 time)	Provide training on standard operating procedures on money laundering related to natural resources offenses (1 time)	Provide training on standard operating procedures on money laundering related to natural resources offenses (1 time)
			Provide training on law enforcement, file the report of natural resources crime to the court (1 time)	Provide training on law enforcement, file the report of natural resources crime to the court (1 time)	Provide training on law enforcement, file the report of natural resources crime to the court (1 time)
			Training workshop to disseminate the Code of Environment and natural resources and some related regulations (1 time)	Training workshop to disseminate the Code of Environment and natural resources and some related regulations (1 time)	Training workshop to disseminate the Code of Environment and natural resources and some related regulations (1 time)
	1-3. Develop and implement training plans for capacity enhancement of local authority and	Code of Environment and Natural Resources and supported regulations have	Training workshop to disseminate the Code of Environment and natural	Training workshop to disseminate the Code of Environment and natural	Training workshop to disseminate the Code of Environment and natural

	community.	been disseminated to local authority and community protected area.	resources and some related regulations (1 time)	resources and some related regulations (1 time)	resources and some related regulations (1 time)
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Source: SNRM Project

On the other hand, Plan of Operation to achieve the Overall Goal in FA includes the implementation of following activities after the end of the Project:

- (1) Promote development and implementation of CF management plans;
- (2) Expand forest rehabilitation and plantation in CFs;
- (3) Expand the implementation of agroforestry systems in CFs;
- (4) Strengthen mechanisms to conflict resolution, and monitoring and evaluation; and
- (5) Develop the CF strategic plan.

The progress of all of those activities will be reported in the Technical Working Group on Forestry Reform (TWG-FR) to be held quarterly in FA.

3 Recommendations for the Cambodian side

The following four recommendations were provided on the NFMS related activities supported by the Team:

- (1) Although the version 1 of CEMIS has been developed in MoE under the support of UNDP, the operation of CEMIS has not been started yet. For the application and effective utilization of CEMIS to the sustainable natural resource management, closer collaboration between DGIS and GDNPA in MoE, MoE and FA, as well as central and provincial governments are required;
- (2) Equipment procured for NFMS related activities including drones, computers and drone image processing software, etc. were handed over to MoE, FA and Stung Treng Provincial DoE and FAC. For those equipment, periodical maintenance (especially on drones and drone batteries) should be carried out in order to sustain good conditions to be used for forest monitoring activities;
- (3) In SNRM, ToT programs were implemented in MoE, FA, Stung Treng DoE and FAC, and trainers were raised throughout the project period. After the end of the project, the trained trainers should share the acquired knowledge to untrained staffs to sustain the project outputs; and
- (4) In NFMS related trainings, training materials related to map utilization, satellite image processing and interpretation, GIS, drone operation and drone data processing were prepared. Generally, the advancement of GIS and remote sensing technology is very fast. Therefore, the Team requests counterparts to review the training materials periodically after the project and update the materials if necessary to reflect the recent GIS and remote sensing technology.

Appendices

Appendix 1: Final Report of Forest Inventory Survey in Stung Treng Province of Cambodia

Appendix 2: Map Utilization Training Material

Appendix 3: GIS Training Material (Basic)

Appendix 4 : GIS Training Material (Intermediate to Advanced)

Appendix 5: Multi-copter Drone Operation Training Material

Appendix 6: Fixed-wing Drone Operation Training Material

Appendix 7: Satellite Image Processing and Interpretation Training Material

Appendix 8: Presentation Materials for the 1st Technical Seminar

Appendix 9: Presentation Materials for the 2nd Technical Seminar

Appendix 1: Final Report of Forest Inventory Survey in Stung Treng Province of Cambodia



Royal University of Agriculture
Final Report
of Forest Inventory Survey in Stung Treng Province of Cambodia



Submitted to:
The Project for National and Sub-National Capacity Development for Sustainable Natural
Resource Management in Cambodia (SNRM)



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ACRONYMS AND ABBREVIATIONS

AGB	Above Ground Biomass
BGB	Below Ground Biomass
BUR	Biennial Update Report
C	Carbon
CAES	Center for Agricultural and Environmental Studies
CO ₂	Carbon Dioxide
CPA	Community Protected Areas
CF	Community Forestry
DBH	Diameter at Breast Height
DoE	Department of Environment
FAO	Food and Agriculture Organization
FA	Forestry Administration
FRL	Forest Reference Level
GHG	Greenhouse Gases
GDA	General Directorate of Agriculture
GDANCP	General Department of Administration for Nature Conservation and Protection
GDW	Global Wood Density
H	Height
JICA	Japan International Cooperation Agency
MAFF	Ministry of Agriculture, Forestry and Fisheries
MoE	Ministry of Environment
NFI	National Forest Inventory
PFE	Permanent Forest Estate
PD AFF	Provincial Department of Agriculture, Forestry and Fisheries
REDD+	Reducing Emissions from Deforestation and forest Degradation, plus
RGC	Royal Government of Cambodia
RS	Root to Shoot
RUA	Royal University of Agriculture
SNRM	The Project for National and Sub-National Capacity Development for Sustainable Natural Resource Management in Cambodia
SOC	Soil Organic Carbon
t/ha	Ton/hectare
UNFCCC	United Nations Framework Convention on Climate Change
WD	Wood Density

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We finally would like to thank JICA for their continuous support in improving forest biomass estimates and carbon stock for the forests in Cambodia.

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EXECUTIVE SUMMARY

Introduction

The Forest Inventory Survey under the Project of National and Sub-national Capacity Development for Sustainable Natural Resource Management (SNRM) was conducted in Stung Treng Province as part of the National Forest Inventory (NFI). It is expected that the collected data will be used to develop the next emission factors (EF) and the national forest reference level (FRL), as well as to improve the EF and FRL setting in the future.

Methodology

The forest inventory survey followed the sampling design of the proposal for Cambodia National Forest Inventory (NFI) (2014) and the Field Manual for the NFI of Cambodia (2018). The table below shows the basic features of the forest inventory.

Number of clusters and points: 120 clusters and 360 plots
Survey period: November 2021 – June 2022
Target area: Stung Treng province
Target biomass: AGB, BGB, dead wood, litter and soil

Results and discussion

Forest Types	AGB (Ct/ha)	BGB (Ct/ha)	Deadwood (Ct/ha)	Litter (Ct/ha)	Soil (Ct/ha)	Total (Ct/ha)	Total CO ₂ (t/ha)
Evergreen forest	114.88	42.51	6.91	1.74	68.49	234.53	859.94
Semi-evergreen forest	71.97	14.40	8.89	0.94	63.77	159.97	586.56
Deciduous forest	37.29	7.46	4.36	1.04	65.24	115.39	423.10
Non forest	4.35	0.87	1.76	1.03	61.30	69.31	254.14

In the second FRL for Cambodia (2021), carbon pools included AGB and BGB. Litter, dead wood and soil organic carbon are excluded due to lack of data. In the same framework of the carbon pools (AGB and BGB), the results of forest inventory in Stung Treng indicated that total carbon in Deciduous forest was 44.75 t/ha, equivalent to 164.08 CO₂ equivalents, which is lower than Semi-evergreen forest is 86.37 t/ha, equivalent to 316.69 CO₂ equivalents. Finally, it is found that the total carbon in Evergreen forest was 157.39 t/ha, equivalent to 577.10 CO₂ equivalents and is the highest carbon storage, compared to the National Forest Reference Level (FRL).

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Forest Type	#Plot	AGB (t/ha)	BGB (t/ha)	Total Biomass (t/ha)	Total Carbon (t/ha)	Total CO ₂ (t/ha)	(95% CI)
Evergreen forest	117	244.42	90.44	334.86	157.39	577.10	12%
Semi-evergreen forest	90	153.13	30.63	183.76	86.37	316.69	13%
Deciduous forest	108	79.35	15.87	95.22	44.75	164.08	13%
Non forest	45	9.25	1.85	11.10	5.22	19.14	102 -196%

Recommendation

The forest survey illustrated the carbon stocks of each forest type in Stung Treng Province and suggested that the survey methods could be improved in the study as follows:

- A method to measure parts of illegally harvested timber. This should be integrated into the field manual;
- The results of the AGB for each forest type show a different trend compared to the FRL data. Another study should support and verify the FRL data in a future study;
- The quality of FRL should be considered in the implementation of all forest management;
- A study should encourage academia to continue their studies to build human resource capacity, and the data could be made available for academic purposes;
- The results of the study should contribute to the GHG inventory in Cambodia, along with the national GHG inventory and BUR.

2

I Introduction

Many plant species, especially native species, are essential for understanding plant communities in Cambodia. The country is predominantly rich in biodiversity and other natural resources for socio-economic development, food, livelihood, and human welfare. Most of these resources are threatened with extinction by human activities. The land is predominantly rich in biodiversity and other natural resources for socio-economic development, people's food, livelihood, and welfare. Most plant species, especially native ones, are keystone species. The study will contribute to the greenhouse gas inventory of the country's plant communities. Cambodia's forestlands are managed by two government institutions: The Forestry Administration (FA) of the Ministry of Agriculture, Forestry and Fisheries (MAFF) and the General Department of Administration for Nature Conservation and Protection (GDANCP) of the Ministry of Environment (MoE). FA is the government agency under the MAFF whose responsibility is to manage the forest and forest resources of the Permanent Forest Estate (PFE), which includes naturally growing and planted state forest resources and is divided into the Permanent Forest Reserve (PFR) and Private Forest. The PFR consists of production forest, protection forest and conversion forest. According to the Forestry Law (2002), the private forest is maintained by the owners, who also have the right to manage it, establish a national GHG balance, and harvest, use, sell, and distribute the product themselves. Reducing Emission from Deforestation and Forest Degradation (REDD) BUR, and the Role of Protecting, Sustainably Managing Forests and Increasing Forest Carbon Stocks in Developing Countries (REDD+) is a mechanism that provides financial incentives to reduce greenhouse gases resulting from deforestation and forest degradation.

With the support of JICA through Asia Air Survey Co. Ltd, the Center for Agricultural and Environmental Studies (CAES) of the Royal University of Agriculture signed an agreement to conduct a forest inventory for the Project for National and Sub-National Capacity Development for Sustainable Natural Resource Management. A forest inventory was conducted in Stung Treng Province as part of Cambodia's National Forest Inventory.

1.1 Background

The Forest Inventory Survey for the Project for National and Sub-National Capacity Development for Sustainable Natural Resource Management, hereafter referred to as the Forest Inventory Survey. The Forest Inventory Survey is conducted in Stung Treng Province as part of the National Forest Inventory.

The NFI was established 337 clusters (6x6km), but the number of clusters was changed due to: 1. land use category, 2. contamination, 3. accessibility and others. Under the National and Sub-national Capacity Development for Sustainable Natural Resource Management in Cambodia (SNRM), the targets of the forest inventory survey is to select 120 clusters out of 337 eligible clusters in Stung Treng Province. The white dots in Figure 1 are 120 eligible clusters already selected. It follows the Proposal for Cambodia National Forest Inventory (NFI) sampling design (2014). The distance between the clusters is 6 kilometers.



Figure 1. Location of 120 eligible clusters in Stung Treng Province

1.2 Objective of the forest inventory survey

The Forest Inventory Survey is implemented in Stung Treng Province as a part of the National Forest Inventory (NFI) following the Proposal for Cambodia National Forest Inventory sampling design (2014), and Field Manual for the NFI of Cambodia (2018). The collected data is expected to use for the improvement of emission factors and national forest reference level.

II. Methodology

For the Forest Inventory Survey in Stung Treng Province was conducted from January 10 to February 18, 2022, and continued from March 26 to 31, 2022. The field survey was conducted by CAES to carry out the forest inventory survey with 5 teams composition, each team consisted of a team leader, 4 assistants, a ranger and a local guide. The field survey was conducted with the assistance of JICA short-term experts. Data collection was field checked by the team leader prior to data entry. Quality assurance and quality control were not conducted by the MoE and FA in the study. The overall procedure of this survey follows the sampling design of the National Forest Inventory (NFI) (2014) and the Field Manual for the National Forest Inventory of Cambodia published by the Food and Agriculture Organization (FAO) in 2018. It is a tool to produce information on the status of forests and forest resources for land use policies at national and regional levels. In addition, the NFI is a potential key component of the national forest monitoring system required by the United Nations Framework Convention on Climate Change (UNFCCC) to assess anthropogenic forest-related greenhouse gas emissions by sources and remove by sinks. The target carbon pools of the forest inventory are: Aboveground biomass (AGB), belowground biomass (BGB), dead wood, litter, and soil.

A one-day technical training session was conducted for all survey teams before the pre-survey. The pre-survey lasted 4 days, including a trip to Stung Treng province to demonstrate the inventory technique to the survey teams prior to the actual survey in the field. The classroom training and pre-survey were conducted

by JICA forest inventory experts. After the pre-survey in the field, all team members collected all information and other notes related to the task and returned them to the experts. Then, the experts made recommendations to improve the quality of the survey.

2.1 Clusters and Plots Design

The systematic cluster sampling method is used for field sampling. Clusters of sample plots are the primary sampling units. Plots and trees are the units of record for registering the data. The locations of the sample plots are fixed. Under no circumstances may the plots be moved. If the plot is inaccessible, e.g. due to landmines, it is noted as inaccessible and only land use/vegetation type information is recorded. 120 clusters with a total of 360 plots are selected (1 cluster consists of 3 plots), see Figure 1. For each tree within the plot, the species name, breast height diameter, position on the plot, stem quality, health status, origin and stem height are recorded. The following parameters were measured on the sample trees: Total tree height, stump diameter and stump height. Plot marking, GPS, and other measurements are made in a manner that allows for remeasurement for quality control and future inventories. The geographic coordinate system used in the NFI is UTM-48 North, and the geoid datum is WGS84. In the high mountain layers, the distance from plot center to plot center is 100 m (Figure 2). Each circular plot is divided into 5 subplots (Figure 3) to cover all vegetation in efficiently organized areas (Table 1).

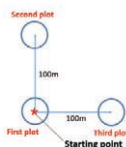


Figure 2. Cluster with circular plots

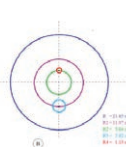


Figure 3. Subplots design

Table 1. Survey unit specification, circular plot design for upland forest

Unit name	Radius	Area	Size of trees	Field form
Cluster				F1
Plot	21.85 m	1500 m ²	dbh ≥ 30 cm	F2, F3, F5
Subplot 1	11.97 m	450 m ²	dbh ≥ 10 cm	F5
Subplot 2	5.64 m	100 m ²	dbh ≥ 5 cm	F5
Subplot 3 for samplings, shrubs and climbers	2.62 m	25 m ²	- Trees: 1cm< dbh < 5 cm	F4A

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			- Shrubs, climbers: dbh ≥ 5cm	
Subplot 4 for seedlings, small shrubs and climbers	1.13 m	4 m ²	- Trees: dbh < 1 cm or no dbh	F4B
Subplot 1 for dead wood (lying) and stumps	11.97 m	450 m ²	- Shrubs, climbers: 1cm< dbh < 5 cm	F6
Subplot 1 for bamboo	11.97 m	450 m ²	diameter ≥ 10 cm	F7
Litter and soil composite samples			In Field manual for soil and litter sampling	F8, F9

2.2 Data Collections

2.2.1 General information of Cluster and Plot

The data and information of Cluster and Plot were collected and recorded based on the Field Manual for the National Forest Inventory of Cambodia (2018, FAO). For example, date and time of survey, GPS coordinates, Accessibility and others were for Cluster information, Land use/Vegetation type (LUV), Environment and Diversity, Slope and others were for plot information. Five photos (N, E, S, W, and Top (sky)) were taken from the center of each plot. In addition, canopy cover was calculated using the 360 images from the 360 camera (RICOH THETA) and Canopon2 (<http://takenaka-akio.org/lets/canopon2/>) software (Figure 4).

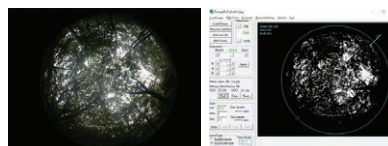


Figure 4. Image by 360 camera and User interface of Canopon2

2.2.2 Tree Species

The names of the tree species are recorded for each tree in the field. If a tree species is unknown to the team, the team leader can take a photo of the particular tree in question and later ask a botanist for advice. The team should always collect leaf, flower, and/or fruit samples from unknown tree species, if possible.

2.2.3 Diameter at Breast Height (DBH) Measurement

Measurement of standing trees is preferably done with the diameter tape. The device should have a metric scale and the smallest unit in millimeters. A 1.3 m stick was used to determine the breast height above the

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ground. The diameter was given in centimeters to one decimal digit. Climbing plants should be removed if they significantly interfere with the measurements. Nothing should prevent direct contact between the tape and the bark of the tree being measured. The measurement was made according to the published NFI Field Manual 2018.

2.2.4 Tree Height Measurement

The hypsometer was used to measure tree height. It is excellent for forest inventory because it has special functions and is able to measure in dense vegetation. The ultrasonic method is suitable for measuring circular sample plots. The hypsometer can be used for the following purposes: Distance measurement, height measurement (tree height) and slope measurement (in degrees, degrees and percent). In addition to the hypsometer, other devices can be used to measure tree height: Suunto inclinometer, Nikon Forest Laser Finger, etc. In this survey, the top height and boot height were measured.

2.2.5 Deadwood Measurement

Dead trees can be either standing or lying. The combined broken parts (individually shorter than 1 m) of the same tree are counted and measured as one part if the total length of the parts exceeds 1 m. The measurement method varies depending on the category and position of the deadwood. Both standing deadwood and fallen deadwood were measured accordingly.

2.2.6 Litter Collection

The area for taking litter samples is 1 m² (1m x 1m). There were 4 litter sampling locations in a cluster with circular plots arranged in an X-shape with the soil profile in the center (Figure 5-B). When locating the litter sampling sites, a person stands at the soil pit and throws a small piece of wood (e.g., a small dead branch about 20 cm long) backwards, and the point where the object falls is the litter sampling site. For the North-East point, the subject should stand facing South-West (Figure 5-B). This point is the central point of the square. Alternatively, scatter samples can be taken in 4 directions (NE, SE, NW, SW) with a distance of 3 meters from the soil pit. The litter samples were mixed well and then a sample was taken (about 100 - 150 grams). The final sample is the mixture of all samples in the cluster group; the total weight of this sample should be at least 200 grams. Do not forget to label the plastic bag with the sample with the following information: Cluster number, Litter sample ID, and Date of collection.

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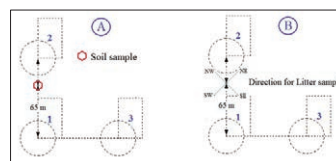


Figure 5. Soil profile location and litter location for uplands

2.2.7 Soil Sampling

The soil sampling point was established 65 m from the starting point in a northerly direction (Figure 5-A), but can be moved if necessary. However, the new location must not deviate more than ±10 m from its original coordinates.

A 100-ml sample was to be collected at each of the 5-cm, 15-cm, and 25-cm depths (Figure 6). This was necessary because the carbon content of the soil normally decreases with depth. If the sample was taken only from the soil at shallow depth, which contains more organic matter than the soil at depth, the amount of soil carbon may be overestimated (Figure 6, cited and modified from FFPRI, 2008).

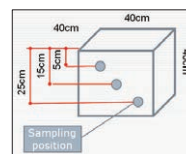


Figure 6. Soil sampling position in the pits

Press the 100-ml sampling cylinder (also called a "ring") (Figure 7) into the pit wall and collect a soil sample as shown in Figure 8. The cylinder must be pressed into the soil surface in such a way that the sample is not compacted. It was also important not to include live biomass and litter in the sample that may have accidentally fallen from the soil surface. Live and dead fine roots (less than 2 mm in diameter) are considered soil organic matter.

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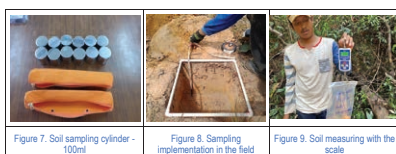


Figure 7. Soil sampling cylinder - 100ml

Figure 8. Sampling implementation in the field

Figure 9. Soil measuring with the scale

2.2.8 Material/Equipment Preparation

The inventory equipment for this survey was prepared using a checklist before travelling to the forest. Each team leader carefully checks that all equipment is prepared and brings it to the team. The list of equipment can be found in Table 2 below.

Table 2. Field equipment

Item No.	Name of equipment	Model/Spec.	Qty (including spares)
1	Handheld GPS receiver	Garmin GPS Map	6
2	Hypsometer	Haglöf Vertex Laser Geo	6
3	Diameter measuring tape	5m	12
4	Diameter measuring tape	2m	12
5	Measuring tape	50m	12
6	Climometer compass	Suunto Tandem	6
8	Small caliper	150mm	6
9	Soil sampling cylinder		12
10	Scale	50g precision	6
11	Waterproof bag		6
12	Colour tape		36
13	360 degree digital camera	Ricoh Theta	6

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Figure 10. Field equipment for 5 teams Source: (SNRM, 2021)

2.3 Data analysis

2.3.1 Carbon Stock Estimation (AGB & BGB)

A large amount of carbon is stored in natural forests, and when forests are cleared, the carbon is converted to carbon dioxide in the atmosphere (Condit, 2008). The purpose here is to describe the best scientific methods available for estimating carbon stocks in forests and in the vegetation left behind after forest clearing. The mass of living organisms in a forest is called biomass. One method that has been found to be very accurate is to measure the size of the organisms and determine their weight from their dimensions. Most of the biomass in a forest is in trees, and the focus of biomass estimation methods is on measuring the above-ground portion of trees. In contrast, the portion of the biomass that is below ground is the roots, which are much more difficult to measure. For this reason, almost all inventories of forest biomass refer only to aboveground weight. However, aboveground biomass has been estimated using different allometric equations for different forest types. The Chave et al. equation (Jérôme Chave et al., 2014) was used for Evergreen forests, and the equation developed in Cambodia for upland forest (Kim, Sola, et al. 2019) was used for Semi-evergreen and Deciduous forests, as well as for Community land and non-forests.

Table 3. Allometric equations used to determine tree mass and each carbon pools of the forest types encountered in the study areas.

Forest types	Equation	RS	References
Evergreen forest	$AGB = 0.0673 \cdot (DBH^{*2} \cdot H^{*} WD)^{0.976}$	0.37	Chave et al., 2014
Semi-evergreen forest	$AGB = 0.0607 \cdot DBH^{*2} \cdot 2692 \cdot H^{*0.5122} \cdot WD^{*0.3183}$	0.20	Kim, Sola, et al., 2019

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Deciduous forest	$AGB = 0.0607 \cdot DBH^2 \cdot 2.2692 \cdot H^{0.5122} \cdot WD^{0.3183}$	0.20	Kim, Sola, et al., 2019
Community land	$AGB = 0.0607 \cdot DBH^2 \cdot 2.2692 \cdot H^{0.5122} \cdot WD^{0.3183}$	0.20	Kim, Sola, et al., 2019
Non forest	$AGB = 0.0607 \cdot DBH^2 \cdot 2.2692 \cdot H^{0.5122} \cdot WD^{0.3183}$	0.20	Kim, Sola, et al., 2019

Note: AGB = Aboveground biomass (kg); BGB = Belowground biomass (kg); DBH = Diameter at breast height (cm); WD = wood density (g/cm³)

Aboveground biomass of trees was summed at the plot level and converted to tons per hectare. Since most projects covered different areas, a simple average was used. Using the average aboveground biomass of forest type, a 95% confidence interval was calculated. Finally, carbon stocks were calculated as the sum of aboveground and belowground biomass multiplied by conversion factors:

$$\text{Equation Conversion from AGB to Carbon Stock of AGB and BGB} \\ C \text{ stock} = AGB + (1 + RS) \cdot C F \cdot 44/12$$

Where:

- RS: Root-to-shoot ratio. Different root-to-shoot ratios were applied to the different forest types: 0.37 for Evergreen forest (IPCC 2006) and 0.2 for all other types (IPCC 2006).
- CF: Carbon fraction, using the carbon fraction value 0.47 (IPCC 2006)
- 44/12: Atomic mass conversion from carbon to CO₂.

Wood density of *Dipterocarpus obtusifolius*, *Dipterocarpus tuberculatus*, *Shorea obtusa*, *Terminalia alata*, and *Xylia xylocarpa* followed the equation developed in Cambodia for upland forest (Kim, Sola, et al., 2019). For other species, wood density was added to tree-level data based on average values for species and genus averages from the Global Wood Density (GWD) Database (Jerome Chave et al., et al., 2009) (Zanne et al., et al., n.d.). Southeast Asia and Southeast Asia Tropical data were selected and the average values for each species and genus were calculated. Wood density for each tree was based on species if available in the GWD, genus if species was not available, or a default value of 0.57 g/cm³ if both species and genus were unknown, not recorded, or not included in the data. The default value was based on an average wood density for tropical Asia (Reyes et al., et al., 1992).

Height-diameter allometric equations

Table 4. Developing tree height-diameter allometric equations

Forest types	Model
Evergreen forest	$H = 1.3 + 29.9423 \cdot (1 - \exp(-0.0407 \cdot DBH^{0.8198}))$
Semi-evergreen forest	$H = 1.3 + 29.0466 \cdot (1 - \exp(-0.0407 \cdot DBH^{0.8198}))$
Deciduous forest	$H = 1.3 + 21.986 \cdot (1 - \exp(-0.0407 \cdot DBH^{0.8198}))$
Community land	$H = 1.3 + 14.3706 \cdot (1 - \exp(-0.0407 \cdot DBH^{0.8198}))$
Non forest	$H = 1.3 + 14.3706 \cdot (1 - \exp(-0.0407 \cdot DBH^{0.8198}))$

Note: H = Tree Height

2.3.2 Calculation of Dead Wood Mass

Biomass calculations for standing dead trees were performed in the same manner as for standing trees. To estimate dead wood mass, the volume of each deadwood piece is first calculated. Then the volume is converted to dry mass using wood densities based on decomposition classes (see Table 5). Some literature values are useful to adopt the estimate of dead wood mass. For example, wood densities were estimated in three decomposition classes in Amazonian forests in Peru (Chao et al., 2008; Table 6). The decomposition rate of stumps was uniformly assumed to be 0.41 because it was not measured during the field survey. For fallen trees, wood density values were used for each decomposition level.

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Table 5. Allometric equations used to determine tree mass and each carbon pools in Dead Wood.

Forest types/Pools	Equation	References
Standing Dead trees	Mass = Same of standing tree (Table3)	Chao et al., 2008
Stump	Mass = $V \cdot WD$ decomposition class $V = A \cdot L \cdot 100$ $A = (d1/2)^2 \cdot (d2/2) \cdot \pi$ $WD = 0.41$	Chao et al., 2008
Fallen Dead Wood	Mass = $V \cdot WD$ decomposition class $V = \frac{1}{3} \cdot \pi \cdot \left(\frac{d1^2}{4} + \frac{d1 \cdot d2}{2} + \frac{d2^2}{4} \right) \cdot L$	Chao et al., 2008

Note: WD = wood density (g/cm³) V = Tree Volume (m³)

Table 6. Wood density in each decay class

Decomposition Class	Wood density (g cm ⁻³)
1	0.55
2	0.41
3	0.23

Source: (Chao et al., 2008)

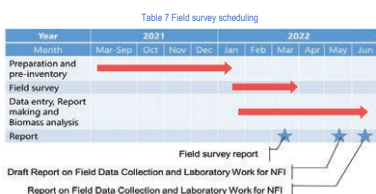
2.3.3 Calculation of Soil and Litter Carbon Pools

The soil sample was taken at depths of 5 cm, 15 cm, and 25 cm. The measuring tape was laid parallel to the soil core placed on the plastic film. Then, the soil core is cut open at the appropriate depth and the 100 ml sampling cylinder is inserted to collect the sample. Then, each collected soil sample is placed in a sample bag and the name of the cluster, the date and the depth of the sample are noted for each bag. The soil samples were collected during the field survey and analyzed at the soil laboratory of the General Directorate of Agriculture (GDA). The soil samples were oven dried and recorded promptly. At the laboratory, soil samples were analyzed for the following parameters: organic matter, nitrogen, pH, total carbon, and hydrogen. Litter samples were collected in the field and placed in plastic bags. After weighing the litter and then deduct the net weight of the bags, the samples were placed directly into the drying oven. The samples were weighed daily until they were uniformly dried.

2.4 Plan of Forest Inventory Survey

Because the cluster sites are spread over almost the entire area of Stung Treng Province, the field research team created a survey plan. Each team completed their tasks according to the schedule below. This survey required 48 working days (detailed schedule in Appendix 1) to cover the 120 clusters. Soil and litter samples were transported from the forest to the city center each week so that quality could be checked. Laboratory work such as data entry and biomass analysis will be conducted following the field survey (see Table 7).

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III. Results and Discussions

3.1 Result of Field Survey

As per the agreement between CAES and Asia Air Survey Co. Ltd, 120 clusters, or 360 sample plots, were sampled; however, due to the condition of the forest inventory, the team was only able to complete 114 clusters (342 plots) and the remaining 8 clusters were not accessible (see Figure 11). However, during the meeting with the JICA team of experts based on the signed agreement, they agreed to propose a new schedule to complete the additional clusters at the end of March in order to reach the agreed plots. As shown in the weekly reports, the team spent 40 working days in the field, with a day lasting approximately 13 to 16 hours (start time 5:30, 6, or 6:30 a.m., return time 5:00, 6:30, and 9:00 a.m.) (Appendix 2). Finally, the survey team completed 120 clusters (360 plots).

Table 8. Accessibility of Plots in Field Measurement

Forest Type	# Implementation plot*	# Inaccessible plot **
Evergreen forest	117	11
Semi-evergreen forest	90	10
Deciduous forest	108	0
Non forest	45	3
Total	360	24

* Recorded in the fields

** Based on the classification of 2018 Forest Cover Map

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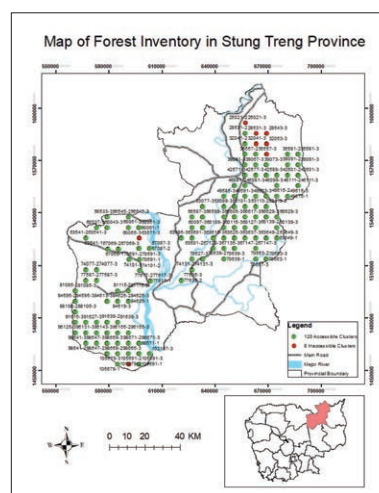


Figure 11. Map of accessible and inaccessible clusters in Stung Treng Province

For the accessible and inaccessible clusters were attached in the Appendix 3 & Appendix 4 below.

3.2 Clusters and Plots in Field Measurement (without inaccessible cluster/plot)

A total of 120 clusters equally 360 plots were performed. It is shown that the clusters and plots in the field survey (see Table 9), including Evergreen forest for litter (38 clusters), soil (37 clusters), and a number of plots AGB, BGB, and Deadwood (117 plots). Semi-evergreen forest for litter (31 clusters), soil (39 clusters), and a number of plots AGB, BGB, and Deadwood (90 plots). Deciduous forest for litter (39 clusters), soil (35 clusters), and a number of plots AGB, BGB, and deadwood (108 plots).

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Table 9. Clusters and Plots in Field Measurement

Code	Land use/Vegetation type Class	#Cluster (Litter)	#Cluster (Soil)	#Plot (AGB, BGB, Deadwood)
1	Evergreen forest	38	37	117
3	Semi-evergreen forest	31	39	90
4	Deciduous forest	39	35	108
-	Non forest	12	9	45
11	Oil palm	(0)	(1)	(0)
21	Shrubland	(2)	(2)	(5)
23	Orchard	(3)	(0)	(12)
31	Grassland	(0)	(2)	(1)
33	Abandoned field	(3)	(4)	(13)
35	Barren land	(0)	(0)	(1)
40	Cropland	(3)	(0)	(11)
41	Swidden agriculture	(1)	(0)	(2)
Total		120	120	360

3.3 Main Tree Species for Each Forest Type

According to the field inventory in Stung Treng, the tree species were found 382 species, including Unknown Species 40 species at the tree plot in all Land use/Vegetation type. It was also described on a number of species in three forest types (Table 10). The main tree species in the study site are: *Lagerstroemia caliculata*, *Vatica odorata*, *Aporosa planchoniaria*, *Nauclea orientalis*, *Diospyros crumenata*, *Syzygium cumini*, *Iringia malayana*, *Xylocopa vietiana*, *Syzygium polyanthum*, *Shorea vulgaris*, *Momcyton acuminatum* var. *tenius*, *Diospyros nitida*, *Cratogeomys cochinchinensis*, *Xylocopa xylocarpa*, *Terminalia alata*, *Shorea obtusa*, *Dipterocarpus tuberculatus*, *Dipterocarpus obtusifolius* (See Appendix 5).

Table 10. Main species in three forest types

No	Species Name	Evergreen forest	Semi-evergreen forest	Deciduous forest
1	<i>Aporosa planchoniaria</i>	154	30	3
2	<i>Diospyros crumenata</i>	119	83	7
3	<i>Diospyros nitida</i>	50	21	1
4	<i>Iringia malayana</i>	62	50	28
5	<i>Lagerstroemia caliculata</i>	228	304	61
6	<i>Momcyton acuminatum</i> var. <i>tenius</i>	55	49	15
7	<i>Nauclea orientalis</i>	132	0	0
8	<i>Shorea vulgaris</i>	59	3	2
9	<i>Syzygium cumini</i>	80	21	16

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10	<i>Syzygium polyanthum</i>	60	2	0
11	<i>Vatica odorata</i>	214	62	4
12	<i>Cratogeomys cochinchinensis</i>	29	55	31
13	<i>Xylocopa xylocarpa</i>	7	0	92
14	<i>Xylocopa vietiana</i>	62	6	4
15	<i>Terminalia alata</i>	0	2	142
16	<i>Dipterocarpus obtusifolius</i>	0	1	62
17	<i>Dipterocarpus tuberculatus</i>	0	1	117
18	<i>Shorea obtusa</i>	0	1	147

3.4 Comparison of AGB (t/ha) in difference provinces

Comparing the data of AGB in Cambodia with those of Stung Treng, AGB in the study area is higher than in Kampong Thom, Kratie, Oddar Meanchey, Pursat, Ratanakiri, and Siem Reap, but lower than in Mondulokiri and Kong Kong and Preah Vihear provinces. AGB in Mondulokiri is largely from the REDD + Keo Seima Wildlife Sanctuary REDD + Project and other protected areas that are less disturbed, resulting in higher AGB values. In Koh Kong, mangrove forests, which have ecosystem carbon stocks, are the main area and have higher carbon stocks than upland and floodplain forests. However, the study was conducted for the whole province, and one part is dense and another part is open forest.

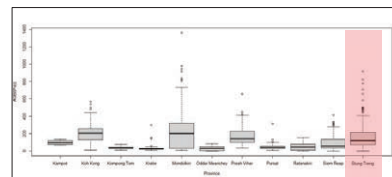


Figure 12. Comparison of AGB between study site and other provinces

3.5 Result of AGB (t/ha) for each Forest Type

According to the study, Figure 13 shows that Evergreen forest, where the amount of AGB is almost 1000 t/ha, but the frequency of the data is ranked between 50-500 t/ha happened nearly 20 times. In Semi-evergreen forest, the amount of AGB is not more than 500 t/ha, but the frequency of data is ranked between 0-350 t/ha, a frequency of about 15 times. In Deciduous forest, the amount of AGB is between 0-150 t/ha, frequency of the data occurred between 25-35 times. The graph showed the amount of AGB of each forest type, Evergreen forest amount nearly 1000 t/ha, Semi-evergreen forest is between 0-300 t/ha and Deciduous forest is between 0-250 t/ha.

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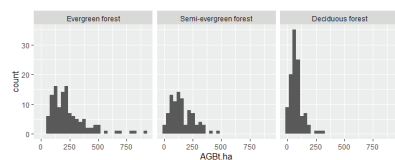


Figure 13. Frequency of AGB in each forest types

3.6 Relationship between Tree Height and DBH

Trees exhibit considerable variation and flexibility in their crown size, height, and Diameter at Breast Height. The size of a tree crown and its height above the ground is important to the tree in that it determines the total amount of light the tree receives for photosynthesis. An examination of the relationship between height and diameter for all tree data is shown in Figure 14, with most diameter classes occurring between 5-50 cm in the field survey. H and DBH are particularly important for biomass and carbon stock calculations. In the absence of total height data in the field, the height of each tree is calculated using the DBH data by developing a nonlinear regression model.

In general, the correlation between tree height and DBH is such that the tree is tall and the DBH size is large, so the relationship between tree DBH and the number of tree species per tree is captured. A positive correlation between tree height and species diversity is found, but with significant and increasing variation with increasing DBH. This means that the variations in tree height were explained by variations in stem diameter.

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Figure 14. Relationship between Tree Height and DBH

3.7 AGB & BGB Carbon Pools

Table 11 describe AGB and BGB carbon pool in different forest types. The AGB in each plot was different depending on the number of trees are present in the plot and forest types. The total aboveground biomass in this study was excluded bamboo. The total biomass (AGB and BGB) in Deciduous forest was 95.22 t/ha, equal to 44.75 C t/ha, Semi-evergreen forest was 183.76 t/ha, equal to 86.37 C t/ha, while Evergreen forest was 334.86 t/ha and equal to 157.39 C t/ha, and Non-forest was 11.10 t/ha, equal to 5.22 C t/ha.

Table 11. AGB & BGB carbon pool in different forest types

Forest Type	#Plot	AGB	BGB	(RS)	Total Biomass	Total Carbon	Sd	CI (95%)
Evergreen forest	117	244.42	90.44	0.37	334.86	157.39	161.76	29.31
Semi-evergreen forest	90	153.13	30.63	0.20	183.76	86.37	98.91	20.43
Deciduous forest	108	79.35	15.87	0.20	95.22	44.75	55.97	10.56
Non forest	45	9.25	1.85	0.20	11.10	5.22	24.59	7.19

3.8 Standing Dead Wood, Stump and Fallen Dead Wood Carbon Pools

Deadwood plays an important ecological role in forest ecosystems, and the decomposition of this material can contribute significantly to the net production of the forest ecosystem. It has been defined as one of the carbon pools for carbon stock calculations. Dead wood is potentially a large carbon pool with relatively long

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turnover times. Dead wood can help reduce erosion rates, store large amounts of nutrients and water, provide energy and nutrients for soil micro- and macro-organisms, and provide a place for seedling development. In this study, the average biomass from deadwood in Deciduous forests, Semi-evergreen forests, and Evergreen forests was slightly different (9.28 t/ha, 18.91 t/ha, and 14.70 t/ha, respectively). The result here (see Table 12) is similar to a study conducted by USAID (2014) that estimated biomass from dead wood in Cambodia. Including biomass from deadwood in the estimate increases the total carbon stock at the research site.

Table 12. Dead wood carbon pool in different forest types

Forest Type	#Plot	Deadwood (t/ha)	Total Carbon (t/ha)	Total CO ₂ (t/ha)	Sd	CI (95%)
Evergreen forest	117	14.70	6.91	25.34	23.75	4.30
Semi-evergreen forest	90	18.91	8.89	32.60	23.55	4.87
Deciduous forest	108	9.28	4.36	15.99	16.75	3.16
Non forest	45	3.74	1.76	6.45	9.34	2.73

3.9 Litter Carbon Pool

Forest and plant litter fall in terrestrial systems is an important pathway for returning nutrients to the soil. Litter has been defined as one of the carbon pools in ecosystem carbon stock calculations. Since a sample of the litter layer is collected from a determined plot, it is sufficient to determine the coefficient for converting the sampling area per hectare. Based on forest types, Evergreen forest the value was 1.74 C/ha Semi-evergreen forest was 0.94 C/ha Deciduous forest was 1.04 C/ha and Non-forest was 1.03 C/ha. The result was similar to a study by RUA (2020), which estimated the biomass from turnover leaves in Cambodia.

Table 13. Litter carbon pool in difference forest type

Forest Types	#Cluster	Litter(t/ha)	Total C (t/ha)	CO ₂ (Mg/ha)	Sd	CI (95%)
Evergreen Forest	38	3.70	1.74	6.38	1.31	0.42
Semi-evergreen Forest	31	2.00	0.94	3.45	0.82	0.29
Deciduous Forest	39	2.21	1.04	3.81	1.04	0.33
Non forest	12	2.20	1.03	3.78	1.66	0.94

3.10 Soil Organic Carbon Pools

Soil organic carbon is important to terrestrial ecosystems. Here, we present estimates of organic carbon stocks in soils of the upper reaches of Stung Treng Province based on soil types. The results show that the total organic carbon stock in the different forest types in which the soil layer is located, as well as the C stocks for each pool in each of the three layers. The soil depth was 40 cm in each case. Note that the sample was taken only from the soil at shallow depth, which contains more organic matter than the soil at depth (see

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3.12 Other Results

Table 16 shows the number of species and individuals of seedlings, shrubs, and vines in each sub-plot. The results of these surveys were not used to estimate forest biomass. It is expected that these data will be utilized in future studies of biodiversity, forest ecosystem and other.

Table 16. Number of species and individuals of seedling, shrub, climber and sapling

Forest Type	Seedlings		Small Shrubs and Climbers		Sapling		Shrubs and Climbers	
	Species	#Tree	Species	#Tree	Species	#Tree	Species	#Tree
Evergreen forest	190	1,450	37	125	158	1,168	22	45
Semi-evergreen forest	154	1,245	17	69	148	595	13	20
Deciduous forest	110	760	13	27	86	364	4	10
Oil palm	-	-	-	-	-	-	-	-
Shrubland	5	25	-	-	5	16	-	-
Orchard	6	18	1	1	8	21	-	-
Grassland	-	-	-	-	-	-	-	-
Abandoned field	14	69	1	4	11	41	1	1
Barren land	-	-	-	-	-	-	-	-
Cropland	3	20	-	-	11	17	1	2
Swidden agriculture	3	5	-	-	3	7	-	-
Total	318	3,592	56	226	214	2,229	35	78

3.13 Discussions

Based on the Second Forest Reference Level (FRL) in Cambodia (2021), the national FRL is for the entire national territory. The carbon pools included AGB and BGB. Litter, deadwood and soil organic carbon are excluded due to the lack of data. The AGB of Semi-evergreen forest (165.23 t/ha) is higher than Evergreen forest (133.12 t/ha), while Deciduous forest (70.87 t/ha) and other forests (73.03 t/ha) are similar (Table 18). Also, BGB of Evergreen forest (49.26 t/ha) is higher than Semi-evergreen forest (33.05 t/ha), while Deciduous forest (14.17 t/ha) and Other forests (14.85 t/ha) are similar respectively. Overall, each carbon pool of the Semi-evergreen forests (93.19 C/ha) is higher than in other forest types, compared to Evergreen forest (86.72 C/ha) and Deciduous forests (39.97 C/ha) and followed by Other forests (41.30 C/ha). Semi-evergreen forest (341.70 t/ha) has a total CO₂ equivalent that is higher, compared to other forest types. However, bamboo was excluded from the first and second Cambodia FRL because the area of land cover represented bamboo class were very small.

A study on carbon stock assessment conducted by MoE (2020), the amount of AGB in the evergreen forest is higher, compared to the deciduous forest in the study. Amount of AGB in average of deciduous forest and evergreen forest was significantly different as 91 t/ha and 169 t/ha respectively. The result was similar to the Cambodia Initial Forest Reference Level (FRL), which the AGB of deciduous forest was 85 t/ha and evergreen forest was 163 t/ha (RGC, 2017). Moreover, the results were similar to the study of (Karki et al., 2016) who estimated the AGB in deciduous forest and evergreen forest in Nepal. Their result found that the average AGB in deciduous forest was 116.63 t/ha and evergreen forest was 177.58 t/ha. This result was a

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Table 14). Due to the large amount of carbon stored in the soil, soil organic carbon may increase significantly based on the different forest types, including 68.49 t/ha for the Evergreen forest, Semi-evergreen forest 63.77 t/ha Deciduous forest 65.24 t/ha and Non-forest forests 61.30 t/ha.

Table 14. Soil carbon pool in different forest types

Forest Types	#Cluster	Soil C (Mg/ha)			Total C (t/ha)	Sd	CI (95%)
		SL1	SL2	SL3			
Evergreen Forest	37	24.93	22.66	20.90	68.49	16.16	5.21
Semi-evergreen Forest	39	23.81	20.68	19.28	63.77	14.78	4.64
Deciduous Forest	35	23.85	22.38	19.01	65.24	19.61	6.50
Non forest	9	25.44	23.95	21.81	61.30	13.74	8.98

3.11 Total Ecosystem Carbon Stock Assessment in Stung Treng Province

The study focused on five carbon pools, including aboveground and belowground biomass carbon, deadwood carbon pool, litter carbon pool, and SOC. Litter, deadwood, and understorey are important carbon pools for forest ecosystems and constitute the most important carbon pools in quantifying for national emissions reporting. Table 15 illustrates some interesting facts about total ecosystem carbon stocks in different forest types. It allows comparisons between the number of different forest types. In Evergreen forest, the AGB (114.88 C/ha) is higher than forest types followed by Semi-evergreen forests (71.97 C/ha). Whereas, the BGB (42.51 C/ha) in Evergreen forest is also higher followed by Semi-evergreen forests (14.40 C/ha). However, the deadwood of Semi-evergreen forest (8.89 C/ha) is similar, compared to Evergreen forest (6.91 C/ha), and stored higher carbon. The carbon stored in the litter (1.74 C/ha) of Evergreen forest is higher followed by Deciduous-forest types (1.04 C/ha). The SOC stored in Evergreen forests (68.49 C/ha) is slightly higher, compared to Deciduous forests (65.24 C/ha) and Semi-evergreen forests (63.77 C/ha), followed by Non-forest types (61.30 C/ha). Overall, each carbon pool of total ecosystem carbon stock indicated that in Evergreen forest (234.53 C/ha) is higher than in other forest types, compared to Semi-evergreen forests (159.97 C/ha) and Deciduous forests (115.39 C/ha). Finally, Evergreen forest (859.94 t/ha) has a total CO₂ equivalent that is higher, compared to other forest types in Stung Treng province.

Table 15. Total Ecosystem carbon stock in difference forest type

Forest Types	AGB (C/ha)	BGB (C/ha)	Deadwood (C/ha)	Litter (C/ha)	Soil (C/ha)	Total (C/ha)	Total CO ₂ (t/ha)
Evergreen forest	114.88	42.51	6.91	1.74	68.49	234.53	859.94
Semi-evergreen forest	71.97	14.40	8.89	0.94	63.77	159.97	586.56
Deciduous forest	37.29	7.46	4.36	1.04	65.24	115.39	423.10
Non forest	4.35	0.87	1.76	1.03	61.30	69.31	254.14

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slight higher than AGB in deciduous forest in Cambodia because the level of density, height, and DBH. However, it was considered in the same category for both study if link to FRL in Cambodia. Overall, the estimated total AGB was 130 t/ha (MoE, 2020). The total AGB in the study was included sapling and bamboo. Therefore, the estimated value of total AGB was higher than Cambodia FRL, which excluded saplings and bamboo. The total AGB in deciduous forest was 149.31 t/ha, equal to 70.2 CO₂ equivalent, while the evergreen forest was 238.7 t/ha and equal to 112.2 CO₂ equivalent. Therefore, the total average AGB from the study was 194 t/ha equal to 91.2 CO₂ equivalent by including sapling and bamboo.

Another study conducted by RUA (2020), it showed that litter biomass pool was approximately 1-2 t/ha. The evergreen forest had mostly an amount of biomass rather than other forest types in Cambodia. Soil carbon pool not yet studied for Upland Forest, Cambodia. It has only mangrove forest in Koh Kong and Preah Sihanuk (USAID, 2014).

The results of forest inventory in Stung Treng indicated that the total carbon in Deciduous forest was 44.75 t/ha, equal to 164.08 CO₂ equivalent, which is lower than Semi-evergreen is 86.37 t/ha, equal to 316.69 CO₂ equivalent (Table 17). Finally, it is concluded that the total carbon in Evergreen forest was 157.39 t/ha, equal to 577.10 CO₂ equivalent was the highest carbon storage, compared to the National Forest Reference Level (FRL).

Table 17. Result of forest inventory in Stung Treng (AGB, BGB)

Forest Type	#Plot	AGB (t/ha)	BGB (t/ha)	Total Biomass (t/ha)	Total Carbon (t/ha)	Total CO ₂ (t/ha)	(95% CI)
Evergreen forest	117	244.42	90.44	334.86	157.39	577.10	12%
Semi-evergreen forest	90	153.13	30.63	183.76	86.37	316.69	13%
Deciduous forest	108	79.35	15.87	95.22	44.75	164.08	13%
Non forest	45	9.25	1.85	11.10	5.22	19.14	-102 -196%

Table 18. Result of National FRL (AGB, BGB)

Forest Type	#Plot	AGB	BGB	Total Biomass	Total Carbon	Total CO ₂ e	(CI)
Evergreen forest	446	133.12	49.26	182.38	86.72	314.30	5%
Semi-evergreen forest	49	165.23	33.05	198.28	93.19	341.70	19%
Deciduous forest	132	70.87	14.17	85.04	39.97	146.55	10%
Other forest	54	73.03	14.85	87.88	41.30	151.43	0%

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IV. Conclusions and Recommendations

4.1 Conclusion

This study provides current estimates of forest biomass and carbon stock in all forest types throughout Stung Treng Province in Cambodia, representing important biophysical outcomes of the forest landscape. As this is an entry-level initiative, the results and findings of this forest inventory survey need to be cross-checked and validated by other research in similar ecological zones. In 2022, a total of 120 clusters or 360 permanent observation plots were surveyed with all forest types in natural forests. Vegetation parameters were calculated along with total carbon stock separately for the different forest carbon pools, including aboveground and belowground biomass carbon, deadwood carbon pool, litter carbon pool, and SOC. It can be found that the four forest types (Evergreen forest, Semi-evergreen forest, Deciduous forest, and Other forest types) can sequester more carbon in the future if the trees have sufficient DBH, which means a greater tendency to build biomass and carbon content. In 360 circular plots, 382 species were recorded in the tree layer as the main species composition, including: *Lagerstroemia calyculata*, *Vatica odorata*, *Diospyros crumenata*, *Aporosa planchoniana*, *Terminalia alata*, *Xylocarpus*, *Shorea obtusa*, *Irvingia malayana*, *Nauclea orientalis*, *Cratogeomys cochinchinensis* were the dominant tree species in the fourth forest type based on density.

The carbon stock density of Evergreen forest (234.53 Ctha) was higher than that of Semi-evergreen forest (159.97 Ctha), Deciduous forest (115.39 Ctha) and Non-forest (69.31 Ctha) in Table 15. The results of AGB were a significant difference from the second Cambodia FRL as the value of carbon stock was 85.72 Ctha for Evergreen forest, 93.19 Ctha for Semi-evergreen, 39.97 Ctha for Deciduous forest and 41.30 Ctha for Non forest (excluding stumps, fallen dead wood and bamboo) (Table 18). Overall, each carbon pool of the total ecosystem carbon stock shows that in Evergreen forest (234.53 Ctha), equivalent to 859.94 ttha, has higher CO₂ equivalent than the other forest types in Stung Treng province. The results will support the government's strategy in terms of sustainable management of the forest sector in Cambodia.

In conclusion, the total carbon in Evergreen Forest was 157.39 ttha, equal to 577.10 CO₂ equivalents was the highest carbon storage in the study, compared to the National Forest Reference Level (FRL).

4.2 Recommendation

When conducting a study in Stung Treng province, the finding results identified some weak points of the survey method as a main area of concern. This lack of data comparison from different sources, particularly the soil study was most needed. Given these findings, we proposed improving a field manual due to lack of some details of survey methods that would achieve the following:

- A method to measure parts of illegally cut timbers. This should integrate into the field manual;
- The results of AGB for each forest type indicate a different trend compared to FRL data. Another study should support and check the data of FRL in future study;
- When conducting the whole scale of forestry, the quality of FRL should be considered;
- A study should encourage academia to continue studying in terms of capacity building of human resources, and the data could be available for academic purposes;
- The results of the study should contribute to GHG inventory in Cambodia, together with both national GHG inventory and BUR; and
- Should have other studies in different provinces to see how the data is comparatively collected.

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V. Challenges and Lessons learned

5.1 Challenges

Despite the fact that the RUA team, which is well experienced in forest research in Cambodia, foresaw the obstacles and took certain actions, the following difficulties arose during the field survey. The information is shared as it will contribute to the development of future NFI implementation plans.

- Some clusters are inaccessible due to inaccessible roads and it is a very high risk to walk through the mountainous area with very steep slopes.
- Spending a long time to find the target clusters, as the result of no access road, very stony steep slope road in Siem Pang area. The team cannot use motorized machinery (e.g. hand tractor) to transport the survey equipment, material, fuel, and foods to some clusters. Therefore, using motorbikes was a good option; however, there was a limitation on transportation, so, the team must go back to the village for buying food, fuel, etc. Sometimes, motorbikes were broken during the working time.
- The site camp is normally located near the water sources (e.g. canal or stream). Sometimes it was quite far from target clusters, so the team returns back to the site camp mostly arriving at night time.
- During the survey field, the team encountered illegal logging activities where they were cutting; however, the team informed that it was a study conducted by the university for the national inventory data. Then, they understood what the explanation was and agreed to stay together in the forest for different purposes.
- Some clusters were located in the company, and the team entered without any permission.
- Some clusters are located in Evergreen forests or hilly areas near the water source where there were some wild pig miles, snakes, or other insects biting the team.
- A few days of forest fire during the dry season, particularly for the cluster or plots local in Deciduous forest (dry open forest) were a lot of *Vietnamossasa pusilla* available.
- One cluster is located at another side of the river, where there was no bridge or ferry, so the team must rent the local small boat to reach the cluster. It was a high risk since most of the team members could not swim and the boat have no safety swimming suit.
- Transceiver was short distance making it difficult to contact our team members just only from one plot to another plot in the same clusters. Lost the team members in the forest.
- Difficult to find local guides to join us as they did not know the tree name or road accessibility.

5.2 Lessons learned

Lessons learned were implemented to make the field survey efficient and smooth.

- Building capacity of the survey team, including pre-survey phase and building good networking with local guides and forest rangers through being friendly, kind and share something with them, and also enjoy what they coordinated in the field.
- Strong coordination from the MOE, particularly the facilitation of DoE, PDAFF, and FA to CPAs and CFs
- Knowledge sharing including culture and language among the teams and others
- Participation at all levels, particularly local authorities always collaborated with the team to work in the areas where the clusters are located in.
- Leadership in teamwork to achieve the assigned tasks and collaboration by team members
- Preparation with maps included Google Earth maps, CF maps, CPA maps.
- Meeting with Director of CPAs and CF leaders for interviewing on the current situation.

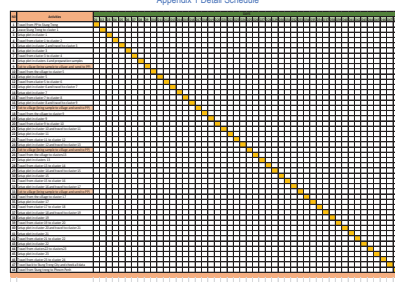
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Appendix 1 Detail Schedule



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App1-9

No	Species name	Frequency
46	Dehaasia cuneata	36
47	Diospyros pilosanthera	36
48	Gluta lacoffera, Pierre	36
49	Melodorum fruticosum	36
50	Diospyros beaudii	34
51	Diospyros undulata	34
52	Acronychia pedunculata	31
53	Albizia lebeck	31
54	Dipterocarpus dyeri	31
55	Shorea roxburghii	31
56	Memecylon laevigatum	30
57	Parinari ananensis	30
58	Shorea siamensis	30
59	Syzygium formale	29
60	Bombax anceps	28
61	Heritiera javanica	28
62	Nautica officinalis	28
63	Dipterocarpus altus	28
64	Mangifera duperreana	26
65	Mangifera foetida	26
66	Milusa mollis	26
67	Dillenia perlagyna	24
68	Grewia eriocarpa	24
69	Hopea fereae	24
70	Polyalthia cerasoides	24
71	Stenocarpium cylindricum	24
72	Cereya arborea	23
73	Garcinia fereae	23
74	Spodias pinnata	23
75	Anacardium occidentale	22
76	Bromolagium emarginata	22
77	Methuca elliptica	22
78	Quassia amara	22
79	Dalbergia nigrescens	21
80	Dipterocarpus intricatus	21
81	Garcinia virescens	21
82	Krema collicosa	21
83	Uvaria purpurea	21
84	Artocarpus chama	20
85	Sterculia glava Mq.	20
86	Lagerthoemia speciosa	19
87	Terminalia chebula	19
88	Lophopetalum duperreanum	18
89	Terminalia dilatata	18
90	Aporosa ficifolia	17
91	Dalbergia oliveri	17
92	Haldina cordifolia	17

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No	Species name	Frequency
93	Hopea odorata	17
94	Unknown27	17
95	Cleistanthus tomentosus	16
96	Delium cochinchinense	16
97	Melientha suavis	16
98	Croton poilanei	15
99	Pterocarpus macrocarpus	15
100	Scaphium macropodium	15
101	Diospyros cambodiana	14
102	Dipterocarpus turbinatus	14
103	Polyalthia intermedia	14
104	Pterocarpium semisagittatum	14
105	Cananga latifolia	13
106	Dillenia ovata	13
107	Fagraea fragrans	13
108	Hopea pierrei	13
109	Mitragyna sp.	13
110	Alseodaphne monophylla	12
111	Callicarpa brevipes	12
112	Ficus microcarpus	12
113	Hydrocarpus annamensis	12
114	Krema globularis	12
115	Methuca cambodiana	12
116	Pterocarpium grevilleifolium	12
117	Syzygium grandis	12
118	Syzygium siamensis	12
119	Diospyros malabarica	11
120	Morinda tomentosa	11
121	Walsura trichostemon	11
122	Apostasia wallichii	10
123	Baccaurea ramiflora	10
124	Ficus variegata	10
125	Garcinia oliveri	10
126	Pinus kesiya	10
127	Suregada multiflora	10
128	Syzygium litorale	10
129	Vernanthesa javala	10
130	Zizyphus cambodiana	10
131	Barringtonia asiatica	9
132	Canarium altum	9
133	Canarium polyadelphum	9
134	Drypetes cambodica	9
135	Myristica iners	9
136	Strychnos nux-vomica	9
137	Terminalia pierrei	9
138	Velicia phillystrana	9
139	Abutilon indicum	8

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No	Species name	Frequency
140	Alstonia scholaris	8
141	Bauhinia variegata	8
142	Dalbergia enteloides	8
143	Diospyros buxifolia	8
144	Aglais edulis	7
145	Bauhinia viridescens	7
146	Calumangium tomentosum	7
147	Cordia cochinchinensis	7
148	Elaeocarpus hygrophilus	7
149	Krema pierrei	7
150	Lepisanthes rubiginosa	7
151	Lithocarpus hermendi	7
152	Polyalthia thorelii	7
153	Unknown25	7
154	Aglais cambodiana	6
155	Albizia thorelii	6
156	Antidesma phassambilla	6
157	Boehavia chinensis	6
158	Chrysophyllum roxburghii	6
159	Citroia ternatea	6
160	Daphniphyllum meijus	6
161	Dasymaschalon tomentaceum	6
162	Diplokinema sp.	6
163	Duabanga grandiflora	6
164	Dysoxylum lourei	6
165	Euclea apta	6
166	Garcinia schaefferi	6
167	Mastixa pentandra	6
168	Parkia sumatrana	6
169	Shorea henryana	6
170	Shorea hypochrysa	6
171	Unknown64	6
172	Zanthoxylum rhetsa	6
173	Butea monosperma	5
174	Calophyllum polyanthum	5
175	Discorea hispida	5
176	Diospyros kaki	5
177	Diospyros montana	5
178	Memecylon hamandi	5
179	Murraya paniculata	5
180	Oroxylum indicum	5
181	Schoutenia hypoleuca	5
182	Streblus asper	5
183	Syzygium fulcosum	5
184	Adenanthesia pectinata	4
185	Crutia chrysantha	4
186	Dasymaschalon macrocalyx	4

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No	Species name	Frequency
187	Diospyros hasseltii	4
188	Gardenia angkorensis	4
189	Lagerthoemia boudoni	4
190	Lannea coromandelica	4
191	Lepisanthes tetraphylla	4
192	Macura cochinchinensis	4
193	Markhamia stipitata	4
194	Memecylon edule	4
195	Nephelium melliferum	4
196	Ochna integerrima	4
197	Pternandra caerulea	4
198	Shorea thorelii	4
199	Spodias malayana	4
200	Sterculia parviflora	4
201	Syzygium grata	4
202	Unknown103	4
203	Unknown26	4
204	Unknown93	4
205	Xanthophyllum gleucum	4
206	Altingia cambodiana	3
207	Bruguiera sexangula	3
208	Buchanania siamensis	3
209	Canthium dicocum	3
210	Carypha umbraculifera	3
211	Crateva adansonii	3
212	Croton joffe	3
213	Dalbergia horrida	3
214	Diospyros elvretoides	3
215	Drosera burmanii	3
216	Dysoxylum sp.	3
217	Elaeocarpus macrocerus	3
218	Firmiana simplex	3
219	Garcinia merguensis	3
220	Garuga pinnata	3
221	Grewia sinuata	3
222	Holopterna pubescens	3
223	Hopea helferi	3
224	Hopea recopei	3
225	Lagerthoemia macrocarpa	3
226	Mangifera cochinchinensis	3
227	Memecylon scutellatum	3
228	Millingtonia hortensis	3
229	Neolitsea chui	3
230	Pternia mollissima	3
231	Pterocymbium litorale	3
232	Pterocarpium diversifolium	3
233	Senna gambelliana	3

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No	Species name	Frequency
234	<i>Syzygium cochinchinense</i>	3
235	<i>Tectonia grandis</i>	3
236	<i>Terminalia bellica</i>	3
237	<i>Terminalia catappa</i>	3
238	Unknown101	3
239	Unknown19	3
240	Unknown6	3
241	Unknown75	3
242	Unknown85	3
243	<i>Vilox pedunculatis</i>	3
244	<i>Acacia intsa</i>	2
245	<i>Achyranthes bidentata</i>	2
246	<i>Albizia lebbecoides</i>	2
247	<i>Alstonia spathulata</i>	2
248	<i>Anthocephalus chinensis</i>	2
249	<i>Antidesma japonicum</i>	2
250	<i>Antidesma laurifolium</i>	2
251	<i>Azadirachta indica</i>	2
252	<i>Bauhinia harmsiana</i>	2
253	<i>Bauhinia pottsii</i>	2
254	<i>Buchanania reticulata</i>	2
255	<i>Calophyllum thorelii</i>	2
256	<i>Canarium subulatum</i>	2
257	<i>Dillenia scabrella</i>	2
258	<i>Diospyros filipendula</i>	2
259	<i>Elaeocarpus thorelii</i>	2
260	<i>Eurythmus cochinchinensis</i>	2
261	<i>Ficus lutea</i>	2
262	<i>Ficus religiosa</i>	2
263	<i>Garcinia delphyana</i>	2
264	<i>Geltonia floribunda</i>	2
265	<i>Grewia exaltica</i>	2
266	<i>Hymenocardia wallichii</i>	2
267	<i>Intsia bijuga</i>	2
268	<i>Mammea siamensis</i>	2
269	<i>Parameria laevigata</i>	2
270	<i>Phyllanthus emblica</i>	2
271	<i>Polygonospermum suaveolens</i>	2
272	<i>Polylethia jacunda</i>	2
273	<i>Randia uliginosa</i>	2
274	<i>Sapum seiferum</i>	2
275	<i>Shorea guiso</i>	2
276	<i>Temstroemia penangiana</i>	2
277	<i>Tristanopsis burmannica</i>	2
278	Unknown114	2
279	Unknown38	2
280	Unknown65	2

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No	Species name	Frequency
281	Unknown90	2
282	<i>Walaura villosa</i>	2
283	<i>Zizyphus oenopolia</i>	2
284	<i>Acacia harmandiana</i>	1
285	<i>Albizia xylocarpa</i>	1
286	<i>Aglaia leptantha</i>	1
287	<i>Alpinia conchigera</i>	1
288	<i>Alpinia galanga</i>	1
289	<i>Antidesma acidum</i>	1
290	<i>Antidesma cambodianum</i>	1
291	<i>Antidesma montanum</i>	1
292	<i>Artocarpus nidius</i>	1
293	<i>Arytera littoralis</i>	1
294	<i>Balanata baccata</i>	1
295	<i>Barringtonia acutangula</i>	1
296	<i>Bauhinia bassacensis</i>	1
297	<i>Butea superba</i>	1
298	<i>Cassarea graveolens</i>	1
299	<i>Cassia fistula</i>	1
300	<i>Cassia timorensis</i>	1
301	<i>Croton thorelii</i>	1
302	<i>Dacrydium elatum</i>	1
303	<i>Dalbergia cultrata</i>	1
304	<i>Desmodium auricomum</i>	1
305	<i>Desmodium longipes</i>	1
306	<i>Dillenia hookeri</i>	1
307	<i>Dillenia obovata</i>	1
308	<i>Diospyros decandra</i>	1
309		1
310	<i>Dipterocarpus costatus</i>	1
311	<i>Dracaena cambodiana</i>	1
312	<i>Elaphanthus tomentosus</i>	1
313	<i>Engelhardtia roxburghiana</i>	1
314	<i>Erythrina variegata</i>	1
315	<i>Erythrophloeum succubum</i>	1
316	<i>Euphorbia hirta</i>	1
317	<i>Eurycoma longifolia</i>	1
318	<i>Ficus fistulosa</i>	1
319	<i>Ficus sp.1</i>	1
320	<i>Flacourtia indica</i>	1
321	<i>Garcinia schomburgkiana</i>	1
322	<i>Gardneria cambodiana</i>	1
323	<i>Glycosmis pentaphylla</i>	1
324	<i>Grewia tomentosa</i>	1
325	<i>Homalium grandiflorum</i>	1
326	<i>Hopsea reticulata</i>	1
327	<i>Hymenodictyon orissense</i>	1
328	<i>Impatiens balsamina</i>	1

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No	Species name	Frequency
329	<i>Ixora diversifolia</i> var. <i>flexilis</i>	1
330	<i>Kneria duperrana</i>	1
331	<i>Korthalsia laciosa</i>	1
332	<i>Lasiacanthus repoeuensis</i>	1
333	<i>Lepisanthes senegalensis</i>	1
334	<i>Litsea umbellata</i>	1
335	<i>Lophopetalum wallichii</i>	1
336	<i>Lophopetalum wightianum</i>	1
337	<i>Madhuca kampongsanensis</i>	1
338	<i>Mallotus eriostipodius</i>	1
339	<i>Mallotus repandus</i>	1
340	<i>Memezyton edule</i>	1
341	<i>Morinda persicaefolia</i>	1
342	<i>Muntingia calabura</i>	1
343	<i>Pantadenia adenanthera</i>	1
344	<i>Pavonia rigida</i>	1
345	<i>Phyllanthus amarus</i>	1
346	<i>Podocarpus nerifolius</i>	1
347	<i>Pouzolzia zeylanica</i>	1
348	<i>Psychotria revesi</i>	1
349	<i>Rhodomyrtus tomentosa</i>	1
350	<i>Sandoricum kneriifolium</i>	1
351	<i>Scheuchzeria palustris</i>	1
352	<i>Scleropyrum pentlandium</i>	1
353	<i>Sonneratia caseolaris</i>	1
354	<i>Spatholobus perfluvius</i>	1
355	<i>Tetracera scandens</i>	1
356	Unknown102	1
357	Unknown104	1
358	Unknown106	1
359	Unknown107	1
360	Unknown108	1
361	Unknown109	1
362	Unknown110	1
363	Unknown112	1
364	Unknown117	1
365	Unknown118	1
366	Unknown119	1
367	Unknown120	1
368	Unknown17	1
369	Unknown20	1
370	Unknown38	1
371	Unknown53	1
372	Unknown72	1
373	Unknown85	1
374	Unknown87	1
375	Unknown92	1

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No	Species name	Frequency
376	Unknown94	1
377	Unknown95	1
378	Unknown96	1
379	Unknown97	1
380	Unknown98	1
381	<i>Ventilago harmandiana</i>	1
382	<i>Xylocarpus pierrei</i>	1
383	<i>Xylocarpus brachystachys</i>	1

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Appendix 6 Material and equipment for field study

- Equipment to be procured by the Contractor

No.	List of equipment	Quantity	Unit
1	Food and water	1575	person/day
2	Camp equipment	5	set
3	First aid kit	5	set
4	Flashlight with violet filter	36	set
5	Backpack	36	piece
6	Saw	6	number
7	Shovel	6	number
8	Pick	6	number
9	Hammer	6	number
10	Bush knife	6	number
11	Helmet	36	number
12	Boots	36	pairs
13	Metallic pin for plot marking	65	piece
14	Paint spray	240	bottle
15	Telephone card	1	L.S.
16	Rope and string	120	piece
17	Tarpaulin	5	piece
18	Glove	1050	pairs
19	Sample bag	1	L.S.
20	Pipe (quadrant frame)	1	L.S.
21	Mosquito spray	50	bottle
22	Mosquito gel	72	bottle
23	Rain coat	36	set
24	Batteries (GPS)	225	piece
25	Powerbank (solar charger)	5	piece

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- Equipment to be provided by the Employer

No.	List of equipment	Quantity	Unit
1	Handheld GPS receiver	6	set
2	Hypsometer	6	set
3	Diameter measuring tape (10m)	12	piece
4	Diameter measuring tape (2m)	12	piece
5	Measuring tape (50m)	12	piece
6	Clinometer compass	6	piece
7	Small caliper	6	piece
8	Soil sampling cylinder	12	piece
9	Scale	6	piece
10	Waterproof bag	6	piece
11	Colour tape	36	bundle
12	360-degree digital camera	6	set
13	Transceiver	10	set
14	Telescopic staff (8m)	6	piece

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Appendix 7 Photos of field work activities



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Team 1&4 traveled to cluster in Virak Chey 8 Feb 2022



Team 1 collected litter fall on 19 Jan 2022



Team 3 set up plot in Daung village on 16 Jan 2022



Inaccessible cluster due to forest fire on 4 Feb 2022



Team 2 & 3 move from Kumdeng to Spong on 19 Jan 2022



Team 2 & 3 at Virack Vorhey on 8 Feb 2022



JICA Expert met the team 2, 3&5 on 24 Jan 2022



Team 1&4 in Virak Chey on 13 Feb 2022

Appendix 2: Map Utilization Training Material



គម្រោងអភិវឌ្ឍន៍សមត្ថភាពក្នុងការគ្រប់គ្រងធនធានធម្មជាតិ
ប្រកបដោយនិរន្តរភាពនៅថ្នាក់ជាតិនិងថ្នាក់ក្រោមជាតិ



មាតិកា

- ❑ ការណែនាំអំពីវគ្គបណ្តុះបណ្តាល
- ❑ ការស្វែងយល់អំពីការបង្កើនរបស់ផែនទីទៅជាផែនទី
- ❑ ការស្វែងយល់អំពីលក្ខណៈនៃការបង្កើនផែនទី
- ❑ ការស្វែងយល់អំពី Azimuth
- ❑ ការស្វែងយល់អំពី Azimuth សាកល
- ❑ ការស្វែងយល់អំពីទីតាំងរបស់ខេត្តស្ទឹងត្រែងនៅលើផែនទី
- ❑ ការស្វែងយល់អំពីខ្សែវេទ្យាវង្ស និងសណ្ឋានដី
- ❑ ការស្វែងយល់អំពីផែនទីសណ្ឋានដី
- ❑ ការស្វែងយល់អំពីសញ្ញាប្រើប្រាស់លើផែនទី
- ❑ ការស្វែងយល់អំពីព័ត៌មានបន្ទាប់បន្សំនៃផែនទី
- ❑ ការអនុវត្តន៍៖ ការប្រើប្រាស់ត្រីវិស័យនៅទីវាល

ការណែនាំអំពីវគ្គបណ្តុះបណ្តាល

គោលបំណង

អ្នកចូលរួមនឹងសិក្សាស្វែងយល់អំពីចំណេះដឹងមូលដ្ឋាននៃការប្រើប្រាស់ផែនទី

ការរំពឹងទុក

- ស្វែងយល់អំពីមូលដ្ឋានគ្រឹះនៃការប្រើប្រាស់ផែនទី
- ស្វែងយល់អំពីផែនទីសណ្ឋានដី និងសញ្ញាសំគាល់លើផែនទី
- ចេះប្រើប្រាស់ត្រីវិស័យដើម្បីស្វែងរកចំណុចលើផែនទី។

ការស្វែងយល់អំពីការបង្កើនរបស់ផែនទីទៅជាផែនទី



ភពផែនដី



ភូគោល

- ភូគោល គឺជាសំដៅលើផែនទីមានរាងកូចមួយដែលត្រូវបានបង្កើនពីភពផែនដី។ វាបានបង្ហាញពីទំហំ ចម្ងាយ រូបរាង និងទីសំដៅនៃភពផែនដី។
- តែងតែអានមើលដោយឃើញទាំងមូលដោយការមើលតែមួយភ្លែតបានដែរ វាអាចមើលឃើញពេញបានដោយការបង្វិល។

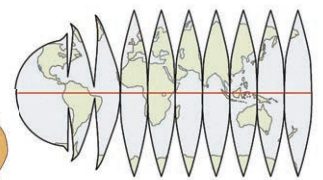
ការស្វែងយល់អំពីការបង្កើនរបស់ផែនទីទៅជាផែនទី (ត)

- ផែនទីពិភពលោក ខុសគ្នាបន្តិចបន្តួច ទាំងរូបរាង ចម្ងាយ ទំហំ និងទីតាំងធៀបទៅនឹងភូគោលតែងតែស្រួលយកទៅតាមខ្លួនជាង។



ការស្វែងយល់អំពីការបង្កើនរបស់ផែនទីទៅជាផែនទី (ត)

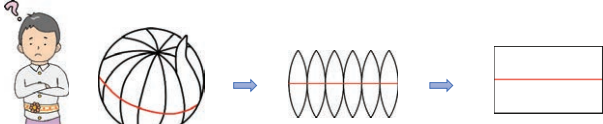
- ផែនទីពិភពលោកអាចបង្កើតបានដោយប្រើប្រាស់វិធីសាស្ត្របង្កើន (Projection) ដើម្បីធ្វើផែនទីរាងមូលក្លាយទៅជាផែនទីសំប៉ែត។ វិធីសាស្ត្របង្កើនមានច្រើនប្រភេទ អ្នកផលិតផែនទីអាចជ្រើសរើសអាស្រ័យលើគោលបំណង។



ការប្រៀបធៀបការបង្កើនផែនទីទៅជាផែនទី

ការស្វែងយល់អំពីការបង្កើនរបស់ផែនដីទៅជាផែនទី (ត)

- ខាងក្រោមនេះជា រូបភាពត្រូវបានឆ្លាក់
- ដើម្បីបំបាត់គម្លាតទាំងនេះ រូបរាងដើមនៃផែនដី និងមហាសមុទ្រនឹងផ្លាស់ប្តូរខុសពីស្ថានភាពដើម។



- ក្នុងការទទួលបានភាពត្រឹមត្រូវនៃផែនទី អ្នកផលិតផែនទីត្រូវជ្រើសរើសវិធីសាស្ត្របង្កើនជាក់លាក់ និងព័ត៌មានដែលចង់ឲ្យបាន។

ការស្វែងយល់អំពីការបង្កើនរបស់ផែនដីទៅជាផែនទី (ត)

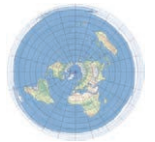
- វិធីសាស្ត្របង្កើនដែលត្រូវបានប្រើប្រាស់សម្រាប់ការផលិតផែនទីមាន Mercator, Mollweide, និង Azimuthal ៖



ត្រូវបានបង្កើតឡើងនៅឆ្នាំ១៥៦៩
ដោយ Gerardus Mercator



ត្រូវបានបង្កើតឡើងនៅឆ្នាំ១៨០៥
ដោយ Karl B. Mollweide



គេជឿជាក់ថា វិធីនេះត្រូវបាន
បង្កើតដោយជនជាតិអឺរ៉ុប

ការស្វែងយល់អំពីលក្ខណៈនៃការបង្កើនផែនទី

ការបង្កើន Mercator

បំពេញគម្លាតនេះជាមួយនឹងផ្ទៃដី
និងផ្ទៃសមុទ្រ



- ចំណុចប្រសព្វរបស់ផែនទីរវាងរយៈទទឹង និងរយៈបណ្តោយនៅមុំត្រឹមត្រូវ។ វិធីសាស្ត្រនេះ មុំម៉ាញ៉េទិចត្រូវបានពណ៌នាជាខ្សែត្រង់ ដែលជាគន្លងនាំផ្លូវ។
- នៅជិតអេក្វាទ័រ រង្វាស់នេះលម្អៀងខ្លាំង ហើយនៅពេលចម្ងាយកាន់តែជិតប៉ូលខាងជើង និងខាងត្បូង ភាពខុសគ្នានៃទំហំកាន់តែធំ។

ការស្វែងយល់អំពីលក្ខណៈនៃការបង្កើនផែនទី (ត)

ការបង្កើន Mollweide

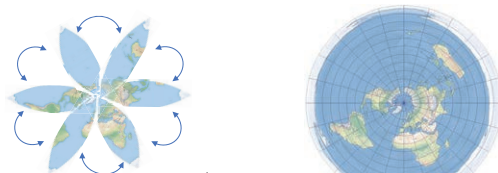
ភ្ជាប់ចុងទូកទាំងនេះចូលគ្នាតែមួយ



- ការភ្ជាប់ចុងនៃផែនទីទាំងអស់ជាមួយអ័ក្សក្នុងសមាមាត្រ 2:1 ដែលការភ្ជាប់នេះមានធ្វើឲ្យផែនដីមានរាងជាពងក្រពើ។
- ផែនទីនេះ មានភាពត្រឹមត្រូវចំពោះទំហំទីតាំង តែប៉ុន្មាន ទិស មុំ និងចម្ងាយមានភាពខុសគ្នា។ ដែលភាគច្រើនកើតឡើងនៅជិតប៉ូល (ជើង និងត្បូង) និងខិតកាន់តែជិតជាយថាហេតុនេះ។

ការស្វែងយល់អំពីលក្ខណៈនៃការបង្កើនផែនទី (ត)

ការបង្កើន Azimuthal



បំពេញគម្លាតនេះជាមួយនឹងផ្ទៃដី
និងផ្ទៃសមុទ្រ

- វិធីសាស្ត្រនេះ បង្ហាញយ៉ាងត្រឹមត្រូវទាំងចម្ងាយ និងទិសពីចំណុចកណ្តាលនៃផែនទី។
- ភាគច្រើននៃផែនទីប្រភេទនេះប្រើប្រាស់នៅតំបន់ប៉ូលដែល ខ្សែរយៈបណ្តោយ និងរយៈទទឹងបែងចែកស្មើគ្នា ដើម្បីតំណាងឱ្យចម្ងាយដ៏ត្រឹមត្រូវ។
- ភាពខុសគ្នាចំពោះរូបរាង កម្រិត និងទីតាំងកើនឡើង ពេលវាចេញកាន់តែឆ្ងាយពីចំណុចកណ្តាល។

ការស្វែងយល់អំពី Azimuth

- ផែនទីចាំបាច់ណាស់ត្រូវបង្ហាញអំពីភាពត្រឹមត្រូវនៃ azimuth/ទិស។ ប្រសិនបើអ្នកមើលខុសនោះអ្នកនឹងទៅកន្លែងខុស។ ផែនទីត្រូវប្រើប្រាស់ azimuth ដើម្បីបង្ហាញពីទិសច្បាស់លាស់។



ការស្វែងយល់អំពី Azimuth (ត)



ត្រីវិស័យ ៨ទិស

របៀបកំណត់ទិសនៅចំណុចណាមួយនៅលើផែនដី

- កំណត់ទិសខាងជើង និងត្បូង ដែលជាកំណត់កែងនឹងខ្សែវេឌ្យនេះ។ ទិសទាំងបួននេះត្រូវបានបំបែកជា ៨ទិស ដូចជា ទិសឦសាន និង ទិសនិរតី ឬបំបែកបន្ថែមទៀតទៅជា ១៦ ឬ ៣២ទិស។
- ត្រីវិស័យនេះបង្ហាញ azimuths នៃទិសខាងជើង ត្បូង កើត និងលិច។ វាមានមូលដ្ឋានមួយ ដែលតែងតែចង្អុលទៅកាន់ទិសខាងជើង។

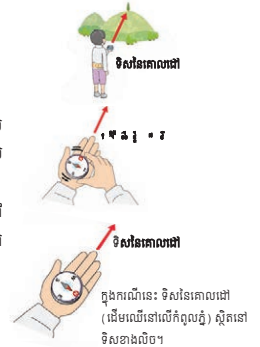
ការស្វែងយល់អំពី Azimuth (ត)

របៀបប្រើប្រាស់ត្រីវិស័យ

- ត្រីវិស័យត្រូវបានប្រើប្រាស់ដើម្បីស្វែងរក azimuths/ទិស៖

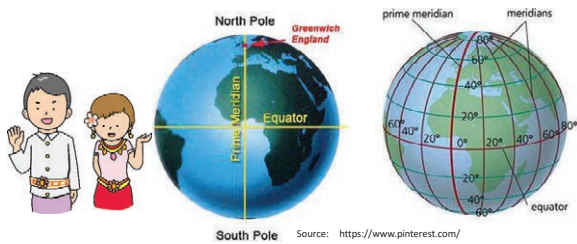


1. បែរមុខទៅកាន់ទិស ដែលត្រូវសិក្សា និងដាក់ត្រីវិស័យផ្នែកលើបាតដៃរបស់អ្នក។
2. នៅពេលមូលម៉ាញ៉េទិចឈប់ដើរ សូមបង្វិល ត្រីវិស័យ ដើម្បីឱ្យផ្នែកណាមួយចង្អុល ទៅកាន់ "N" នៅលើត្រីវិស័យ។
3. ពេលនេះ ត្រីវិស័យស្ថិតនៅទីតាំងត្រឹមត្រូវ ហើយ។ សូមពិនិត្យមើលទិសដែលអ្នកប្រើ ទៅ នៅលើត្រីវិស័យ។



ការស្វែងយល់អំពី Azimuth សាកល

- ភាគច្រើនទិសខាងជើងរបស់ផែនដីត្រូវបានដាក់នៅផ្នែកខាងលើ (ដាក់ផែនទីនៅលើផ្ទៃក្រប)។



ខ្សែពណ៌លឿងបង្ហាញ ទិសខាងជើង ត្បូង កើត និងលិច។

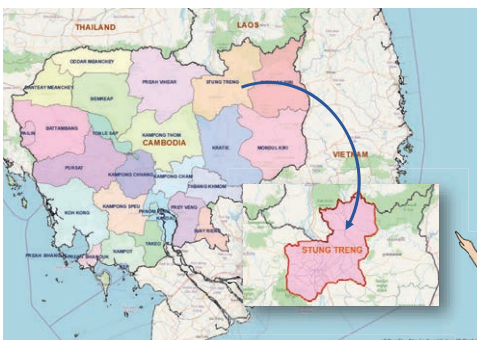
ខ្សែពណ៌ក្រហមបង្ហាញ ទិសខាងជើង និងត្បូង។ ខ្សែពណ៌បៃតងដែលជួបប្រសព្វគ្នាជាមួយនឹងខ្សែ ពណ៌ក្រហមនៅមុខត្រីមាត្រីវិស័យនៃទិសខាង កើត និងលិច។

ការស្វែងយល់អំពី Azimuth សាកល (ត)

- ខ្សែវេឌ្យចម្បង (Primer Meridian) នៅ Greenwich វាគឺជាខ្សែវេឌ្យ ដែលឆ្លងកាត់លើចំណុច កណ្តាលវាជាតំបន់ជាយក្រុងមួយនៃទីក្រុងឡុង។ ខ្សែនេះត្រូវបានប្រើប្រាស់ជាខ្សែវេឌ្យគោល សម្រាប់រយៈបណ្តោយ ០ដឺក្រេ ០នាទី ០វិនាទី ហើយខ្សែនេះត្រូវបានប្រើជាអន្តរជាតិ។
- ខ្សែអេក្វាទ័រ វាគឺជាស្តង់ដារមួយនៃស្តង់ដាររយៈទទឹង និងបង្ហាញរយៈទទឹងកម្រិត ០ដឺក្រេ វាគឺជា រង្វង់ធំបំផុតនៅក្នុងខ្សែរយៈទទឹង។ អន្តរគោលខាងជើងស្ថិតនៅកាតខាងជើងនៃខ្សែអេក្វាទ័រ និង អន្តរគោលខាងត្បូងស្ថិតនៅកាតខាងត្បូងនៃខ្សែអេក្វាទ័រ។

ការស្វែងយល់អំពីទីតាំងរបស់ខេត្តស្ទឹងត្រែងនៅលើផែនទី

តើខេត្តស្ទឹងត្រែងស្ថិតនៅកន្លែងណា?



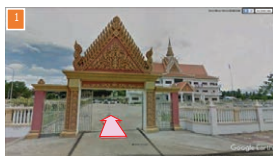
ការស្វែងយល់អំពីទីតាំងរបស់ខេត្តស្ទឹងត្រែងនៅលើផែនទី (ត)

តើខេត្តស្ទឹងត្រែងមានប៉ុន្មានស្រុក? ប៉ុន្មានឃុំ?



ការស្វែងយល់អំពីទីតាំងរបស់ខេត្តស្ទឹងត្រែងនៅលើផែនទី (ត)

ការបង្ហាញអំពីរូបភាពនៃទីតាំងមួយនៅលើផែនទី

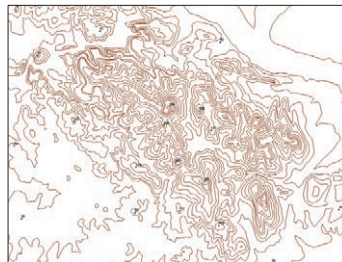


- រូបទី១៖ អ្នកអាចមើលឃើញតែផ្នែកខាងមុខ ទំហំ រូបរាង មិនអាចកំណត់បាន
- រូបទី២៖ អ្នកអាចមើលឃើញថាជាអគារដើមរលើ ផ្លូវ ប៉ុន្តែមិនមានព័ត៌មានបង្ហាញពីឈ្មោះនៃវត្ថុទាំងនោះទេ
- រូបទី៣៖ អគារត្រូវបានបង្ហាញជាពណ៌តំណាង និងមានឈ្មោះទីតាំងងាយយល់។

20

ការស្វែងយល់អំពីខ្សែវណ្ណវង្ស និងសណ្ឋានដី

- សណ្ឋានដីជាកន្លែងមានបីសណ្ឋាន៖ ផ្ទៃរាប និងកម្ពស់។ នៅលើផែនទីមានតែសណ្ឋានពីរប៉ុណ្ណោះដែលត្រូវបានបង្ហាញ។
- ខ្សែវណ្ណវង្សត្រូវបានប្រើប្រាស់ដើម្បីបង្ហាញពីកម្ពស់ វាជាបន្ទាប់គ្នាបន្តបន្ទាប់នៃចំណុចដែលមានកម្ពស់ដូចគ្នា។



21

ការស្វែងយល់អំពីខ្សែវណ្ណវង្ស និងសណ្ឋានដី (ត)

ការអានខ្សែវណ្ណវង្ស

- ពេលដាក់ម្រាមដៃចូលគ្នា វាដូចគ្នានឹងបន្ទាប់វណ្ណវង្សនៃផ្ទៃដីដ៏ធំមួយ



- ពេលអ្នកបំបែកមេដៃរបស់អ្នកចេញពីម្រាមដៃដទៃទៀត ចន្លោះរវាងមេដៃ និងម្រាមចង្អុលដែលរបស់អ្នកដូចគ្នានឹងជ្រលងភ្នំ។



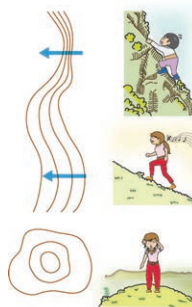
- ពេលអ្នកបំបែកម្រាមដៃរបស់អ្នកចេញពីគ្នា អ្នកអាចទទួលបានរូបភាពមួយនៃសណ្ឋានដីជាមួយនឹងជ្រលងភ្នំនៅចន្លោះសណ្ឋានដីទាំងនោះ



22

ការស្វែងយល់អំពីខ្សែវណ្ណវង្ស និងសណ្ឋានដី (ត)

ការអានខ្សែវណ្ណវង្ស (ត)

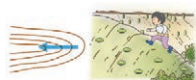


- ខ្សែវណ្ណវង្សកាន់តែចង្អៀត សណ្ឋានដីកាន់តែចោត។ អ្នកមិនអាចដើរនៅកន្លែងបែបនេះបានឡើយ ដោយសារវាពិបាកឡើង និងគ្រោះថ្នាក់។
- ខ្សែវណ្ណវង្សមានចន្លោះដែលបង្ហាញថា ទីជម្រាលមិនចោត។ វាងាយស្រួលឡើង/ដើរ និងមិនសូវមានហានិភ័យ។
- ខ្សែវណ្ណវង្សជាចង្អៀត វាមានន័យថា ជាកន្លែងខ្ពស់។ អ្នកអាចមើលឃើញយ៉ាងល្អអំពីពិភពកន្លែងជុំវិញនោះ។

23

ការស្វែងយល់អំពីខ្សែវណ្ណវង្ស និងសណ្ឋានដី (ត)

ការអានខ្សែវណ្ណវង្ស (ត)



- សញ្ញាញពណ៌ខៀវបង្ហាញថា ការដើរនៅលើផ្ទៃភ្នំហើយវាស្ថិតនៅទីតាំងខ្ពស់ជាងកន្លែងជុំវិញ



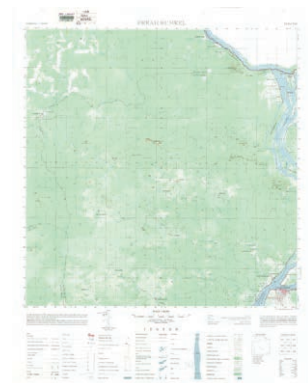
- បន្ទាត់ពណ៌ខៀវនៅទីនេះបង្ហាញថា អ្នកកំពុងដើរចុះទៅតាមចង្អុលនោះ។ វាជាទីតាំងទាបជាងទីតាំងជុំវិញ និងពិបាកដើរដោយសារវាហាក់ដូចជាផ្លូវចង្អៀត។



- ផែនទីនេះបង្ហាញថា កន្លែងនេះមិនអាចឡើងបានឡើយ។ ចំនួនខ្សែវណ្ណវង្ស ដែលឆ្លងកាត់តាមសញ្ញាចំណោតបង្ហាញនូវកម្ពស់ប្រហាក់ប្រហែលនៃចំណោតនោះ។

24

ការស្វែងយល់អំពីផែនទីសណ្ឋានដី



ផែនទីសណ្ឋានដី 1:100,000 ដល់ត្រង់ ២០០៣ ដោយ JICA និងMPYT

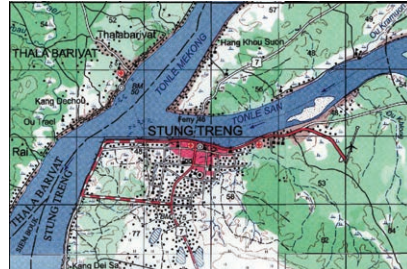
- **អំពីផែនទី៖** ផែនទីសណ្ឋានដី 1:100,000 ដែលប្រទេសកម្ពុជាកំពុងតែប្រើបច្ចុប្បន្ននេះត្រូវបានផលិតក្រោមគម្រោង “ការសិក្សាស្តីពី ការបង្កើតទិន្នន័យមូលដ្ឋាន GIS សម្រាប់ព្រះរាជាណាចក្រកម្ពុជា” ក្រោមកិច្ចសហការរវាង ក្រសួងសាធារណការ និងដឹកជញ្ជូន (MPYT) របស់កម្ពុជា និងទីភ្នាក់ងារកិច្ចសហប្រតិបត្តិការដប៉ុន (JICA) ពីឆ្នាំ ១៩៩៨ ដល់២០០៣។

25

ការស្វែងយល់អំពីសញ្ញាប្រើប្រាស់លើផែនទី

- ផែនទីសណ្ឋានដី 1:100,000 នេះមានសញ្ញាលើផែនទីជាង ៩០សញ្ញានៅក្នុងសញ្ញាសម្គាល់
- សញ្ញាលើផែនទីទាំងនេះត្រូវបានគេហៅថា “វត្ថុតំណាង” ដែលមាននៅលើដី ឬ “លក្ខណៈភូមិសាស្ត្រ” នៅក្នុងផែនទី និង GIS
- សញ្ញាលើផែនទីត្រូវបានចែកចេញជា៖ ការធ្វើដំណើរ អគារ សណ្ឋានដី ព្រំប្រទល់រដ្ឋបាល ប្រព័ន្ធទឹក ដងទន្លេបឹងប្តូរ និងរុក្ខជាតិ ហើយសញ្ញាទាំងនេះមាននៅក្នុងសញ្ញាសម្គាល់

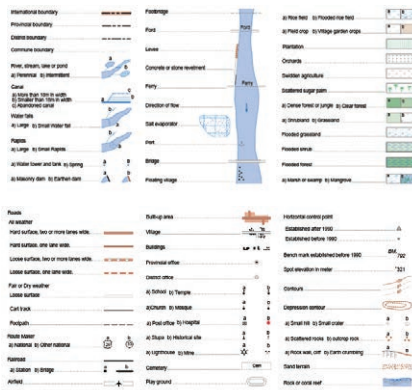
ការស្វែងយល់អំពីសញ្ញាប្រើប្រាស់លើផែនទី (ត)



- រូបភាពដកស្រង់នៃផ្នែកកណ្តាលរបស់ក្រុងខេត្តស្ទឹងត្រែងពីផែនទីសណ្ឋានដី 1:100,000 ។
- អ្នកអាចមើលឃើញវត្ថុនានា ដែលត្រូវតំណាងដោយសញ្ញា សម្គាល់។ សម្រាប់ទំហំ វាមានចម្ងាយ ២គីឡូម៉ែត្រ សម្រាប់មួយការងារ។

ការស្វែងយល់អំពីសញ្ញាប្រើប្រាស់លើផែនទី (ត)

រូបភាពខាងក្រោមបង្ហាញនូវ សញ្ញាសម្គាល់នៃផែនទីសណ្ឋានដីរបស់កម្ពុជា៖



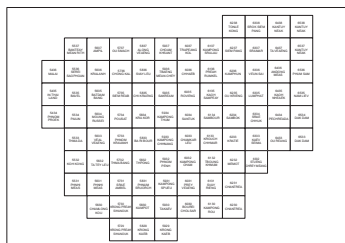
ការស្វែងយល់អំពីព័ត៌មានបន្ទាប់បន្សំនៃផែនទី

- នៅជុំវិញនៃផែនទីសណ្ឋានដី មានចន្លោះមួយ សម្រាប់ការបន្ថែមព័ត៌មាន ដែលគេហៅថា ព័ត៌មានបន្ទាប់បន្សំ។
- ព័ត៌មានដែលត្រូវបានបង្ហាញ មាន៖
 - ឈ្មោះ និងលេខផែនទី
 - ប្រភពដើមនៃផែនទី
 - ព័ត៌មានអំពីការវាស់វែងដើម្បីបង្កើតទិន្នន័យផែនទី
 - បង្គុំសន្លឹកផែនទី
 - សន្ទស្សន៍ព្រំប្រទល់រដ្ឋបាល
 - អក្សរកាត់
 - តម្លៃរយៈបណ្តោយ និងរយៈទទឹង
 - តម្លៃក្រឡាចក្រគ្រង UTM
- កំណត់ត្រាអំពីគោលដៅ
- របាយការណ៍
- និងមុំជ្រុងទិសខាងជើង។

ការអនុវត្តន៍៖ ការប្រើប្រាស់ត្រីវិស័យនៅទីវាល

ការពន្យល់លម្អិត៖

1. សន្ទស្សន៍សន្លឹកផែនទី៖ គឺជាខ្នាតនៃផែនទីសណ្ឋានដី 1:100,000 និងឈ្មោះព្រមទាំងលេខនៃសន្លឹកផែនទីនីមួយៗ។
2. ប្រភពដើមនៃផែនទី៖ ព័ត៌មានអំពីទិន្នន័យសម្ភារៈ និងធនធាន ដើម្បីបង្កើតផែនទីសណ្ឋានដី 1:100,000 ដែលត្រូវបានពណ៌នា។
3. ព័ត៌មានអំពី ការអង្កេតវាស់វែងដើម្បីបង្កើតទិន្នន័យផែនទី សណ្ឋានដី 1:100,000 ដែលត្រូវបានពណ៌នា។



ការអនុវត្តន៍៖ ការប្រើប្រាស់ត្រីវិស័យនៅទីវាល

ការពន្យល់លម្អិត (ត)៖

4. បង្គុំសន្លឹកផែនទី សន្ទស្សន៍ព្រំប្រទល់រដ្ឋបាល សន្ទនុក្រមជាមួយនឹងការបកប្រែសន្ទនុក្រមភាសាខ្មែរ ជាមួយនឹងការបកប្រែភាសាអង់គ្លេស៖
 - បង្គុំសន្លឹកផែនទីបង្ហាញចំនួននៃសន្លឹកផែនទីជាប់ៗគ្នា។
 - សន្ទស្សន៍ព្រំប្រទល់រដ្ឋបាលបង្ហាញនូវព្រំប្រទល់ និងឈ្មោះអង្គភាពរដ្ឋបាលនីមួយៗក្នុងទំហំ ដែលត្រូវបានបង្រួម ដោយសារផែនទីសណ្ឋានដីមានសញ្ញាសម្គាល់ និងអក្សរច្រើនហើយវាពិបាកក្នុងការមើលឃើញព្រំប្រទល់រដ្ឋបាល។
 - សន្ទនុក្រមភាសាខ្មែរ ជាមួយនឹងការបកប្រែភាសាអង់គ្លេសបង្ហាញនូវពាក្យ និងឈ្មោះវត្ថុចម្បងៗ ដែលពាក់ព័ន្ធនឹងផែនទីជាភាសាខ្មែរ និងអង់គ្លេស។

ការអនុវត្តន៍៖ ការប្រើប្រាស់ត្រីវិស័យនៅទីវាល

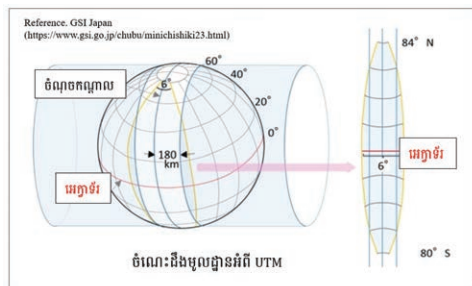
ការពន្យល់លម្អិត (ត) ៖

- រយៈបណ្តោយ និងរយៈទទឹង តម្លៃក្រឡាចក្រគ្រង UTM កំណត់ត្រាអំពីគោលដៅ៖
 - ផែនទីសណ្ឋានដី 1:100,000 តម្លៃរយៈបណ្តោយ និងរយៈទទឹងត្រូវបានបង្ហាញនៅជ្រុងទាំងបួននៃផែនទីសណ្ឋានដី គម្លាតរវាងខ្សែរយៈបណ្តោយ និងខ្សែរយៈទទឹង គឺ៣០នាទី។
 - តម្លៃក្រឡាចក្រគ្រង UTM ត្រូវបានបង្ហាញជាងកតាជាម៉ែត្រ។ ផែនទីសណ្ឋានដី 1:100,000 ប្រើប្រាស់ទទឹងក្រឡាចក្រគ្រងប្រវែង ២គីឡូម៉ែត្រ។ ប្រព័ន្ធកូអរដោនេ UTM ផ្តល់កូអរដោនេលើផែនទីលើក្រឡាចក្រគ្រងនៃភាពសំប៉ែតរបស់ផែនទីដើម្បីងាយស្រួលក្នុងការគណនា។ ប្រព័ន្ធកូអរដោនេ UTM បែងចែកជា ៦០ តំបន់ដែលគ្រប់រយៈបណ្តោយចាប់ផ្តើមនៅ ៦ដឺក្រេ និងពង្រីកពី ៨០ដឺក្រេនៃរយៈទទឹងភាគខាងត្បូង ទៅ ៨៤ដឺក្រេនៃរយៈទទឹងភាគខាងជើង។ ប្រទេសកម្ពុជាស្ថិតនៅក្នុងតំបន់ ៤៨។

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ការអនុវត្តន៍៖ ការប្រើប្រាស់ត្រីវិស័យនៅទីវាល

ការពន្យល់លម្អិត (ត) ៖



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ការអនុវត្តន៍៖ ការប្រើប្រាស់ត្រីវិស័យនៅទីវាល

ការពន្យល់លម្អិត (ត) ៖

- រយៈបណ្តោយ និងរយៈទទឹង តម្លៃក្រឡាចក្រគ្រង UTM កំណត់ត្រាអំពីគោលដៅ (ត)៖
 - កំណត់ត្រាអំពីចម្ងាយបង្ហាញអំពីទីកន្លែងនានាដែលផ្លូវ និងផ្លូវថ្នល់ឆ្លងកាត់ក្នុងផែនទីនឹងទៅដល់។
- របាយការណ៍
 - របាយការណ៍ត្រូវបានបង្ហាញជាប្រភេទមួយ
 - នៅក្នុងរបាយការណ៍ ១សង់ទីម៉ែត្រស្មើនឹង ១០០០ម៉ែត្រ (១គីឡូម៉ែត្រ)។

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ការអនុវត្តន៍៖ ការប្រើប្រាស់ត្រីវិស័យនៅទីវាល

ការពន្យល់លម្អិត (ត) ៖

- មុំជៀបទិសខាងជើង

ផែនទីសណ្ឋានដី 1:100,000 បង្ហាញអំពីទិសខាងជើងបីប្រភេទ៖ ទិសខាងជើងពិត (True North) ក្រឡាចក្រគ្រងទិសខាងជើង (Grid North) និងម៉ាញ៉េទិចទិសខាងជើង (Magnetic North) ។

 - ទិសខាងជើងពិត (សញ្ញា ★) នៅចំណុចណាមួយ គឺជាបន្ទាត់នៃរយៈបណ្តោយ (ខ្សែវេឌ្ឍ) នៅលើផែនទី ដែលឆ្លងកាត់លើចំណុចនោះ។
 - នៅក្នុងផែនទីសណ្ឋានដី 1:100,000 ទិសខាងជើងក្រឡាចក្រគ្រងទៅតាមទិសខាងជើងនៃក្រឡាចក្រគ្រង UTM ។
 - ម៉ាញ៉េទិចទិសខាងជើង (សញ្ញា ៀ) គឺជាទិសខាងជើង ដែលបង្ហាញដោយម៉ាញ៉េទិច។ នៅកម្ពុជា វាផ្ទៀងប្រហែល ២នាទីនៃទិសខាងលិចនៃទិសខាងជើងពិត។ តម្លៃមុំផ្លាស់ប្តូរជារៀងរាល់ឆ្នាំ និងអាចត្រូវគណនា សម្រាប់ទីតាំងណាមួយនៅប្រទេស NOAA (រដ្ឋបាលមហាសមុទ្រ និងបរិយាកាសជាតិ) <https://www.ngdc.noaa.gov/geomag/calculators/magcalc.shtml#igrfwmm>

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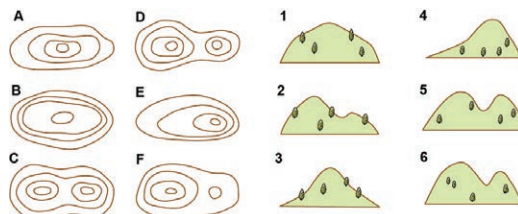
ការអនុវត្តន៍៖ សំណួរពិភាក្សា

- តើវិធីសាស្ត្រប្លែងមួយណា ដែលត្រូវបានប្រើប្រាស់ សម្រាប់ផែនទីសណ្ឋានដីកម្ពុជា 1:100,000 ? សូមពិនិត្យមើលការសញ្ញាសម្គាល់ (Legend) នៅលើផែនទី។
- តើ "ទិសខាងជើង" មួយណា ដែលត្រូវបានប្រើប្រាស់ សម្រាប់ផែនទីសណ្ឋានដីកម្ពុជា 1:100,000 ? សូមពិនិត្យមើលការសញ្ញាសម្គាល់ (Legend) នៅលើផែនទី។
- ដោយពិនិត្យមើលសាលាក្រុងខេត្តស្ទឹងត្រែង តើប្រភេទទំនាក់ទំនងនៅទិសខាងណា ? សូមពិនិត្យមើលជាមួយនឹងមុខងារ "ពង្រីក (zoom-in)" របស់ Google Earth ។

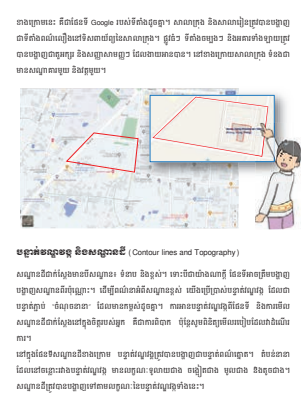
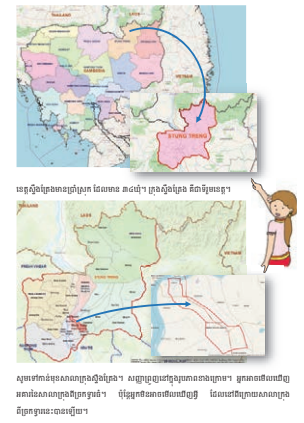
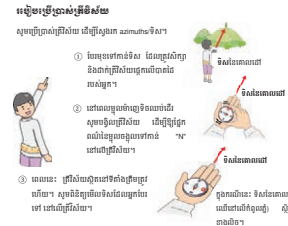
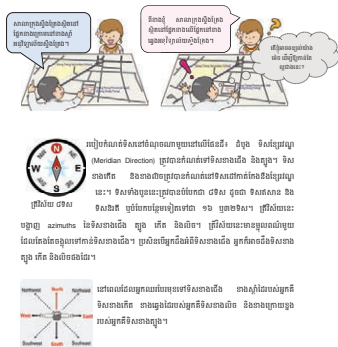
36

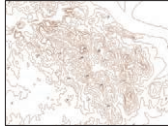
ការអនុវត្តន៍៖ សំណួរពិភាក្សា (ត)

- ការបង្ហាញភ្នំពីរូបភាពលេខ ១ ទៅ ៦ ត្រូវបានពណ៌នាដោយផែនទីដែលមានខ្សែវេឌ្ឍរង្វង់ពីរូបភាព A ទៅ F ។ សូមផ្ដល់រូបភាព ដែលត្រឹមត្រូវជាមួយគ្នា។



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- ខេត្តពេញនិយមក្នុងការប្រើប្រាស់ប្រព័ន្ធបណ្តាញសង្គម ជាពិសេស ប្រព័ន្ធបណ្តាញ Facebook ។

- នៅពេលអ្នកដាក់ប្រាក់ដែលគ្មាន វាជូនគ្នាដឹងបន្ទាប់ពីការប្រើប្រាស់នៃប្រាក់ដ៏ចម្លង។



- នៅពេលអ្នកបំបែកលើរបស់អ្នកចេញពីប្រកបដៃដទៃទៀត ចន្លោះដាច់លើ និងប្រកបច្បុលដៃ របស់អ្នកដូចគ្នាដឹងច្រឡំ។



- ប្រសិនបើអ្នកចម្លែកគ្រាន់តែជាមិត្តភក្តិ អ្នកអាចទទួលបានរូបភាពមួយនៃសណ្ឋានដី ជាមួយនឹងជ្រលងភ្នំនៅចន្លោះសណ្ឋានដីទាំងនោះ



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- បង្កាត់ល្អិតល្អន់ក្នុងតំបន់រុក្ខជាតិ សណ្ឋានដី
កាន់តែចោត។ អ្នកមិនអាចដើរទៅកន្លែងបែប
នេះបានឡើយ ដោយសារវាពិតជាឡើង ខឹង
គ្រោះថ្នាក់។

- ចេញ្ច្រាវទូលាយរវាងបង្គោលដៃស្តុបបង្ហាញថា ទីជម្រកសមិទ្ធិភាព។ វាងាយស្រួលឡើងស្ទើរដឹងមិនសូវមានបរិយាកាស។

- ខេត្តពេលដែលបុគ្គលដែលបានបង្កើតឡើង វាមាន
ដើមថា វាបានកើនឡើង ឬក៏ពុំបានកើនឡើង។ អ្នក
អាចមើលឃើញយ៉ាងណាដែលវាកើនឡើងដូច្នេះ។

- នៅពេលអ្នកដើរតាមការបង្ហាញសញ្ញា ព្រលួញណាំដៀវ វាមានន័យថា ការដឹកនាំលើផ្លូវ ក្នុង រោង កី ម៉ាតឡូស៊ីបាតងកន្លែងឱ្យវា ជួរក្នុង ចង្អៀតអាចឆ្លើយតបក្នុងការបោះ ប្រសិនបើអ្នកមិន ប្រយ័ត្ន។
- ការតាមការបង្ហាត់ណាំដៀវនេះមិន:

- ផែនការនេះប្រាប់ថា កន្លែងនេះមិនអាចឡើងបានឡើយ។ ចំនួនឧត្តាស័ណ្ឌស្តី ដែលឆ្លងកាត់តាមសញ្ញាចំណេញចេញខ្លាំងក្នុងប្រហាក់ប្រហែលនៃចំណាត់នោះ។ ចំណាត់ចម្លង ដែល

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មានបន្ទាត់វល្លវង្សច្រើនឆ្លងកាត់ មានន័យថា វាជាចំណោទឥតសង្ស័យ។

សំណួរសាកល្បង

- ① តើវិធីសាស្ត្រគណនាមួយណា ដែលត្រូវបានប្រើប្រាស់ សម្រាប់ផែនទីសណ្ឋានដឹកថ្មជា

1:100,000?

សូមពិនិត្យមើលការពន្យល់ (Legend) នៅលើផែនទី។

- ② តើ “ទិសនាងជើង” មួយណា ដែលត្រូវបានប្រើប្រាស់ សម្រាប់ផែនទីសណ្ឋានដឹកថ្ម?

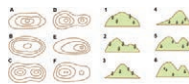
1:100,000?

សូមពិនិត្យមើលកាតព្វកិច្ច (Legend) នៅលើផែនទី។

- ③ ដោយជំនួយរបស់សាលាក្រុងស្ទឹងត្រែង តើព្រះកម្មវត្ថុស្ថិតនៅទីសាងសង់ណា?

សូមជំនុំរូបមើលជាមួយដឹងមុនងារ “ពង្រីក (zoom-in)” របស់ Google Earth ។

- ④ ការបង្ហាញអំពីរូបភាពលេខ ១ ទៅ ៦ ត្រូវបានដាក់ជាដោយផ្ទៃនៃផលប៉ះពាល់នៃការបង្ហាញអំពីរូបភាព A ទៅ F ។ សូមផ្តល់ឈ្មោះនៃផលប៉ះពាល់នៃការបង្ហាញអំពីរូបភាព A ទៅ F ។



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- ⑤ ផែនទីនីមួយៗនាងត្រូវរកកំពុងឈ្មោះនាងរំពឹងសំណួរនិងប្រភពនាងលើវា។ សូមស្វែងរកកំហុសនាងនៅលើផែនទី។



ផែនទីនេះចង្អុលទៅទិសទាំងបី ដោយសារវាគ្មានសញ្ញា azimuth នៅក្នុងផែនទីនេះឡើយ។

18

Appendix 3: GIS Training Material (Basic)



មាតិកា

- ❑ ការណែនាំអំពីវគ្គបណ្តុះបណ្តាល/Introduction to Training
- ❑ ការប្រើប្រាស់ GIS នៅក្នុងកិច្ចការពារធនធានធម្មជាតិ /GIS Application in Natural Resource Management
- ❑ មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី/Basic Concept of Map Production
- ❑ ការណែនាំអំពីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS/Understanding GIS
- ❑ ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS/Common Tools in GIS
- ❑ ការបង្កើតទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/GIS Data Creating
- ❑ ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/GIS Data Downloading
- ❑ ការកែតម្រូវទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/GIS Data Editing
- ❑ ការរៀបចំទិន្នន័យក្នុងការផលិតផែនទី/Data Preparation for Mapping

2

មាតិកា (បន្ត)

- ❑ ការកាត់យកទិន្នន័យវ៉ិចទ័រ/Clipping Vector Data
- ❑ ការកាត់យកទិន្នន័យរូបភាព/Masking Raster Data
- ❑ ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់/Topographic Analysis
- ❑ ការប្រើប្រាស់និមិត្តសញ្ញា/Applying GIS Symbols
- ❑ ការរៀបចំផែនទីលើក្រដាស/Map Layout
- ❑ ការបញ្ចេញទិន្នផលផែនទីជាទម្រង់ Geo-PDF/Export Geo-PDF
- ❑ ការបញ្ចូលទិន្នន័យ Geo-PDF ទៅកម្មវិធី Avenza/Input Geo-PDF to Avenza

3

ការណែនាំអំពីវគ្គបណ្តុះបណ្តាល (បន្ត)

គោលបំណង/Objective

អ្នកចូលរួមនឹងអាចមានចំណេះដឹងអំពីមូលដ្ឋានគ្រឹះនៃការផលិតផែនទី និងការប្រើប្រាស់កម្មវិធីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS/Participant will be able to understand the basic concept of map production and uses of GIS

ការរំពឹងទុក/Expectation

- ស្វែងយល់អំពីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ ការផលិតទិន្នន័យ និងការទាញយកទិន្នន័យមកប្រើប្រាស់ក្នុងការផលិតផែនទី/Understanding GIS, Data Creation, and Data Downloading
- អាចប្រើប្រាស់មុខងារសំខាន់ៗក្នុងកម្មវិធី ArcGIS Pro /Able to use common tools of ArcGIS Pro
- អាចប្រើប្រាស់លទ្ធផលផលិតផែនទីទៅក្នុងកម្មវិធី Avenza សម្រាប់ប្រើប្រាស់ការងារក្នុងមូលដ្ឋាន / Able to use GIS outputs in Avenza app for field work

4

ការប្រើប្រាស់ GIS នៅក្នុងកិច្ចការពារធនធានធម្មជាតិ /GIS Application in Natural Resource Management



ការប្រើប្រាស់លើវិស័យកសិកម្ម/Application in Agriculture



ការប្រើប្រាស់លើវិទ្យាសាស្ត្រដី/Soil Science



ការប្រើប្រាស់លើការត្រួតពិនិត្យតាមដានការស្រោចស្រពដំណាំ/ Application in Crop-Irrigation Demand Monitoring



ការប្រើប្រាស់លើម៉ូដែលដំណាំ/ Application in Crop Modelling

ការប្រើប្រាស់ GIS នៅក្នុងកិច្ចការពារធនធានធម្មជាតិ (បន្ត) /GIS Application in Natural Resource Management(Cont.)

- ការប្រើប្រាស់ក្នុងការគ្រប់គ្រងធនធានទឹក/Application in Water Resource Management
- ការប្រើប្រាស់ក្នុងការត្រួតពិនិត្យតាមដានគុណភាពទឹក/ Application in Water Quality Monitoring
- ការប្រើប្រាស់ក្នុងការគ្រប់គ្រងព្រៃឈើ និងវិភាគជម្រកសត្វព្រៃ/ Forest Management and Wildlife Habitat Analysis
- ការប្រើប្រាស់ក្នុងការគ្រប់គ្រងគ្រោះមហន្តរាយ/ Application in Natural Disaster Management

Ref: Kumar, Navneet & Yamaç, Sevim & Velmurugan, A Velmurugan. (2015). Applications of Remote Sensing and GIS in Natural Resource Management. The Andaman Science Association. 20. 1-6.

6

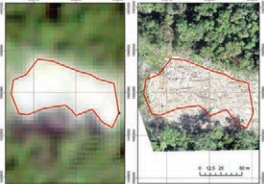
ការប្រើប្រាស់ GIS នៅក្នុងកិច្ចការពារធនធានធម្មជាតិ (បន្ត)
 /GIS Application in Natural Resource Management(Cont.)

ការប្រើប្រាស់ក្នុងការគ្រប់គ្រងព្រៃឈើ/Forest Management



(Ref: Bunthum, 2022)

ការបោះបង្គោលព្រំប្រទល់តំបន់ការពារ/PAs Demarcation

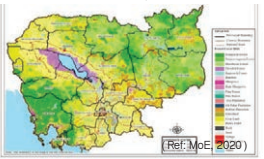


កំណត់ទីតាំងកាប់ឈើ/Identify deforestation area



(Ref: Chanvreak, 2022)

សិក្សាពីទីតាំងភ្លើងព្រៃ/Study of Forest Fire Location



(Ref: MoE, 2020)

សិក្សាពីបំរែបំរួលការប្រែប្រួលដី/Study of land use/land cover change

តើនៅក្នុងនាយកដ្ឋានរបស់អ្នក GIS បានប្រើប្រាស់លើការងារអ្វីខ្លះ ?
 How do you use GIS in your department ?

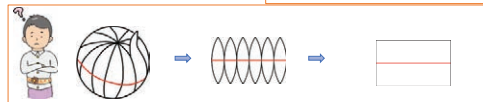
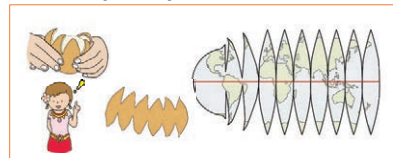
មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី/Basic Concept of Map Production



- ភូគោល គឺជាសំដៅលើផែនដីដែលមានរាងកូចមួយ បម្លែងពីភពផែនដី។ វាបានបង្ហាញពីទំហំ ចម្ងាយ រូបរាង និងទិសដៅនៃភពផែនដី។ តែវាមិនអាចមើលដោយឃើញទាំងមូលដោយការមើលតែមួយភ្លែតទេ វាអាចមើលឃើញពេញបានដោយការបង្វិល។
- ផែនទីពិភពលោក ខុសគ្នាបន្តិចបន្តួច ទាំងរូបរាង ចម្ងាយ ទំហំ និងទីតាំងរៀបចំទៅនឹងភូគោល តែវាងាយស្រួលយកទៅតាមខ្លួនជាង។

មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី (បន្ត) /Basic Concept of Map Production(Cont.)

- ផែនទីពិភពលោកអាចបង្កើតបានដោយប្រើប្រាស់វិធីសាស្ត្របម្លែង (Projection) ដើម្បីធ្វើផែនទីរាងមូលក្លាយទៅជាផែនទីសំប៉ែត។ វិធីសាស្ត្របម្លែងមានច្រើនប្រភេទ អ្នកផលិតផែនទីអាចជ្រើសរើសអាស្រ័យលើគោលបំណង។



- ខាងលើនេះជា រូបភាពត្រូវបានពន្យល់
- ដើម្បីបំបាត់គម្លាតទាំងនេះ រូបរាងដើមនៃផែនដី និងមហាសមុទ្រនឹងផ្លាស់ប្តូរខុសពីស្ថានភាពដើម។
- ក្នុងការទទួលបានភាពត្រឹមត្រូវនៃផែនទី អ្នកផលិតផែនទីត្រូវជ្រើសរើសវិធីសាស្ត្របម្លែងជាក់លាក់ និងព័ត៌មានដែលចង់ឲ្យបាន។

មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី (បន្ត) /Basic Concept of Map Production(Cont.)

មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី (បន្ត) /Basic Concept of Map Production(Cont.)

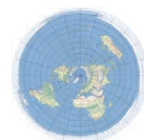
- វិធីសាស្ត្របម្លែងដែលត្រូវបានប្រើប្រាស់សម្រាប់ការផលិតផែនទីមាន Mercator, Mollweide, និង Azimuthal ៖



ត្រូវបានបង្កើតឡើងនៅឆ្នាំ១៥៦៩
ដោយ Gerardus Mercator



ត្រូវបានបង្កើតឡើងនៅឆ្នាំ១៨០៥
ដោយ Karl B. Mollweide



គេជឿជាក់ថា វិធីនេះត្រូវបាន
បង្កើតដោយជនជាតិអេហ្ស៊ីប

មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី (បន្ត) /Basic Concept of Map Production(Cont.)

ការប្លែង Mercator

បំពេញគម្លាតនេះជាមួយនឹងផ្ទៃដី និងផ្ទៃសមុទ្រ



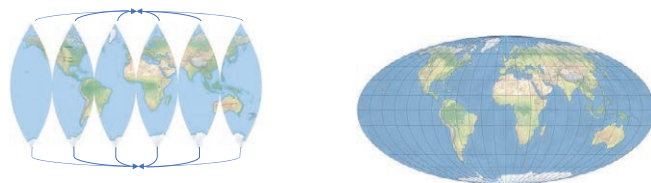
- ចំណុចប្រសព្វរបស់ផែនទីរវាងរយៈទទឹង និងរយៈបណ្តោយនៅមុំត្រឹមត្រូវ។ វិធីសាស្ត្រនេះ មុំម៉ាញ៉េទិចត្រូវបានពណ៌នាជាខ្សែត្រង់ ដែលជាគន្លងនាំផ្លូវ។
- នៅជិតអេក្វាទ័រ រង្វាស់នេះលម្អៀងខ្លាំង ហើយនៅពេលចម្ងាយកាន់តែជិតប៉ូលខាងជើង និងខាងត្បូង ភាពខុសគ្នានៃទំហំកាន់តែធំ។

13

មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី (បន្ត) /Basic Concept of Map Production(Cont.)

ការប្លែង Mollweide

ភ្ជាប់ចុងទូកទាំងនេះចូលគ្នាតែមួយ



- ការភ្ជាប់ចុងនៃផែនទីទាំងអស់ជាមួយអ័ក្សក្នុងសមាមាត្រ 2:1 ដែលការភ្ជាប់នេះមានធ្វើឲ្យផែនទីមានរាងជាពងក្រពើ។
- ផែនទីនេះ មានភាពត្រឹមត្រូវចំពោះទំហំទីតាំង តែប៉ុន្មាន ទិស មុំ និងចម្ងាយមានភាពខុសគ្នា។ ដែលភាគច្រើនកើតឡើងនៅជិតប៉ូល (ជើង និងត្បូង) និងខិតកាន់តែជិតដោយផែនទី។

មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី (បន្ត) /Basic Concept of Map Production(Cont.)

ការប្លែង Azimuthal



បំពេញគម្លាតនេះជាមួយនឹងផ្ទៃដី និងផ្ទៃសមុទ្រ

- វិធីសាស្ត្រនេះ បង្ហាញយ៉ាងត្រឹមត្រូវទាំងចម្ងាយ និងទិសពីចំណុចកណ្តាលនៃផែនទី។
- ភាគច្រើនផែនទីប្រភេទនេះប្រើប្រាស់នៅតំបន់ប៉ូលដែល ខ្សែរយៈបណ្តោយ និងរយៈទទឹងបែងចែកស្មើៗគ្នា ដើម្បីកំណត់ឱ្យចម្ងាយដ៏ត្រឹមត្រូវ។
- ភាពខុសគ្នាចំពោះរូបរាង កម្រិត និងទីតាំងកើនឡើង ពេលវាចេញកាន់តែឆ្ងាយពីចំណុចកណ្តាល។

មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី (បន្ត) /Basic Concept of Map Production(Cont.)

និយមន័យ/Definition

- ផែនទីសំដៅលើរូបតំណាងរបស់ផែនដី ឬផ្នែកណាមួយដែលត្រូវបានគូសលើផ្ទៃរាបស្មើ ត្រង់ក្នុងមាត្រដ្ឋានជាក់លាក់ណាមួយ/Map is representing the earth surface or some part at specific scale drawn on flat surface (Manitoba, 2006)



(Ref: esa, 2023)

(Ref: Raikar, 2024)

16

មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី (បន្ត) /Basic Concept of Map Production(Cont.)

- វាមានសញ្ញាសម្គាល់ និងពណ៌តំណាងយ៉ាងច្រើនខុសៗគ្នា/It has many different kind of symbols and colours to represent land surface.

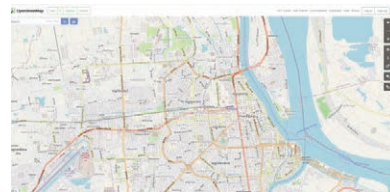


(Ref: MoE, 2020)

17

មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី (បន្ត) /Basic Concept of Map Production(Cont.)

- ប្រភេទនៃផែនទី/Type of Maps (Dutton Institute, 2018) :
 - ផែនទីទូទៅតាមគោលបំណង/General purpose: ត្រូវបានស្គាល់ថាជាផែនទីគោល ឬផែនទីយោង វាជាទូទៅបង្ហាញពីព័ត៌មានសម្រាប់ការប្រើប្រាស់សាធារណៈជនទូទៅ /Known as basemaps or reference maps and it usually has information for general use.

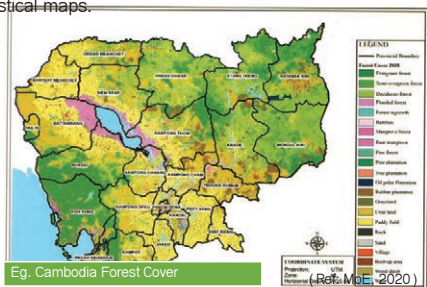


Eg. Open Street Map

18

មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី (បន្ត) /Basic Concept of Map Production(Cont.)

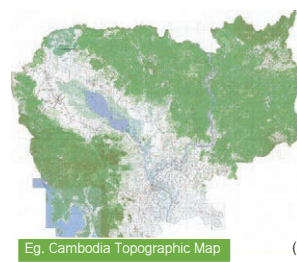
- ប្រភេទផែនទី/Type of Maps (Dutton Institute, 2018) :
 - ផែនទីដើម៉ាទិច/Thematic maps: ត្រូវបានស្គាល់ថាផែនទីគោលបំណងជាក់លាក់ ផែនទីប្រធានបទមួយ ឬផែនទីបង្ហាញពីស្ថិតិ/Known as special purpose, single topic or statistical maps.



19

មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី (បន្ត) /Basic Concept of Map Production(Cont.)

- ប្រភេទផែនទី/Type of Maps (Dutton Institute, 2018) :
 - ផែនទីខាតូមេទ្រិច/Cartometric maps: ផែនទីកាន់តែជាក់លាក់ដែលបង្កើតឡើងក្នុង គោលបំណងសុក្រឹតភាពក្នុងការវាស់វែង ឬការគណនាផ្សេងៗ/More specialized type of map made for accurate measurements.



(Ref: Mekong Maps, 2012)

20

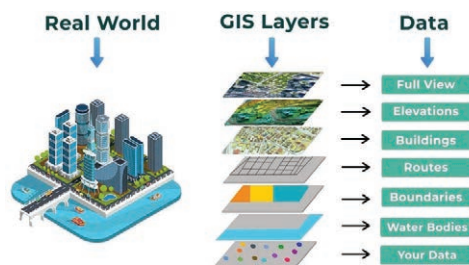
មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី (បន្ត) /Basic Concept of Map Production(Cont.)

- ការបង្កើតផែនទីល្អមួយអាស្រ័យលើ/Making good map depend on:
 - ស្វែងយល់ពីកម្រិតយល់ដឹងនៃអ្នកប្រើប្រាស់ផែនទី/ Understanding knowledge level of map users
 - ការបង្ហាញអំពីព័ត៌មានលើផែនទី/Distribution of map information
 - ចេះប្រើប្រាស់សញ្ញា និងពណ៌បានត្រឹមត្រូវ/ Use appropriate symbols and colors
 - ការដាក់ចំណងជើង ការសំគាល់ផ្សេងៗ និងការប្រើប្រាស់ទំហំអក្សរបានត្រឹមត្រូវ/ Placing title, notes and fonts correctly
 - ការប្រើប្រាស់បារមាត្រដ្ឋាន និងសញ្ញាសំគាល់ទិសខាងជើង/ Using scale bars and north arrow correctly

21

មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី (បន្ត) /Basic Concept of Map Production(Cont.)

- ការបង្កើតផែនទីល្អមួយអាស្រ័យលើ/Making good map depend on:
 - ការដាក់ទិន្នន័យបានត្រឹមត្រូវ/Placing correct GIS Layer



(Ref: Pedamkar, 2023)

22

មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី (បន្ត) /Basic Concept of Map Production(Cont.)

មាត្រដ្ឋានស្តង់ដារ/Standard Scale

មាត្រដ្ឋានផែនទី/ Scale	1cm លើផែនទី/ 1cm on Map (បើប្រើ/ on Ground)	ឧទាហរណ៍ការប្រើប្រាស់/Example Uses
1:10 000	100m	ការអប់រំ អ្នកដឹកនាំតាមដងផ្លូវ/Education, car navigation..
1:25 000	250m	ដំណើរផ្សេងៗ EIA/ Bushwalking, EIA..
1:50 000	500m	ដំណើរផ្សេងៗ រុករក/ adventure touring....
1:100 000	1km	ការធ្វើផែនការ បើកបរ-GPS/Planning, GPS navigation...
1:250 000	2.5km	ការធ្វើផែនការផ្នែកបរិស្ថាន/Environmental planning...
1:1 000 000	10km	
1:2.5 000 000	25km	ផែនទីយោងទូទៅ ផែនទីទេសចរណ៍/ General reference, tourist maps
1:5 000 000	50km	
1:10 000 000	100km	

(Ref: Australian Government, 2010)

23

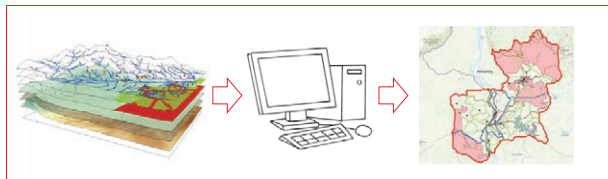
មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី (បន្ត) /Basic Concept of Map Production(Cont.)

- ឧបសគ្គមួយចំនួនអំពីការបង្កើតផែនទី/Some obstacles for map producing:
 - ទិន្នន័យត្រូវការប្រើប្រាស់មិនគ្រប់/No enough data
 - ទិន្នន័យទទួលបានមានប្រភពមិនច្បាស់លាស់/Data with unclear source
 - ការងារលើសសមត្ថភាពកុំព្យូទ័រ/Low specs computer handling large maps
 - ការបង្ហាញព័ត៌មានមិនគ្រប់គ្រាន់/Missing map information
 - ដែនកំណត់នៃទិន្នន័យអនុញ្ញាតបង្ហាញនៅលើផែនទី/ Limitation of data uses for mapping
 - ទិន្នន័យដែលត្រូវការមិនអាចចូលទៅប្រមូលបាន/ Environmental issue blocks accessibility for data collection
 - បច្ចេកវិទ្យានៅមានកម្រិត/Technology limitation

24

ការណែនាំអំពីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS/Understanding GIS

- Geographic Information System (GIS) ត្រូវបានប្រើប្រាស់ជាភាសាខ្មែរថាប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រគឺជាប្រព័ន្ធមួយដែលគេបានធ្វើឡើងសម្រាប់៖ ការចាប់យក ការរក្សាទុក ការវិភាគ ការប្រើប្រាស់ និងការគ្រប់គ្រងទិន្នន័យព័ត៌មានភូមិសាស្ត្រ/GIS has been used in khmer language as ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ refer to a system for capturing, storing, analyzing, and data management.



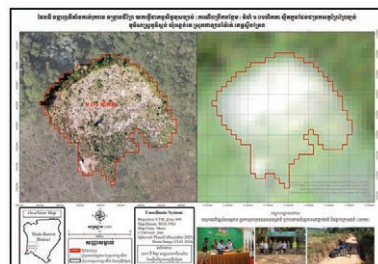
Ref: University of Wisconsin-Madison & UNESCO Bangkok

25

ការណែនាំអំពីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS(បន្ត)/Understanding GIS(Cont.)

- មុខងារប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/GIS Function

- ការចាប់យក/capturing
- ការរក្សាទុក/storing
- ការស្វែងរក/query
- ការវិភាគ/analyze
- ការបង្ហាញ/display
- លទ្ធផល/output



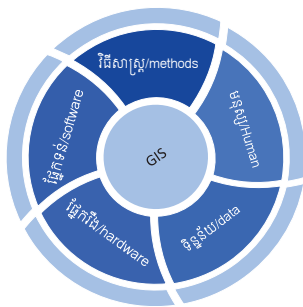
26

ការណែនាំអំពីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS(បន្ត)/Understanding GIS(Cont.)

ធាតុផ្សំនៃប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/GIS Components

- ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រមានធាតុផ្សំដែលមានទំនាក់ទំនងគ្នាចំនួន ៥/
GIS integrates five key components:

- មនុស្ស/Human
- ទិន្នន័យ/Data
- ផ្នែករឹងរបស់កុំព្យូទ័រ/Hardware
- ផ្នែកទន់របស់កុំព្យូទ័រ/Software
- និងវិធីសាស្ត្រ/and Methods



27

ការណែនាំអំពីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS(បន្ត)/Understanding GIS(Cont.)

ទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/GIS Data

- ទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រមានពីរ/Two type of GIS data:
 - Spatial Data/Geo-Spatial សំដៅលើទិន្នន័យណាមួយដែលអាចយកមកផលិតផែនទីបាន ដែលត្រូវបានស្គាល់ជា/refer to any data able to use for mapping known as ទិន្នន័យវ៉ិចទ័រ/Vector Data និងទិន្នន័យរូបភាព/Raster Data (Ramesh et al., 2019)
 - Non-Spatial Data/Attribute Data សំដៅលើទិន្នន័យដែលបានរក្សាទុកជាតារាង ឬទិន្នន័យពណ៌នាអំពីព័ត៌មាននៃទីតាំងភូមិសាស្ត្រ/refer to data stored as attribute or data describes geographic feature (Wolfgang et al., 2018)
 - វាត្រូវបានចែកជាពីរប្រភេទ/it divides into two:
 - ទិន្នន័យបរិមាណ/Quantitative: ទិន្នន័យលំដាប់/Ordinal, ទិន្នន័យចន្លោះ/Interval , និងទិន្នន័យអនុបាត/and Ratio
 - និងទិន្នន័យគុណភាព/and Qualitative: ទិន្នន័យនាមសព្ទ/Nominal data

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ការណែនាំអំពីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS(បន្ត)/Understanding GIS(Cont.)

ទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត)/GIS Data (Cont.)

- ❖ ម៉ូដែលទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/GIS data model:
 - សំដៅលើទម្រង់ដែលគេបានប្រើប្រាស់ដើម្បីតំណាងភូមិសាស្ត្រ ឬផ្ទៃដីជាទិន្នន័យ refer to structure that has been used for representing geographic objects or surfaces as data.
 - ម៉ូដែលទិន្នន័យមាន៣ប្រភេទ/3 types of GIS data model (Esri, 2018) :
 - ម៉ូដែលទិន្នន័យវ៉ិចទ័រ/Vector Data Model: ទិន្នន័យខ្សែបន្ទាត់/Lines ទិន្នន័យចំណុច/Points និងទិន្នន័យពហុកោណ/Polygon
 - ម៉ូដែលទិន្នន័យរូបភាព/Raster Data Model: រូបភាព/Images និងក្រឡាចគ្រឿង/and grid

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ការណែនាំអំពីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS(បន្ត)/Understanding GIS(Cont.)

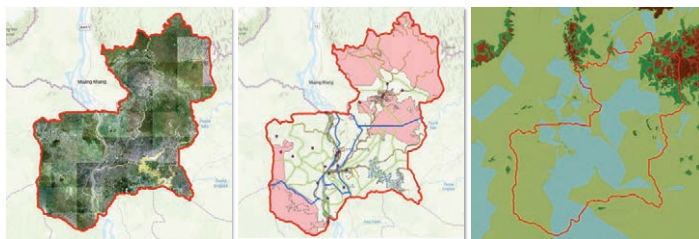
ទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត)/GIS Data (Cont.)

- ❖ ម៉ូដែលទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/GIS data model:
 - ម៉ូដែលទិន្នន័យមាន៣ប្រភេទ/3 types of GIS data model (Esri, 2018) :
 - ម៉ូដែលទិន្នន័យទិន្ន/TIN Data Model: ទិន្នន័យដែលបានបង្កើតពីទិន្នន័យវ៉ិចទ័រ (ឧ. ខ្សែបន្ទាត់រយៈកម្ពស់) សម្រាប់បង្ហាញជាទម្រង់ផ្ទៃ 3D ហើយម៉ូដែលនេះប្រើវិធីសាស្ត្រត្រីកោណដើម្បីភ្ជាប់ពីចំណុចមួយទៅចំណុចមួយទៀត វាត្រូវបានវិស្វកម្មប្រើប្រាស់ដើម្បីសិក្សាពីទីផ្សារ ឬជ្រលង ហើយវាក៏ត្រូវបានប្រើប្រាស់ដើម្បីបង្កើតជាទិន្នន័យរយៈកម្ពស់ (DEM)/TIN can be generated from vector data (eg. Contour line and height points), It represents 3D surface and this model uses triangles to connect points. It has been used by engineer for analysis ridges and valleys. It also used to generate digital elevation model (DEM) (GISGeography, 2024).

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ការណែនាំអំពីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS(បន្ត)/Understanding GIS(Cont.)

ទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត)/GIS Data (Cont.)



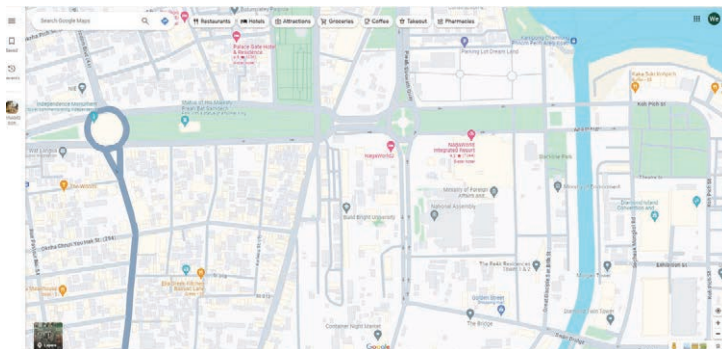
ម៉ូដែលទិន្នន័យរូបកាត/ Raster Data Model
GeoTIFF/.tiff

ម៉ូដែលទិន្នន័យវ៉ិចទ័រ/ Vector Data Model
Shapefile/.Shp

ម៉ូដែលទិន្នន័យទឹក/ TIN Data Model
TIN dataset/.adf

ការណែនាំអំពីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS(បន្ត)/Understanding GIS(Cont.)

ស្វែងយល់ពីទិន្នន័យ GIS ដែលមានក្នុង Google Maps/Explore GIS data in Google Maps



ការណែនាំអំពីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS(បន្ត)/Understanding GIS(Cont.)

❖ ការវិវត្តន៍របស់ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/Evolution of GIS (Esri, 2018)

- ប្រវត្តិដើមនៃប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/The Early History of GIS: ចាប់ផ្តើមតាំងពីឆ្នាំ 1960 ក្នុងទម្រង់ជាការសិក្សាស្រាវជ្រាវ និងការវិភាគព័ត៌មានភូមិសាស្ត្រ/started in 1960 as academic research and analysis geography.
- ការប្រើប្រាស់ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រដំបូង/The First GIS: លោក ថមលីនសុនជាអ្នកផ្តួចផ្តើមផែនការ និងអភិវឌ្ឍ ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រនៃប្រទេសកាណាដា ដែលជាកម្មវិធីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រដំបូងគេក្នុងកំពូលទំនើបលើពិភពលោកក្នុងឆ្នាំ1963 ហើយលោកជាអ្នកបង្កើតការគណនាដោយស្វ័យប្រវត្តដើម្បីរក្សាទុកទិន្នន័យ និងដំណើរការទិន្នន័យសម្រាប់គ្រប់គ្រងការប្រើប្រាស់ដីនៅក្នុងប្រទេសកាណាដា/Mr. Tomlinson is the first person in Canada who initiate, plan and develop first computerized GIS in the world in 1963 and he created automated computing to store and process data for Canada land-use management.

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ការណែនាំអំពីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS(បន្ត)/Understanding GIS(Cont.)

❖ ការវិវត្តន៍របស់ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/Evolution of GIS (Esri, 2018)

- មន្ទីរពិសោធន៍ហាវដ/ The Harvard Laboratory: លោក Fisher បានបង្កើតកម្មវិធីកុំព្យូទ័រសម្រាប់ផលិតផែនទី ហើយលោកក៏បានបង្កើតមន្ទីរពិសោធន៍ និងក្លាយជាមជ្ឈមណ្ឌលស្រាវជ្រាវសម្រាប់វិភាគ និងពិនិត្យមើលប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រដែលបានប្រើប្រាស់លើការងារជាច្រើន/ Mr. Fisher created first computer mapping software. He established Harvard Laboratory and became research center for spatial analysis and visualization
- ការបង្កើត Esri/Esri is Founded: លោក Dangermond ជាសមាជិកមន្ទីរពិសោធន៍ហាវដ និងភរិយា លោកស្រី Laura ជាអ្នកបង្កើតវិទ្យាស្ថានស្រាវជ្រាវប្រព័ន្ធបរិស្ថាន ដែលវិទ្យាស្ថានប្រើប្រាស់ការផលិតផែនទី និងវិភាគព័ត៌មានភូមិសាស្ត្រហើយក៏ជាជំនួយដល់អ្នករៀបចំផែនការការប្រើប្រាស់ដី និងអ្នកគ្រប់គ្រងធនធានដី។

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ការណែនាំអំពីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS(បន្ត)/Understanding GIS(Cont.)

❖ ការវិវត្តន៍របស់ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/Evolution of GIS (Esri, 2018)

- ការបង្កើត Esri/Esri is Founded: ក្រុមហ៊ុនរបស់លោកបានបង្កើតវិធីសាស្ត្រផលិតផែនទី និងវិភាគព័ត៌មានភូមិសាស្ត្រលើការងារជាច្រើន ដែលត្រូវបានប្រើប្រាស់ដល់បច្ចុប្បន្ននេះ/ Mr. Dangermond is a member of Havard Lab and his wife founded Environmental Systems Research Institute, Inc.(Esri). Firm applied mapping and spatial analysis to assist land use planner and land resource manager. His institute established mapping and spatial analysis method currently used.

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ការណែនាំអំពីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS(បន្ត)/Understanding GIS(Cont.)

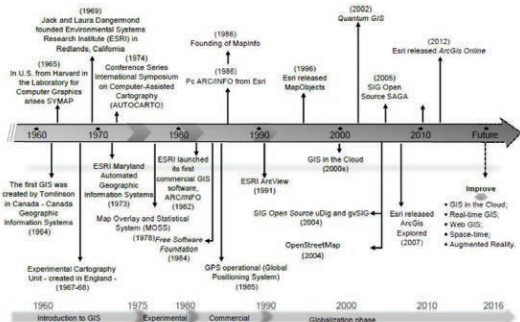
❖ ការវិវត្តន៍របស់ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/Evolution of GIS (Esri, 2018)

- ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រក្លាយជាពាណិជ្ជកម្ម/GIS Goes Commercial: បន្ទាប់ពីការប្រើប្រាស់កាន់តែទូលំទូលាយ និងមានតម្លៃថោក មានគម្រោងជាច្រើនបានប្រើប្រាស់ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រក្នុងការដោះស្រាយបញ្ហាជាក់ស្តែង ដោយឃើញតម្លៃការប្រើប្រាស់កើនឡើងក្រុមហ៊ុនបានបង្កើត ARC/INFO ដែលជាផលិតផលពាណិជ្ជកម្មដំបូងក្នុងឆ្នាំ 1981/After operating widely use and more powerful, many project applied GIS to solve real-world issues. These increasing demand lead to company developed and released first commercial GIS product (ARC/INFO) in 1981.
- ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្របច្ចុប្បន្ននេះ/GIS Today: ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្របានផ្តល់អោយអ្នកប្រើប្រាស់អាចបង្កើតផែនទីឌីជីថលសម្រាប់ដោះស្រាយបញ្ហាសកល ហើយបច្ចុប្បន្ននេះស្ថាប័នជាច្រើនបានបង្កើតផែនទី និងចែករំលែកការងាររបស់ពួកគេនៅលើគេហទំព័រ/GIS allow users to create digital map to solve real world issues. Many organization are producing map and share their work.

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ការណែនាំអំពីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS (បន្ត) /Understanding GIS(Cont.)

- ❖ ការវិវត្តន៍របស់ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/Evolution of GIS
 - ព្រឹត្តិការណ៍សំខាន់នៃការវិវត្តន៍/Major events of evolution (Remoaldo et al., 2017)



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ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS/Common Tools in GIS

- ❑ កម្មវិធីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រដែលពេញនិយមប្រើ/Commonly used GIS software:
 - ArcGIS (Commercial)



- QGIS (Free Open Source)

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ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS (បន្ត) /Common Tools in GIS(Cont.)

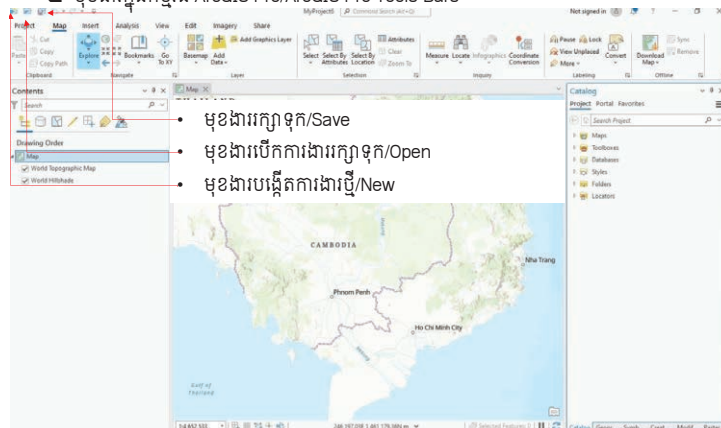
- ❑ មុខងារក្នុងកម្មវិធី ArcGIS Pro/ArcGIS Pro Tools Bars



39

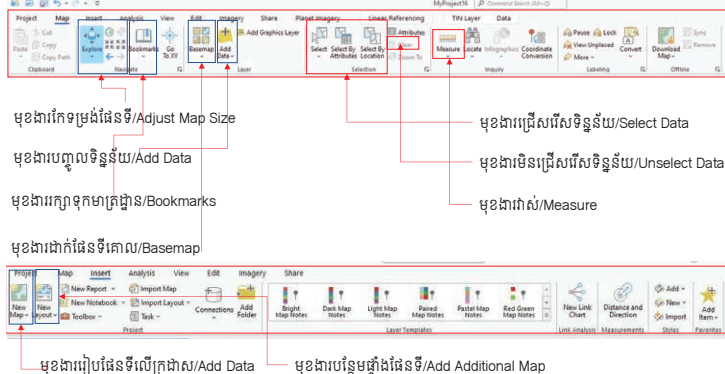
ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS (បន្ត) /Common Tools in GIS(Cont.)

- ❑ មុខងារក្នុងកម្មវិធី ArcGIS Pro/ArcGIS Pro Tools Bars



ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS (បន្ត) /Common Tools in GIS(Cont.)

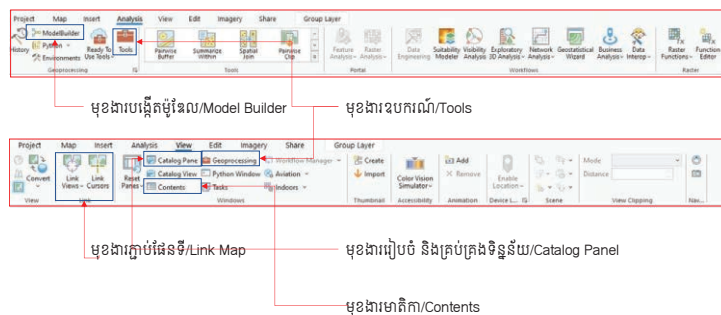
- ❑ មុខងារក្នុងកម្មវិធី ArcGIS Pro/ArcGIS Pro Tools Bars



41

ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS (បន្ត) /Common Tools in GIS(Cont.)

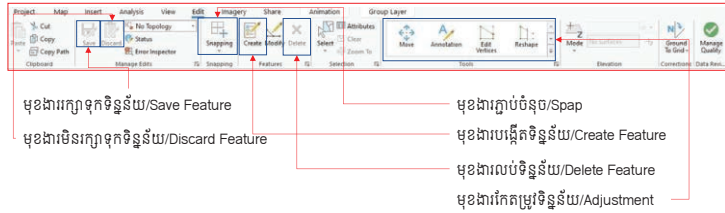
- ❑ មុខងារក្នុងកម្មវិធី ArcGIS Pro/ArcGIS Pro Tools Bars



42

ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS (បន្ត) /Common Tools in GIS(Cont.)

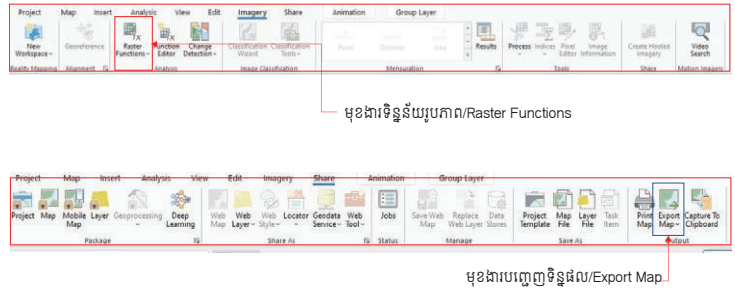
❑ មុខងារក្នុងកម្មវិធី ArcGIS Pro/ArcGIS Pro Tools Bars



43

ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS (បន្ត) /Common Tools in GIS(Cont.)

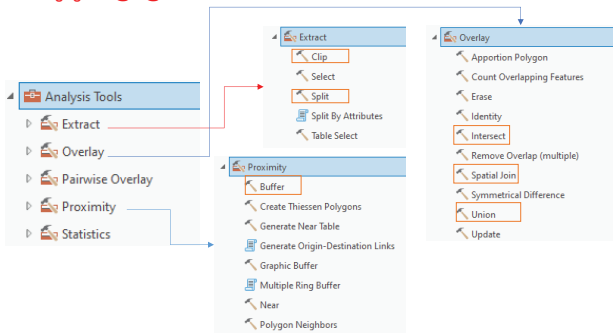
❑ មុខងារក្នុងកម្មវិធី ArcGIS Pro/ArcGIS Pro Tools Bars



44

ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS (បន្ត) /Common Tools in GIS(Cont.)

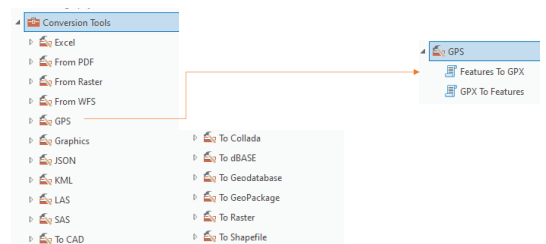
❖ ឧបករណ៍ប្រើប្រាស់ញឹកញាប់/Common Tools



45

ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS (បន្ត) /Common Tools in GIS(Cont.)

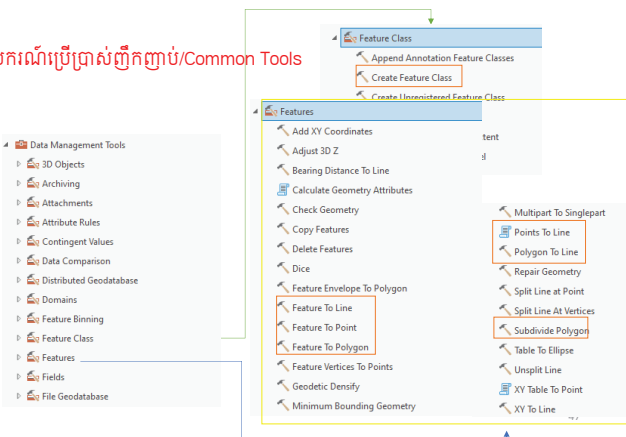
❖ ឧបករណ៍ប្រើប្រាស់ញឹកញាប់/Common Tools



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ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS (បន្ត) /Common Tools in GIS(Cont.)

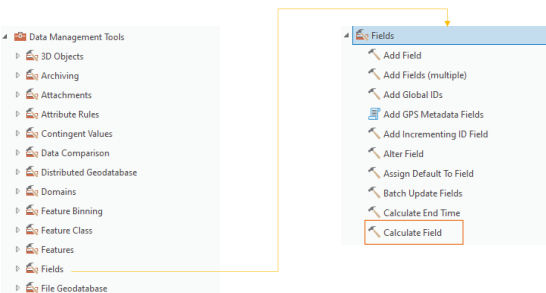
❖ ឧបករណ៍ប្រើប្រាស់ញឹកញាប់/Common Tools



48

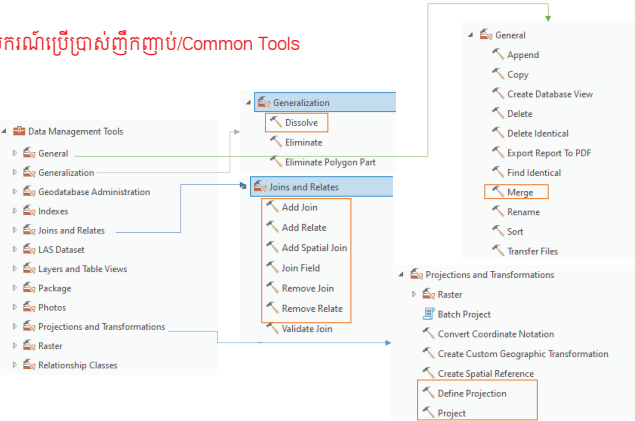
ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS (បន្ត) /Common Tools in GIS(Cont.)

❖ ឧបករណ៍ប្រើប្រាស់ញឹកញាប់/Common Tools



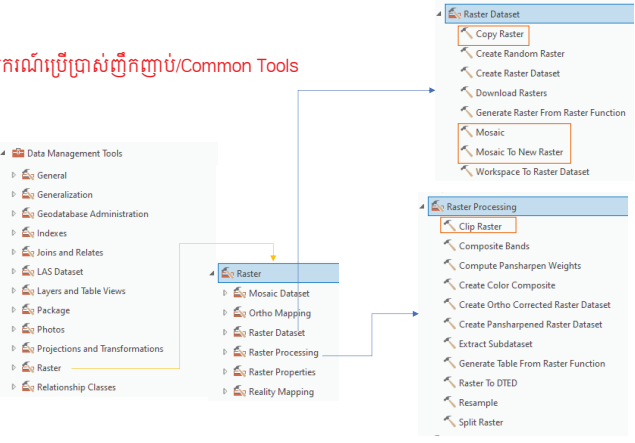
ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS (បន្ត) /Common Tools in GIS(Cont.)

❖ ឧបករណ៍ប្រើប្រាស់ញឹកញាប់/Common Tools



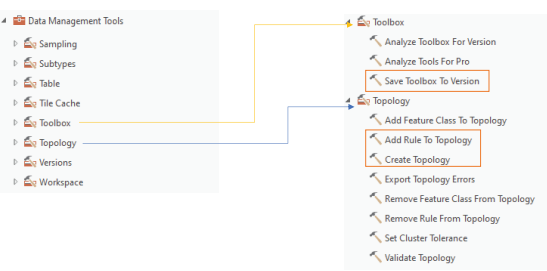
ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS (បន្ត) /Common Tools in GIS(Cont.)

❖ ឧបករណ៍ប្រើប្រាស់ញឹកញាប់/Common Tools



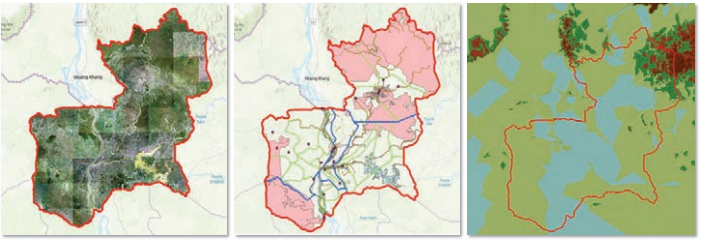
ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS (បន្ត) /Common Tools in GIS(Cont.)

❖ ឧបករណ៍ប្រើប្រាស់ញឹកញាប់/Common Tools



ការបង្កើតទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/GIS Data Creating

❖ ម៉ូដែលទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/GIS data model



ម៉ូដែលទិន្នន័យរូបភាព/
Raster Data Model

GeoTIFF/.tiff

ម៉ូដែលទិន្នន័យវ៉ិចទ័រ/
Vector Data Model

Shapefile/.Shp

ម៉ូដែលទិន្នន័យទឹក/
TIN Data Model

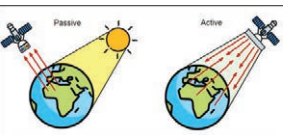
TIN dataset/.adf

ការបង្កើតទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត) /GIS Data Creating (Cont.)



ម៉ូដែលទិន្នន័យរូបភាព/
Raster Data Model

GeoTIFF/.tiff



ទិន្នន័យរូបភាពដែលត្រូវបានថតដោយវិធីសាស្ត្រ Photogrammetry & Remote Sensing ត្រូវបានប្រើប្រាស់ដើម្បីដាក់ញឹកញាប់ក្នុងកម្មវិធីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រក្នុងការសិក្សា និងវិភាគបញ្ហាផ្សេងៗលើសកល/Raster data captured by Photogrammetry and Remote Sensing technique are applied in GIS for research and analysis real-world issue.

ការបង្កើតទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត) /GIS Data Creating (Cont.)

- វិធីសាស្ត្រ Photogrammetry សំដៅលើបច្ចេកវិទ្យាវិទ្យាសាស្ត្រដែលវិភាគរូបភាពដោយដែលបានចាប់យកដោយការមើលតាមរយៈភាពត្រួតស៊ីគ្នានៃរូបភាព។ ទិន្នន័យដែលទទួលបានពីការដំណើរការរូបភាពមាន៖ រូបភាព ទិន្នន័យ 3D Point cloud បង្កើនភាព និងទិន្នន័យ 3D/Photogrammetry refer to science and technology for analyzing overlapped photographs captured by camera. Processed outputs: image, 3D point clouds, orthomosaic, and 3D Model (James et al., 2010).
- គុណសម្បត្តិ/Pros៖ មិនមានកាលបរិច្ឆេទខ្លាំង/ accurate
- គុណវិបត្តិ/Cons៖ ការងារទំហំធំនៅមានកម្រិតនៅប្រទេសយើង/
Large area tasks still limited in Cambodia

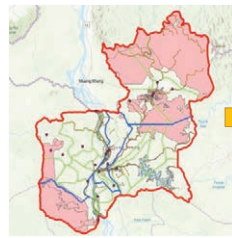
ការបង្កើតទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត)/GIS Data Creating (Cont.)

- វិធីសាស្ត្រ Remote Sensing សំដៅលើបច្ចេកវិទ្យាវិទ្យាសាស្ត្រដែលបានចាប់យករូបភាពលើផ្ទៃដីដោយផ្ទាល់រយៈពេលតាមរយៈការចំណាំងផ្លាស់ និងការបញ្ចេញលេកវិទ្យុដែនម៉ាញ៉េទិច ដែលអាចចាប់យកទាំងពេលយប់ និងពេលថ្ងៃ។ វាត្រូវបានចែកជាពីរ៖ ការដំណើរដោយមិនចាំបាច់មានថាមពលព្រះអាទិត្យ និងការចាំងផ្លាស់ពីផែនដី (Active RS) និងការដំណើរការដោយចាំបាច់មានថាមពលព្រះអាទិត្យ និងការចាំងផ្លាស់ពីផែនដី (Passive RS)។ ទិន្នផលដែលទទួលបានពីការដំណើរការ អាចប្រើប្រាស់លើការងារជាច្រើន៖ ផលិតផលទី បម្រែបម្រួលការប្រើប្រាស់ដី គម្របព្រៃ ជម្រកសត្វ ភ្លើងឆេះព្រៃ... Remote Sensing refer to science and technology for capturing the earth surface from satellite by reflected and emitted electromagnetic radiation and able to retrieve day and night data. It divides into two types: satellite required sun energy and reflectance of the earth (Passive RS) and satellite not required sun energy and reflectance of the earth (Active RS). Processed outputs: Land use-land cover mapping, forest cover mapping, forest fire mapping...
- គុណសម្បត្តិ/Pros៖ សាកសមសម្រាប់ការងារផ្ទៃដីធំ និងអាចពិនិត្យមើលបម្រែបម្រួលពីមុនៗបាន/
Suitable for large area mapping and analysis historical data
- គុណវិបត្តិ/Cons៖ កម្រិតច្បាស់នៃរូបភាពសម្រាប់ផ្ទៃដីធំ និងចំណាយថវិកាច្រើនសម្រាប់ទិញ/
Limitation of resolution for large scale and expensive for high resolution

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ការបង្កើតទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត)/GIS Data Creating (Cont.)

- ❖ ម៉ូដែលទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/GIS data model



ម៉ូដែលទិន្នន័យវ៉ិចទ័រ/
Vector Data Model

Shapefile/.Shp

- ប្រភពទិន្នន័យវ៉ិចទ័រ/Vector data source:
 - ការចុះប្រមូលផ្ទាល់/Field collection៖ ប្រើប្រាស់ឧបករណ៍ GPS
 - ការទាញយកទិន្នន័យពីអ៊ីនធឺណិត/Download available data
 - ការគូសចេញពីរូបភាពផ្ទាល់ដោយប្រើប្រាស់រូបភាពពីអវកាស/Using satellite images
- ទិន្នន័យវ៉ិចទ័រអាចបង្កើតបានតាមរយៈ/Vector data can be created:
 - ទិន្នន័យពី X Y Z ពី Excel/Input from Excel
 - បង្កើតនៅក្នុងកម្មវិធីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/
Create in GIS software

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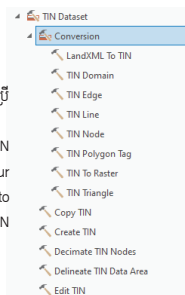
ការបង្កើតទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត)/GIS Data Creating (Cont.)



ម៉ូដែលទិន្នន័យទីស៊ីន/
TIN Data Model

TIN dataset/.adf

- ទិន្នន័យទីស៊ីនអាចបង្កើតបានតាមរយៈការប្រើប្រាស់ទិន្នន័យខ្សែបន្ទាត់រយៈកំពស់ដោយប្រើប្រាស់មុខងារ TIN dataset/TIN data can be created using contour lines and TIN data can be used to generate grid DEM using Create TIN in TIN Dataset.



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ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត)/GIS Data Downloading(Cont.)

ទិន្នន័យវ៉ិចទ័រ/Vector data

- ❑ ទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រដោយឥតគិតថ្លៃ/download open GIS data

- ① Open Development Cambodia (ODC)



<https://data.opendatacambodia.net>

- ② Humanitarian Data Exchange (HDX)



<https://data.humdata.org/>

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ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត)/GIS Data Downloading(Cont.)

ទិន្នន័យវ៉ិចទ័រ(បន្ត)/Vector data(Cont.)

- ❑ ទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រដោយឥតគិតថ្លៃ/download open GIS data

- ❖ ប្រើប្រាស់គេហទំព័រ ODC /Using ODC website:

- ទាញយកទិន្នន័យ/ download data:
 1. Road and railway networks in Cambodia (2012 & 2024)
 2. Public transportation
 3. Population census 2019
 4. Basic map of Cambodia (2014)
 5. Economic census 2011
 6. Distribution of mangrove forests in Cambodia
 7. Water bodies in Cambodia
 8. Basic information of school (2012)
 9. Community forestry (2008-2017)
 10. Cropland in Cambodia
 11. Natural protected areas and biodiversity conservation corridors
 12. Protected areas and forests (2013)

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ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត)/GIS Data Downloading(Cont.)

ទិន្នន័យវ៉ិចទ័រ(បន្ត)/Vector data(Cont.)

- ❑ ទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រដោយឥតគិតថ្លៃ/download open GIS data

- ❖ ប្រើប្រាស់គេហទំព័រ HDX /Using HDX website:



<https://data.humdata.org/>

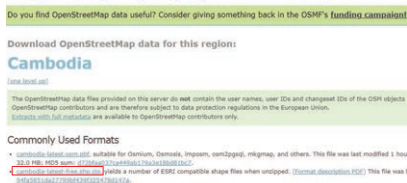
60

ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ(បន្ត)/GIS Data Downloading(Cont.)

ទិន្នន័យវ៉ិចទ័រ(បន្ត)/Vector data(Cont.)

- ❑ ទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រដោយឥតគិតថ្លៃ/download open GIS data

③ GEOFABRIK



<https://download.geofabrik.de/asia/cambodia.html>

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ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ(បន្ត)/GIS Data Downloading(Cont.)

ទិន្នន័យរូបភាព/Raster data

- ❑ ទាញយកទិន្នន័យរូបភាពដោយឥតគិតថ្លៃ/Downloading raster data

① United States Geological Survey (USGS)



<https://earthexplorer.usgs.gov/>

② NASA Earthdata



<https://search.asf.alaska.edu/>

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ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ(បន្ត)/GIS Data Downloading(Cont.)

ទិន្នន័យរូបភាព(បន្ត)/Raster data(បន្ត)

- ❑ ទាញយកទិន្នន័យរូបភាពដោយឥតគិតថ្លៃ/Download raster data

③ Sentinel Hub EO



<https://apps.sentinel-hub.com/eo-browser/>

④ Norway's International Climate & Forests Initiative (NICFI)



<https://planet.com/nicfi/>

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ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ(បន្ត)/GIS Data Downloading(Cont.)

ទិន្នន័យរូបភាព(បន្ត)/Raster data(បន្ត)

- ❑ ទាញយកទិន្នន័យរូបភាពដោយឥតគិតថ្លៃ/Download raster data

⑤ SERVIR SOUTHEAST ASIA



Land cover data

<https://servir.adpc.net/tools/regional-land-cover-monitoring-system>

Tree canopy data

<https://www.landcovermapping.org/en/forest-monitor/>

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ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ(បន្ត)/GIS Data Downloading(Cont.)

ទិន្នន័យរូបភាព(បន្ត)/Raster data(បន្ត)

- ❑ ទាញយកទិន្នន័យរូបភាពដោយឥតគិតថ្លៃ/Download raster data

⑥ ALOS PALSAR



ALOS Global Digital Surface Model "ALOS World 3D - 30m (AW3D30)"

https://www.eorc.jaxa.jp/ALOS/en/dataset/aw3d30/aw3d30_c.htm

ALOS PALSAR 12.5m

<https://search.asf.alaska.edu/#/?dataset=ALOS>

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ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ(បន្ត)/GIS Data Downloading(Cont.)

ទិន្នន័យរូបភាព(បន្ត)/Raster data(បន្ត)

- ❑ ទាញយកទិន្នន័យរូបភាពដោយឥតគិតថ្លៃ/Download raster data

⑦ Global Surface Water



<https://global-surface-water.appspot.com/download>

⑦ FAO's SEPAL



<https://sepal.io/>

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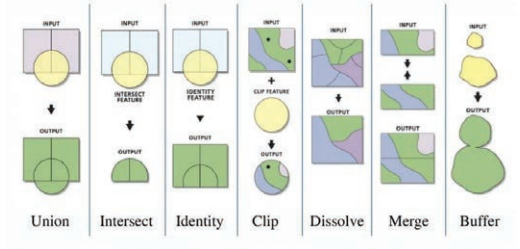
ការកែតម្រូវទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/GIS Data Editing

- ទិន្នន័យដែលបានពីការបង្កើត ឬការទាញយក អ្នកប្រើប្រាស់អាចកែតម្រូវវាបាន/
Data created and data downloaded can be edited:
 - ការជ្រើសរើសទីតាំងផលិតផល/Select site for mapping
 - ការបន្ថែមទិន្នន័យ/Add data
 - ការបន្ថយទិន្នន័យ/Erase data
 - និងការគណនា/Mathematical Calculation
- ឧបករណ៍ដែលប្រើដើម្បីកែតម្រូវទិន្នន័យមាន/Editing tools:
 - មុខងារកាត់/Clip or Mask
 - មុខងារបន្ថែម/Add Field
 - មុខងារទិន្នន័យ/Delete
 - មុខងារនិងការគណនា/Calculate

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ការកែតម្រូវទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ(បន្ត)/GIS Data Editing(Cont.)

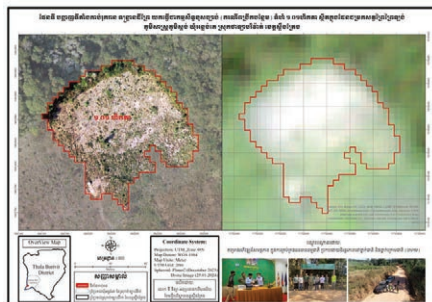
- ទិន្នន័យដែលបានពីការបង្កើត ឬការទាញយក អ្នកប្រើប្រាស់អាចកែតម្រូវវាបាន/
Data created and data downloaded can be edited:
 - និងមុខងារផ្សេងៗ/Additional: Merge, Divide, Split, Buffer, Union, Dissolve...



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ការរៀបចំទិន្នន័យក្នុងការផលិតផលផែនទី/Data Preparation for Mapping

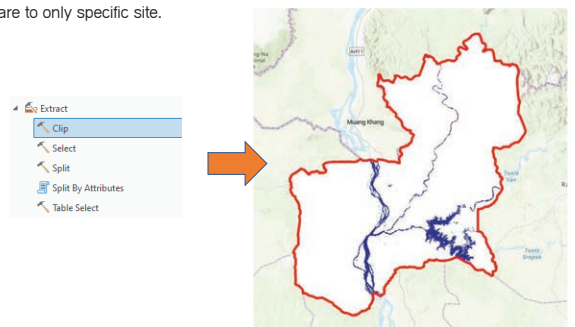
- នៅក្នុងផែនទីនេះទិន្នន័យដែលប្រើប្រាស់រួមមាន៖ រូបភាពផ្កាយរណប រូបភាពផ្ទៃ ព្រំប្រទល់ដី និងរូបភាពផ្ទៃដែលបានដំណើរការរួច/In this map, data used for mapping: satellite image, drone image, polygon of site and drone image processed.



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ការកាត់យកទិន្នន័យវ៉ិចទ័រ/Clipping Vector Data

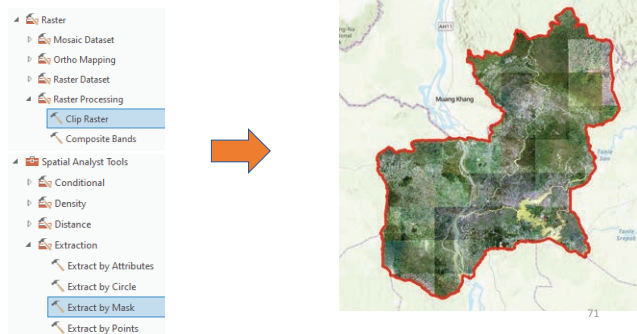
- ក្នុងផែនទីនេះអ្នកផលិតបានប្រើប្រាស់មុខងារកាត់នៅក្នុងកម្មវិធីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ ការកាត់នេះគឺដោយសារគាត់ចង់បង្ហាញតែទីតាំងដី/In this map, map creator applies tool "clip" in GIS software to only specific site.



70

ការកាត់យកទិន្នន័យរូបភាព/Masking Raster Data

- ក្នុងផែនទីនេះអ្នកផលិតបានប្រើប្រាស់មុខងារកាត់រូបភាពនៅក្នុងកម្មវិធីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ ការកាត់នេះគឺដោយសារគាត់ចង់បង្ហាញតែទីតាំងដី/In this map, map creator applies tool "Mask or clip raster" in GIS software to only specific site.

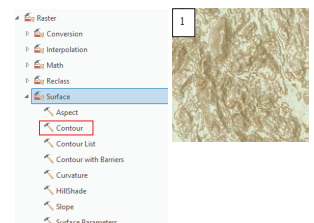


71

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់/Topographic Analysis

- ① Contour: វាបង្ហាញពីខ្សែបន្ទាត់នៃទិន្នន័យរយៈកម្ពស់ដែលដូចគ្នានៅក្នុងទម្រង់វ៉ិចទ័រ ហើយវាក៏ជាវិធីសាស្ត្រដើម្បីសិក្សាពីសណ្ឋានដី/It indicated as lines represent ground elevation. It can be used for understanding topography.

- នៅក្នុងកម្មវិធីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ Contour អាចបង្កើតបានដោយប្រើប្រាស់មុខងារ "Contour"/
In GIS software contour can be created using "Contour" tool.

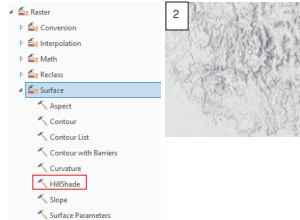


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ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)/Topographic Analysis(Cont.)

② Hillshade: វាជាវិធីសាស្ត្រក្នុងការសិក្សាពីផ្ទៃសណ្ឋានដីវាត្រូវបានប្រើប្រាស់ជាទិន្នន័យប្រើប្រាស់ដើម្បីផលិតផែនទីសណ្ឋានដីផងដែរ/It's used to study topographic surface and also been used as data for creating topographic map.

- នៅក្នុងកម្មវិធីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ Hillshade អាចបង្កើតបានដោយប្រើប្រាស់មុខងារ "Hillshade"/ In GIS software Hillshade can be created using "Hillshade" tool.

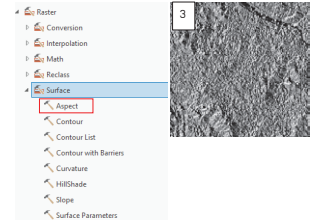


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ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)/Topographic Analysis(Cont.)

③ Aspect: វាបង្ហាញទិសដៅបែរចុះនៃមុខជ្រាល/It indicates direction downhill slope face

- នៅក្នុងកម្មវិធីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ Aspect អាចបង្កើតបានដោយប្រើប្រាស់មុខងារ "Aspect"/ In GIS software Aspect can be created using "Aspect" tool.

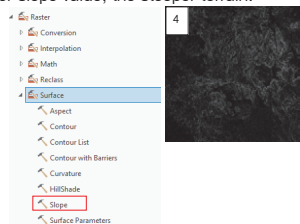


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ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)/Topographic Analysis(Cont.)

④ Slope: វាបង្ហាញពីភាពចោតនៃផ្ទៃដី តម្លៃលេខទិន្នផលកាន់តែខ្ពស់សណ្ឋានដីកាន់តែរាប តម្លៃលេខទិន្នផលកាន់តែទាបសណ្ឋានដីកាន់តែចត់/It indicates steepness of land surface. The lower slope value, the flatter terrain and the higher slope value, the steeper terrain.

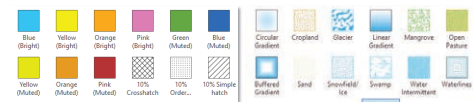
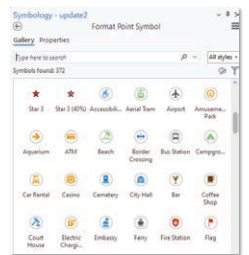
- នៅក្នុងកម្មវិធីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ Slope អាចបង្កើតបានដោយប្រើប្រាស់មុខងារ "Slope"/ In GIS software Aspect can be created using "Slope" tool.



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ការប្រើប្រាស់និមិត្តសញ្ញា/Applying GIS Symbols

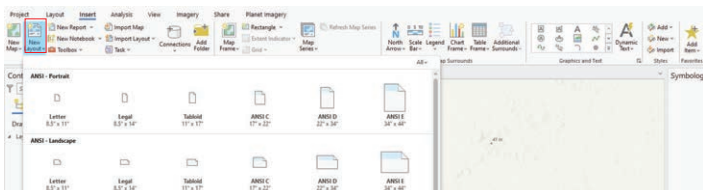
- នៅក្នុងកម្មវិធីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ អ្នកប្រើប្រាស់អាចប្រើប្រាស់មុខងារនិមិត្តសញ្ញា ក្នុងការរចនាផែនទី អោយកាន់តែងាយស្រួលក្នុងការមើល/In GIS software, users can use symbology tools to make better map visualization.
- ដើម្បីប្តូរនិមិត្តសញ្ញា អ្នកប្រើប្រាស់ត្រូវចុចលើសញ្ញាចាស់នោះផ្ទាំងនិមិត្តសញ្ញានឹងផុសឡើង/To change symbol user only requires to click on old symbol then symbology menu will pop up.



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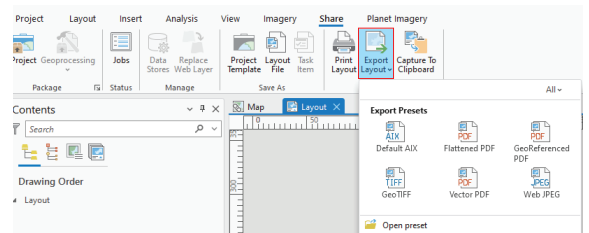
ការរៀបចំផែនទីលើក្រដាស/Map Layout

- បន្ទាប់ពីការជ្រើសរើសទីតាំងដែលចង់បង្ហាញលើផែនទី ការជ្រើសរើសពណ៌ និងការវិភាគលើទិន្នន័យ អ្នកប្រើប្រាស់ត្រូវរៀបចំទិន្នន័យផែនទីនៅលើក្រដាសក្នុងកម្មវិធីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ រួមទាំងបន្ថែមព័ត៌មានដូចជា៖ ឈ្មោះផែនទី សញ្ញាសំគាល់ទិសខាងជើង និងព័ត៌មានផ្សេងៗ/After clipping selected site, symbology, and analysis users require to bring all data to layout in GIS software included map title, north arrow and other information.
- អ្នកប្រើប្រាស់អាចដាក់ផែនទីលើក្រដាសបានដោយប្រើប្រាស់មុខងារ New Layout នៅក្នុង Insert/Users bring all data to layout by using New Layout tools in Insert bar.



ការបញ្ចេញទិន្នផលផែនទីជាទម្រង់ Geo-PDF

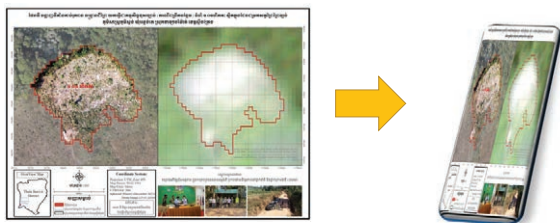
- បន្ទាប់ពីផែនទីបានរៀបចំលើក្រដាសរួចរាល់ អ្នកប្រើប្រាស់អាចបញ្ចេញទិន្នផលផែនទី ជាទម្រង់ pdf ឬរូបភាពបានដោយប្រើមុខងារ Export Layout នៅក្នុង Share/After finished map layout users can export map into pdf or image formats by using Export Layout tool in Share bar.



78

ការបញ្ចូលទិន្នន័យ Geo-PDF ទៅកម្មវិធី Avenza

- កម្មវិធី Avenza ជាកម្មវិធីមួយដែលអាចប្រើប្រាស់ផែនទីដែលបានបញ្ចេញចេញនៅទីវាលដោយមិនប្រើប្រាស់អ៊ីនធឺណិត ហើយឧទាហរណ៍ជាច្រើនក៏បាននឹងកំពុងប្រើប្រាស់សម្រាប់ការងារទីវាលផងដែរ/ Avenza is an app able to be used with exported map and it can be used at field without internet connection and currently rangers are also using it for their field works.



79

សំណួរ និងចម្លើយ Question and Answer



គម្រោងអភិវឌ្ឍន៍សមត្ថភាពក្នុងការគ្រប់គ្រងធនធានធម្មជាតិប្រកបដោយ
និរន្តរភាពនៅថ្នាក់ជាតិនិងថ្នាក់ក្រោមជាតិ



វគ្គបណ្តុះបណ្តាលគ្រូបង្គោលទៅលើការផលិតផែនទី (កម្រិតដំបូង)

មាតិកា

- ការណែនាំអំពីវគ្គបណ្តុះបណ្តាល
- ការណែនាំអំពីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS
- ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ
- ការទាញយកទិន្នន័យផ្លូវ
- ការទាញយកទិន្នន័យផ្ទៃដី
- ការទាញយកទិន្នន័យផែនទីការប្រើប្រាស់ដីពី SERVIR-Mekong
- ការទាញយកទិន្នន័យរយៈកម្ពស់
- ការទាញយកទិន្នន័យទឹកលើពិភពលោក
- ការរៀបចំទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង

2

មាតិកា (បន្ត)

- ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរ៉ូប៊ីតទ័រ)
- ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរូបភាព)
- ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់
- ការប្រើប្រាស់មុខងារកែលម្អលើផែនទី
- ការបញ្ចេញទិន្នផលផែនទីជាទម្រង់ Geo-PDF
- ការបម្លែងទិន្នន័យរ៉ូប៊ីតទ័រជាទម្រង់ KML/KMZ
- ការបញ្ចូលទិន្នន័យ KML/KMZ ទៅកម្មវិធី Avenza
- ការអនុវត្តន៍៖ ការប្រើប្រាស់កម្មវិធី Avenza
- ការវាយតម្លៃទៅលើការអនុវត្តន៍

3

ការណែនាំអំពីវគ្គបណ្តុះបណ្តាល (បន្ត)

គោលបំណង

អ្នកចូលរួមនឹងសិក្សាស្វែងយល់អំពីការប្រើប្រាស់ផែនទីកម្រិតមធ្យម

ការរំពឹងទុក

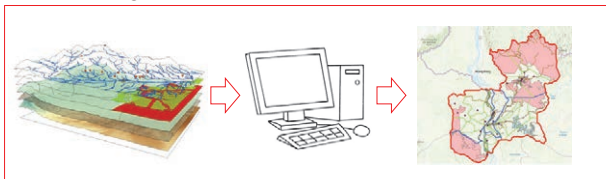
- ស្វែងយល់អំពីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ និងការទាញយកទិន្នន័យមកប្រើប្រាស់ក្នុងការផលិតផែនទី
- ស្គាល់មុខងារប្រើប្រាស់របស់កម្មវិធី ArcGIS Pro ដើម្បីពិនិត្យមើលទិន្នន័យដែលបានទាញយក
- អាចបញ្ចូលទិន្នន័យភូមិសាស្ត្រចូលទៅក្នុងកម្មវិធី Avenza សម្រាប់ប្រើប្រាស់ការងារទីវាល

4

ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS

និយមន័យ

- Geographic Information System (GIS) ត្រូវបានបកប្រែជាកាសារខ្មែរថាប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ គឺជាប្រព័ន្ធមួយដែលគេបានធ្វើឡើងសម្រាប់៖ ការចាប់យក ការរក្សាទុក ការវិភាគ ការប្រើប្រាស់ និងការគ្រប់គ្រងទិន្នន័យព័ត៌មានភូមិសាស្ត្រ។



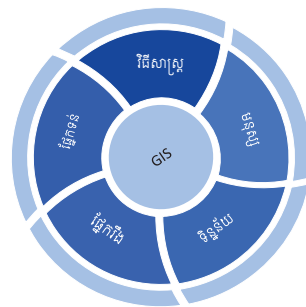
ប្រភព៖ University of Wisconsin-Madison និង UNESCO Bangkok

5

ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS (បន្ត)

ធាតុផ្សំនៃប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ

- ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រមានធាតុផ្សំដែលមានទំនាក់ទំនងគ្នាចំនួន ៥៖
 - មនុស្ស
 - ទិន្នន័យ
 - ផ្នែកវិធីរបស់កុំព្យូទ័រ
 - ផ្នែកទំនាក់ទំនងរបស់កុំព្យូទ័រ
 - និងវិធីសាស្ត្រ។

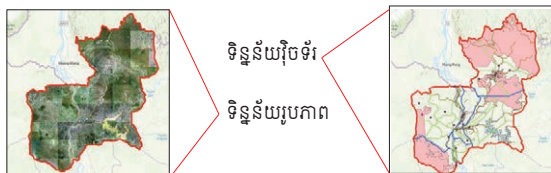


6

ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS (បន្ត)

ទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ

- ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រមានធាតុផ្សំដែលមានទំនាក់ទំនងគ្នាចំនួន ៥៖
 - ទិន្នន័យរូបវិទ្យា៖ ទិន្នន័យខ្សែបន្ទាត់ ទិន្នន័យចំណុច ទិន្នន័យនិងពហុកោណ
 - ទិន្នន័យរូបភាព៖ រូបភាពពីផ្កាយរណប រូបភាពពីជ្រុង រូបភាពពីទូរសព្ទ



ទិន្នន័យរូបវិទ្យា

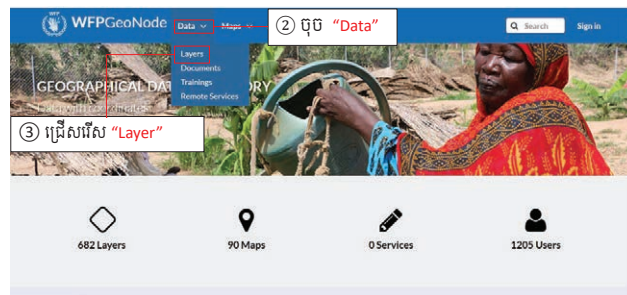
ទិន្នន័យរូបភាព

7

ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ

ទិន្នន័យរដ្ឋបាល

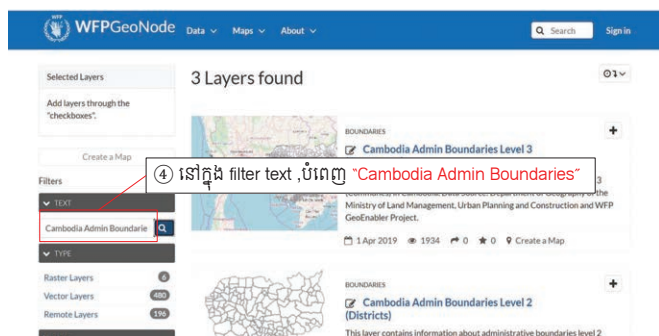
- ចូលទៅកាន់៖ <https://www.geonode.wfp.org>



8

ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត)

ទិន្នន័យរដ្ឋបាល (បន្ត)

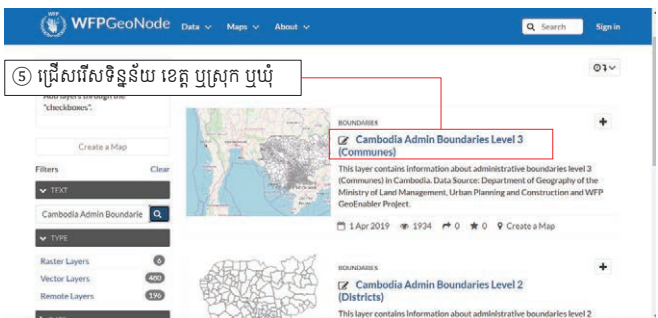


៤ នៅក្នុង filter text ,បំពេញ "Cambodia Admin Boundaries"

9

ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត)

ទិន្នន័យរដ្ឋបាល (បន្ត)

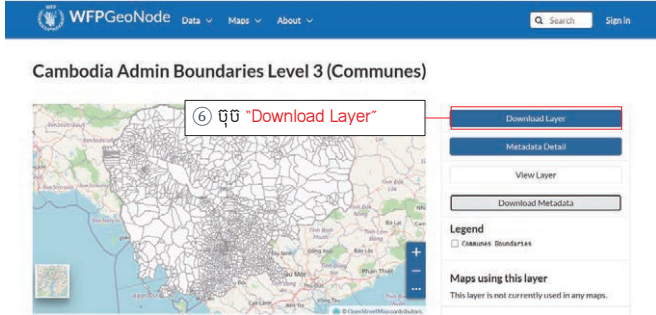


៥ ជ្រើសរើសទិន្នន័យ ខេត្ត ឬស្រុក ឬឃុំ

10

ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត)

ទិន្នន័យរដ្ឋបាល (បន្ត)



11

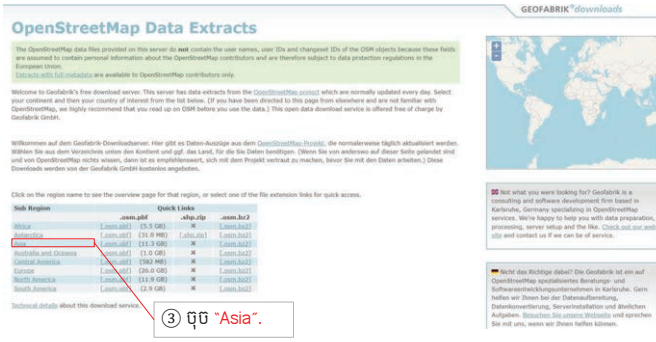
ការទាញយកទិន្នន័យផ្លូវ

① ចូលទៅកាន់: <https://www.geofabrik.de>



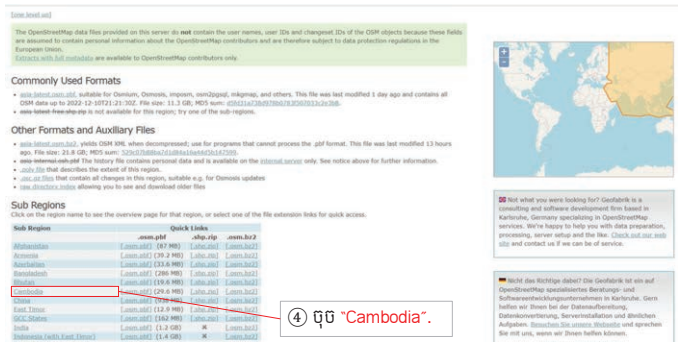
12

ការទាញយកទិន្នន័យផ្លូវ (បន្ត)



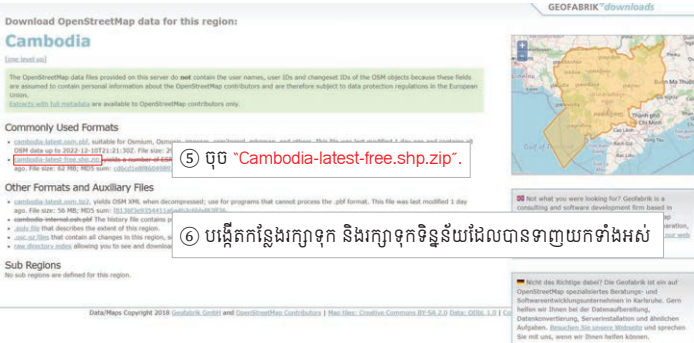
13

ការទាញយកទិន្នន័យផ្លូវ (បន្ត)



14

ការទាញយកទិន្នន័យផ្លូវ (បន្ត)



15

ការទាញយកទិន្នន័យផ្លូវ (បន្ត)

តារាងទិន្នន័យដែលបានទាញយក

	Category	Name	Data type	Description
1	LU/LC	gis_osm_landuse_a_free_1	Polygon	Land use data categorized into 19.
2		gis_osm_places_a_free_1	Polygon	Land information categorized into 4; city, hamlet, island, and village.
3		gis_osm_places_free_1	Point	Land information categorized into 8.
4		gis_osm_natural_a_free_1	Polygon	Land information categorized into 3; beach, spring, and tree.
5		gis_osm_natural_free_1	Point	Land information categorized into 5.
6		gis_osm_water_a_free_1	Polygon	Water resource information categorized into 4; reservoir, riverbank, water, and wetland.
7		gis_osm_waterways_free_1	Polyline	Water resource information categorized into 4; stream, river, canal, and drain.
8	POI	gis_osm_buildings_a_free_1	Polygon	Building footprints with facility information.
9		gis_osm_pois_a_free_1	Polygon	POI
10		gis_osm_pois_free_1	Point	POI
11		gis_osm_pofw_a_free_1	Polygon	POI for religious facility.
12		gis_osm_pofw_free_1	Point	POI for religious facility.

16

ការទាញយកទិន្នន័យផ្លូវ (បន្ត)

តារាងទិន្នន័យដែលបានទាញយក (បន្ត)

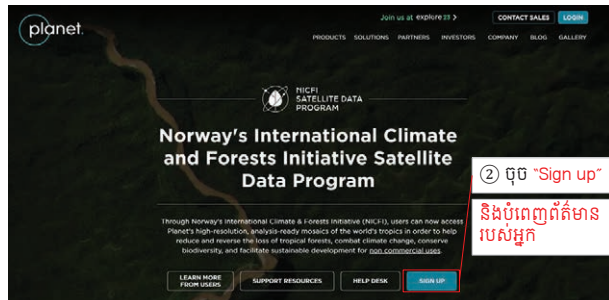
	Category	Name	Data type	Description
13	Transportation	gis_osm_traffic_a_free_1	Polygon	Traffic facility information.
14		gis_osm_traffic_free_1	Point	Traffic facility information.
15		gis_osm_transport_a_free_1	Polygon	Transportation facility information.
16		gis_osm_transport_free_1	Point	Transportation facility information.
17		gis_osm_roads_free_1	Polyline	Road network data with load class, oneway, bridge, and tunnel.
18		gis_osm_railways_free_1	Polyline	Railways network data with railway name.

17

ការទាញយកទិន្នន័យផ្កាយរណប Planet

ការបង្កើតគណនី

① ចូលទៅកាន់ <https://www.planet.com/nicfi/>



18

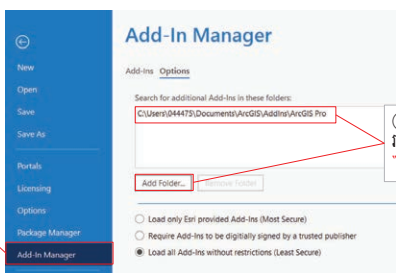
ការទាញយកទិន្នន័យផ្កាយរណប Planet (បន្ត)

ការដំឡើងមុខងារទាញយក

③ ស្វែងរកកន្លែងរក្សាទុកម៉ូឌីដែលបានទាញយក៖

%System Drive%\Users\<username>\Documents\ArcGIS\AddIns\ArcGISPro

④ បើកកម្មវិធី
ArcGIS Pro, និងចុច
"Add-In Manager"



⑤ សរសេរកន្លែង
រក្សាទុក និងចុច
"Add Folder..."

19

ការទាញយកទិន្នន័យផ្កាយរណប Planet (បន្ត)

ការដំឡើងមុខងារទាញយក (បន្ត)

⑥ បើកកម្មវិធី ArcGIS Pro ម្តងទៀត រួចចូលទៅ Planet Imagery និង log in

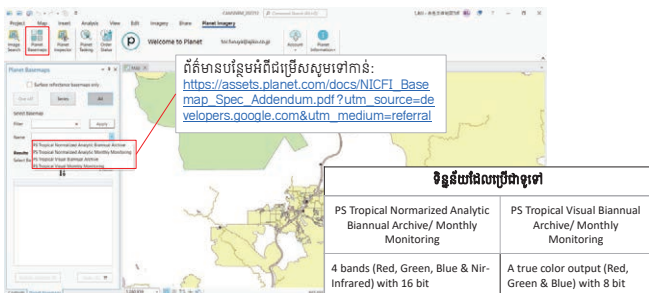


20

ការទាញយកទិន្នន័យផ្កាយរណប Planet (បន្ត)

ការទាញយក

① ចុច "Planet Basemaps" និងជ្រើសរើស "basemaps"

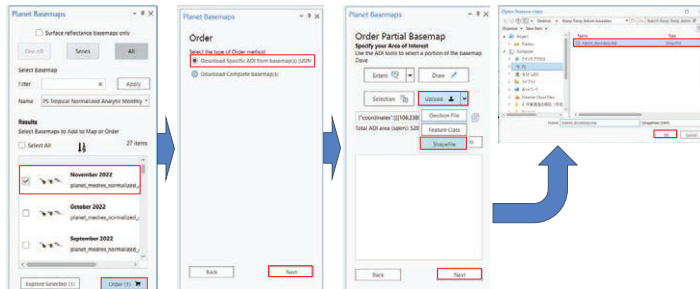


21

ការទាញយកទិន្នន័យផ្កាយរណប Planet (បន្ត)

ការទាញយក (បន្ត)

② ជ្រើសរើស "ជម្រើសទាញយក" និងប្រើប្រាស់ទិន្នន័យរៀបចំ

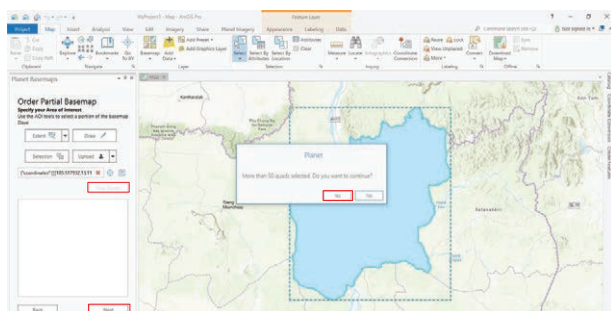


22

ការទាញយកទិន្នន័យផ្កាយរណប Planet (បន្ត)

ការទាញយក (បន្ត)

③ ជ្រើសរើស “YES” និង ចុច “បន្ទាប់”

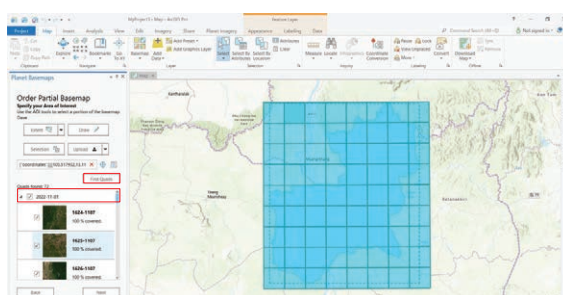


23

ការទាញយកទិន្នន័យផ្កាយរណប Planet (បន្ត)

ការទាញយក (បន្ត)

④ ចុច “Find Quads” និងជ្រើសរើសរូបដែលចង់ទាញយក



24

ការទាញយកទិន្នន័យផ្កាយរណប Planet (បន្ត)

ការទាញយក (បន្ត)

⑤ បំពេញ “ឈ្មោះ” ចុច “Submit Order” និង “Open Planet Status Panel”

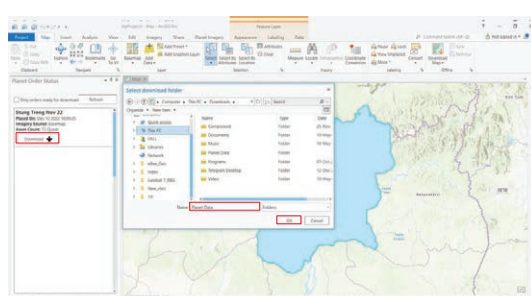


25

ការទាញយកទិន្នន័យផ្កាយរណប Planet (បន្ត)

ការទាញយក (បន្ត)

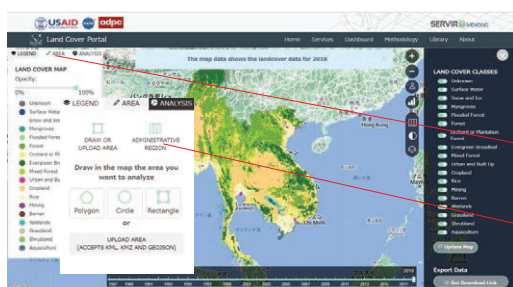
⑥ ចុច “Downloads” និងបំពេញឈ្មោះទិន្នន័យ



26

ការទាញយកទិន្នន័យផែនទីការប្រើប្រាស់ដីពី SERVIR-Mekong

① ចូលទៅកាន់៖ <https://www.landcovermapping.org/en/landcover>

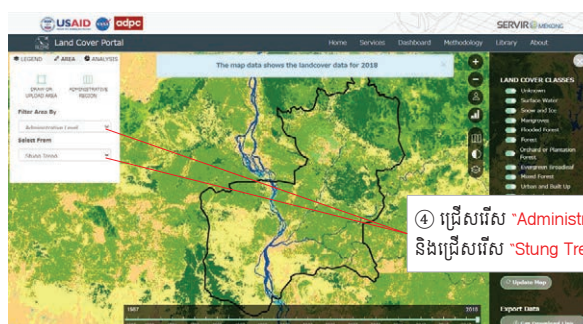


② ចុច “AREA”.

③ ជ្រើសរើស “ADMINISTRATIVE REGION”.

27

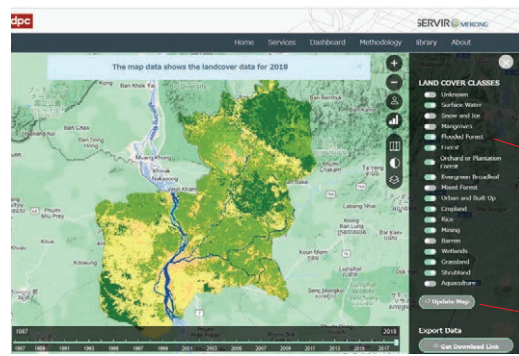
ការទាញយកទិន្នន័យផែនទីការប្រើប្រាស់ដីពី SERVIR-Mekong (បន្ត)



④ ជ្រើសរើស “Administrative Level” និងជ្រើសរើស “Stung Treng”

28

ការទាញយកទិន្នន័យផែនទីការប្រើប្រាស់ដីពី SERVIR-Mekong (បន្ត)

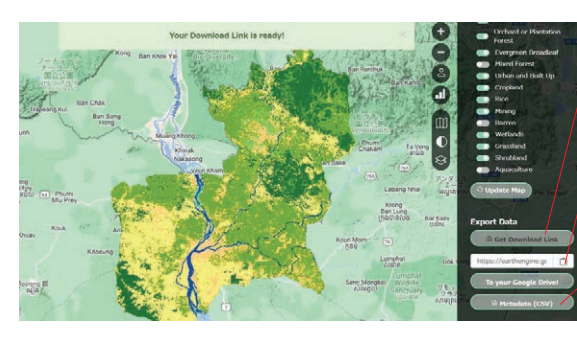


⑤ ទាញប៊ីច "Unknown", "Snow and Ice", "Mangroves", "Mixed Forest", "Barren", និង "Aquaculture", ដែលជាទិន្នន័យដែលមិនតម្រូវសម្រាប់ខេត្តស្ទឹងត្រែង

⑥ ចុច "Update Map".

29

ការទាញយកទិន្នន័យផែនទីការប្រើប្រាស់ដីពី SERVIR-Mekong (បន្ត)



⑥ ចុច "Get Download Link".

⑦ ចុច Copy រួចដាក់នៅក្នុងកម្មវិធីអ៊ីនធឺណែត

⑧ ចុច "Metadata (CSV)"

30

ការទាញយកទិន្នន័យរយៈកម្ពស់ (DEM_AW3D_30m)

① ចូលទៅកាន់៖ <https://www.eorc.jaxa.jp/ALOS/en/aw3d30/registration.htm>

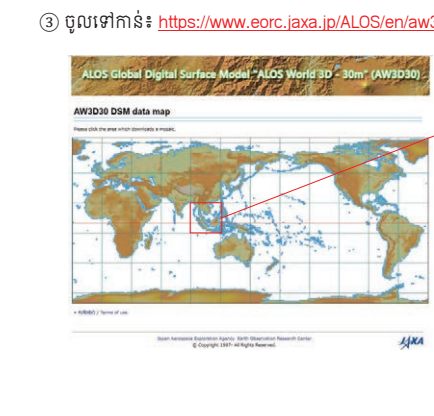


② បំពេញព័ត៌មានផ្ទាល់ខ្លួន

31

ការទាញយកទិន្នន័យរយៈកម្ពស់ (DEM_AW3D_30m) (បន្ត)

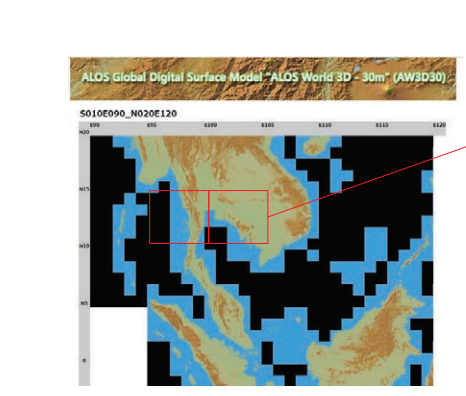
③ ចូលទៅកាន់៖ <https://www.eorc.jaxa.jp/ALOS/en/aw3d30/data/index.htm> និង Log in



④ ជ្រើសរើសក្រឡាចត្រង្គដែលមានប្រទេសកម្ពុជានៅខាងក្នុង

32

ការទាញយកទិន្នន័យរយៈកម្ពស់ (DEM AW3D 30m) (បន្ត)

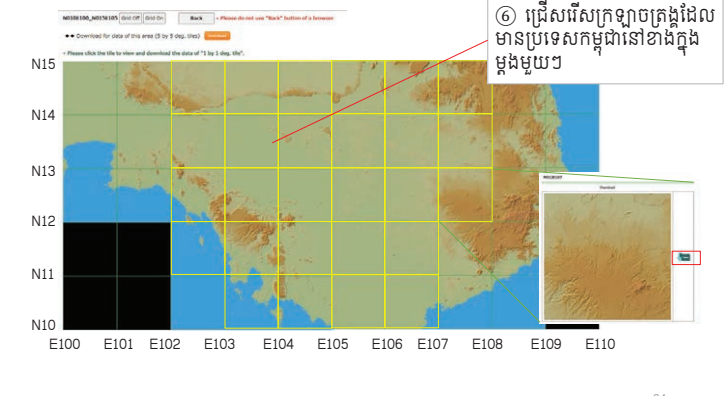


⑤ ជ្រើសរើសក្រឡាចត្រង្គដែលមានប្រទេសកម្ពុជានៅខាងក្នុង៖

- N010E100_N015E105
- N010E105_N015E110

33

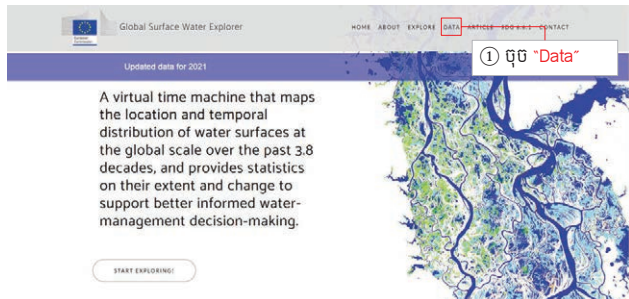
ការទាញយកទិន្នន័យរយៈកម្ពស់ (DEM AW3D 30m) (បន្ត)



⑥ ជ្រើសរើសក្រឡាចត្រង្គដែលមានប្រទេសកម្ពុជានៅខាងក្នុងម្តងមួយៗ

34

ការទាញយកទិន្នន័យទឹកលើពិភពលោក



35

ការទាញយកទិន្នន័យទឹកលើពិភពលោក (បន្ត)



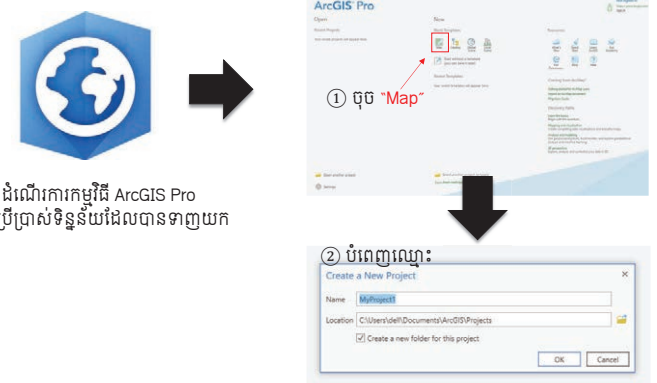
36

ការទាញយកទិន្នន័យទឹកលើពិភពលោក (បន្ត)



37

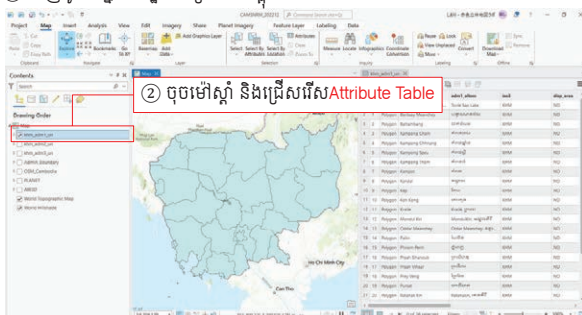
ការរៀបចំទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង



38

ការរៀបចំទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (បន្ត)

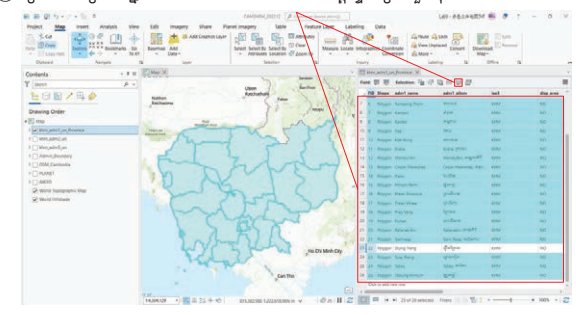
1 ទាញចូលទិន្នន័យរដ្ឋបាលប្រទេសកម្ពុជា



39

ការរៀបចំទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (បន្ត)

3 ជ្រើសរើសគ្រប់ទិន្នន័យទាំងអស់ បើកលែងតែ ខេត្តស្ទឹងត្រែង រួចចុចលប់

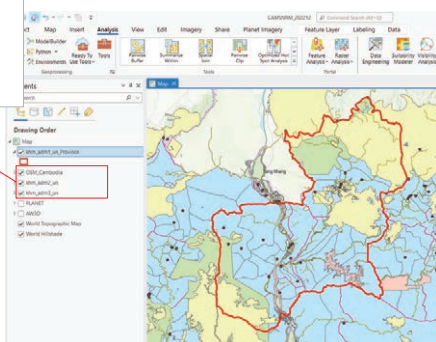


40

ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរ៉ែទាំ)

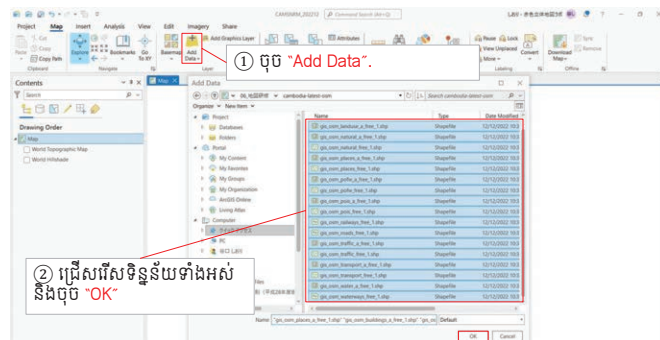
ទាញចូលទិន្នន័យទាំងអស់៖

- ទិន្នន័យរដ្ឋបាលស្រុក
- ទិន្នន័យរដ្ឋបាលឃុំ
- ទិន្នន័យផ្លូវ



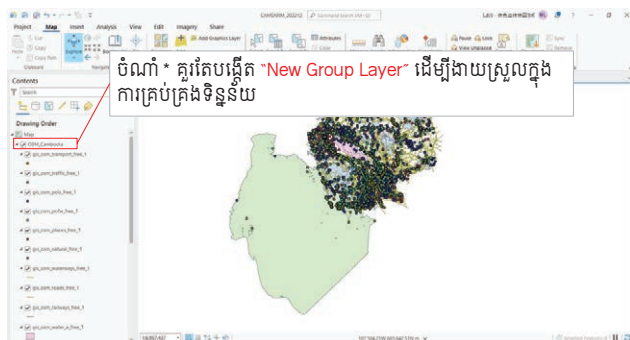
41

ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរ៉ែទាំ) (បន្ត)



42

ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរ៉ែទាំ) (បន្ត)



43

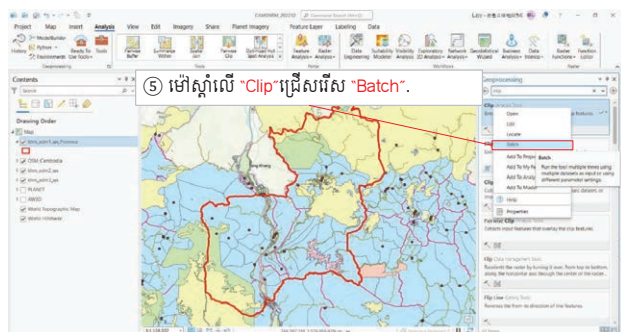
ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរ៉ែទាំ) (បន្ត)



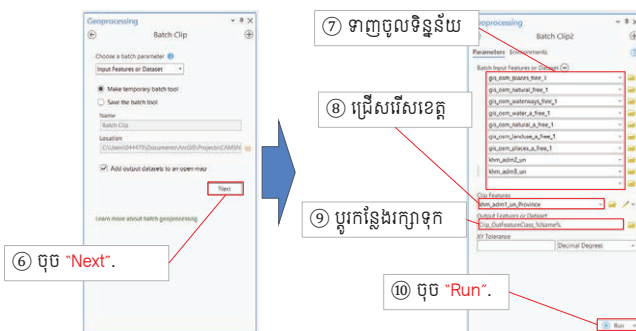
44

ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរ៉ែទាំ) (បន្ត)

ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរ៉ែទាំ) (បន្ត)



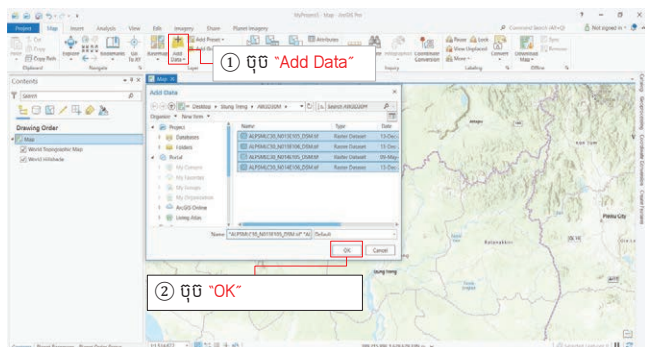
45



46

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

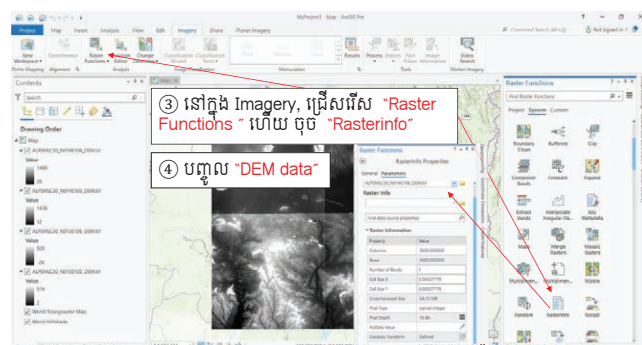
ការរៀបចំទិន្នន័យរយៈកម្ពស់



53

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

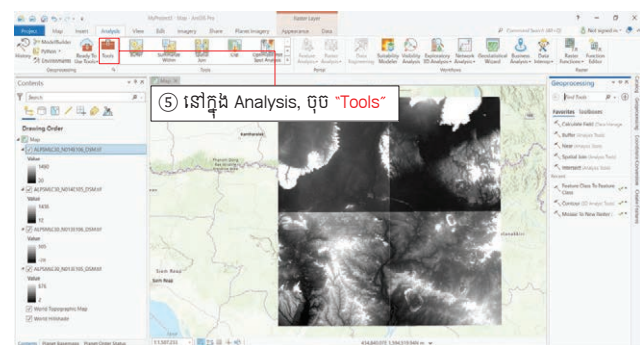
ការរៀបចំទិន្នន័យរយៈកម្ពស់ (បន្ត)



54

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

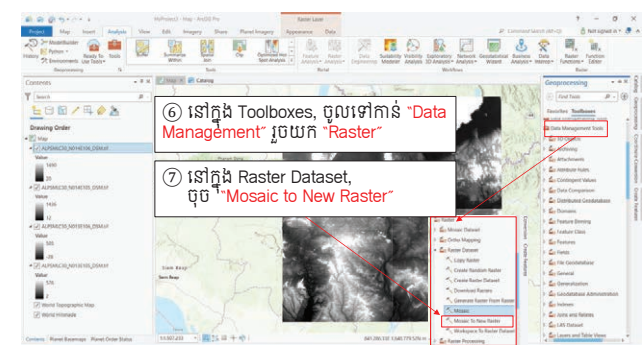
ការរៀបចំទិន្នន័យរយៈកម្ពស់ (បន្ត)



55

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

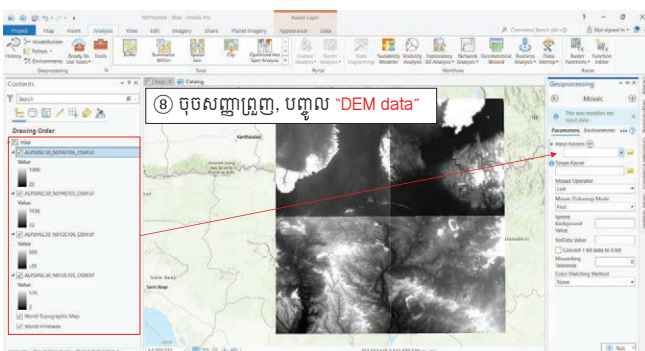
ការរៀបចំទិន្នន័យរយៈកម្ពស់ (បន្ត)



56

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

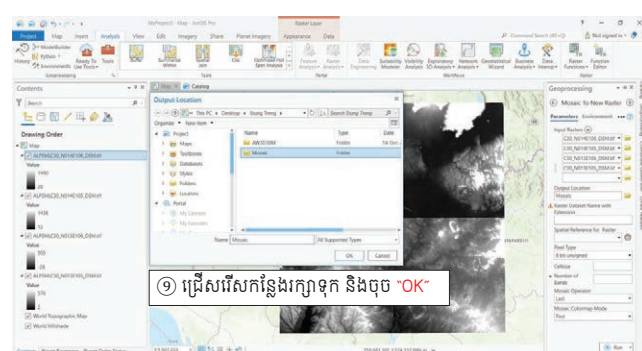
ការរៀបចំទិន្នន័យរយៈកម្ពស់ (បន្ត)



57

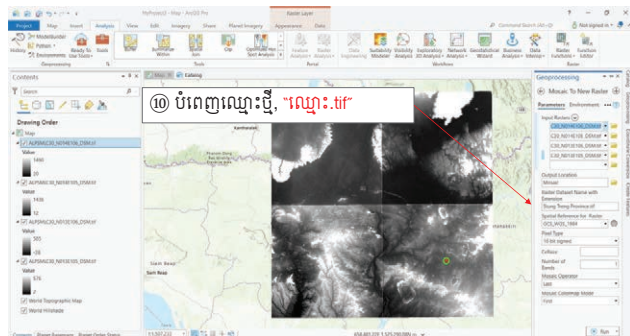
ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

ការរៀបចំទិន្នន័យរយៈកម្ពស់ (បន្ត)



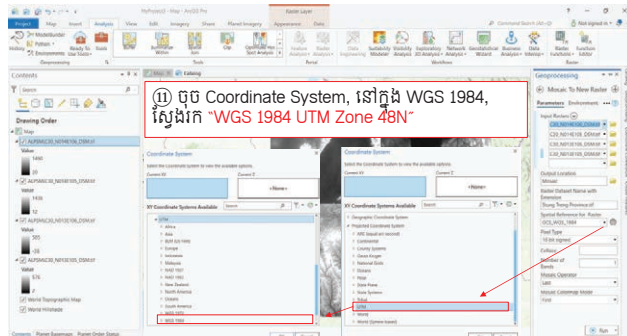
58

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
ការរៀបចំទិន្នន័យរយៈកម្ពស់ (បន្ត)



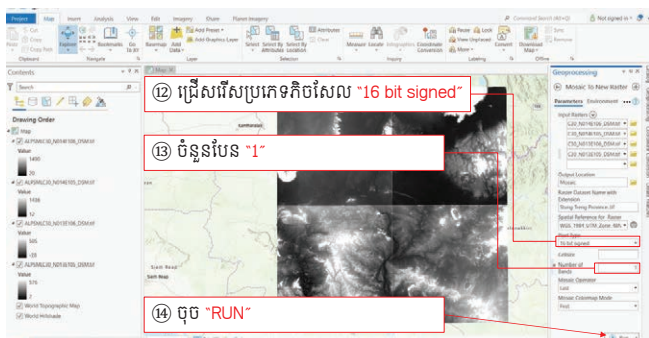
59

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
ការរៀបចំទិន្នន័យរយៈកម្ពស់ (បន្ត)



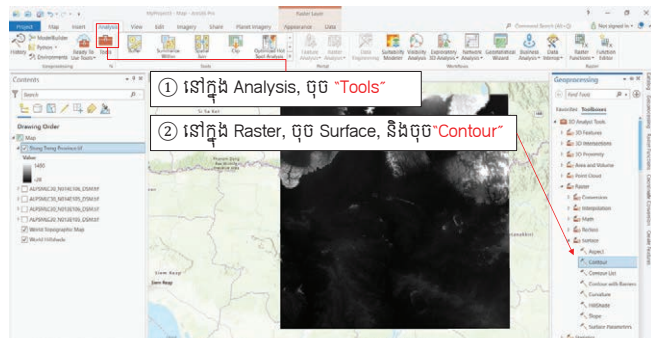
60

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
ការរៀបចំទិន្នន័យរយៈកម្ពស់ (បន្ត)



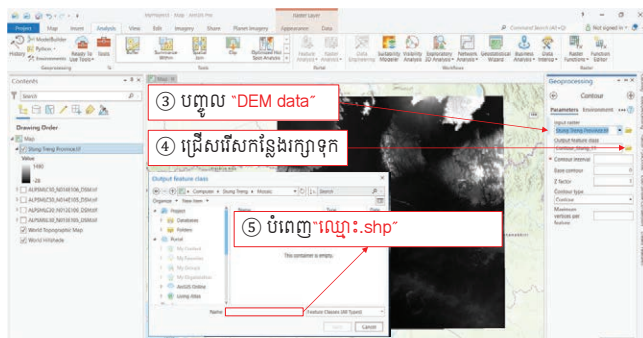
61

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
ការបង្កើតទិន្នន័យខ្សែបន្ទាត់រយៈកម្ពស់



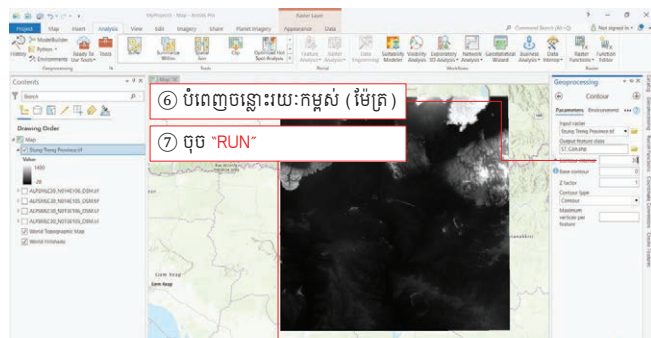
62

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
ការបង្កើតទិន្នន័យខ្សែបន្ទាត់រយៈកម្ពស់ (បន្ត)



63

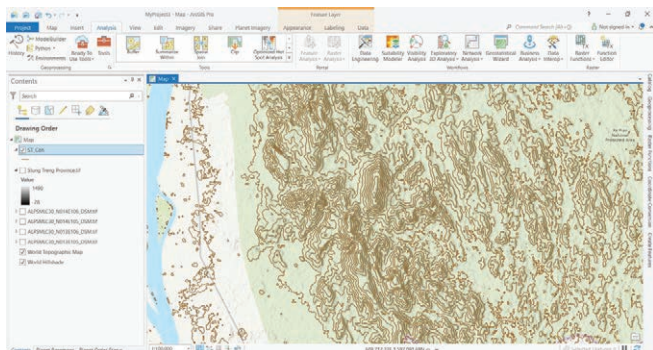
ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
ការបង្កើតទិន្នន័យខ្សែបន្ទាត់រយៈកម្ពស់ (បន្ត)



64

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

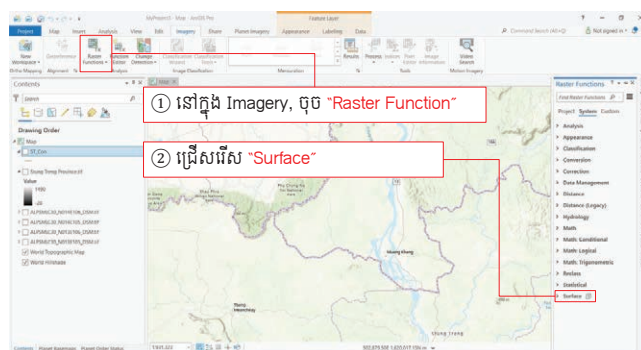
ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញពីរយៈកម្ពស់ (បន្ត)



65

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

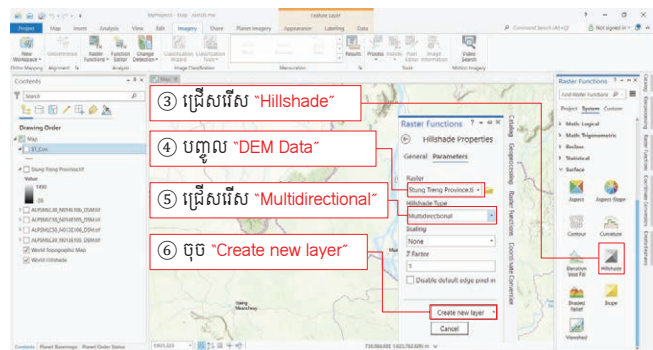
ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញពីរយៈកម្ពស់ (បន្ត)



66

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

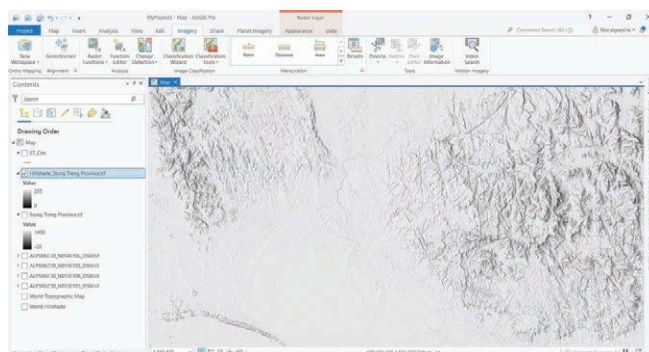
ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញពីរយៈកម្ពស់ (បន្ត)



67

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

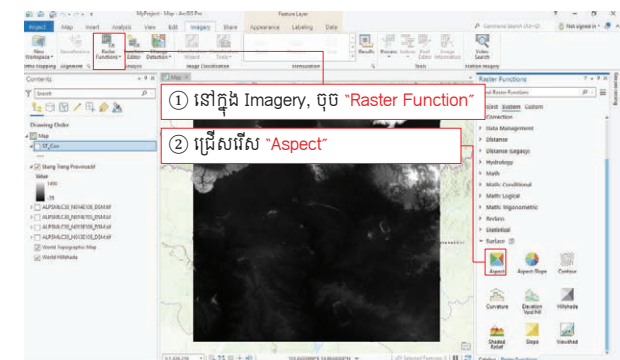
ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញពីរយៈកម្ពស់ (បន្ត)



68

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

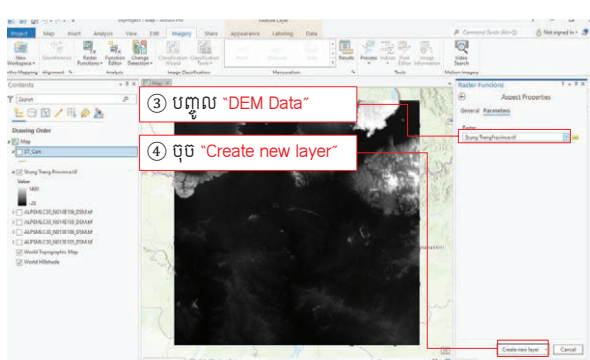
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69

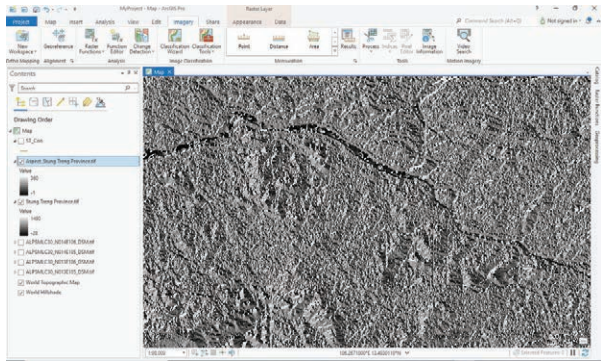
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ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញពីរយៈកម្ពស់ (បន្ត)



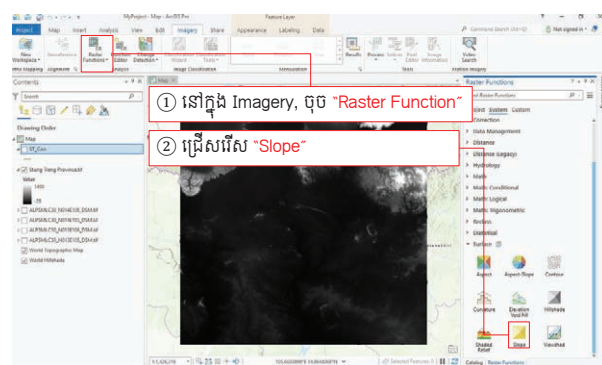
70

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
 ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញទិសដៅទីជម្រាល ឬទីខ្ពស់ (បន្ត)



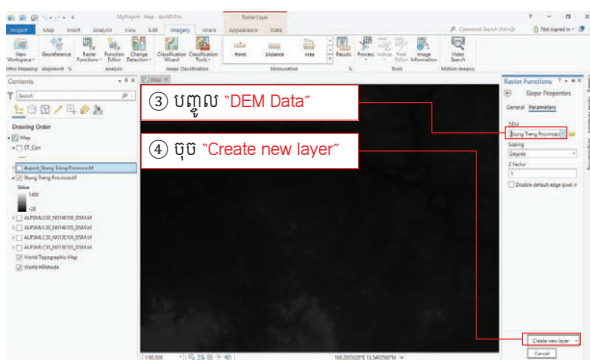
71

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
 ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញទីជម្រាល



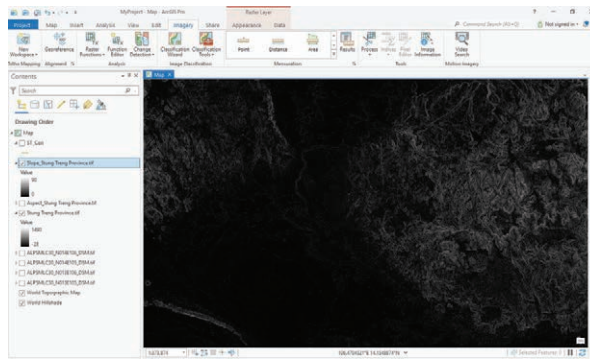
72

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
 ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញទីជម្រាល (បន្ត)



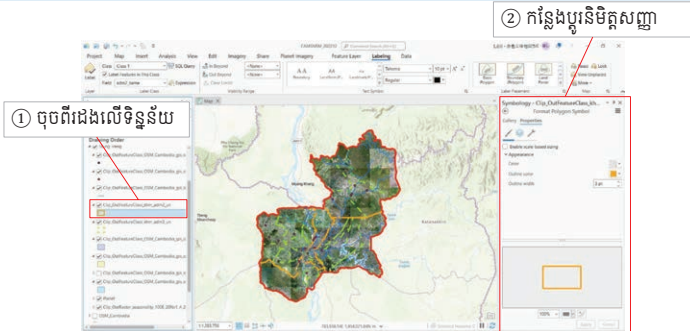
73

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
 ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញទីជម្រាល (បន្ត)



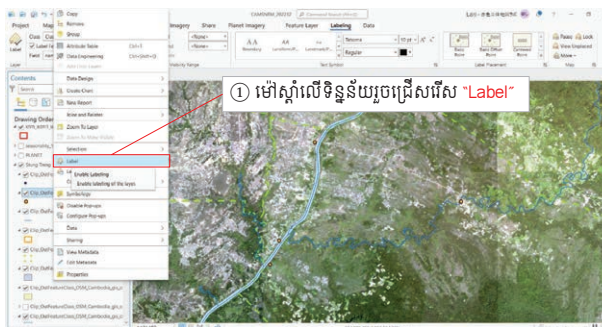
74

ការប្រើប្រាស់មុខងារកែលម្អលើផែនទី
 ការប្រើប្រាស់និមិត្តសញ្ញា (ពណ៌ ទំហំ និងប្រភេទខ្សែបន្ទាត់)



75

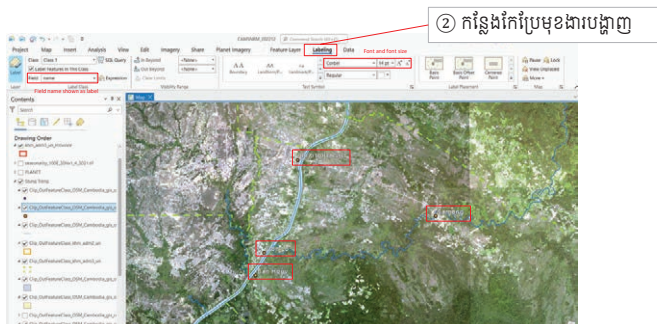
ការប្រើប្រាស់មុខងារកែលម្អលើផែនទី (បន្ត)
 ការប្រើប្រាស់មុខងារបង្ហាញឈ្មោះ



76

ការប្រើប្រាស់មុខងារកែលម្អលើផែនទី (បន្ត)

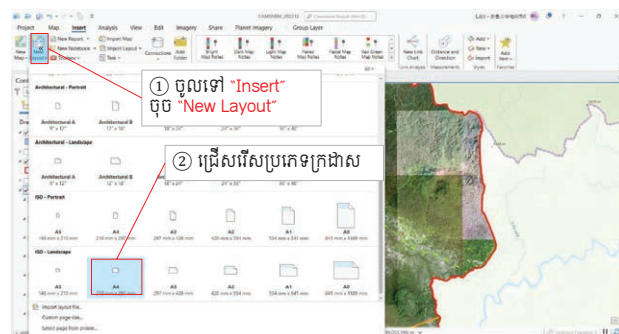
ការប្រើប្រាស់មុខងារបង្ហាញឈ្មោះ (បន្ត)



77

ការប្រើប្រាស់មុខងារកែលម្អលើផែនទី (បន្ត)

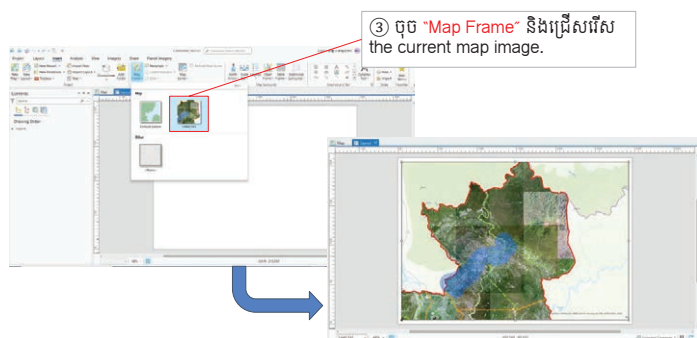
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78

ការប្រើប្រាស់មុខងារកែលម្អលើផែនទី (បន្ត)

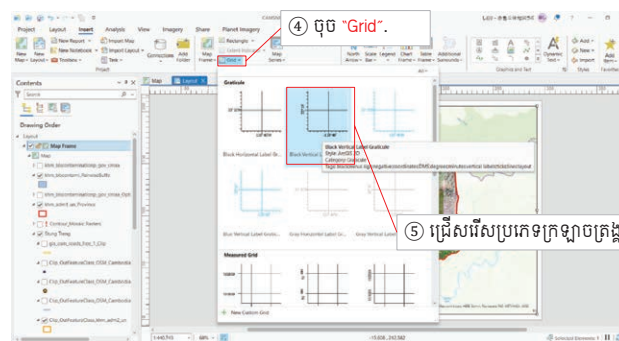
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79

ការប្រើប្រាស់មុខងារកែលម្អលើផែនទី (បន្ត)

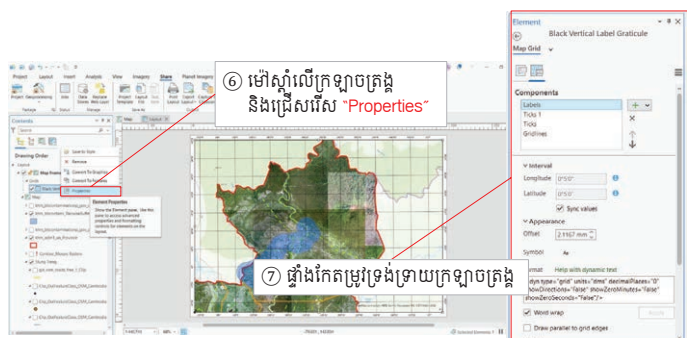
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80

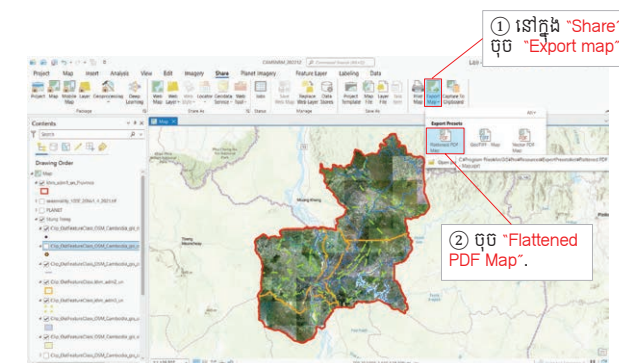
ការប្រើប្រាស់មុខងារកែលម្អលើផែនទី (បន្ត)

ការប្រើប្រាស់មុខងារកំណត់ផែនទីលើក្រដាស(បន្ត)



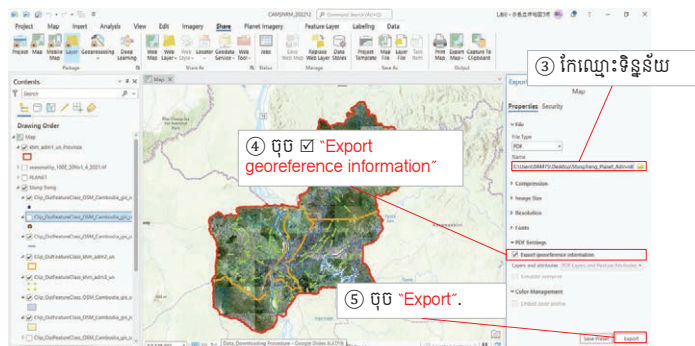
81

ការបញ្ចេញទិន្នផលផែនទីជាទម្រង់ Geo-PDF



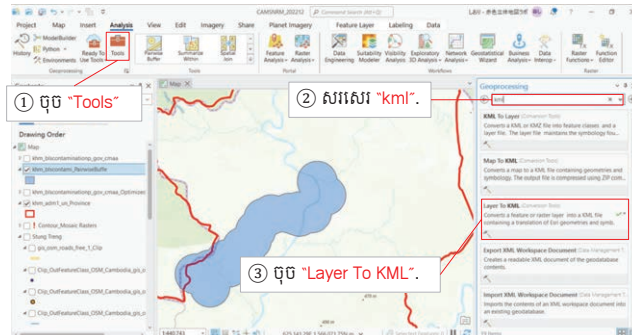
82

ការបញ្ចេញទិន្នផលផែនទីជាទម្រង់ Geo-PDF (បន្ត)



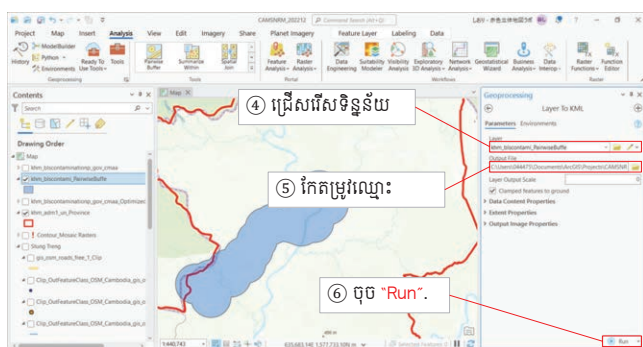
83

ការបង្កើនទិន្នន័យរូបថតជាទម្រង់ KML/KMZ



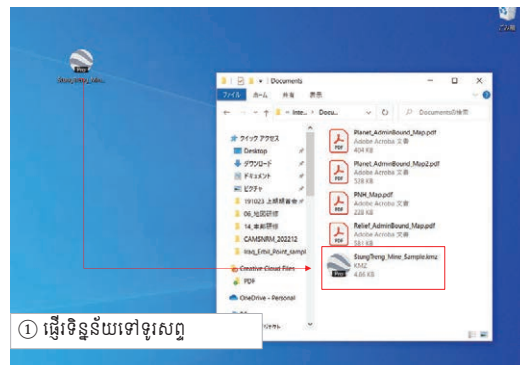
84

ការបង្កើនទិន្នន័យរូបថតជាទម្រង់ KML/KMZ (បន្ត)



85

ការបញ្ចូលទិន្នន័យ KML/KMZ ទៅកម្មវិធី Avenza



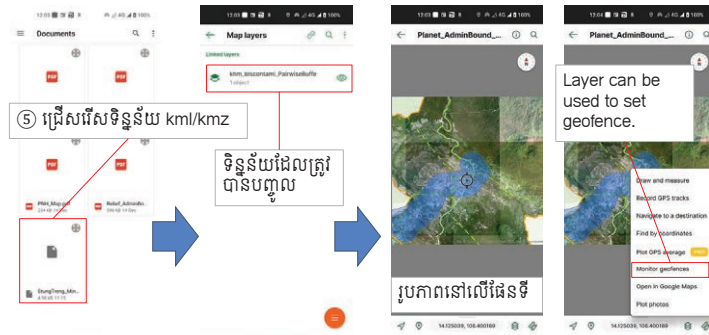
86

ការបញ្ចូលទិន្នន័យ KML/KMZ ទៅកម្មវិធី Avenza (បន្ត)



87

ការបញ្ចូលទិន្នន័យ KML/KMZ ទៅកម្មវិធី Avenza (បន្ត)



88



គម្រោងអភិវឌ្ឍន៍សមុទ្រកាត
ជួនកាលប្រគល់ឯកសារធនធានធម្មជាតិក្នុងប្រទេសកម្ពុជាដល់អង្គការ ដើម្បីកំណត់ និងបង្កើនការប្រើប្រាស់
JICA SNRM

ការអនុវត្តការប្រើប្រាស់កម្មវិធីប្រព័ន្ធគំរាងទ្វារឌីជីថល
សម្រាប់ការស៊ើបអង្កេតទិន្នន័យប្រភេទ Basic Practice for GIS Mapping



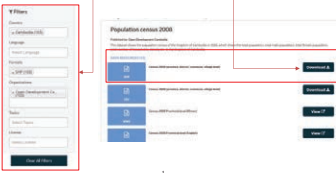
April 2024

ការប្រើប្រាស់ទិន្នន័យ

- ការប្រើប្រាស់ទិន្នន័យប្រភេទ
- គេហទំព័រ ODC
- ចូលទៅកាន់ <https://opendatacambodia.net/> រឺ ចុចលើ DataHub



- ប្រភេទទិន្នន័យប្រភេទប្រភេទ - Cambodia និង ឡាន - SHP
- ប្រភេទទិន្នន័យប្រភេទប្រភេទប្រភេទ - SHP



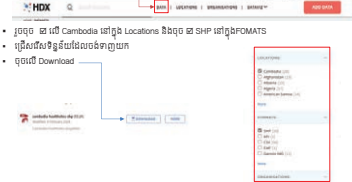
1

អង្គប្រឹក្សាប្រាជ្ញា

- Road and railway networks in Cambodia (2012 & 2024)
- Public transportation
- Population census 2019
- Basic map of Cambodia (2014)
- Economic census 2011
- Distribution of mangrove forests in Cambodia
- Water bodies in Cambodia
- Basic information of school (2012)
- Community forestry (2008-2017)
- Cropland in Cambodia
- Natural protected areas and biodiversity conservation corridors
- Protected areas and forests (2013)

2

- គេហទំព័រ VGV
- ចូលទៅកាន់ <https://data.bund.go.jp/>
- ចូលទៅកាន់ Data



អង្គប្រឹក្សាប្រាជ្ញា

- Cambodia Healthsites
- Cambodia - Subnational Administrative Boundaries (OCHA)
- Cambodia - Roads
- Cambodia - Rivers

3

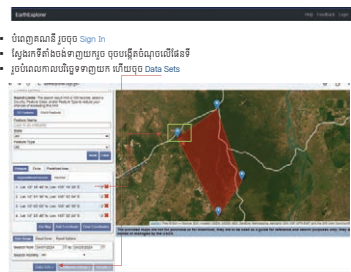
- គេហទំព័រ GCOFAROK
- ចូលទៅកាន់ <https://opendatacambodia.net/>
- ចូលទៅកាន់ Cambodia latest free shp zip



4

ការប្រើប្រាស់ទិន្នន័យបណ្តាញ

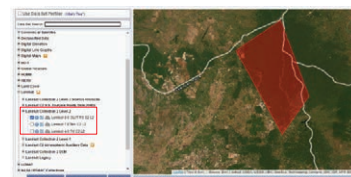
- ការប្រើប្រាស់ទិន្នន័យបណ្តាញ
- គេហទំព័រ [USGS](https://earthexplorer.usgs.gov/)
- ចូលទៅកាន់ <https://earthexplorer.usgs.gov/>
- ចុចលើ Login



- បំពេញឈ្មោះ ឬចុច Sign In
- ឆ្លើយសំណួរសុវត្ថិភាព ចូលប្រើប្រាស់ទិន្នន័យបណ្តាញ
- ប្រើប្រាស់ទិន្នន័យបណ្តាញ ឬចុច Data Sets

5

- ប្រើប្រាស់ Landsat កម្រិតច្បាស់ 30m

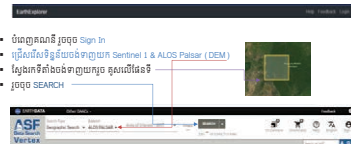


- ឬចុច គេហទំព័រ
- ចុចលើ ឆ្លើយសំណួរសុវត្ថិភាព
- ឆ្លើយសំណួរសុវត្ថិភាព
- ប្រើប្រាស់ទិន្នន័យបណ្តាញ ឬចុច Data Sets

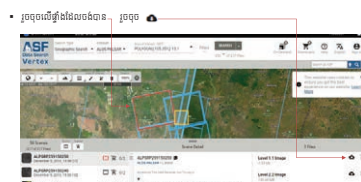


6

- គេហទំព័រ [EarthData](https://search.asf.alaska.edu/)
- ចូលទៅកាន់ <https://search.asf.alaska.edu/>
- ចុចលើ Login



- បំពេញឈ្មោះ ឬចុច Sign In
- ប្រើប្រាស់ទិន្នន័យបណ្តាញ Sentinel 1 & ALOS Palsar (DEM)
- ឆ្លើយសំណួរសុវត្ថិភាព ចូលប្រើប្រាស់ទិន្នន័យបណ្តាញ
- ប្រើប្រាស់ទិន្នន័យបណ្តាញ ឬចុច SEARCH



7

- គេហទំព័រ [Planet](https://planet.com/) កម្រិតច្បាស់ 4m
- ចូលទៅកាន់ <https://planet.com/>
- បំពេញឈ្មោះ ឬចុច Next
- បំពេញឈ្មោះ ឬចុច Sign In
- ប្រើប្រាស់ BaseMaps Viewer



- ប្រើប្រាស់ទិន្នន័យបណ្តាញ ឬចុច Sign In



8

- ចូលមកកាន់ គេហទំព័រ
- ចូលទៅកាន់ <https://www.landcovermapping.org/en/landcover/>



- ចុចលើ ឆ្លើយសំណួរសុវត្ថិភាព
- ឆ្លើយសំណួរសុវត្ថិភាព

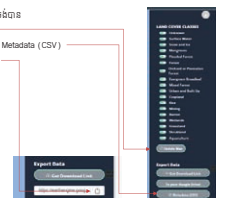
ប្រើប្រាស់ទិន្នន័យបណ្តាញ ឬចុច Upload file

9

- គេហទំព័រ [SEPMR SOUTHEAST ASIA](https://www.landcovermapping.org/en/landcover/)
- ចូលទៅកាន់ <https://www.landcovermapping.org/en/landcover/>
- ប្រើប្រាស់ Country Level & Cambodia
- ប្រើប្រាស់ ឬចុច



- ប្រើប្រាស់ទិន្នន័យបណ្តាញ ឬចុច Upload file
- ចុច Update Map
- ឬចុចលើ Get Download Link & Metadata (CSV)
- Copy ឆ្លើយសំណួរសុវត្ថិភាព



10

- **စီမံကိန်း SERVER SOUTHEAST ASIA**
- **အေစီစီစော့ပုံစံ**၊ **အီကွဲလီပုံစံ**၊ **ပျဉ်းမာန်ပုံစံ**
- **ပျဉ်းမာန် Area**
- **ပျဉ်းမာန် Country Level & Cambodia**
- **ပျဉ်းမာန်ဖော်ပြဖို့**
- **ပျဉ်းမာန် Get Download URL**
- **Download URL**
- **ပျဉ်းမာန် Copy ပေါ်ပေါက်ပုံစံ**

[illegible]

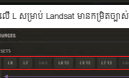
១. ចុចលើតាម <https://www.sepall.in>
 ២. ចុចលើ [Launch](#)
 ៣. ចុចលើ [Documentation](#)

៤. បំពេញតាមលំហូរដើម្បីបង្កើត [Sign In](#)
 ៥. ចុចលើ [+ Add recipe](#)
 ៦. ប្រើសេរីដី Create a mosaic: using Landsat or Sentinel 2
 ៧. ចុចលើ [Official Website](#)
 ៨. ចុចលើ [Create a mosaic using Landsat or Sentinel 2](#)
 ៩. ប្រើសេរីដី Cambodia ដើម្បីបង្កើត [Area of Interest](#)
 ១០. ចុចលើ [Next](#)
 ១១. ចុចលើ [COUNTY/PROVINCE](#)
 ១២. ចុចលើ [COUNTRY](#)
 ១៣. ចុចលើ [PROVINCE/AREA](#)
 ១៤. ចុចលើ [Kampong Thom](#)
 ១៥. ចុចលើ [BUFFER](#)
 ១៦. ចុចលើ [1 km buffer](#)
 ១៧. ចុចលើ [SELECT COUNTRY/PROVINCE](#)
 ១៨. ចុចលើ [SELECT FROM EE TABLE](#)
 ១៩. ចុចលើ [DRAW A POLYGON](#)

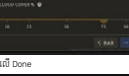
- បំបែករូបភាពបង្កើតជាក្រឡាញក
- ប្រែប្រួល Next



• ចូលលើ L, វាប្រាប់ Landuse មានក្រឡាញ់ច្បាស់ 30m ឬ 50 វាប្រាប់ Sentinel2 មានក្រឡាញ់ច្បាស់ 10m



• ចូលលើ Done



[illegible]

• တတိယ close ပြုလုပ်ပေးပါ။

• ကျွန်ုပ်တို့သော့ခံသောလက်ခံရစာ

WANTS TO RETRIEVE

BLANK GREEN RED N/A SWIFT SWIRL

REDEEMED1 REDEEMED2 REDEEMED3 REDEEMED4

• အသေးစကားလုံးအဖြစ် ပြုလုပ်ပါ။ **More**

WORKSPACE PATH

downloaded 42 2024-04-24 05:56:25

• ကျွန်ုပ်တို့၏ 100

File downloaded workspace

100

RETRIEVE

• တတိယ Retrieve

Cancel Retrieve

• တတိယ **File**။ ယေမီဖီစီကျွန်ုပ်တို့အသေးစကားလုံး။ လေ့ကျင့်ရသောလက်ခံရစာ။

• တတိယ **File**။ ပြုလုပ်သောလေ့ကျင့်သောလက်ခံရစာ

Optical_mosaic_2023-11-22_14-30-31

Optical_mosaic_2023-11-22_14-30-31.tif

Optical_mosaic_2023-11-22_14-30-31.tif (100 images)

Optical_mosaic_2023-11-22_14-30-31.tif (17 images)

• တတိယစကားလုံးအဖြစ်ပြုလုပ်ရန်

Optical_mosaic_2023-11-22_14-30-31.tif

Optical_mosaic_2023-11-22_14-30-31.tif (17 images, 17 images)

ការរៀបចំទិន្នន័យសម្រាប់ផលិតផលទី

- រៀបចំទិន្នន័យ រៀបចំ និងបញ្ជាក់ ដាក់ផ្សេងគ្នា
- សម្រាប់ទិន្នន័យ (.shp) សូមចុចលើស្តីប្រយោគ Extract Here



17

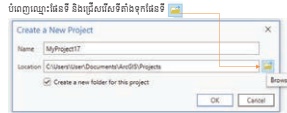


ការរៀបចំ ArcGIS Pro

- ចុចលើកញ្ចប់



- ប្រើប្រាស់ Map



- ចុច OK

18



សូមប្រើប្រាស់បញ្ជីបញ្ជីដែលបានផ្តល់ឈ្មោះ
ដើម្បីស្វែងយល់ពីឈ្មោះព្រំប្រទល់

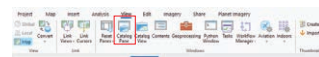


ការប្រើប្រាស់ទិន្នន័យរៀបចំ

- កម្រិតទិន្នន័យរៀបចំ (x y z) ដែលត្រូវបានកំណត់នៅក្នុងបញ្ជីបញ្ជីឈ្មោះ (ឯកទេស)

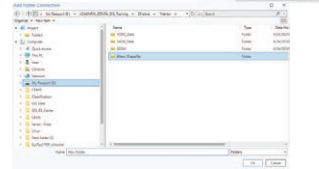
N°	X	Y
1	493318.27	1277336.87
2	493295.00	1277557.90
3	493605.01	1277541.35
4	493634.64	1277321.86

- ចុចលើ View ប្រើប្រាស់ Catalog Pane ផ្ទាំងនិងបញ្ជីបញ្ជីឈ្មោះ



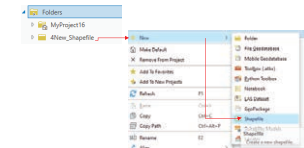
- ដាក់ស្លាកលើ Folders ប្រើប្រាស់ Add Folder Connection

- ប្រើប្រាស់បញ្ជីបញ្ជីឈ្មោះដែលបានបង្កើត ចុច OK



20

- ដាក់ស្លាកលើទិន្នន័យរៀបចំ ប្រយោគ New ហើយ Shapefile



- បំពេញឈ្មោះប្រើប្រាស់ Point



- កម្រិតទិន្នន័យរៀបចំ

- ចុចលើ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ UTM



- ដាក់ស្លាក ហៅ ឈ្មោះ WGS 1984
- ដាក់ស្លាក WGS 1984 ឈ្មោះ Northern Hemisphere ប្រព័ន្ធប្រភេទកូអរដោនេ WGS 1984 Zone 48N
- ចុច OK និង Run
- ចុចលើ បញ្ជីបញ្ជីឈ្មោះ ប្រព័ន្ធប្រភេទកូអរដោនេ និងប្រព័ន្ធប្រភេទកូអរដោនេ



- ដាក់ស្លាកលើផលិតផល ប្រើប្រាស់ Absolute X,Y,Z



- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

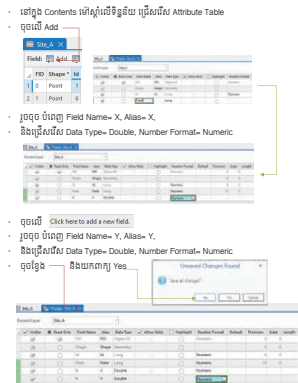
- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

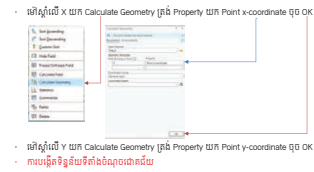
- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

- ប្រព័ន្ធប្រភេទកូអរដោនេ ប្រព័ន្ធប្រភេទកូអរដោនេ

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កម្រងទិន្នន័យរូបវន្ត

- ទិន្នន័យរូបវន្ត (x y z) គឺជាស្រទះរក្សាទុកទិន្នន័យរូបវន្តតាមរយៈតារាងទិន្នន័យ (រូបភាព)

N°	X	Y
1	493318.27	1277336.87
2	493295.00	1277557.90
3	493605.01	1277541.35
4	493634.64	1277321.86

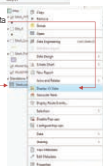
- បញ្ចូលទិន្នន័យទៅ Excel រួច Save As
- និងប្តូរទិន្នន័យទៅ CSV ឬ UTF-8



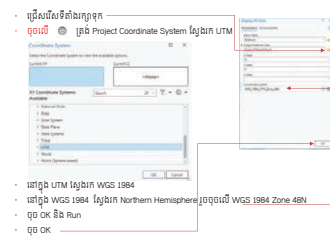
- នៅក្នុង Map ចុច Add Data រួចប្តូរទិន្នន័យ ចុចដើរ រួចចុច OK



- នៅក្នុង Contents ប្រើស្រទះទិន្នន័យ ប្រើស្រទះ Display XY Data



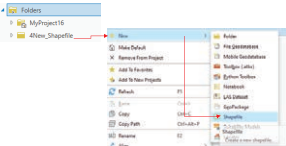
25



26

កម្រងទិន្នន័យផ្សេងៗ

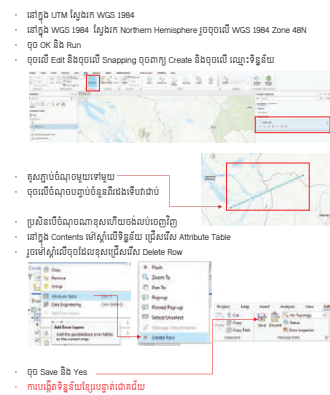
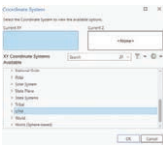
- ទិន្នន័យផ្សេងៗ គឺជាស្រទះរក្សាទុកទិន្នន័យផ្សេងៗ ប្រភេទទិន្នន័យ
- ប្រើស្រទះទិន្នន័យផ្សេងៗ រួមមាន New ឬ New Shapelite



- បំប្លែងទិន្នន័យទៅជា Polyline

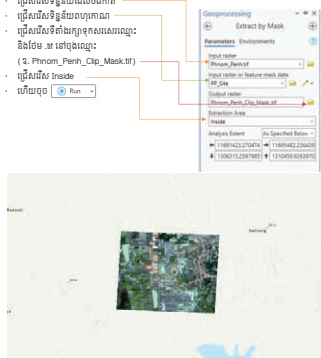


- កម្រងទិន្នន័យផ្សេងៗ គឺជាស្រទះទិន្នន័យផ្សេងៗ
- ចុចដើរ រួចចុច OK រួចចុច OK



29

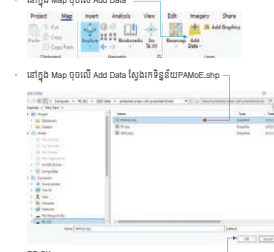
- ជ្រើសរើសទិន្នន័យដែលចង់កាត់
- ជ្រើសរើសទិន្នន័យបរាគុណ
- ជ្រើសរើសទីតាំងក្បែរទុកសរសេរឈ្មោះ និងថ្ងៃខែ ឆ្នាំ នៅចុងឈ្មោះ
(ឧ. Phnom_Penh_Clip_Mask.tif)
- ជ្រើសរើស Inside
- ហើយចុច  Run



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- ការជ្រើសរើសទីតាំងដាក់លាក់
(ទិន្នន័យប្រែប្រួល)

- [illegible]



- GG OK

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- ការពិនិត្យកូអរដោនេ (WGS 1984 Zone 48N)
- ដើម្បីពិនិត្យមើលទិន្នន័យ
- នៅក្នុង View ចុចលើ Geoprocessing



- នៅក្នុង Geoprocessing ចុចលើ Toolboxes ហើយស្វែងរក Data Management



- នៅក្នុង Data Management ផ្សេងៗ Projection and Transformation

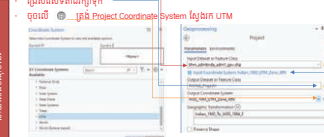
- Batch Project
- Convert Coordinate Reference
- Create Custom Geographic Transformation
- Create Spatial Reference
- Define Projection

- បញ្ចូលទិន្នន័យ រួចជិតវិញមើលកុរអោយនោះ
- ក្នុងការបង្ហាញទិន្នន័យកំពុងប្រើប្រាស់ជាទិន្នន័យ UTM ឬ WGS 1984 Zone 48N

- գտնել

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- ប្រសិនបើមិនចេញ ហាម ឬក្នុងករណីផ្សេង
- បញ្ចូលទិន្នន័យ រួចពិនិត្យមើលក្នុងករណីផ្សេង
- ប្រើសរសេរទិន្នន័យក្នុងករណីផ្សេង



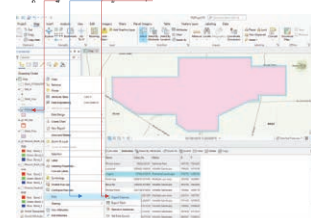
- នៅក្នុង UTM ស្វែងរក WGS 1984
- នៅក្នុង WGS 1984 ស្វែងរក Northern Hemisphere រួចចុចលើ WGS 1984 Zone 48N
- ចុច OK
- និងចុច

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- នៅក្នុង Contents ម៉ោងស្តារលើទិន្នន័យ ជ្រើសរើស Attribute Table
- ស្វែងរកតំបន់ការពារដែលចង់កាត់
- ចុចលើលេខនៅមុខវ៉ាល់ជើង



- រៀនសូត្រលើទិន្នន័យ យក Data ចេញ Export Features

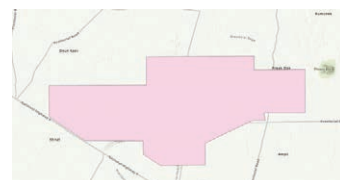


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- ជ្រើសរើសទីតាំងរក្សាទុក បំពេញឈ្មោះ និងចុច Save



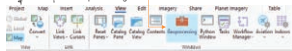
- JGGG OK



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ការជ្រើសរើសទីតាំងដាក់លាក់
(ទិន្នន័យប្រែប្រួល)

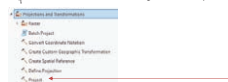
- ចិន្ទន័យត្រូវការ ពហុកោណទីតាំង និងចិន្ទន័យចងកាត់
- ការកាត់ចិន្ទន័យមុខងារពីវិធីសាស្ត្រ ប្រើមុខងារ Select និង Clip
- ការកាត់ចិន្ទន័យដោយ ប្រើមុខងារ Clip
- ការបំប្លែងត្រីកូណដង់ស៊ីតេ (WGS 1984 Zone 48N)
- ដើម្បីបំប្លែងចិន្ទន័យ
- នៅក្នុង View ចុចលើ Geoprocessing



- នៅក្នុង Geoprocessing ចុចលើ Toolboxes ហើយស្វែងរក Data Management



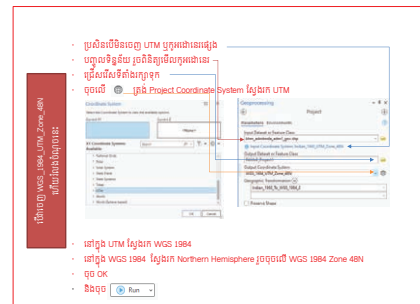
- នៅក្នុង Data Management ស្វែងរក Projection and Transformation
- នៅក្នុង Projection and Transformation ស្វែងរក Project ចុចលើវា



- បញ្ចូលទិន្នន័យ រួចពិនិត្យមើលកូអរដោនេ
- ក្នុងការបង្ហាញទិន្នន័យកំពុងប្រើប្រាស់ជាទិន្នន័យ UTM ឬ WGS 1984 Zone 48N

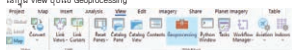


- **ဖုတ်စ်**



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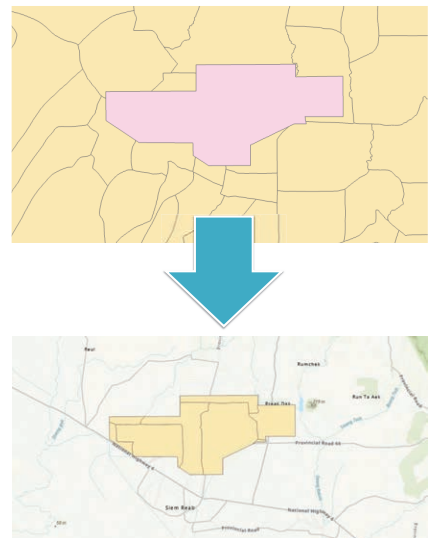
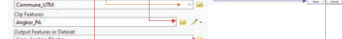
- នៅក្នុង Contents ម៉ោស្ត្រីលើទិន្នន័យ ជ្រើសរើស Attribute Table
- ស្វែងរកតំបន់ការពារដែលចង់កាត់
- ចុចលើលេខនៅមុខវ៉ិដេដ
- នៅក្នុង View ចុចលើ Geoprocessing



- នៅក្នុង Geoprocessing ចុចលើ Toolboxes ហើយស្វែងរក Analysis ចុចលើ Extract

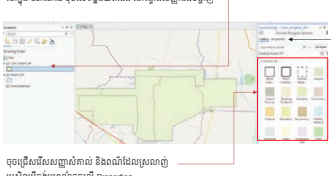


- ជ្រើសរើសទិន្នន័យចងកាត់
- ជ្រើសរើសទីតាំងចងបានទិន្នន័យ
- ជ្រើសរើសទីតាំងរក្សាទុក បំពេញឈ្មោះ ចុច Save និងចុច

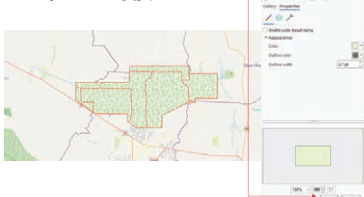


ការដាក់សញ្ញាសំគាល់ និងការបង្ហាញ
ទិន្នន័យក្នុងផែនទី (ការដាក់សញ្ញាសំគាល់)

- ការដាក់សញ្ញាសំគាល់ និងការបង្ហាញទិន្នន័យក្នុងផែនទី
 - ការដាក់សញ្ញាសំគាល់
 - នៅក្នុង Contents ចុចលើទិន្នន័យពីរដង នោះវានឹងបង្ហាញ



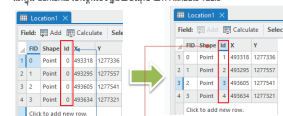
- ជ្រើសរើសពណ៌ដែលអ្នកចង់ប្រើ Apply



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ការដាក់សញ្ញាសំគាល់ និងការបង្ហាញទិន្នន័យ
ក្នុងផែនទី (ការបង្ហាញទិន្នន័យក្នុងផែនទី)

- ការដាក់សញ្ញាសំគាល់ និងការបង្ហាញទិន្នន័យក្នុងផែនទី
 - ការបង្ហាញទិន្នន័យក្នុងផែនទី
 - ការបង្ហាញបង្គោលព្រំ ឬទីតាំងចំណុច *
 - នៅក្នុង Contents ម៉ោងព័ត៌មានន័យចំណុច យក Attribute Table



- ក្នុងការបង្ហាញនេះ ខ្ញុំចង់បង្ហាញបង្គោលជាសេខ ដូចនេះត្រង់ ២៨
- ត្រូវបំពេញលេខរៀង
- នៅក្នុង Edit យក Save



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ការរៀបចំនីតិវិធី

- ការរៀបចំផែនទីលើក្រដាស
 - ការជ្រើសរើសក្រដាស
 - នៅក្នុង Insert ជ្រើសរើស New Layout ...

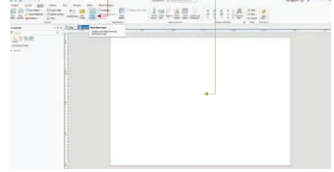


- រូបស្វែងរក A4 (បញ្ជី ឬផ្ទៃ)

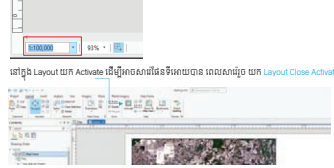


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- ការដាក់ផែនទីលើក្រដាស
- នៅក្នុង Insert ជ្រើសរើស Map Frame យកផែនទីមកតុលក្នុងក្រដាស



- ជ្រើសរើសមាត្រដ្ឋានដែលចង់បង្កើត

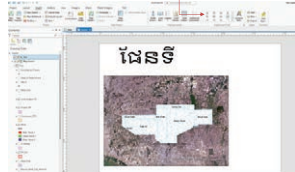


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- ដើម្បីសាងទំហំផែនទី ចុច Layout ឃ្លា Select



- ដើម្បីដាក់អត្ថបទ ឬចំណងជើង ចុច Insert យក A ច្របាប់ទាញលើផែនទី



- ការកែទំហំអក្សរ ចុច Text រួចកែទៅផែនទីជាក់ស្តែង

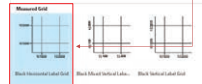


61

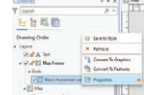
- ការដាក់ក្រឡាចត្រង្គលើផែនទី ចុចលើផែនទី រួចយក Grid



- នៅក្នុង Grid ស្វែងរក Measured Grid រួចជ្រើសរើស

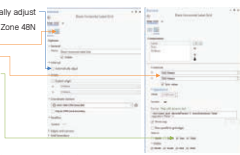


- នៅក្នុង Contents ចុចលើស្តាំលើ **Black Horizontal Label Grid** យក Properties ផ្ទាំងនឹងបង្ហាញនៅស្តាំដែ



62

- 1. **အော့ဖ်** နှစ်ကတည်းက **Automatic** အဖြစ် **adjust** ဖြစ်နေပါသည်။
- 2. **WGS 1984 UTM Zone 48N** ဖြစ်နေပါသည်။
- 3. **Components** ဖြစ်နေပါသည်။
- 4. **ပုံရိပ်** ကြောင့် **အော့ဖ်** ဖြစ်နေပါသည်။
- 5. **အော့ဖ်** **East & West** ဖြစ်နေပါသည်။



- ការដាក់តារាងទិន្នន័យលើផែនទី នៅក្នុង Insert ជ្រើសរើស Table Frame



- ជ្រើសរើសប្រភេទតារាងដែលចង់បាន និងតុលលើផែនទី



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- នៅក្នុង Contents ចុចដក ☐ លើទិន្នន័យដែលមិនចង់បង្ហាញ



- **ការដាក់សញ្ញាសំគាល់ទិស** ចុចលើ North Arrow ជ្រើសរើសសញ្ញា រួចគូសលើផែនទី

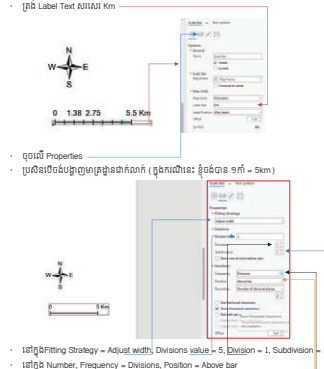


- ការដាក់សញ្ញាបណ្ណាល័យ ចុចលើ Scale Bar ជ្រើសរើសសញ្ញានៅក្នុង Metric
- រួចគូសលើផែនទី



2

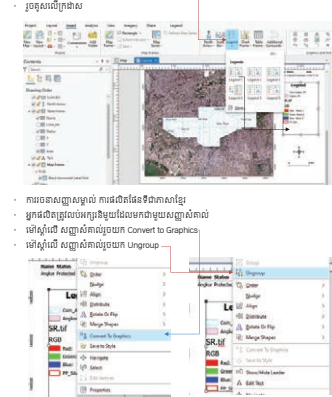
- ការកំណត់តម្លៃមាត្រដ្ឋានដែលចង់បាន
- ម៉ៅស្តាញើរមាត្រដ្ឋាន រួចយក Properties
- ត្រង់ Label Text សរសេរ Km



- **Fit** Fitting Strategy = Adjust width, Divisions value = 5, Division = 1, Subdivision = 1
- **Fit** Number, Frequency = Divisions, Position = Above bar

65

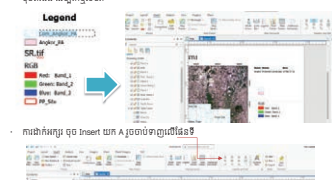
- ការដាក់សញ្ញាសំគាល់
- នៅក្នុង Insert ជ្រើសរើស
- ចុចស្របលើក្រដាស



- ការចងក្រងសញ្ញាសម្គាល់ ការផលិតផែនទីជាកាសាឌ្យ
- អ្នកផលិតត្រូវបំប្លែងរូបមន្តដែលមកជាមួយសញ្ញាសម្គាល់
- មើលស្តារឡើង សញ្ញាសម្គាល់រួមបញ្ចូល Convert to Graphics
- មើលស្តារឡើង សញ្ញាសម្គាល់រួមបញ្ចូល Ungroup

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- ចុចពីរដង ដើម្បីកែប្រែបំណង



- ការដាក់អក្សរ ចុច Insert យក A រួចចាប់ទាញលើផែនទី



- ការដាក់ logo ឬដាក់រូប

- រួចជ្រើសរើស និងតុលលើក្រដាស



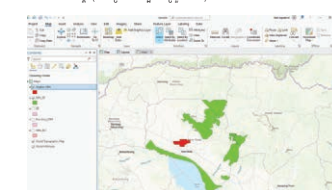
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- ការដាក់បន្ថែមផែនទីបង្ហាញទីតាំង

- នៅក្នុង Insert ជ្រើសរើស New Map រួចយក New Map

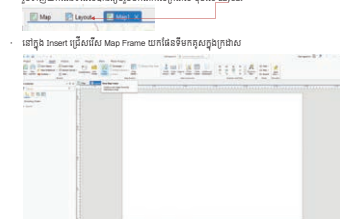


- ខ្ញុំចង់បង្ហាញពីតំបន់ការពារក្នុងខេត្តសៀមរាប ១៣និយ័តដែលខ្ញុំដាក់មាន៖ តំបន់ការពារក្នុងខេត្តសៀមរាប និងតំបន់ការពារជ្រូក (ពណ៌ក្រហមដើម្បីងាយស្រួលមើល)



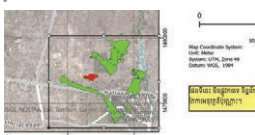
36

- រួចទាញយកផែនទីដែលបានរៀបរួចមកដាក់លើក្រដាស ចុចលើ Layout



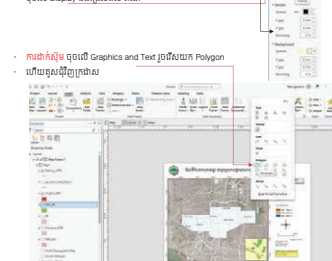
- នៅក្នុង Insert ជ្រើសរើស Map Frame យកផែនទីមកតុសក្នុងក្រដាស

- រួចសាងទំហំដែលចង់បាន



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- កង្វះកំណែប្រែក្រោយ
- មើលលើផែនទីរួមក្នុង Properties
- ចូរលើ Display និងជ្រើសរើស ពណ៌



- **ករណីកំស្លឹម** ចូចលើ Graphics and Text រួចវែសយក Polygon
- ហើយគូសជុំវិញក្រដាស

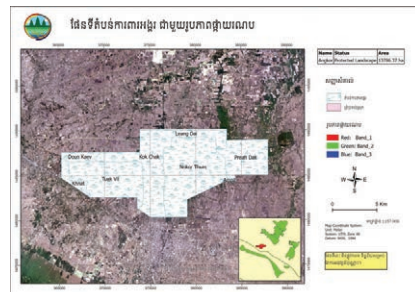
- កងធាតុស្រុះ ចុះលើ Gra
- ហើយគូសដុំវិញកងាស

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- ការបញ្ចេញទិន្នន័យជាទម្រង់ Geo-PDF
- ទៅក្នុង Share ប្រើសេរី Export Layout ហើយយក GeoReferenced PDF
- ប្រើប្រាស់ប៊ូតុងទី៣ ដើម្បី Export



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1. ចាប់ផ្តើម

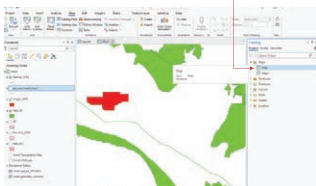
ប្រើប្រាស់ប៊ូតុងទី៣



- ទៅក្នុងView ចូលដល់ Contents

2. ប្រើប្រាស់ផែនទី

- ទៅក្នុងView ចូលដល់ Catalog Pane
- ទៅក្នុង Maps ចូលដល់ ផែនទីដែលចាត់



3. ប្រើប្រាស់ផែនទី

- ទៅក្នុងView ចូលដល់ Catalog Pane
- ទៅក្នុង Layout ចូលដល់ ផែនទីដែលចាត់



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Appendix 4: GIS Training Material (Intermediate to Advanced)

Day 01 Orientation

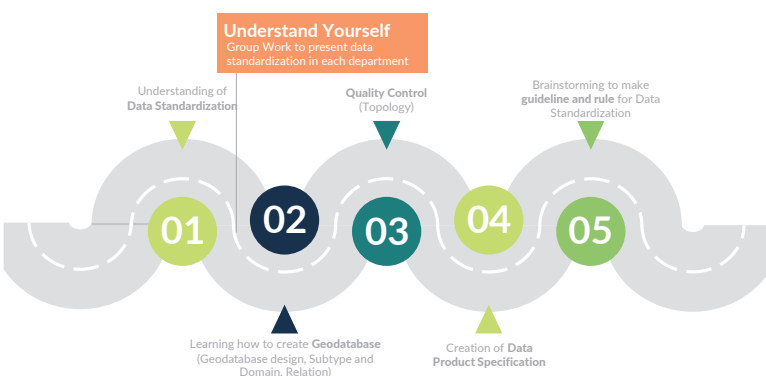
Intermediate and Advanced GIS Training

From 15th July to 19th July, 2024

Overview of training

Target	Mainly for the departments of GIS data producer.
Training Period	From 15th to 19th July 2024.
Equipment	Laptop with ArcGIS Pro and Microsoft Office
Contents	❖ Understanding of Data Standardization. ❖ Learning how to create Geodatabase which contributes to have data uniformity. ❖ Learning how to prepare Data Product Specification. ❖ Brainstorming about Guideline and Rule for Data Standardization.

Overview of training



Training curriculum

Date	Time (TBD)		Program outline	Course style	Equipment
1	15-Jul-24	9:00 - 12:00 14:00 - 16:00	Mon	9:00 - 9:30 Training orientation and self-introduction	Presentation
				9:30 - 10:30 Understanding of Data Standardization (Data Product Specification)	Presentation
				10:30 - 11:30 Summarize the spatial data and its standardization in each department	Groupwork
				11:30 - 12:00 Presentation about spatial data and its standardization in each department	Groupwork
				14:00 - 15:00 Presentation about spatial data and its standardization in each department (Ctnrd.)	Groupwork
2	16-Jul-24	9:00 - 12:00 14:00 - 16:00	Tue	15:00 - 16:00 Understanding of Geodatabase	Groupwork
				9:00-12:00 Creation of Geodatabase (Setting subtype and domain for Land use land cover data)	Hands-on
3	17-Jul-24	9:00 - 12:00 14:00 - 16:00	Wed	14:00-16:00 Understanding of Topology	Presentation and Hands-on
				9:00-12:00 Creation of Data Product Specification for LULC data	Hands-on
4	18-Jul-24	9:00 - 12:00 14:00 - 16:00	Thu	14:00 - 16:00 Geodatabase design for PA boundary	Groupwork
				9:00 - 10:30 Discussion of Geodatabase design for PA boundary	Groupwork
				10:30 - 12:00 Setting of Relation (Administrative boundary and PA boundary data)	Hands-on
5	19-Jul-24	9:00 - 12:00	Fri	14:00 - 16:00 Guideline and Rule for data standardization	Presentation and Groupwork
				9:00-11:00 Review of the training	-
				11:00-12:00 Summary questionnaire	PC, ArcGIS Pro, Word

Day 01 Data Standards

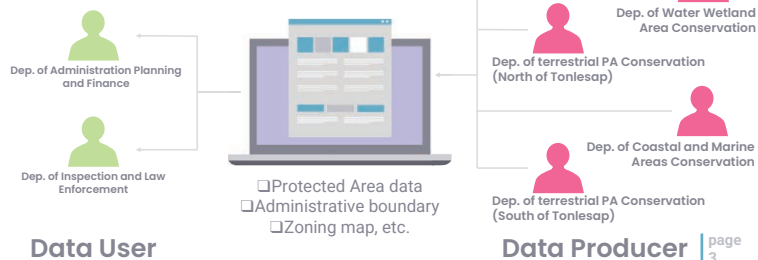
Intermediate and Advanced GIS training

From 15th July to 19th July, 2024

What is Data Standards?

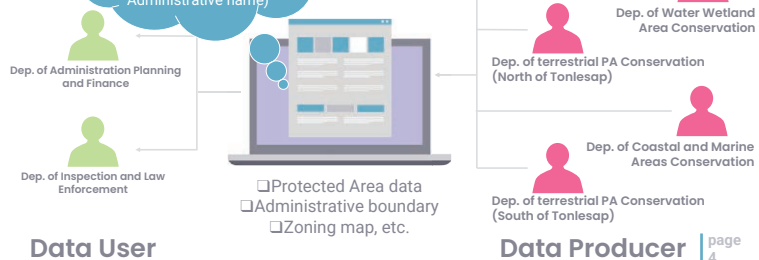
What is "Data Standards"?

Let's start from thinking about GDNPA.



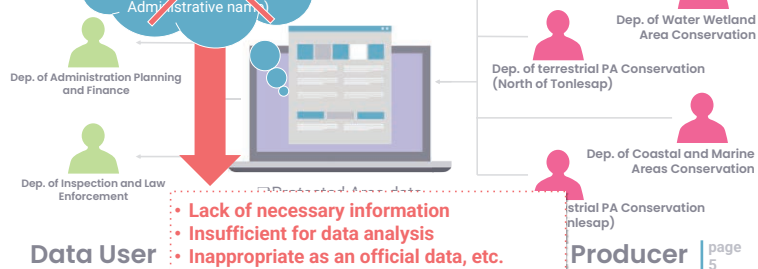
What is

Let's start from thinking about MPA.



What is

Let's start from thinking about MPA.



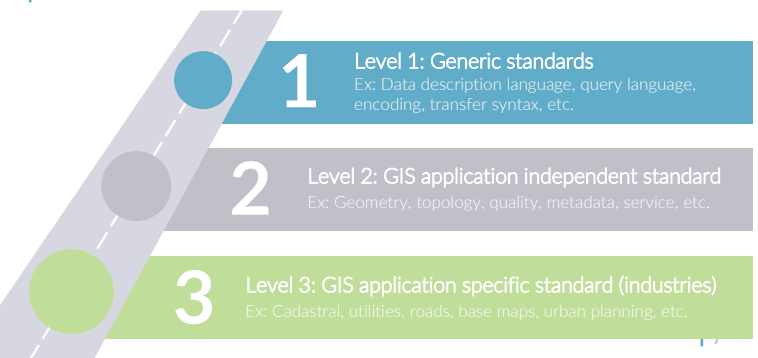
Data standards

The objective of the data standard is to allow **the producer and user to interpret and understand data same way.**

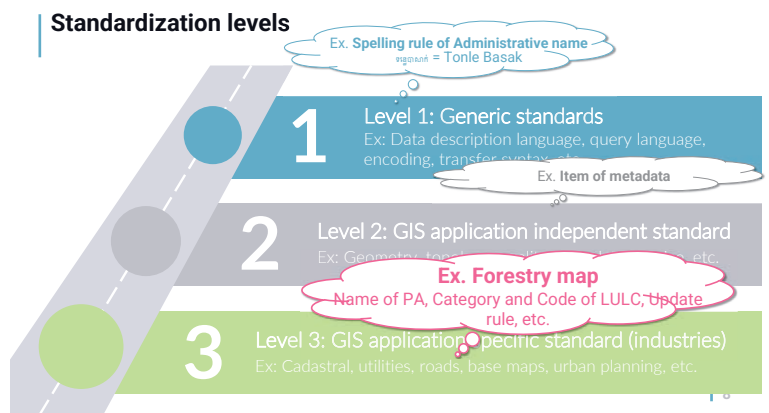
The standards provide definition of data structure, data content and rules that

- I. Increase **mutual understanding** of the geographic data among the users
- II. **Eliminate the technical problems** of exchanging the data
- III. **Increase the integration, combination and interoperability**

Standardization levels



Standardization levels



Open Geospatial Consortium (OGC)

Established in the year 1995 by

- Data base system vendors
- GIS vendors
- Information technology companies

OGS works on the development of **open solutions** linked to the processing of Geographical information.

The objective here is to **efficient transfer of GIS data across systems of various platform**.

Besides, **ISO/TC211** (Technical Committee of Geographic Information / Geomatics) has standardized the rules of **Data Product Specifications (DPS)** as **ISO 19131**, (finalized in 2007, amended in 2011, updated in 2022).

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Elements of standardization

The following are some of the elements being worked on in ISO 19100 series

1. Conceptual modelling and application schemas
2. Transfer format
3. Encoding
4. Spatial representation
5. Spatial referencing
6. Temporal characteristics
7. Data quality description and evaluation
8. Visualization / Portraying
9. Geographic information services and interface
10. Object catalogue
11. Metadata

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The Project for National and Sub-National Capacity Development for Sustainable Natural Resource Management

Day 02 Geodatabase Creation

Intermediate and Advanced GIS Training

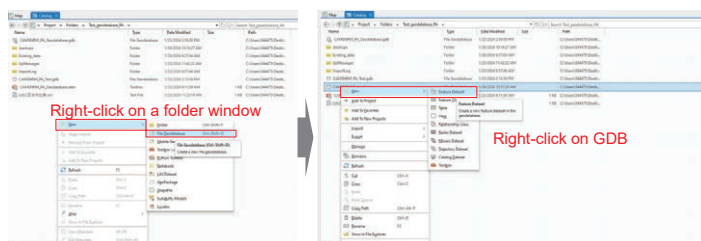
From 15th July to 19th July, 2024

Agenda

1. Creation of Geodatabase
2. Input LULC data
 - a. Downloading LULC data from SERVIR ASIA
 - b. Reclassify the downloaded raster data
 - c. Polygonization of classified data
 - d. Append the LULC data to created geodatabase
3. Finalize LULC data according to MoE classification

1. Creation of Geodatabase

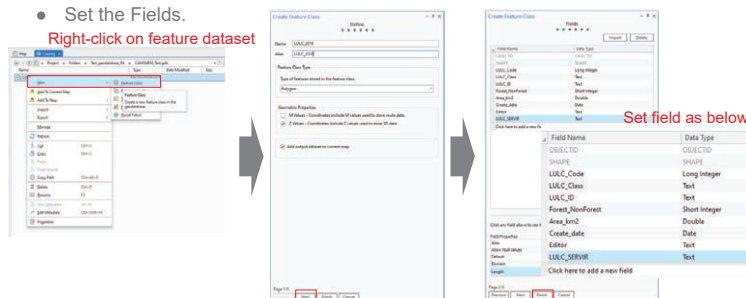
- In Catalog view, Create New File Geodatabase (Name: CAMSNRM_Test.gdb)
- Create New Feature Dataset under the geodatabase (Name: LULC/ Coordinate system: WGS_1984_UTM_Zone_48N)



1. Creation of Geodatabase

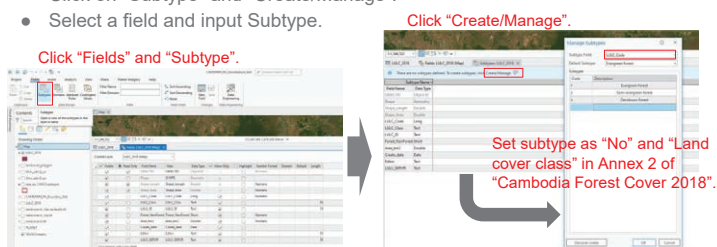
- Create Feature Class (Name and Alias: **LULC_2018/** Type: **Polygon**).
- Set the Fields.

Right-click on feature dataset



1. Creation of Geodatabase

- Set the Subtype. Open attribute table. From Table tab, click on "Fields".
- Click on "Subtype" and "Create/Manage".
- Select a field and input Subtype.



1. Creation of Geodatabase

- Input LULC category name in "LULC_Class" field.
- Input LULC category ID in "LULC_ID" field.

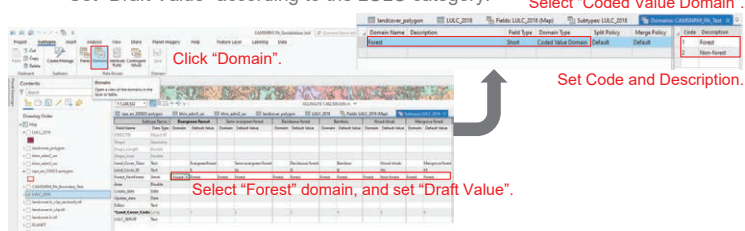
↓ Input LULC category name one by one.

↑ Input LULC category ID based on Annex 2.

Field Name	Data Type	Domain	Default Value	Domain	Default Value	Domain	Default Value	Domain	Default Value	Domain	Default Value	Domain	Default Value	Domain	Default Value
Subtype	Text	Emergent Forest		Semi-emergent Forest		Deciduous Forest		Bamboo		Wood Shrub		Mangrove Forest		Rice Mangrove	
Land_Cover_Class	Text	Emergent Forest		Semi-emergent Forest		Deciduous Forest		Bamboo		Wood Shrub		Mangrove Forest		Rice Mangrove	
Land_Cover_ID	Text	1		2		3		4		5		6		7	

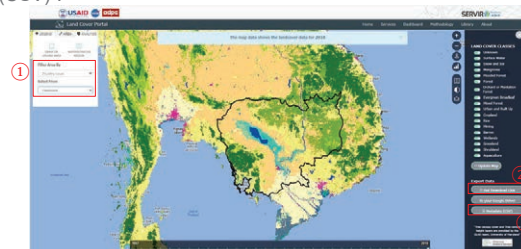
1. Creation of Geodatabase

- Create Domain. Select "Forest_NonForest" field.
- Click on "Domain" and select "Coded Value Domain".
- Set the code and description.
- Set "Draft Value" according to the LULC category.



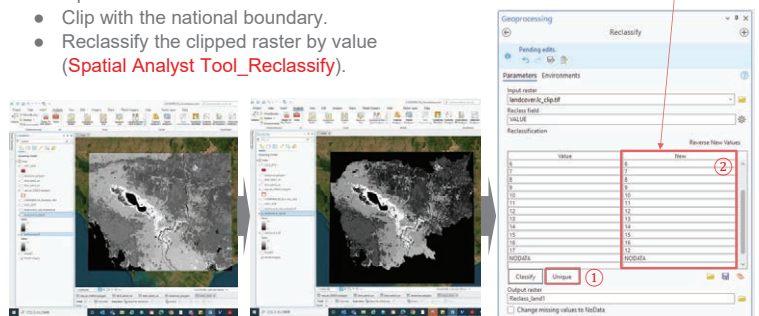
2. Input LULC data_Downloading LULC data from SERVIR SEA

- Open [Regional Land Cover Monitoring System \(landcovermapping.org\)](http://landcovermapping.org)
- Click on "AREA" and select "Country level" and "Cambodia".
- Click on "Get Download Link" and download in a new tab.
- Click on "Metadata (CSV)".



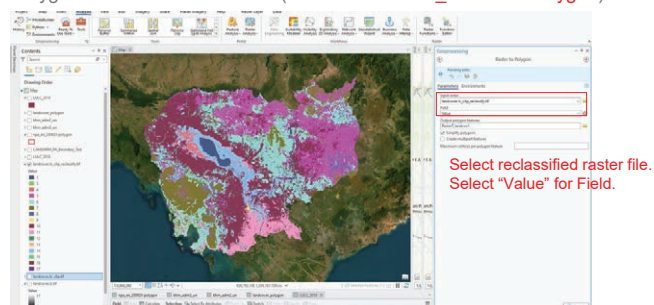
2. Input LULC data_Reclassify the downloaded raster data

- Open the downloaded LULC raster data.
- Clip with the national boundary.
- Reclassify the clipped raster by value (Spatial Analyst Tool_Reclassify).



2. Input LULC data_Polygonization of classified data

- Polygonize the classified raster (Conversion Tools_Raster to Polygon).



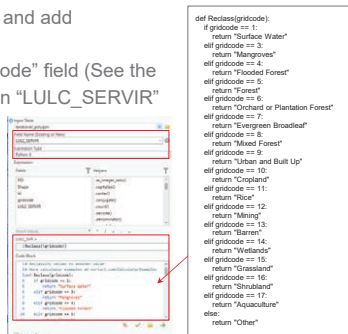
2. Input LULC data_Polygonization of classified data

- Open the attribute table of polygon data and add "LULC_SERVIR" field (Type: Text (50)).
- Input LULC category according to "gridcode" field (See the downloaded metadata file). Right click on "LULC_SERVIR" field and select "Calculate field".

-Expression Type: Python 3

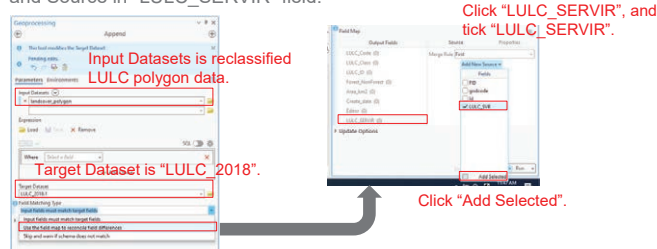
-LULC_SERVIR: Reclass(Igridcode!)

-Code Block: Input as right figure.



2. Input LULC data_Append the LULC data to created geodatabase

- Append the LULC data to created geodatabase (**Data Management Tools_Append**).
- Select "Use the field map to reconcile field differences" and set the Output Fields and Source in "LULC_SERVIR" field.



3. Finalize LULC data according to MoE classification

- Input Land Cover Code according to "LULC_category_comparison.xlsx".

For example, select "Forest" in "LULC_SERVIR" field, and calculate field of "Land Cover Code as "Deciduous forest".

Area	Land Cover Code	Land Cover Class	Land Cover ID	Forest/Non-forest	Area	Create date	Update date	Editor	LULC_SERVIR
012.576407	Deciduous forest	Deciduous forest	D	Forest	0.071014	1/23/2024	<Null>	<Null>	Forest
009.076111	Deciduous forest	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Mixed Forest
4391.270045	Tree plantation	Tree plantation	TP	Forest	0.134391	1/23/2024	<Null>	<Null>	Orchard or Plantation...
009.780749	Deciduous forest	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Mixed Forest
009.974632	Deciduous forest	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Mixed Forest
009.398108	Grassland	Grassland	G	Non-forest	0.050899	1/23/2024	<Null>	<Null>	Grassland
1848.524978	Deciduous forest	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Forest
1798.534189	Deciduous forest	Deciduous forest	D	Forest	0.101798	1/23/2024	<Null>	<Null>	Forest
1798.640241	Bergreen forest	Bergreen forest	B	Forest	0.101798	1/23/2024	<Null>	<Null>	Bergreen Broadleaf
009.671540	Deciduous forest	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Mixed Forest
1798.556407	Deciduous forest	Deciduous forest	D	Forest	0.1018	1/23/2024	<Null>	<Null>	Forest
2699.805705	Deciduous forest	Deciduous forest	D	Forest	0.1527	1/23/2024	<Null>	<Null>	Mixed Forest

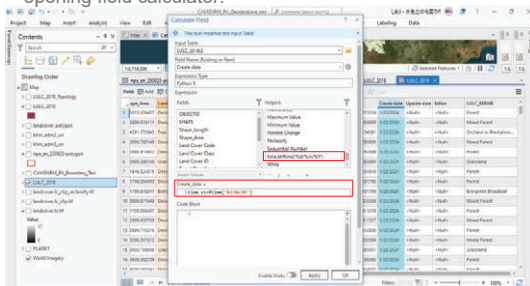
3. Finalize LULC data according to MoE classification

- In case of using "Field calculation", subtype and domain setting will not apply automatically.
- Therefore, "Land Cover Class", "Land Cover ID", and "Forest/Non-forest" fields should be input manually by using field calculation.

Area	Land Cover Code	Land Cover Class	Land Cover ID	Forest/Non-forest	Area	Create date	Update date	Editor	LULC_SERVIR
012.576407	Deciduous forest	Deciduous forest	D	Forest	0.071014	1/23/2024	<Null>	<Null>	Forest
009.076111	Deciduous forest	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Mixed Forest
4391.270045	Tree plantation	Tree plantation	TP	Forest	0.134391	1/23/2024	<Null>	<Null>	Orchard or Plantation...
009.780749	Deciduous forest	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Mixed Forest
009.974632	Deciduous forest	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Mixed Forest
009.398108	Grassland	Grassland	G	Non-forest	0.050899	1/23/2024	<Null>	<Null>	Grassland
1848.524978	Deciduous forest	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Forest
1798.534189	Deciduous forest	Deciduous forest	D	Forest	0.101798	1/23/2024	<Null>	<Null>	Forest
1798.640241	Bergreen forest	Bergreen forest	B	Forest	0.101798	1/23/2024	<Null>	<Null>	Bergreen Broadleaf
009.671540	Deciduous forest	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Mixed Forest
1798.556407	Deciduous forest	Deciduous forest	D	Forest	0.1018	1/23/2024	<Null>	<Null>	Forest
2699.805705	Deciduous forest	Deciduous forest	D	Forest	0.1527	1/23/2024	<Null>	<Null>	Mixed Forest

3. Finalize LULC data according to MoE classification

- To input "Create_date" field, double click on "time.strftime('%d/%m/%Y')"



The Project for National and Sub-National Capacity Development for Sustainable Natural Resource Management

Day 03 Creation of DPS

Intermediate and Advanced GIS Training

From 15th July to 19th July, 2024

01

What is DPS?

Definition of DPS (ISO 19131)

Data Product Specification

Detailed description of a dataset series together with additional information that will enable it to be **created, supplied to** and **used by another party**.

ISO 19131:2022 Geographic information, Data product specifications

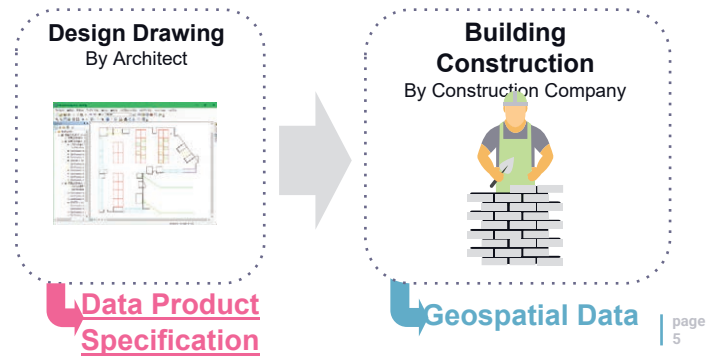
page 3

Role of DPS



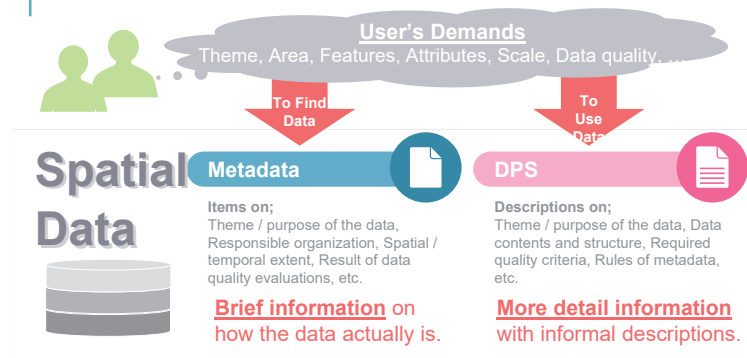
page 4

Role of DPS 1: Design drawing of the data



page 5

Role of DPS 2: Guide for another party



General structure of DPS (ISO 19131:2007)



page 7

Let's try making DPS

Front page information

Theme of the Geographic Information

Ex: Land Use Land Cover data of Sustainable Natural Resources Management Project.

Under this theme a lot of Geo-Spatial data is prepared/generated.

Creation date of the DPS

When was the DPS created for an organization? (specific data / range of dates)

Name of the responsible organizations of this DPS

Name of the organization for whom the DPS is created.

Sample

DATA PRODUCT SPECIFICATIONS
ON
LAND USE LAND COVER DATA
IN
SUSTAINABLE NATURAL RESOURCES
MANAGEMENT PROJECT

(Sample)

DD July 2024

Ministry of Environment, Cambodia
JAPAN COOPERATION AGENCY (JICA)
Asia Air Survey Co., Ltd.

page
9

Overview section

Information about the creation of the DPSs

Basic information on creation of the DPS

Objective

Objectives of the geographic information specified by the DPS

Extent of the data

Information about the spatial, vertical and temporal extent of the data. Maximum and minimum latitude and longitude may be added. (all data under the theme)

Normative reference

Data creation rules, regulations, guidelines, etc. If there are any internal documents or guidelines.

Sample

1. Overview
1.1. Information about the creation of the data product specifications
a. Title: Data Product Specifications on Land Use Land Cover (LULC) data
b. Date: 2024/07/01
c. Prepared by: Ministry of Environment
d. Language: English
e. Topic category: Land Use Land Cover Map
f. Document format: Microsoft Word
1.2. Objectives
This document describes the structure of Geodatabase of Sustainable Natural Resources Management Project (SNRM) data which is designed and developed for natural resources management including forest and others. The database consists of Land Use Land Cover data.
1.3. Extent of the data
The whole country of Cambodia.
1.4. Normative references
Cambodia Forest Cover 2018
Land Cover Data of SERVIR ASIA
Guidelines for Data Product Specifications
Guidelines for Data Quality
Guidelines for Metadata
2. Scope
2.1. Scope identification
This data product specifications on the LULC data in the 'Sustainable Natural Resources Management Project' funded by Japan International Cooperation Agency (JICA).
2.2. Hierarchical level
National level of Cambodia
3. Data Product Identification
3.1. Name
Geodatabase of Sustainable Natural Resources Management Project (SNRM_data)
3.2. Date of data creation
The SNRM_data is the LULC database which is prepared by using land cover data of SERVIR ASIA referring to the land use category of Ministry of Environment, Cambodia.
3.3. Contact information
Ministry of Environment, Cambodia
ADDRESS: Manasoki Tacha Building (Lot 503), Trade Bazaar, Chamkarum, Phnom Penh 120101, Cambodia
TEL: (+855) 23 213 908 / (+855) 23 220 369
FAX:
URL: https://www.moe.gov.kh/en
3.4. Geographic description
The SNRM_data covers the entire Cambodia.

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Scope section

Scope identification

What is the scope of the theme for which this DPS is being created.

Hierarchical level

End user's hierarchy for this DPS.

Sample

2. Scope
2.1. Scope identification
The data product specifications on the LULC data in the 'Sustainable Natural Resources Management Project' funded by Japan International Cooperation Agency (JICA).
2.2. Hierarchical level
National level of Cambodia

page 11

Data Product Identification section

Name

Name of the theme

Date of data creation

When was the data created (specific date / time or period)? It is possible to display the creation date of individual data items.

Contact information

Designation of contact person, department, section, physical address, organizational relevant email, phone no, FAX and website.

Geographic description

The relative extend of the prepared data (i.e., whole Cambodia, only 'XXX' Province).

Sample

3. Data Product Identification
3.1. Name
Geodatabase of Sustainable Natural Resources Management Project (SNRM_data)
3.2. Date of data creation
The SNRM_data is the LULC database which is prepared by using land cover data of SERVIR ASIA referring to the land use category of Ministry of Environment, Cambodia.
3.3. Contact information
Ministry of Environment, Cambodia
ADDRESS: Manasoki Tacha Building (Lot 503), Trade Bazaar, Chamkarum, Phnom Penh 120101, Cambodia
TEL: (+855) 23 213 908 / (+855) 23 220 369
FAX:
URL: https://www.moe.gov.kh/en
3.4. Geographic description
The SNRM_data covers the entire Cambodia.

page 12

Data content and structure section

The DPS creator may refer the other official document where everything about the data structure will be written.

For example:

- Feature dataset
 - Feature class
 - Feature type
 - Field name
 - Field type
 - Field length
 - Field definition
- etc. should be included.

If there is no document, then this kind of document on existing data need to be created.

Sample

4. Data Content and Structure
Data consists of LULC layer.
Item
Description
Geodatabase name: SNRM_DATA.mxd
Feature dataset name: LULC_C_2018
Feature class name: LULC_C_2018
Feature type: Polygon
Number of record: 171,489
Data source: Created by using land cover data of SERVIR ASIA with land use land cover category of Ministry of Environment of Cambodia.
Coordinate system: WGS1984 UTM Zone48N
Unit: Meter
Field name
Alias
Type
Domain
Remarks
OBJECTID
OBJECTID
Shape
Shape
Shape_Length
Shape_Length
Shape_Area
Shape_Area
Land_Cover_Code
Land_Cover_Code
Land_Cover_ID
Land_Cover_ID
Forest_NonForest
Forest_NonForest
Area
Area
Created_date
Created_date
Updated_date
Updated_date
Editor
Editor
Land_Cover_Code
Land_Cover_Code
LULC_SERVIR
LULC_SERVIR

page 13

Data content and structure section

Subtype and domain details should be written.

Sample

Subtype name	Field	Code	Description	Relationship field (Set as default value)	Land_Cover_Class	Land_Cover_ID
LULC category	Land_Cover_Code	1	Evergreen forest	Evergreen forest	E	
		2	Semi-evergreen forest	Semi-evergreen forest	Se	
		3	Deciduous forest	Deciduous forest	D	
		4	Bamboo	Bamboo	B	
		5	Wood shrub	Wood shrub	WS	
		6	Mangrove forest	Mangrove forest	M	
		7	Ram Mangrove	Ram Mangrove	RM	
		8	Rubber plantation	Rubber plantation	Rp	
		9	Flooded Forest	Flooded Forest	FF	
		10	Forest Regrowth	Forest Regrowth	Fr	
		11	Pine Tree	Pine Tree	P	
		12	Pine plantation	Pine plantation	Pp	
		13	Old rubber	Old rubber	Or	
		14	Tree plantation	Tree plantation	Tp	
		15	Paddy field	Paddy field	Pf	
		16	Crop Land	Crop Land	C	
		17	Cropland	Cropland	G	
		18	Build-up area	Build-up area	Ba	
		19	Village	Village	Bv	
		20	Rock	Rock	R	
		21	Sand	Sand	S	
		22	Water	Water	W	

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14

Reference system section

Spatial reference system

Geographic identifiers, as defined in ISO 19111 or ISO 19112. The name and type of the projection system

Temporal reference system

Temporal reference system, as defined in ISO 19108. (i.e., Gregorian Calendar)

ISO 19111:2019 Geographic information, Referencing by coordinates
ISO 19112:2019 Geographic information, Spatial referencing by geographic identifiers
ISO 19108:2002 Geographic information, Temporal schema

Sample

5. Reference Systems
5.1. Spatial reference system
Projection System: WGS 1984 UTM Zone 48N
Projection parameter: Transverse Mercator
Fake Easting: 500000.0
Fake Northing: 0.0
Central Meridian: 45.0
Scale Factor: 0.9996
Latitude of Origin: 0
Linear Unit: Meter (1.0)
Geographic Coordinate System: WGS 1984
Angular Unit: Degree (0.0174532925199433)
Prime Meridian: Greenwich (0.0)
Datum: D WGS 1984
Spheroid: WGS 1984
Semimajor Axis: 6378137.0
Semiminor Axis: 6356752.314245179
Inverse Flattening: 298.257222583
5.2. Temporal reference system
Reference system identifier: Gregorian Calendar

page
15

Data quality section

Direct evaluation method

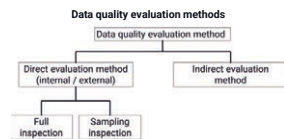
The direct evaluation method may refer internal data only or external reference data for compare. Both internal / external ways may apply to the full inspection and sampling.

Indirect evaluation method

The indirect evaluation system method is a method of quality evaluation of a dataset based on external knowledge or experience. External quantitative quality information or other quality evaluation reports on the resource dataset used in creating the dataset.

Sample

6. Data Quality
The data may include:
The satellite imagery used:
If you use satellite data, please describe details here.
Secondary data:
Land cover data of SERVIR ASIA
Field survey:
If you conduct field survey for data collection, please describe details here.



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16

Data product delivery section

Name of data formats

Data delivery formats which selectable for users. For example: ArcGIS Geodatabase format, Shape files format, etc.

Unit

The units of delivery (e.g., tiles, layers, geographic areas).

Structure of data set

The structure of the data set is along with the data content and structure described in Data Content and Structure Section.

Encoding rules

Name of the character coding standard used for the dataset.

Language

In which language it is delivered.

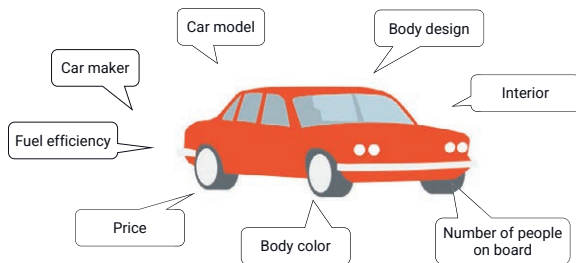
Sample

7. Data Product Delivery
7.1. Name of data formats
ArcGIS Geodatabase format, (Shapefile format)
7.1.1. Unit
Layers, (Dataset)
7.1.2. Structure of the delivery file
7.2.1. Structure of data set
Same as data content and structure document provided as Annex 1.
7.2.2. Encoding rules
UTF-8, ArcGIS Geodatabase format
7.2.3. Language
English, Khmer

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17

Metadata section

What is Metadata?



Search at car dealer, etc.

page
18

Metadata section

Need to describe the rules of the metadata.

The DPS creator may refer the other official document as a metadata description rules. (if anything exists).

Sample

8. Metadata
Metadata of this database is shown as below table.
Data type
Abstract
A spatial data layer containing the land use land cover information in the whole Cambodia.
Data source
Created by using the land cover data of SERVIR ASIA referring the land use land cover category of Ministry of Environment in Sustainable Natural Resources Management Project.
Date of Creation
July 2024
Quality
The original land cover data is 30m resolution. It is recommended that the data layer should not be used exceeding above-mentioned scale in any kind of analysis.
Spatial extent
The data layer covers the whole Cambodia.
Coordinate system
Projection: WGS 1984 UTM Zone 48N
Coordinate system: WGS 1984
History of the dataset
Newly created in this project.
Responsible organization and contact
Ministry of Environment
Purpose of production
To monitor the forest cover area in Cambodia.
Process description
This data layer is created by using the land cover data of SERVIR ASIA referring the land use land cover category of Ministry of Environment.

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Additional information section

Other aspects of the data which are not provided elsewhere in the specification. Free text descriptions is also expected.



Thank you
For your kind attention

The Project for National and Sub-National Capacity Development for Sustainable Natural Resource Management

Day 04 Brainstorming of Data Creation Rule

Intermediate and Advanced GIS Training

From 15th July to 19th July, 2024

Which kind of rule is necessary to standardize the data within GDNPA?

*In case of PA boundary data.

- 1. About Data Structure?
 - Ex. Set basic fields to be included in PA boundary.
 - Coordinate System: UTM Zone 48 N (Datum: WGS1984)
 - Data Creator
 - DPS/ Metadata
 - Must have PA Code (standard)
- 1. About Data Input Rule?
 - Must use official name and spelling for Khmer and English.

The Project for National and Sub-National Capacity Development for Sustainable Natural Resource Management

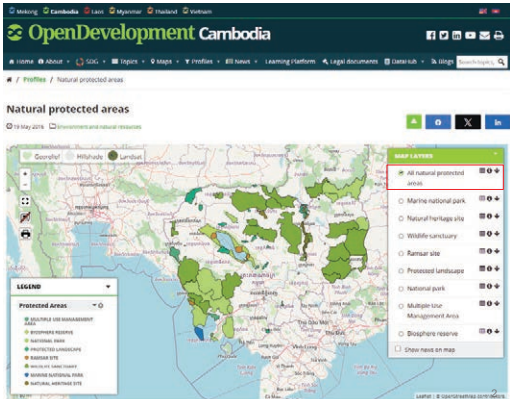
Day 04 Setting of Append/Join (PA boundary)

Intermediate and Advanced GIS Training

From 15th July to 19th July, 2024

0. Data download

[Natural protected areas | Open Development Cambodia \(ODC\)](#)



←Must include for “Relate”/”Join

1. Creation of Geodatabase

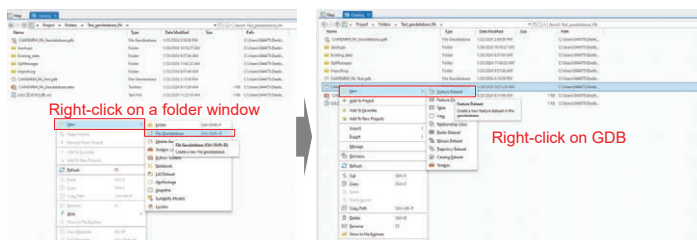
- Geodatabase design_Field

Field name	Alias	Data type	Length	Domain
PA_SN	PA_SN	Short	-	No
PA_Code	PA_Code	Text	10	No
PA_Name_KH	PA_Name_KH	Text	200	No
PA_Name_EN	PA_Name_EN	Text	200	No
PA_Type	PA_Type	Text	50	Domain
Province	Province	Text	255	No
Area_Ha_d	Area_Ha_document	Text	50	No
Area_Ha_a	Area_Ha_actual	Double	-	No
Ref_doc	Reference_document	Text	255	No
Issu_date	Issue_date	Date	-	No

3

1. Creation of Geodatabase

- In Catalog view, Create New File Geodatabase (Name: CAMSNRM_PA_Boundary.gdb)
- Create New Feature Dataset under the geodatabase (Name: PA_Boundary/ Coordinate system: WGS_1984_UTM_Zone_48N)

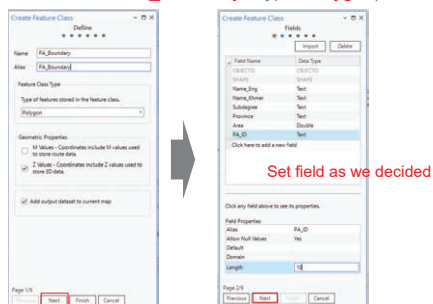


4

1. Creation of Geodatabase

- Create Feature Class (Name and Alias: **PA_Boundary/** Type: **Polygon**).
- Set the Fields.

Right-click on feature dataset



Set field as we decided

5

2. Data integration

- Compare the fields of “PA_Boundary” and existing data.
- Decide how to combine data.

Need the other data source.

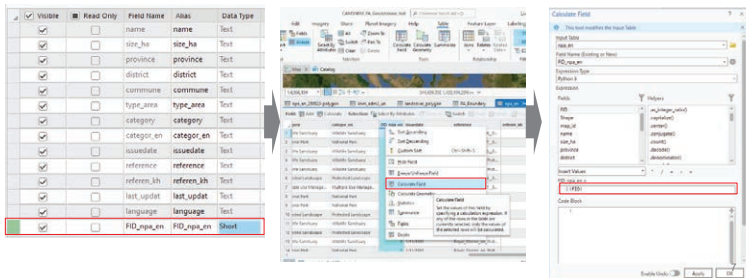
Visible	Read Only	Field Name	Alias	Data Type
☒	☒	OBJECTID	OBJECTID	Object ID
☒	☐	Shape	SHAPE	Geometry
☒	☒	Shape_Length	Shape_Length	Double
☒	☒	Shape_Area	Shape_Area	Double
☒	☐	Name_Eng	Name_Eng	Text
☒	☐	Name_Khmer	Name_Khmer	Text
☒	☐	Subdegree	Subdegree	Text
☒	☐	Province	Province	Text
☒	☐	Area	Area	Double
☒	☐	PA_ID	PA_ID	Text
☒	☐	FID_npa_en	FID_npa_en	Short

6

2. Data integration

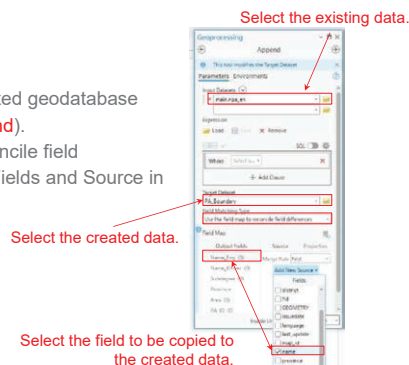
- Data edition of existing data for data integration (Add FID: unique number).

*Necessary to use “Join and Relates” functions.



2. Data integration

- Append the existing data to created geodatabase (**Data Management Tools_Append**).
- Select “Use the field map to reconcile field differences” and set the Output Fields and Source in “the existing data” field.



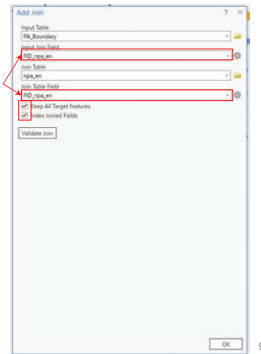
8

2. Data integration

- Join the existing data table to the created data (Joins and Relates, Add Join).

Select "key" field.

Right click on the created data, and click "Add Join".



2. Data integration

Field	Add	Calculate	Selection	Select By Attributes	Tools	Switch	Clear	Print	Copy
1	Name_Eng	Name_Khmer	Subdegree	Province	Area	PA_ID	FD	map	map
2	191	Prey Lang Village Sat...	<Null>	<Null>	431600	<Null>	0	0	pa_id_1
3	192	Prey Lang Village Sat...	<Null>	<Null>	431600	<Null>	1	1	pa_id_2
4	193	Prey Lang Village Sat...	<Null>	<Null>	431600	<Null>	2	2	pa_id_3
5	194	Prey Lang Village Sat...	<Null>	<Null>	431600	<Null>	3	3	pa_id_4
6	195	Prey Lang Village Sat...	<Null>	<Null>	431600	<Null>	4	4	pa_id_5
7	196	Prey Lang Village Sat...	<Null>	<Null>	431600	<Null>	5	5	pa_id_6
8	197	Prey Lang Village Sat...	<Null>	<Null>	431600	<Null>	6	6	pa_id_7
9	198	Prey Lang Village Sat...	<Null>	<Null>	431600	<Null>	7	7	pa_id_8
10	199	Prey Lang Village Sat...	<Null>	<Null>	431600	<Null>	8	8	pa_id_9

Fields of the created data

Fields of the existing data

* Additional exercise

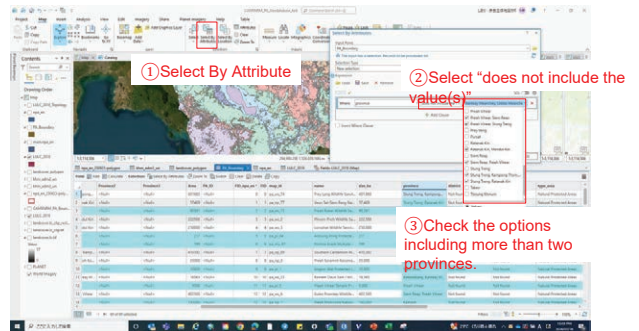
(Copy "Province" information separately.)

Visible	Read Only	Field Name	Alias	Data Type	Allow Null	Highlight	Number Format	Domain	Default	Length
☒	☒	OBJECTID	OBJECTID	Object ID	☒	☐	Numeric			
☒	☒	Shape	Shape	Geometry	☒	☐				
☒	☒	Shape_Length	Shape_Length	Double	☒	☐	Numeric			
☒	☒	Shape_Area	Shape_Area	Double	☒	☐				
☒	☐	Name_Eng	Name_Eng	Text	☒	☐				255
☒	☐	Name_Khmer	Name_Khmer	Text	☒	☐				255
☒	☐	Subdegree	Subdegree	Text	☒	☐				255
☒	☐	Province1	Province1	Text	☒	☐				200
☒	☐	Province2	Province2	Text	☒	☐				255
☒	☐	Province3	Province3	Text	☒	☐				255
☒	☐	Area	Area	Double	☒	☐	Numeric			
☒	☐	PA_ID	PA_ID	Text	☒	☐				10

Add "Province2" and "Province3" fields

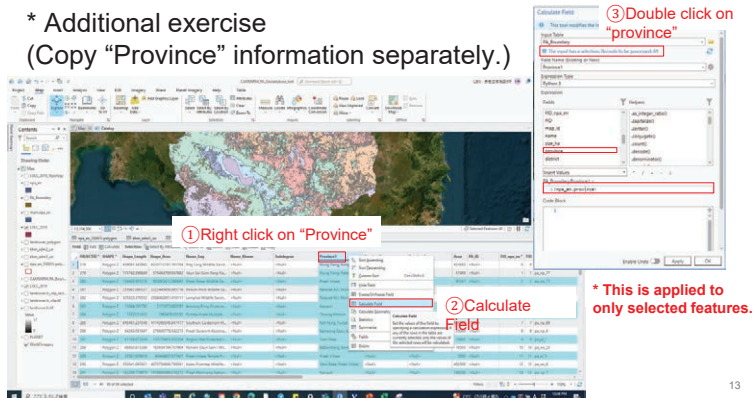
* Additional exercise

(Copy "Province" information separately.)



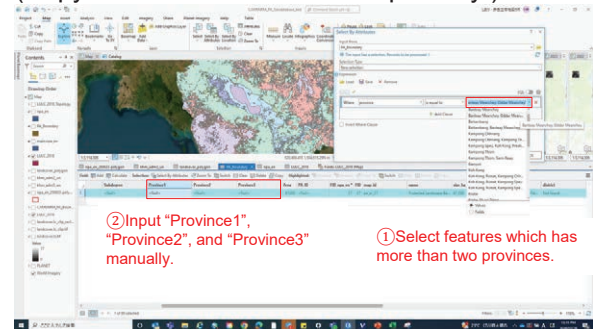
* Additional exercise

(Copy "Province" information separately.)



* Additional exercise

(Copy "Province" information separately.)



Day 01 Orientation

2nd Intermediate and Advanced GIS Training

From 19th August to 23rd August, 2024

Overview of training

Target	Mainly for the departments of GIS data producer.
Training Period	From 19th to 23rd August 2024.
Equipment	Laptop with ArcGIS Pro and Microsoft Office
Contents	- Review of the 1st GIS training (intermediate to advanced). - Practical training to create geodatabase. - How to unify the terminology by using Microsoft Excel. - How to integrate PA boundary data.

Overview of training

More practical

1st Training

15th – 19th July 2024

- Understanding of Data Standardization.
- Learning how to create Geodatabase which contributes to have data uniformity.
- Learning how to prepare Data Product Specification.
- Brainstorming about Guideline and Rule for Data Standardization.

2nd Training

19th – 23rd August 2024

- Review of the 1st GIS training (intermediate to advanced).
- Practical training to create geodatabase.
- How to unify the terminology by using Microsoft Excel.
- How to integrate PA boundary data.

Training curriculum

Time: 9:00-16:00, Venue: MoE

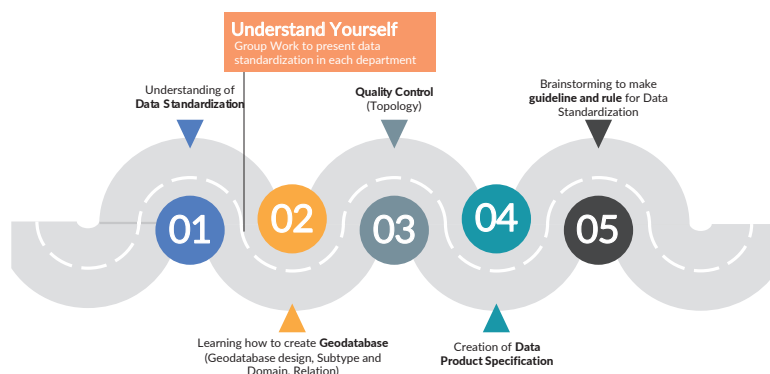
Session No.	Date	Time (TBD)		Program outline	Course style	Equipment
1	19-Aug-24	9:00 – 12:00	Mon	9:00 – 9:30 Training orientation and self-introduction	Presentation	–
		9:30 – 12:00		Review of the 1st training	Presentation and Hands-on	PC, ArcGIS Pro
		14:00 – 16:00		Practice: How to combine multiple data	Presentation and Hands-on	PC, ArcGIS Pro, Word
2	20-Aug-24	9:00 – 12:00	Tue	9:00-12:00 Practice: How to combine multiple data	Hands-on	PC, ArcGIS Pro
		14:00 – 16:00		Practice: How to combine multiple data	Hands-on	PC, ArcGIS Pro
3	21-Aug-24	9:00 – 12:00	Wed	9:00-12:00 Correction of attribute information by using Excel	Presentation and Hands-on	PC, ArcGIS Pro, Excel
		14:00 – 16:00		Correction of attribute information by using Excel	Presentation and Hands-on	PC, ArcGIS Pro, Excel
4	22-Aug-24	9:00 – 12:00	Thu	9:00 – 12:00 Practice: Combine and Modify attribute information of PA boundary data in GDNPA	Presentation and Hands-on	PC, ArcGIS Pro, Word
		14:00 – 16:00		Practice: Combine and Modify attribute information of PA boundary data in GDNPA	Hands-on	PC, ArcGIS Pro
5	23-Aug-24	9:00 – 12:00	Fri	9:00-11:00 Review of the training	–	PC, ArcGIS Pro
		11:00 – 12:00		Summary questionnaire	–	PC

Day 01 Review of 1st Training

2nd Intermediate and Advanced GIS Training

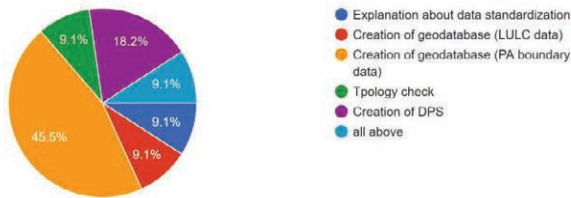
From 19th August to 23rd August, 2024

Overview of the 1st training



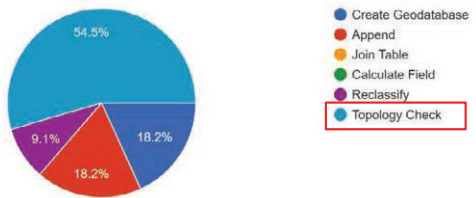
Results of questionnaire

1.2 Which lecture is the most interested?
11 responses



Results of questionnaire

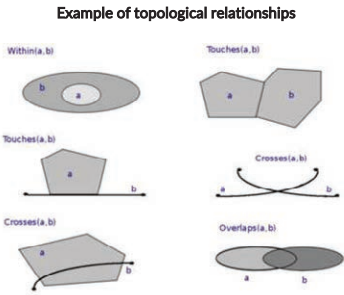
1.3 Which function of ArcGIS is the most difficult?
11 responses



Review of Topology check

What is Topology?

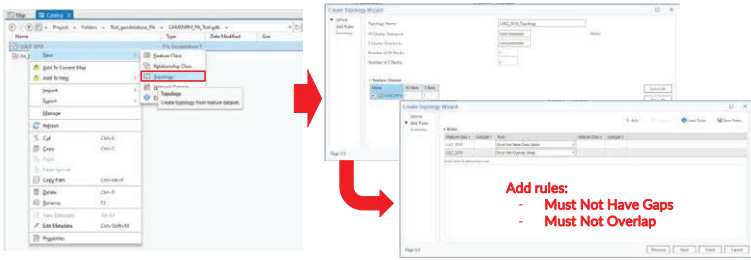
- Qualitative spatial relationships between geographic features.
- Using a topology provides a mechanism to perform integrity checks on your data and helps you validate and maintain better feature representations in your geodatabase.



Review of Topology check

Create a topology

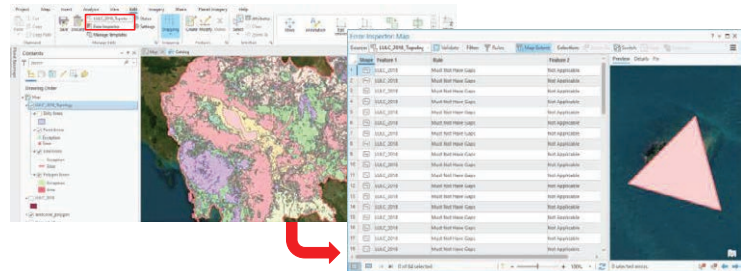
- Create a new topology. Open Catalog View, and right-click on the feature dataset and click on "New" and "Topology".



Review of Topology check

Validate a topology

- From "Edit" tab, select "LULC_2018_Topology" and click on "Error Inspector".
- In Error Inspector window, click on "Validate".



Review of Topology check

Fixing errors

- Editing tools perform topological edits to fix errors.



Day 01 & 02

How to combine multiple data

2nd Intermediate and Advanced GIS Training

From 19th August to 23rd August, 2024

Agenda

1. Explanation of the assignment
2. Making the workflow of assignment
3. Exercise

1. Explanation of the assignment

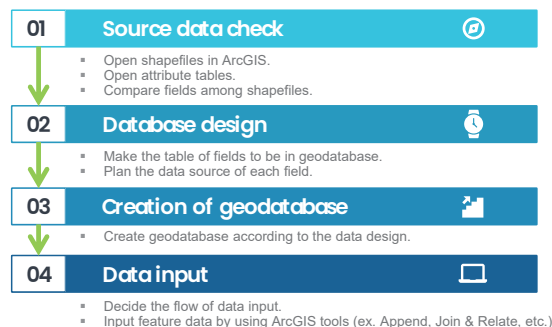
- Combine the following data as geodatabase format;
 - Community protected areas (2006-2021) (English)
 - Community protected areas (2006-2021) (Khmer)
 - Community forestry (2008-2017) (English)
 - Community forestry (2008-2017) (Khmer)

* These data are available from the following links (ODC).

- [Community protected areas \(2006-2021\) - Dataset OD Mekong Datahub \(opendevelopmentcambodia.net\)](#)
- [Community forestry \(2008-2017\) - Dataset OD Mekong Datahub \(opendevelopmentcambodia.net\)](#)

3

2. Making the workflow of assignment



4

3_1. Exercise1:

Fill in the following table about fields of each data.

Community protected areas (2006-2021)

#	Field Name	Suitable Datatype
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

Community forestry (2008-2017)

#	Field Name	Suitable Datatype
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		

5

01 Source data check

- Open shapefiles in ArcGIS.
- Open attribute tables.
- Compare fields among shapefiles.

3_1. Exercise1:

Fill in the following table about fields of each data.

Community protected areas (2006-2021)

#	Field Name	Suitable Datatype
1	map_id	
2	name	
3	size_ha	
4	npa_name	
5	village	
6	commune	
7	district	
8	province	
9	issued_dat	
10	reference	
11	language (English or Khmer)	

* No need to list up "fid" and "GEOMETRY/coords".

Community forestry (2008-2017)

#	Field Name	Suitable Datatype
1	ogc_fid	
2	map_id	
3	name	
4	size_ha	
5	province	
6	district	
7	commune	
8	type_area	
9	category/ category_en	
10	issuedate	
11	reference	
12	last_update	
13	language (English or Khmer)	

6

3.2. Exercise2:

Connect the same or similar fields among the following tables.

Community protected areas (2006-2021)

#	Field Name	Suitable Datatype
1	map-id	
2	name	
3	size_ha	
4	npa_name	
5	village	
6	commune	
7	district	
8	province	
9	issued_dat	
10	reference	
11	language (English or Khmer)	

Community forestry (2008-2017)

#	Field Name	Suitable Datatype
1	ogc_fid	
2	map_id	
3	name	
4	size_ha	
5	province	
6	district	
7	commune	
8	type_area	
9	category/ category_en	
10	issuedate	
11	reference	
12	last_update	
13	language (English or Khmer)	

7

02 Database design

- Make the of fields to be in geodatabase.
- Plan the data source of each field.



3.2. Exercise2:

Connect the same or similar fields among the following tables.

Community protected areas (2006-2021)

#	Field Name	Suitable Datatype
1	map-id	
2	name	
3	size_ha	
4	npa_name	
5	village	
6	commune	
7	district	
8	province	
9	issued_dat	
10	reference	
11	language (English or Khmer)	

Community forestry (2008-2017)

#	Field Name	Suitable Datatype
1	ogc_fid	
2	map_id	
3	name	
4	size_ha	
5	province	
6	district	
7	commune	
8	type_area	
9	category/ category_en	
10	issuedate	
11	reference	
12	last_update	
13	language (English or Khmer)	

8

02 Database design

- Make the list of fields to be in geodatabase.
- Plan the data source of each field.



3.3. Exercise3:

Make the list of fields for the geodatabase.

Fields of the geodatabase for CPA and CF

#	Field Name	Alias	Datatype	Data source	
				Community protected areas (ODC_CPA)	Community forestry(ODC_CF)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					

- Must include CPA/CF name in English and Khmer.
- Must include size (area) information.
- Must include administrative information in English or Khmer.
- Must include reference document and issued data.
- Must include original data source information including sequential number for each original data.

02 Database design

- Make the list of fields to be in geodatabase.
- Plan the data source of each field.



3.3. Exercise3:

Make the list of fields for the geodatabase.

Fields of the geodatabase for CPA and CF

#	Field Name	Alias	Datatype	Data source	
				Community protected areas (ODC_CPA)	Community forestry(ODC_CF)
1	Name_en	Name_en	Text	name	name
2	Name_kh	Name_kh	Text	name (Community protected areas (2006-2021) (Khmer))	name (Community forestry (2008-2017) (Khmer))
3	Size_ha	Size_ha	Double	size_ha	size_ha
4	Type_area	Type_area	Text	-	-
5	Province	Province	Text	province	province
6	District	District	Text	district	district
7	Village	Village	Text	village	village
8	Commune	Commune	Text	commune	commune
9	issued_dat	issued_dat	Date	issued_dat	issued_dat
10	Reference	Reference	Text	reference	reference
11	Source_id	Source_id	Text	Source_id (newly added)	Source_id (newly added)
12	Editor	Editor	Text	-	-

02 Database design

- Make the list of fields to be in geodatabase.
- Plan the data source of each field.



3.4. Exercise4:

Create the geodatabase according to your database design.

Fields of the geodatabase for CPA and CF

#	Field Name	Alias	Datatype	Data source	
				Community protected areas (ODC_CPA)	Community forestry(ODC_CF)
1	Name_en	Name_en	Text	name	name
2	Name_kh	Name_kh	Text	name (Community protected areas (2006-2021) (Khmer))	name (Community forestry (2008-2017) (Khmer))
3	Size_ha	Size_ha	Double	size_ha	size_ha
4	Type_area	Type_area	Text	-	-
5	Province	Province	Text	province	province
6	District	District	Text	district	district
7	Village	Village	Text	village	village
8	Commune	Commune	Text	commune	commune
9	issued_dat	issued_dat	Date	issued_dat	issued_dat
10	Reference	Reference	Text	reference	reference
11	Source_id	Source_id	Text	Source_id (newly added)	Source_id (newly added)
12	Editor	Editor	Text	-	-

03 Creation of geodatabase

- Create geodatabase according to the data design.



3.5. Exercise5:

Decide the flow of data input.

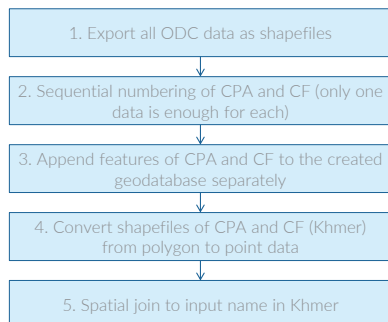
POINTS:

- Let's think CPA and CF separately.
- The first step is sequential numbering of each data (Input original data source information).
- For each data (CPA and CF), (1) Append the original data to the geodatabase, and (2) Join tables to input English/Khmer name.

12

3.5. Exercise5:

Decide the flow of data input.



04 Data input

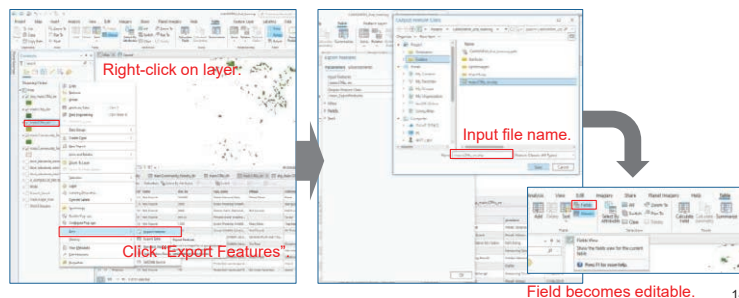
- Decide the flow of data input.
- Input feature data by using ArcGIS tools.

13

3.6. Exercise6:

Input feature data by using ArcGIS.

1. Export all ODC data as shapefiles

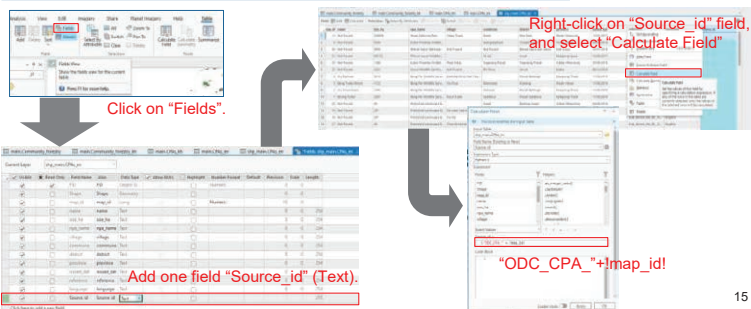


14

3.6. Exercise6:

Input feature data by using ArcGIS.

2. Sequential numbering of CPA and CF (only one data is enough for each)

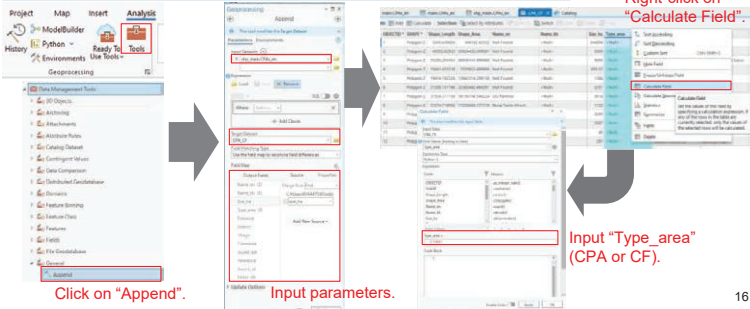


15

3.6. Exercise6:

Input feature data by using ArcGIS.

3. Append features of CPA and CF to the created geodatabase separately.

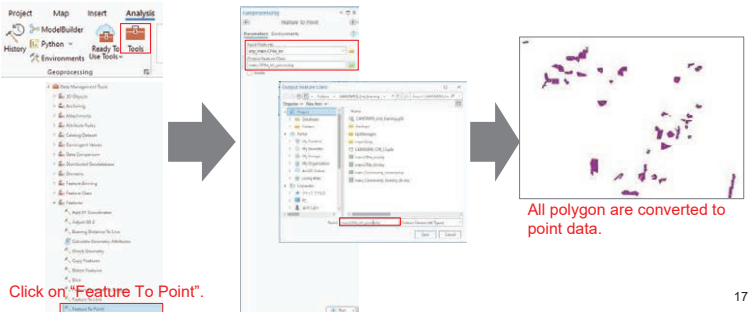


16

3.6. Exercise6:

Input feature data by using ArcGIS.

4. Convert shapefiles of CPA and CF (Khmer) from polygon to point data.

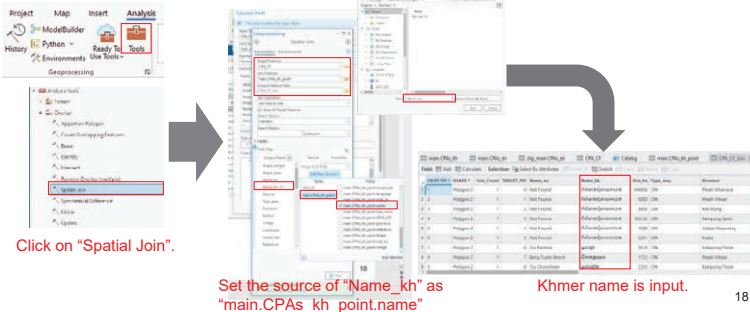


17

3.6. Exercise6:

Input feature data by using ArcGIS.

5. Spatial join to input name in Khmer.



18

Day 03

Correction of attribute information by using Excel

2nd Intermediate and Advanced GIS Training

From 19th August to 23rd August, 2024

Agenda

1. Explanation of the assignment
2. Checking the administrative boundary data
3. Exercise

1. Explanation of the assignment

- Correct the inconsistent attribute information by using Excel;
 - Administrative boundary (main_basemap_commune.shp)
 - * customized for this training.

3

2. Checking the administrative boundary data

Open the shapefile and attribute table. By checking "com_name", write down the inconsistent pattern in the following table.

Number of records:

#	Inconsistent pattern	Example
1	No space in commune name which consists of multiple words.	TaVeaengLeu
2		
3		
4		
5		

4

2. Checking the administrative boundary data

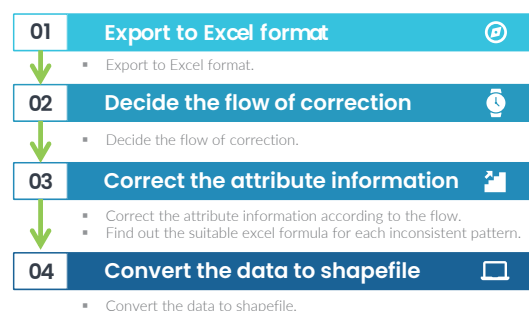
Open the shapefile and attribute table. By checking "com_name", write down the inconsistent pattern in the following table.

Number of records: 1,633

#	Inconsistent pattern	Example
1	No space in commune name which consists of multiple words.	TaVeaengLeu
2	There is space before commune name.	Kouk Trab
3	The first character is not capital.	kandaek, andoung pou
4	All characters are capital.	SAMRAONG
5	Including symbols.	Boeng Tranh Khang T*

5

3. Exercise



6

3.1. Exercise1:

Export to Excel format.

01 Export to Excel format

- Export to Excel format.

Input file name (CAMSNRM_Commune).

Open Excel file.

Click "Table to Excel".

7

3.2. Exercise2:

Decide the flow of correction.

02 Decide the flow of correction

- Decide the flow of correction.

#	Inconsistent pattern	Example
1	No space in commune name which consists of multiple words.	TaVeaengLeu
2	There is space before commune name.	Kouk Trab
3	The first character is not capital.	kandaek, andoung pou
4	All characters are capital.	SAMRAONG
5	Including symbols.	Boeng Tranh Khang T*

*What's happen make the first character capital (ex. kandaek⇒Kandaek) before the correction of spacing (ex. TaVeaengLeu⇒Ta Veaeng Leu)?

➡ "TaVeaengLeu" is amended as "Taveaengleu".

8

3.2. Exercise2:

Decide the flow of correction.

02 Decide the flow of correction

- Decide the flow of correction.

#	Inconsistent pattern	Example
1	No space in commune name which consists of multiple words.	TaVeaengLeu
2	There is space before commune name.	Kouk Trab
3	The first character is not capital.	kandaek, andoung pou
4	All characters are capital.	SAMRAONG
5	Including symbols.	Boeng Tranh Khang T*

②
①
③
④
⑤

9

3.3. Exercise3:

Correct the attribute information: Remove unnecessary

#	Inconsistent pattern	Example
1	There is space before commune name.	Kouk Trab
2	No space in commune name which consists of multiple words.	TaVeaengLeu
3	The first character is not capital.	kandaek, andoung pou
4	All characters are capital.	SAMRAONG
5	Including symbols.	Boeng Tranh Khang T*

Excel formula: =TRIM(Cell)
<https://support.microsoft.com/en-us/office/trim-function-410388fa-c5df-49c6-b16c-9e5630b47919>

① Insert a new column "com_name_correct_1".
② Input "=TRIM(select "com_name")".

*To select all the records easily, let's use "Ctrl+Shift+PgDn".

10

3.3. Exercise3:

Correct the attribute information: Add space between words.

03 Correct the attribute information

- Correct the attribute information according to the flow.
- Find out the suitable excel formula for each inconsistent pattern.

#	Inconsistent pattern	Example
1	There is space before commune name.	Kouk Trab
2	No space in commune name which consists of multiple words.	TaVeaengLeu
3	The first character is not capital.	kandaek, andoung pou
4	All characters are capital.	SAMRAONG
5	Including symbols.	Boeng Tranh Khang T*

Function AddSpace(Vba As String) As String
Update 20140723
Dim xOut As String
For i = 2 To Vba.Length
xOut = Vba.Left(Vba.Mid(Vba, i, 1))
If i < 2 Then
xOut = xOut & " " & Vba.Mid(Vba, i, 1)
Else
xOut = xOut & Vba.Mid(Vba, i, 1)
End If
Next
AddSpace = xOut
End Function

Setting VBA module.

① Open Excel Options from "File" tab.
②
③
④
⑤
⑥
⑦
⑧ Input code and save.

11

3.3. Exercise3:

Correct the attribute information: Add space between words.

03 Correct the attribute information

- Correct the attribute information according to the flow.
- Find out the suitable excel formula for each inconsistent pattern.

#	Inconsistent pattern	Example
1	There is space before commune name.	Kouk Trab
2	No space in commune name which consists of multiple words.	TaVeaengLeu
3	The first character is not capital.	kandaek, andoung pou
4	All characters are capital.	SAMRAONG
5	Including symbols.	Boeng Tranh Khang T*

Function AddSpace(Vba As String) As String
Update 20140723
Dim xOut As String
For i = 2 To Vba.Length
xOut = Vba.Left(Vba.Mid(Vba, i, 1))
If i < 2 Then
xOut = xOut & " " & Vba.Mid(Vba, i, 1)
Else
xOut = xOut & Vba.Mid(Vba, i, 1)
End If
Next
AddSpace = xOut
End Function

Setting VBA module.

⑨ Insert a new column "com_name_correct_2".
⑩ Input "=AddSpace(select "com_name_correct_1")".
⑪ Copy down. "Ctrl+Shift+PgDn" ⇒ "Ctrl+D"

12

3.3. Exercise3:

Correct the attribute information: **Capitalize the first character.**

#	Inconsistent pattern	Example
1	There is space before commune name.	Kouk Trab
2	No space in commune name which consists of multiple words.	TaVaengLeu
3	The first character is not capital.	kandek, andoung pou
4	All characters are capital.	SAMRAONG
5	Including symbols.	Bong Tranh Khang T*

Excel formula: =PROPER(Cell)

<https://support.microsoft.com/en-us/office/proper-function-52a5a283-e8b2-49be-8506-b2887b889f94>

① Insert a new column "com_name_correct_3".

② Input "=PROPER(select com_name_correct_2)".

③ Copy down. "Ctrl+Shift+PgDn" => "Ctrl+D"

13

03 Correct the attribute information

- Correct the attribute information according to the flow.
- Find out the suitable excel formula for each inconsistent pattern.

3.3. Exercise3:

Correct the attribute information: **Find records (All characters are capital)**

#	Inconsistent pattern	Example
1	There is space before commune name.	Kouk Trab
2	No space in commune name which consists of multiple words.	TaVaengLeu
3	The first character is not capital.	kandek, andoung pou
4	All characters are capital.	SAMRAONG
5	Including symbols.	Bong Tranh Khang T*

Excel formula: =EXACT(Cell, UPPER (Cell))

<https://support.microsoft.com/en-us/office/exact-function-52a5a283-e8b2-49be-8506-b2887b889f94>

① Insert a new column "com_name_correct_4".

② Input "=EXACT(I2,UPPER(I2))".

③ Copy down. "Ctrl+Shift+PgDn" => "Ctrl+D"

14

3.3. Exercise3:

Correct the attribute information: **Change to lower character.**

#	Inconsistent pattern	Example
1	There is space before commune name.	Kouk Trab
2	No space in commune name which consists of multiple words.	TaVaengLeu
3	The first character is not capital.	kandek, andoung pou
4	All characters are capital.	SAMRAONG
5	Including symbols.	Bong Tranh Khang T*

Excel formula: =PROPER(Cell)

<https://support.microsoft.com/en-us/office/proper-function-52a5a283-e8b2-49be-8506-b2887b889f94>

④ Insert a new column "com_name_correct_5".

⑤ Select "TRUE".

⑥ Input "=PROPER(select com_name)".

*Be careful!!

Some records consists of more than two words (Ex. OU RAI).
=>Select "com_name" column for PROPER formula.

15

03 Correct the attribute information

- Correct the attribute information according to the flow.
- Find out the suitable excel formula for each inconsistent pattern.

3.3. Exercise3:

Correct the attribute information: **Change to lower character.**

#	Inconsistent pattern	Example
1	There is space before commune name.	Kouk Trab
2	No space in commune name which consists of multiple words.	TaVaengLeu
3	The first character is not capital.	kandek, andoung pou
4	All characters are capital.	SAMRAONG
5	Including symbols.	Bong Tranh Khang T*

⑦ Select "FALSE" in "com_name_correct_4".

⑧ Input "=Select com_name_correct_3".

⑨ Select "All" in "com_name_correct_4", and check the result.

16

3.3. Exercise3:

Correct the attribute information: **Remove symbol " * ".**

#	Inconsistent pattern	Example
1	There is space before commune name.	Kouk Trab
2	No space in commune name which consists of multiple words.	TaVaengLeu
3	The first character is not capital.	kandek, andoung pou
4	All characters are capital.	SAMRAONG
5	Including symbols.	Bong Tranh Khang T*

Excel formula: =SUBSTITUTE(Cell)

<https://support.microsoft.com/en-us/office/substitute-function-643a944e-a904-4336-a9b0-1e58df3bc332>

① Insert a new column "com_name_correct_6".

② Input "=SUBSTITUTE(Select com_name_correct_5)".

③ Copy down. "Ctrl+Shift+PgDn" => "Ctrl+D"

17

03 Correct the attribute information

- Correct the attribute information according to the flow.
- Find out the suitable excel formula for each inconsistent pattern.

3.3. Exercise3:

Correct the attribute information: **Format spacing and copy as value.**

#	Inconsistent pattern	Example
1	There is space before commune name.	Kouk Trab
2	No space in commune name which consists of multiple words.	TaVaengLeu
3	The first character is not capital.	kandek, andoung pou
4	All characters are capital.	SAMRAONG
5	Including symbols.	Bong Tranh Khang T*

Excel formula: =TRIM(Cell)

① Insert a new column "com_name_correct_fin".

② Input "=TRIM(Select com_name_correct_6)".

③ Copy down. "Ctrl+Shift+PgDn" => "Ctrl+D"

④ Select all the records of "com_name_correct_fin" column, and copy.

⑤ Right click on "com_name" column, and Paste Options "Values(V)".

18

Convert the data to shapefile (Join tables).



Convert the data to shapefile (Calculate fields).

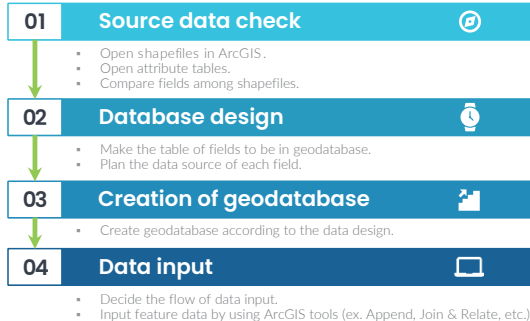


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From 19th August to 23rd August, 2024

3

2. Making the workflow of assignment



4

3.1. Exercise1:

Fill in the following table about fields of each data.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Eastern D				Northern D				Southern D					Sea and Coastal				Wetland D	
2	Field Name	Data Type	Length		Field Name	Data Type	Length		Field Name	Data Type	Length			Field Name	Data Type	Length		Field Name	Data Type
3	FID	Object ID			FID	Object ID			FID	Object ID				FID	Object ID			FID	Object ID
4	Shape	Geometry			Shape	Geometry			Shape	Geometry				Shape	Geometry			Shape	Geometry
5	CODE	Long			CODE	Long			CODE	Long				CODE	Long			CODE	Long
6	PA_Type	Text	30		PA_Type	Text	30		PA_Type	Text	30			PA_Type	Text	30		PA_Type	Text
7	Name_E	Text	100		Name_E	Text	100		Name_E	Text	100			Name_E	Text	100		Name_E	Text
8	Name_Kh	Text	100		Name_Kh	Text	100		Name_Kh	Text	100			Name_Kh	Text	100		Name_Kh	Text
9	PA_ID	Text	10		PA_ID	Text	10		PA_ID	Text	10			PA_ID	Text	10		PA_ID	Text
10	Zoning	Long			Zoning	Long			Zoning	Long				Zoning	Long			Zoning	Long
11	Area	Double			Area	Double			Area	Double				Area	Double			Area	Double
12	Createdate	Date			Createdate	Date			Createdate	Date				Createdate	Date			Createdate	Date
13	Updatedate	Date			Updatedate	Date			Updatedate	Date				Updatedate	Date			Updatedate	Date
14	Editor	Text	50		Editor	Text	50		Editor	Text	50			Editor	Text	50		Editor	Text
15	Respond	Text	254		Respond	Text	254		Respond	Text	254			Respond	Text	254		Respond	Text

01 Source data check

- Open shapefiles in ArcGIS.
- Open attribute tables.
- Compare fields among shapefiles.

3.2. Exercise2:

Make the list of fields for the geodatabase.

Field Name	Alias	Data Type	Allow Null	Domain	Length
FID	FID	Object ID	FALSE		
Shape	Shape	Geometry	FALSE		
Code	Code	Long	FALSE		
PA_ID	PA_ID	Text	FALSE		10
PA_Type	PA_Type	Long	FALSE		30
Name_En	Name_En	Text	FALSE		255
Name_Kh	Name_Kh	Text	FALSE		255
Area	Area	Double	FALSE		
Province	Province	Text	FALSE		255
District	District	Text	FALSE		255
Commune	Commune	Text	FALSE		255
Reference	Reference	Text	FALSE		255
Issue_Date	Issue Date	Text	FALSE		255
Zoning	Zoning	Long	FALSE	✓	
Mgmt_Plan	Management Plan	Long	FALSE	✓	
Createdate	Createdate	Date	FALSE		
Editor	Editor	Text	FALSE	✓	255
Updatedate	Updatedate	Date	FALSE		
Source_ID	Source_ID	Text	FALSE		255
PA_Type2	PA_Type2	Text	FALSE		255

6

02 Database design

- Make the list of fields to be in geodatabase.
- Plan the data source of each field.

3.2. Exercise2:

Make the list of fields for the geodatabase.

Subtype

Subtype name	Field	Code	Description	Relational field (set as default value)	Protected Area Types	Protects at
Protected Area Type	Protected Area Code	1	National Park	National Park	NP	NP
		2	Marine National Park	Marine National Park	MNP	MNP
		3	Wildlife Sanctuary	Wildlife Sanctuary	WS	WS
		4	Protected Landscape	Protected Landscape	PL	PL
		5	Multiple Use Areas	Multiple Use Areas	MUA	MUA
		6	Ramsar	Ramsar	RS	RS
		7	Biosphere Reserve	Biosphere Reserve	BR	BR
		8	Protected Natural Heritage	Protected Natural Heritage	PNH	PNH
		9	Other	Other	O	O

Domain

Domain name	Field type	Code	Description	Remarks
Zoning	Short	1	Zoning	
		2	Non_Zoning	
		3	Yes	
Hght_Plan	Short	1	Yes	
		2	No	
		3	Dep. Administration Planning and Finance	
Editor	Text	1	Dep. Administration Planning and Finance	
		2	Dep. Terrestrial, Eastern Mekong River Conservation	
		3	Dep. Terrestrial, Northern Tonle Sap River Conservation	
		4	Dep. Terrestrial, Southern Tonle Sap River Conservation	
		5	Dep. Wetland and Freshwater Conservation	

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3.3. Exercise3:

Create the geodatabase according to your database design.

Field Name	Alias	Data Type	Allow Null	Domain	Length
FID	FID	Object ID	FALSE		
Shape	Shape	Geometry	FALSE		
Code	Code	Long	FALSE		
PA_ID	PA_ID	Text	FALSE		10
PA_Type	PA_Type	Long	FALSE		30
Name_En	Name_En	Text	FALSE		255
Name_Kh	Name_Kh	Text	FALSE		255
Area	Area	Double	FALSE		
Province	Province	Text	FALSE		255
District	District	Text	FALSE		255
Commune	Commune	Text	FALSE		255
Reference	Reference	Text	FALSE		255
Issue_Date	Issue Date	Text	FALSE		255
Zoning	Zoning	Long	FALSE	✓	
Mgmt_Plan	Management Plan	Long	FALSE	✓	
Createdate	Createdate	Date	FALSE		
Editor	Editor	Text	FALSE	✓	255
Updatedate	Updatedate	Date	FALSE		
Source_ID	Source_ID	Text	FALSE		255
PA_Type2	PA_Type2	Text	FALSE		255

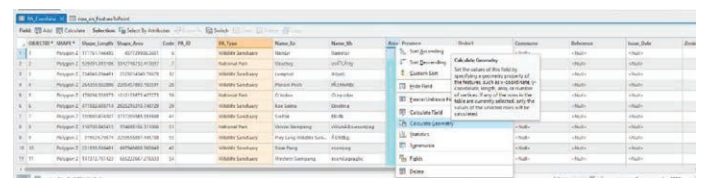
8

03 Creation of geodatabase

- Create geodatabase according to the data design.

3.4. Exercise4:

Input "Area" by calculate geometry.



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3.4. Exercise4:

How to write coding for field calculation (Reclassify).

Input "PA_ID" according to "PA_Type" by using field calculation.

Sample code

```
def Reclass(fid):
    if fid=="National Park":
        return 1
    elif fid=="Marine National":
        return 2
    elif fid=="Wildlife Sanctuary":
        return 3
    elif fid=="Protected Landscape":
        return 4
    elif fid=="Multiple Use Areas":
        return 5
    elif fid=="Ramsar":
        return 6
    elif fid=="Biosphere Reserve":
        return 7
    elif fid=="Protected Natural Heritage":
        return 8
    else:
        return 9
```

*Make code to express "If PA_Type is
National Park, return NP in PA_ID field".

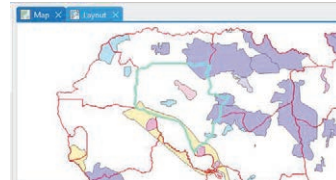
04 Data input

- Decide the flow of data input.
- Input feature data by using ArcGIS tools.

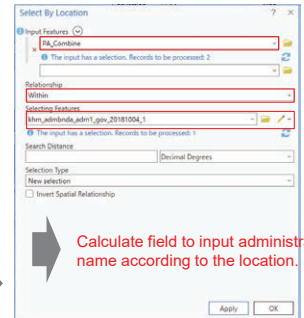
10

3.4. Exercise4:

How to select by location.



Select one province from boundary data.



Calculate field to input administrative
name according to the location.

11

4. What can we do when error is occurred in ArcGIS?

- Check data source
 - Are you using a correct data?
- Check data selection
 - Some features are selected or not.
→If selected, the function is applied only to selected features.
- Check parameter
 - Is all the parameter of tool set correctly?
 - No blank for necessary parameter?
 - Is arcade/python code correct?

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Appendix 5: Multi-copter Drone Operation Training Material



គម្រោងអភិវឌ្ឍន៍សមត្ថភាពក្នុងការគ្រប់គ្រងធនធានធម្មជាតិ
ប្រកបដោយនិរន្តរភាពនៅថ្នាក់ជាតិនិងថ្នាក់ក្រោមជាតិ



មាតិកា

- ❑ ការណែនាំអំពីវគ្គបណ្តុះបណ្តាល
- ❑ ការប្រើប្រាស់ជ្រុងនៅក្នុងកិច្ចការពារធនធានធម្មជាតិ
- ❑ លទ្ធផលរំពឹងទុកបន្ទាប់ពីការហោះហើរជ្រុង
- ❑ ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រុង DJI Phantom 4
- ❑ ការរៀបចំសម្ភារៈសម្រាប់ការហោះហើរជ្រុង DJI Phantom 4
- ❑ ការបង្កើតផែនការហោះហើរជ្រុងដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស
- ❑ ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី
- ❑ ការបញ្ចេញទិន្នផលផែនទីជាទម្រង់ Geo-PDF
- ❑ ការដំណើរការរូបភាព និងការរៀបចំផែនទីរូបភាពពីជ្រុង
- ❑ បទពិសោធន៍ និងការយល់ដឹងបន្ថែមអំពីការហោះហើរ
- ❑ ការអនុវត្តការហោះហើរជ្រុងនៅទីវាល
- ❑ ការវាយតម្លៃទៅលើការអនុវត្ត

2

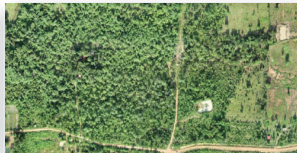
ការណែនាំអំពីវគ្គបណ្តុះបណ្តាល (បន្ត)

គោលបំណង

អ្នកចូលរួមនឹងសិក្សាស្វែងយល់អំពីចំណេះដឹងនៃការហោះហើរជ្រុង DJI Phantom 4 Pro V2.0 និងការដំណើរការរូបភាពសម្រាប់ប្រើប្រាស់ក្នុងការងារជាក់ស្តែង

ការរំពឹងទុក

- អ្នកចូលរួមអាចរៀបចំផែនការសម្រាប់ការហោះហើរជ្រុងសម្រាប់ការងារទីវាល
- អាចបញ្ជាជ្រុងហោះហើរដោយស្វ័យប្រវត្តិសម្រាប់ការផលិតផែនទី
- និងការដំណើរការរូបភាពដែលថតដោយជ្រុងសម្រាប់បង្កើតជាផែនទីរូបភាពថតដោយជ្រុងដែលអាចប្រើប្រាស់ក្នុងការរៀបចំរបាយការណ៍ផ្សេងៗ។



ការប្រើប្រាស់ជ្រុងនៅក្នុងកិច្ចការពារធនធានធម្មជាតិ

ទិដ្ឋភាពទូទៅនៃការប្រើប្រាស់ជ្រុងនៅក្នុងកិច្ចការពារធនធានធម្មជាតិ

- ជ្រុងបានគូរយ៉ាងសំខាន់នៅការគ្រប់គ្រងធនធានធម្មជាតិដែលត្រូវបានប្រើប្រាស់សម្រាប់ផលិតផែនទី ការពិនិត្យនិងការតាមដានធនធានធម្មជាតិ
- វាបានផ្តល់ទិន្នន័យសុក្រិត ច្បាស់លាស់ ជាមួយនឹងការចំណាយសមរម្យទៅលើទិន្នន័យដែលទទួលបាន។



4

ការប្រើប្រាស់ជ្រុងនៅក្នុងកិច្ចការពារធនធានធម្មជាតិ (បន្ត)

ការប្រើប្រាស់ជ្រុងកន្លងមកនៅក្នុងកិច្ចការពារធនធានធម្មជាតិ

- ជ្រុងត្រូវបានប្រើប្រាស់សម្រាប់ការផលិតផែនទី ត្រួតពិនិត្យនិងតាមដានការកាប់បំផ្លាញព្រៃឈើខុសច្បាប់ ការសិក្សាអំពីភ្លើងឆេះព្រៃ ផលិតផែនទី៣D និងប្រើប្រាស់នៅក្នុងសារពើភ័ណ្ឌព្រៃឈើ (ឧ. ទីតាំងរបស់ដើមឈើ)។



5

ការប្រើប្រាស់ជ្រុងនៅក្នុងកិច្ចការពារធនធានធម្មជាតិ (បន្ត)

ការប្រើប្រាស់ជ្រុងកន្លងមកនៅក្នុងកិច្ចការពារធនធានធម្មជាតិ (បន្ត)

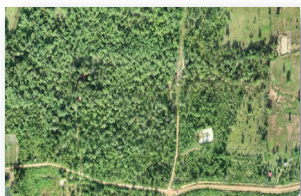
❑ នៅក្នុងកិច្ចការពារធនធានធម្មជាតិ ជ្រុងត្រូវបានប្រើប្រាស់លើមុខងារ៖

- ពិនិត្យនិងតាមដានបម្រែបម្រួល ប្រព័ន្ធអេកូឡូស៊ី
- ពិនិត្យនិងតាមដានសត្វព្រៃ
- ការផលិតផែនទីជម្រកសត្វព្រៃ
- ការត្រួតពិនិត្យនិងការការពារបទល្មើស
- ការធ្វើផែនទីទំហំនៃភ្លើងឆេះព្រៃ
- និងការធ្វើសារពើភ័ណ្ឌព្រៃឈើ ...។



6

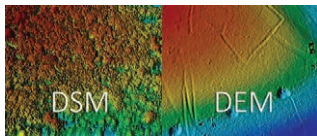
លទ្ធផលរំពឹងទុកបន្ទាប់ពីការហោះហើរជ្រួន



Orthomosaic



Contour lines



DSM

DEM



Digital Surface Model (DSM)

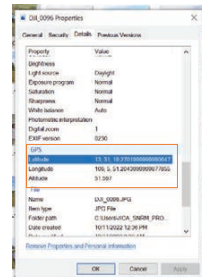


Digital Terrain Model (DTM)

លទ្ធផលរំពឹងទុកបន្ទាប់ពីការហោះហើរជ្រួន (បន្ត)



រូបភាពបង្ហាញពីបច្ចុប្បន្នភាពនៃទីតាំងដែលបានថត



និយាមការនៃទីតាំងដែលបានថត

លទ្ធផលរំពឹងទុកបន្ទាប់ពីការហោះហើរជ្រួន (បន្ត)



រូបភាពភាពដែលទទួលបានពីការដំណើរការរូបភាពជ្រួន

ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រួន DJI Phantom 4

សមត្ថភាពរបស់ជ្រួន

- ឈ្មោះជ្រួន៖ DJI Phantom 4 Pro V2.0
- អាចថតវីដេអូកម្រិត 4k 60fps
- របាំងការពារឧបសគ្គមាន 4 ទិស
- មានមុខងារហោះតាម ក៏ដូចជាកំណត់ការហោះហើរ
- ថ្មមួយគ្រាប់អាចប្រើបាន 30 នាទី
- ចម្ងាយឆ្ងាយអតិបរមាដែលដៃបញ្ជាអាចភ្ជាប់ទៅជ្រួន 2km to 5km¹

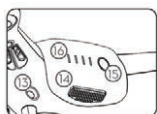


ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រួន DJI Phantom 4 (បន្ត)

ផ្នែករបស់ជ្រួន



1. ជើងទប់លំនឹង និងការម៉ា
2. ប្រព័ន្ធការពារផ្នែកខាងក្រោម
3. កន្លែងដោត USB
4. ប៊ូតុងភ្ជាប់
5. កន្លែងដាក់មេម៉ូរី
6. ប្រព័ន្ធការពារផ្នែកខាងមុខ
7. ប្រព័ន្ធការពារ Infrared
8. ប្រព័ន្ធការពារផ្នែកខាងមុខ
9. ម៉ូទ័រ
10. ស្លាប
11. ពន្លឺបង្ហាញស្ថានភាពជ្រួន
12. អង្គតែង

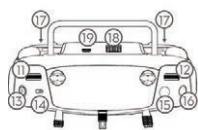


13. ប្រព័ន្ធការពារផ្នែកខាងក្រោម
14. ប៊ូតុងរំលឹក
15. ប៊ូតុង បិទ/បើកថ្ម
16. ពន្លឺស្ថានភាពកម្រិតថ្ម

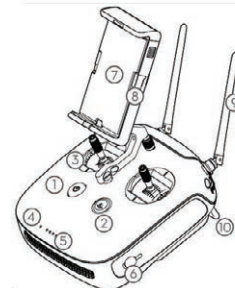
ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រួន DJI Phantom 4 (បន្ត)

មុខងារដៃបញ្ជា

1. ប៊ូតុង បិទ/បើកដៃបញ្ជា
2. ប៊ូតុងត្រឡប់មកផ្ទះ
3. ដងបញ្ជា
4. ពន្លឺស្ថានភាពដៃបញ្ជា
5. ពន្លឺស្ថានភាពកម្រិតថ្ម
6. កន្លែងដោតបញ្ចូលថ្ម
7. ដងគៀបទូរសព្ទ
8. ដងទប់ទូរសព្ទ
9. អង្គតែង
10. ដងកាន់



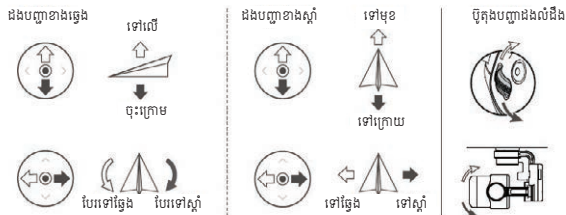
11. ប៊ូតុងបញ្ជាដងទប់ទំនឹង
12. ប៊ូតុងកំណត់ការម៉ា
13. ប៊ូតុងថតវីដេអូ
14. កន្លែងប្រមូលមុខងារហោះហើរ
15. ប៊ូតុងថតរូប
16. ប៊ូតុងផ្អាកការហោះហើរបណ្តោះអាសន្ន (Pause)
17. ប៊ូតុងមុខងារកំណត់ C1 និង C2 (customizable)
18. កន្លែងភ្ជាប់ USB
19. កន្លែងភ្ជាប់ USB តូច



ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រុង DJI Phantom 4 (បន្ត)

មុខងារដែលបញ្ជា (បន្ត)

- មុខងារគ្រប់គ្រងការហោះហើរលើនាំដើម្បី Mode 2
- ផងបញ្ជាខាងឆ្វេងប្រើសម្រាប់កំណត់កម្ពស់ជ្រុង និងផ្នែកខាងមុខជ្រុង ចំណែកផងបញ្ជាខាងស្តាំសម្រាប់ហោះទៅមុខ ក្រោយ ឆ្វេង និងស្តាំ។ ប៊ូតុងបញ្ជាផងលំនឹងគឺបញ្ជាការមកបែរឡើងលើ/បែរចុះក្រោម។



13

ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រុង DJI Phantom 4 (បន្ត)

ការដំឡើងកម្មវិធីសម្រាប់គ្រប់គ្រងការហោះហើរ

❖ ជំហានទី ១៖ ដំឡើង DJI GO 4

❖ ជំហានទី ២៖ រំលឹកអ្នកប្រើប្រាស់



DJI GO 4 App



Tutorial Videos

www.dji.com/phantom-4-pro-v2/info#video

14

ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រុង DJI Phantom 4 (បន្ត)

ការដំឡើងកម្មវិធីសម្រាប់ការធ្វើផែនទី

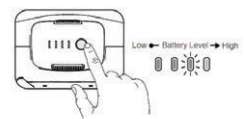
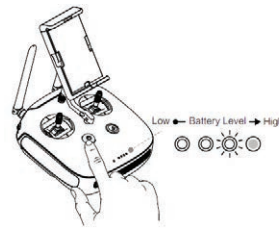


15

ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រុង DJI Phantom 4 (បន្ត)

ការត្រួតពិនិត្យថ្ម

❖ ជំហានទី ៣៖ ពិនិត្យកម្រិតថ្ម



- ❑ ចុចមួយដងដើម្បីពិនិត្យថ្ម
- ❑ ចុចម្តងទៀត និងសង្កត់អោយជាប់ ដើម្បីបើក/បិទ

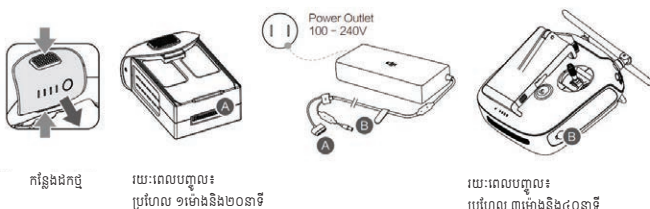
កម្រិតបន្ទុកបន្ទុកក្នុងបញ្ជី				កម្រិតបន្ទុក	កម្រិតបន្ទុក
LED1	LED2	LED3	LED4	កម្រិតបន្ទុក	កម្រិតបន្ទុក
■	■	■	■	0%-25%	កម្រិតបន្ទុក
■	■	■	■	25%-50%	កម្រិតបន្ទុក
■	■	■	■	50%-75%	កម្រិតបន្ទុក
■	■	■	■	75%-100%	កម្រិតបន្ទុក
■	■	■	■	កម្រិតបន្ទុក	កម្រិតបន្ទុក

16

ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រុង DJI Phantom 4 (បន្ត)

ការត្រួតពិនិត្យសាកថ្ម

❖ ជំហានទី ៤៖ ការបញ្ចូលថ្ម



កម្រិតដកថ្ម

រយៈពេលបញ្ចូល៖
ប្រហែល ១ម៉ោងនិង២០នាទី

រយៈពេលបញ្ចូល៖
ប្រហែល ៣ម៉ោងនិង៤០នាទី

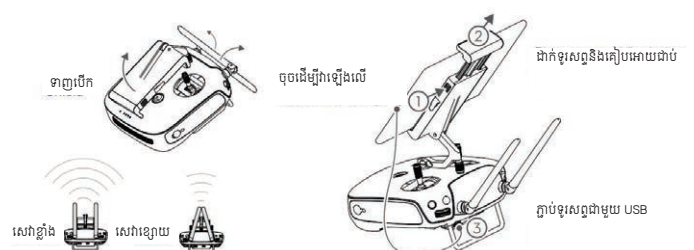
ពេលបញ្ចូលថ្មគួរតែ កំណត់ប្រភេទបញ្ចូលថ្មតាមការណែនាំ

17

ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រុង DJI Phantom 4 (បន្ត)

ការរៀបចំដែលបញ្ជាជ្រុង

❖ ជំហានទី ៥៖ ការរៀបចំដែលបញ្ជាជ្រុង



ទាញបើក

ចុចដើម្បីរកឡើងលើ

ដាក់ទូរសព្ទនិងភ្ជាប់អោយជាប់

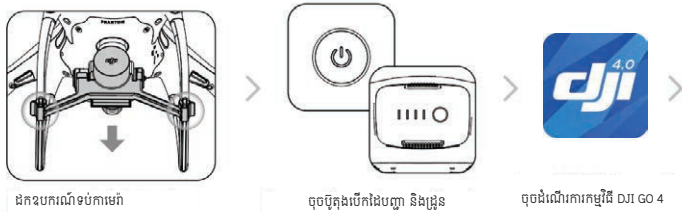
ភ្ជាប់ទូរសព្ទជាមួយ USB

18

ការស្វែងយល់អំពីការប្រើប្រាស់ផ្លែន DJI Phantom 4 (បន្ត)

ការត្រួតមុនពេលហោះហើរ

- ❖ ជំហានទី ៦៖ ការរៀបចំការហោះហើរ និងការធ្វើបច្ចុប្បន្នភាព



ប្រសិនបើដំណើរការលើកដំបូង អ្នកប្រើប្រាស់ត្រូវមាន DJI account និងគ្រូបង្វែរ

19

ការស្វែងយល់អំពីការប្រើប្រាស់ផ្លែន DJI Phantom 4 (បន្ត)

ការត្រួតមុនពេលហោះហើរ (បន្ត)

- ❖ ជំហានទី ៦៖ ការរៀបចំការហោះហើរ និងការធ្វើបច្ចុប្បន្នភាព (បន្ត)



ត្រួតពិនិត្យស្លាបឡើងវិញមុនពេលគ្រប់ការហោះហើរដើម្បីធានាថាវាត្រូវបានភ្ជាប់បានយ៉ាងល្អ

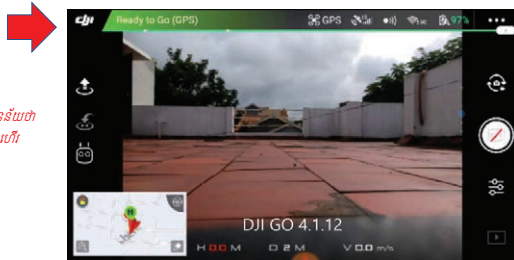
ការស្វែងយល់អំពីការប្រើប្រាស់ផ្លែន DJI Phantom 4 (បន្ត)

ការត្រួតមុនពេលហោះហើរ (បន្ត)

- ❖ ជំហានទី ៧៖ ការហោះហើរ

- ❑ ពិនិត្យ Ready to Go (GPS)

ចោលដំណើរការបង្ហាញឡើងវិញនូវការហោះហើរ



21

ការស្វែងយល់អំពីការប្រើប្រាស់ផ្លែន DJI Phantom 4 (បន្ត)

ការត្រួតមុនពេលហោះហើរ (បន្ត)

- ❖ ជំហានទី ៧៖ ការហោះហើរ (បន្ត)

- ❑ នៅក្នុង DJI GO 4៖



22

ការស្វែងយល់អំពីការប្រើប្រាស់ផ្លែន DJI Phantom 4 (បន្ត)

ការត្រួតមុនពេលហោះហើរ (បន្ត)

- ❖ ជំហានទី ៧៖ ការហោះហើរ (បន្ត)

- ❑ នៅក្នុង DJI GO 4៖



ទាញដងបញ្ជាទាំងពីរទៅលើជើងដើម្បីហោះហើរចុះចត និងកាត់អោយដាច់ដើម្បីបញ្ជប់ម៉ូទ័រ

- ស្លាប់ប្រព័ន្ធដោយស្វ័យប្រវត្តិ ឬម្នាក់ហោះហើរនៅមុនស្លាប់ប្រព័ន្ធដោយស្វ័យប្រវត្តិ
- ដៃអ្នកបញ្ជាផ្លែនត្រូវដាច់ពីដៃអ្នកបញ្ជាផ្លែនដើម្បីធានាថាវាមិនអាចបណ្តាលមុខកំពុងកែច្នៃ

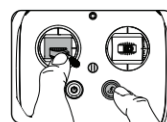
23

ការស្វែងយល់អំពីការប្រើប្រាស់ផ្លែន DJI Phantom 4 (បន្ត)

ការត្រួតមុនពេលហោះហើរ (បន្ត)

- ❖ ជំហានទី ៧៖ ការហោះហើរ (បន្ត)

- ❑ នៅក្នុង DJI GO 4៖



បញ្ជប់ផ្លែននៅពាក់កណ្តាលការហោះហើរនៅពេលការហោះហើរមានបញ្ហា

24

ការរៀបចំសម្ភារៈសម្រាប់ការហោះហើរជ្រួន DJI Phantom 4

១. ត្រួតពិនិត្យសម្ភារៈនៅក្នុងប្រអប់



25

ការរៀបចំសម្ភារៈសម្រាប់ការហោះហើរជ្រួន DJI Phantom 4 (បន្ត)

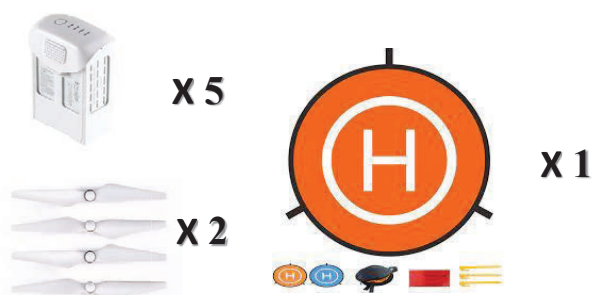
១. ត្រួតពិនិត្យសម្ភារៈនៅក្នុងប្រអប់ (បន្ត)



26

ការរៀបចំសម្ភារៈសម្រាប់ការហោះហើរជ្រួន DJI Phantom 4 (បន្ត)

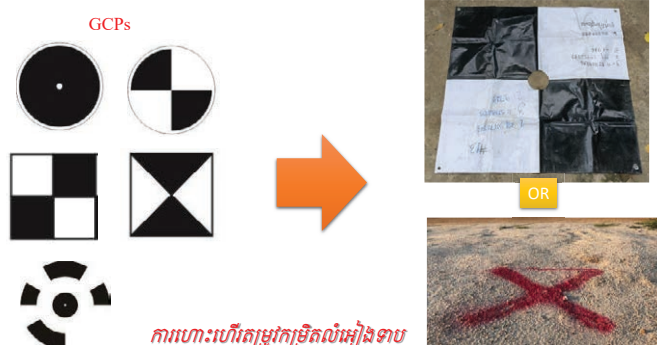
២. សម្ភារៈសម្រាប់ការហោះហើរបន្ថែម



27

ការរៀបចំសម្ភារៈសម្រាប់ការហោះហើរជ្រួន DJI Phantom 4 (បន្ត)

២. សម្ភារៈសម្រាប់ការហោះហើរបន្ថែម (បន្ត)



28

ការរៀបចំសម្ភារៈសម្រាប់ការហោះហើរជ្រួន DJI Phantom 4 (បន្ត)

២. សម្ភារៈសម្រាប់ការហោះហើរបន្ថែម (បន្ត)

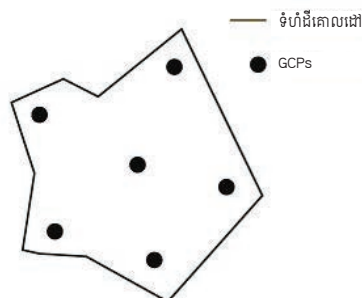


ការវាស់វែង RTK

29

ការរៀបចំសម្ភារៈសម្រាប់ការហោះហើរជ្រួន DJI Phantom 4 (បន្ត)

២. សម្ភារៈសម្រាប់ការហោះហើរបន្ថែម (បន្ត)



ចំណុចដែលត្រូវដាក់ GPCs

30

ការរៀបចំសម្ភារៈសម្រាប់ការហោះហើរជ្រួន DJI Phantom 4 (បន្ត)

ការបញ្ចូលថ្មសម្រាប់ហោះហើរ រក្សាទុក និងដឹកជញ្ជូន

ពិន្ទុបង្ហាញពេលកំពុងបញ្ចូល				LED1	LED2	LED3	LED4	
				■	□	□	□	ភាគរយថ្ម
				■	□	□	□	0%~25%
				■	■	□	□	25%~50%
				■	■	■	□	50%~75%
				■	■	■	■	75%~100%
				□	□	□	□	ថ្មគេញ

- ថ្មរបស់ DJI និងបន្ថយដោយស្វ័យប្រវត្តិរហូតដល់ 60% (ជាធម្មតាបន្ថយនៅពេលរក្សាទុកថ្មអស់ពេល ១០ ថ្ងៃ)
- ការបញ្ចូលថ្មសម្រាប់ហោះហើរត្រូវតែពេញជានិច្ច 100%
- ការរក្សាទុកថ្មក្រោម 60%
- ការដឹកជញ្ជូនថ្មតិចជាង 50%

31

ការរៀបចំសម្ភារៈសម្រាប់ការហោះហើរជ្រួន DJI Phantom 4 (បន្ត)

គោលការណ៍ណែនាំការប្រើប្រាស់ថ្មរបស់ជ្រួនដោយសុវត្ថិភាព



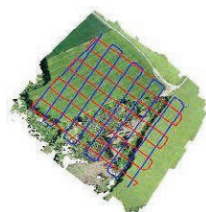
- ពេលប្រើប្រាស់៖** កុំអោយថ្មប៉ះទឹក សូមកុំដាក់ថ្មផ្សេងក្រៅពីថ្មរបស់ DJI សូមកុំប្រើថ្មដែលខូច ឬក្រៅពេក (ច្រើនជាង 40 អង្សាសេ)
- ពេលកំពុងសាក៖** សូមកុំប្រើឆ្នាំងសាកថ្មជាមួយថ្មដទៃ សូមដកថ្មពេលបញ្ចូលពេញ សូមកុំសាកថ្មជាមួយពេលហោះហើររួចឬថ្មនៅក្តៅ
- ពេលរក្សាទុក៖** សូមទុកនៅជិតដៃក្មេងៗ នៅកន្លែងដែលមានសីតុណ្ហភាពក្តៅ មិនត្រូវដឹកជញ្ជូនថ្មជ្រួនដែលខូច ឬកម្រិតថ្មនៅច្រើនជាង 30%



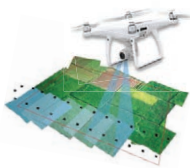
32

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស

ចំណេះដឹងទូទៅនៃការប្រើប្រាស់ជ្រួនដើម្បីប្រមូលទិន្នន័យពីលើអាកាស



ផែនការហោះហើរ



ការចាប់យករូបភាព



រូបភាពដែលបានចាប់យករួម

33

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ចំណេះដឹងទូទៅនៃការប្រើប្រាស់ជ្រួនដើម្បីប្រមូលទិន្នន័យពីលើអាកាស (បន្ត)

ដំណើរការនៃការដំណើរការរូបភាពជ្រួន



ការរៀបចំរូបភាព



កម្មវិធីដំណើរការរូបភាព



លទ្ធផលអាចទទួលបាន

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ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការផលិតផែនទីដែលមានកម្រិតលម្អៀតតិច



OR



RTK Surveying

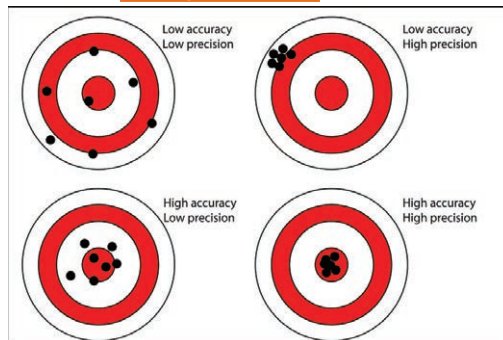
ទិន្នន័យរូបភាពពីជ្រួនគឺមានទាំងទីតាំងរបស់វត្ថុស្ថិតនៅ និងកម្ពស់ ប្រសិនបើការហោះហើរត្រូវការទិន្នន័យកម្ពស់នៅពេលវាស់វែងលើ GCPs ត្រូវប្រមូលទិន្នន័យ X Y និង Z

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ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការផលិតផែនទីដែលមានកម្រិតលម្អៀតតិច (បន្ត)

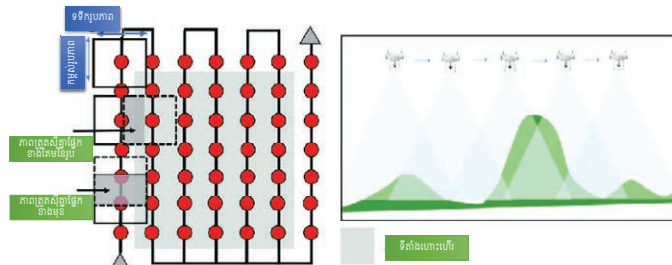
កម្រិតលម្អៀត និងភាពជាក់លាក់



36

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)
ការកំណត់ភាពត្រួតស៊ីគ្នាក្នុងការផលិតផែនទី

- ការប្រើប្រាស់ភាពត្រួតស៊ីគ្នានៃរូបភាពបានគ្រប់គ្រាន់



37

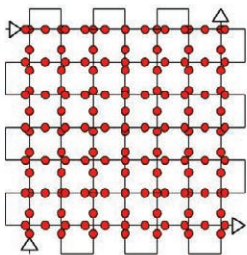
ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)
ការកំណត់ភាពត្រួតស៊ីគ្នាក្នុងការផលិតផែនទី (បន្ត)

- ការប្រើប្រាស់ភាពត្រួតស៊ីគ្នានៃរូបភាពបានគ្រប់គ្រាន់ (បន្ត)
 - តាមរយៈគោលការណ៍វាស់វែងទីតាំងភូមិសាស្ត្ររបស់ GSI នៅប្រទេសជប៉ុន ភាពត្រួតស៊ីគ្នានៃរូបភាពដែលយ៉ាងតិច side overlap 60% និង frontal overlap 80%
 - នៅក្នុងសៀវភៅណែនាំរបស់ Pix4D ភាពត្រួតស៊ីគ្នានៃរូបភាពដែលអាចប្រើលើការងារភាគច្រើនគឺយ៉ាងតិច overlap 60% និង frontal overlap 75%។ ចំពោះការថតរូបនៅក្នុងព្រៃ ឬរុក្ខជាតិក្រាស់ ភាពត្រួតស៊ីគ្នានៃរូបភាពយ៉ាងតិច 85% នៃ side overlap និង frontal overlap។ កម្រិតភាពច្បាស់ GSD ធំជាង 10cm/pix គឺល្អបំផុត។ ចំណែកផ្ទៃដីមិនរាបស្មើជាមួយដំណាំភាពត្រួតស៊ីគ្នានៃរូបភាពយ៉ាងតិច 80% នៃ side overlap និង frontal overlap។

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ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)
ការកំណត់ភាពត្រួតស៊ីគ្នាក្នុងការផលិតផែនទី (បន្ត)

- ការប្រើប្រាស់ភាពត្រួតស៊ីគ្នានៃរូបភាពបានគ្រប់គ្រាន់ (បន្ត)

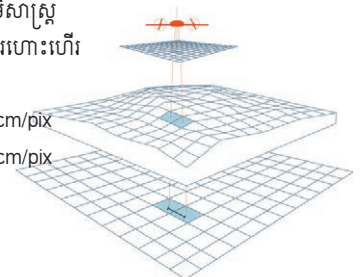


ការថតរូបដំបូលអាកាស ការធ្វើផែនទី 3D នៅក្នុងទីក្រុង តម្រូវអោយហោះហើរតាមផែនការហោះហើរក្រឡាចគ្នា

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ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)
ការកំណត់ភាពត្រួតស៊ីគ្នាក្នុងការផលិតផែនទី (បន្ត)

- ការប្រើប្រាស់ភាពត្រួតស៊ីគ្នានៃរូបភាពបានគ្រប់គ្រាន់ ជាមួយកម្រិតច្បាស់នៃរូបភាព (GSD)
 - តាមរយៈគោលការណ៍វាស់វែងទីតាំងភូមិសាស្ត្ររបស់ GSI នៅប្រទេសជប៉ុន ប្រសិនបើការហោះហើរតម្រូវលើផែនទីដែលមានមាត្រដ្ឋាន៖
 - 1: 250 ការថតរូបជ្រួនត្រូវប្រើ GSD 2cm/pix
 - 1: 500 ការថតរូបជ្រួនត្រូវប្រើ GSD 3cm/pix



GSD កាន់តែតិចរូបភាពនៃការចាប់យកកាន់តែច្រើន ទិន្នន័យទទួលបានកាន់តែល្អ

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ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)
ការកំណត់ភាពត្រួតស៊ីគ្នាក្នុងការផលិតផែនទី (បន្ត)

- ការគណនាកម្រិតភាពច្បាស់នៃរូបភាព (GSD) សម្រាប់ប្រើលើមាត្រដ្ឋានផែនទីជាក់លាក់



GSD: 5cm/pix

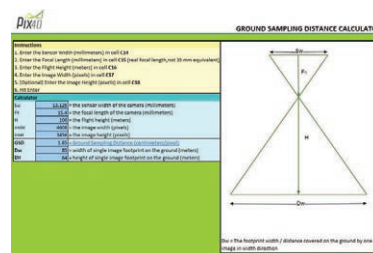
GSD: 30cm/pix

41

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)
ការកំណត់ភាពត្រួតស៊ីគ្នាក្នុងការផលិតផែនទី (បន្ត)

- ការគណនាកម្រិតភាពច្បាស់នៃរូបភាព (GSD) សម្រាប់ប្រើលើមាត្រដ្ឋានផែនទីជាក់លាក់

ប្រសិនបើផលិតផែនទីរូបភាពពីលើអាកាសដែលមានកម្រិតច្បាស់ 5cm/pix តើគួរហោះកម្ពស់ប៉ុន្មាន?



GSD Calculator: Click [HERE](#)

DJI Phantom 4 Pro V2.0 Specs:
 Focal length: 8.6 mm
 Sensor width: 12.8333 mm
 Image width: 5472 pixels
 Image height: 3648 pixels

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ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការកំណត់ល្បឿននៃការចាប់យករូបភាព

- ការប្រើប្រាស់ល្បឿនហោះហើរបានត្រឹមត្រូវ



ល្បឿនកាន់តែយឺតកាន់តែច្បាស់តែពេលហោះកាន់តែច្រើន

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ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

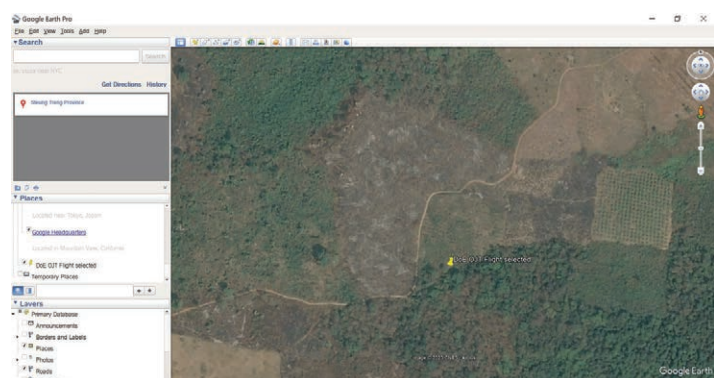
ការសិក្សាពីទីវាល និងការចុះពិនិត្យទីវាល

- ដើម្បីការហោះហើរប្រកបដោយសុវត្ថិភាពយើងត្រូវ៖
 - កំណត់ទីតាំងហោះហើរច្បាស់លាស់ ដោយពិនិត្យមើលតាមរយៈរូបភាពផ្កាយរណប និងចុះទៅទីតាំងផ្ទាល់
 - សាកសួរអាជ្ញាធរមានសម្ថកិច្ចនៅទីនោះ អនុញ្ញាតិអោយហោះហើរដែរឬទេ
 - ពិនិត្យមើលឧបសគ្គដែលអាចប៉ះពាល់ឬការខានដល់ការហោះហើរ
 - ពិនិត្យមើលទីតាំងចុះចតបានត្រឹមត្រូវ
 - ពិនិត្យមើលអាកាសធាតុ ភ្លៀងធ្លាក់ និងល្បឿនខ្យល់បក់។

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ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

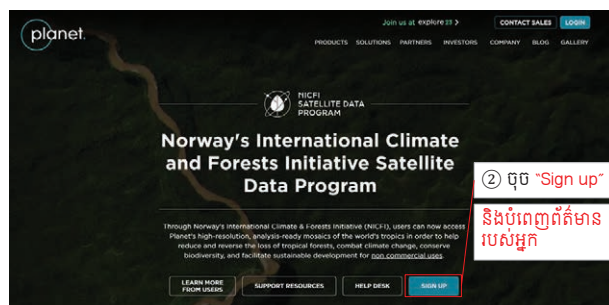
ការសិក្សាពីទីវាល និងការចុះពិនិត្យទីវាល



ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការបង្កើតគណនី

- ចូលទៅកាន់ <https://www.planet.com/nicfi/>



② ចុច "Sign up"
និងបំពេញព័ត៌មាន
របស់អ្នក

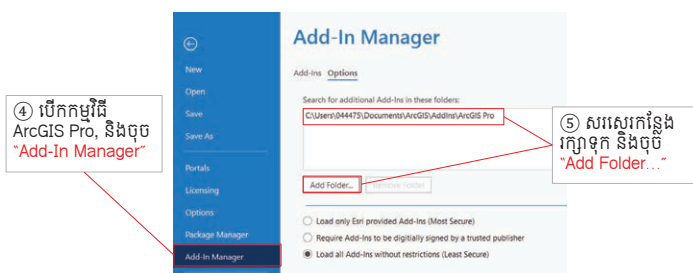
46

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការដំឡើងមុខងារទាញយក

- ស្វែងរកកន្លែងរក្សាទុកកម្មវិធីដែលបានទាញយក៖

%System Drive%\Users\<username>\Documents\ArcGIS\AddIns\ArcGISPro



④ បើកកម្មវិធី
ArcGIS Pro, និងចុច
"Add-In Manager"

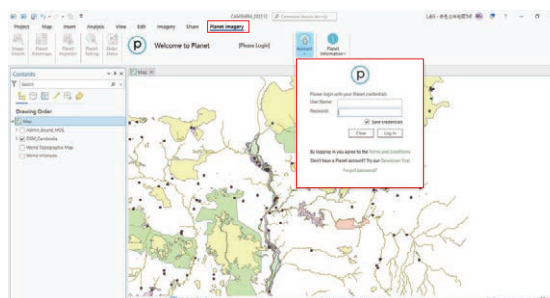
⑤ សរសេរកន្លែង
រក្សាទុក និងចុច
"Add Folder..."

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ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការដំឡើងមុខងារទាញយក (បន្ត)

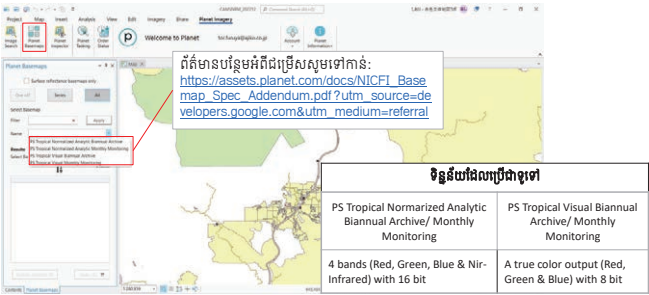
- បើកកម្មវិធី ArcGIS Pro ម្តងទៀត រួចចូលទៅ Planet Imagery និង log in



48

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត) ការទាញយក

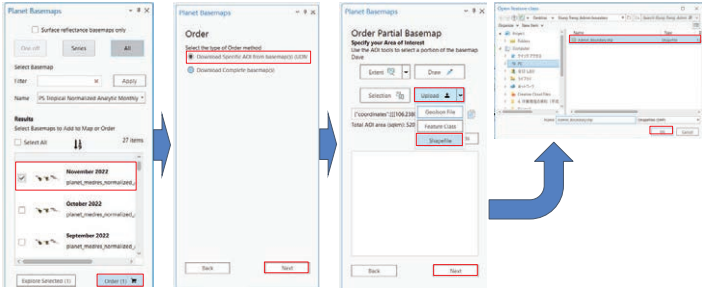
① ចុច “Planet Basemaps” និងជ្រើសរើស “basemaps”



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ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត) ការទាញយក (បន្ត)

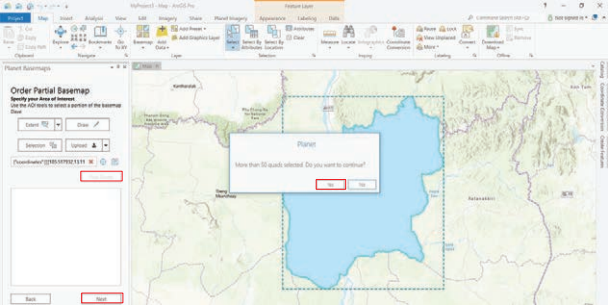
② ជ្រើសរើស “ជម្រើសទាញយក” និងប្រើប្រាស់ទិន្នន័យរំពងចាំ



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ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត) ការទាញយក (បន្ត)

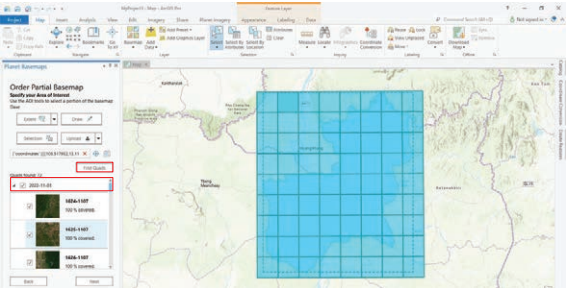
③ ជ្រើសរើស “YES” និង ចុច “បន្ទាប់”



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ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត) ការទាញយក (បន្ត)

④ ចុច “Find Quads” និងជ្រើសរើសរូបដែលចង់ទាញយក



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ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត) ការទាញយក (បន្ត)

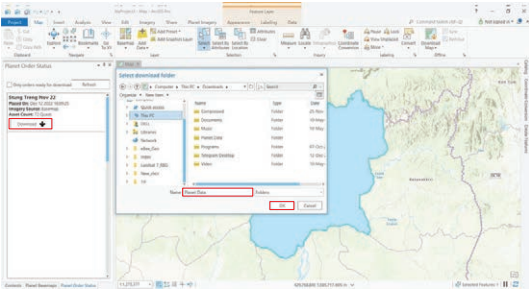
⑤ បំពេញ “ឈ្មោះ” ចុច “Submit Order” និង “Open Planet Status Panel”



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ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត) ការទាញយក (បន្ត)

⑥ ចុច “Downloads” និងបំពេញឈ្មោះទិន្នន័យ



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ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

① ទាញចូលទិន្នន័យទាំងអស់នៅខេត្តស្ទឹងត្រែង៖

- ទិន្នន័យរូបភាពផ្កាយរណប (Planet)
- និងទិន្នន័យទឹកពិភពលោក

② ចុច "Yes"

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

③ ចូល "Analysis" ចុច "Tools"

④ Search "Clip".

⑤ ម៉ៅស្កាំងលើ "Clip Raster" និងជ្រើសរើស "Batch".

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

⑥ ចុច "Next".

⑦ ទាញទិន្នន័យចូល

⑧ ប្តូរទីតាំងក្បាច់

⑨ ជ្រើសរើសខេត្ត

⑩ ពិនិត្យ "Use Input Features..."

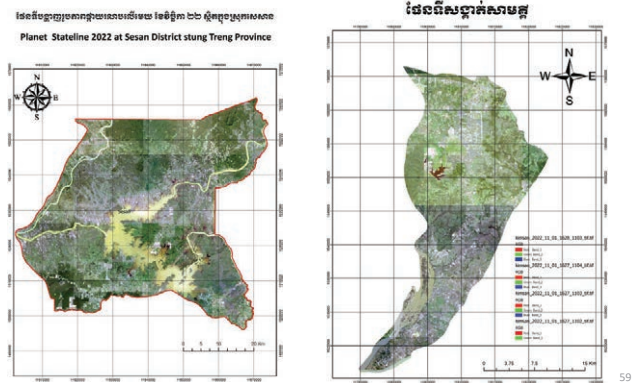
⑪ ចុច "Run".

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

រូបភាពផ្កាយរណបដែលបានកាត់

ទិន្នន័យទឹកដែលបានកាត់

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)
ការធ្វើផែនទីសម្រាប់ប្រើប្រាស់នៅទីវាល



ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)
ការធ្វើផែនទីសម្រាប់ប្រើប្រាស់នៅទីវាល (បន្ត)

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការត្រួតពិនិត្យសម្ភារៈហោះហើរឡើងវិញ



1. បញ្ចូលថ្មជ្រួន ទុរសពូនិងដៃបញ្ជា



2. ពិនិត្យមើលស្លាប



3. ពិនិត្យមើលមេដឹកនាំ



4. ធ្វើបច្ចុប្បន្នភាពសេរីជ្រួន និងដៃបញ្ជា



5. ពិនិត្យមើលអាកាសធាតុ



6. Calibrate ជ្រួន (ប្រសិនបើប្រើប្រាស់ App)

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការជ្រើសរើសកម្មវិធី

□ កម្មវិធីគោល



- កម្មវិធីនេះត្រូវបានណែនាំសម្រាប់ការហោះហើរដោយការបញ្ជា ការថតរូប

□ កម្មវិធីប្រើសម្រាប់ថតរូបដោយស្វ័យប្រវត្តិដើម្បីផលិតផែនទីពីលើអាកាស



DJI Pilot



Pix4Dcapture



Ctrl+DJI

- DJI Pilot ជាកម្មវិធីសម្រាប់ហោះហើរថតរូប ឬផលិតផែនទីរបស់ក្រុមហ៊ុន DJI
- Pix4Dcapture ងាយស្រួលប្រើប្រាស់ប៉ុន្តែមិនមានមុខងារដំណើរការប្រព័ន្ធការពាររបស់ជ្រួន
- Ctrl+DJI ប្រើសម្រាប់ភ្ជាប់ Pix4Dcapture

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ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការជ្រើសរើសកម្មវិធី (បន្ត)

□ កម្មវិធីគោល (បន្ត)



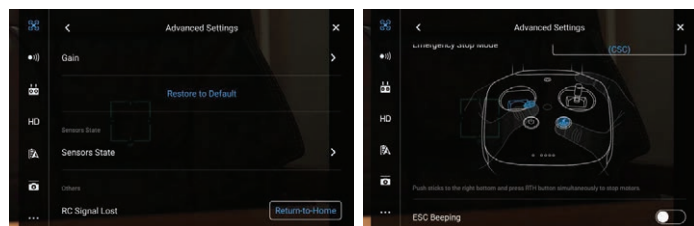
63

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការជ្រើសរើសកម្មវិធី (បន្ត)

□ កម្មវិធីគោល (បន្ត)

- ការកំណត់ដែលណែនាំអោយប្រើ



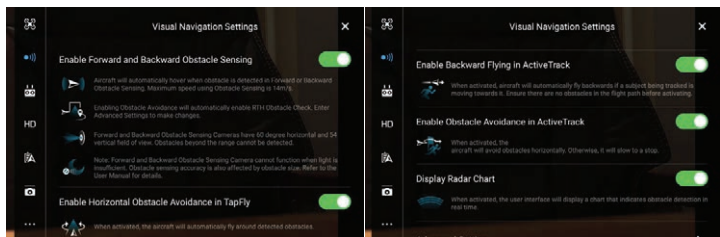
64

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការជ្រើសរើសកម្មវិធី (បន្ត)

□ កម្មវិធីគោល (បន្ត)

- ការកំណត់ដែលណែនាំអោយប្រើ



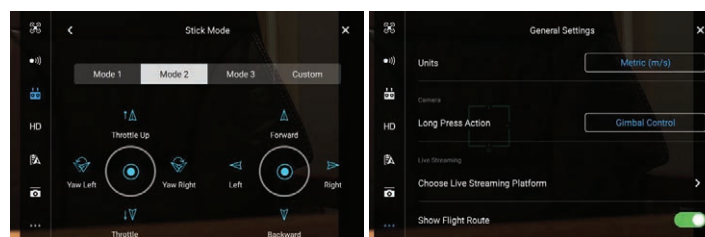
65

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការជ្រើសរើសកម្មវិធី (បន្ត)

□ កម្មវិធីគោល (បន្ត)

- ការកំណត់ដែលណែនាំអោយប្រើ



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ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីពីលើអាកាស (បន្ត)

ការបង្កើតផែនការហោះហើរ

- ❑ កម្មវិធីប្រើសម្រាប់ចតុបដោយស្វ័យប្រវត្តិដើម្បីផលិតផែនទីពីលើអាកាស
 - ដំណើរការកម្មវិធី DJI Pilot
 - ជ្រើសរើស Mission Flight

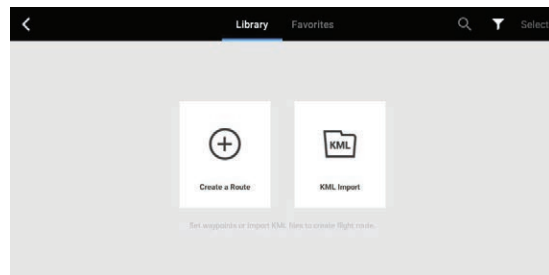


67

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីពីលើអាកាស (បន្ត)

ការបង្កើតផែនការហោះហើរ (បន្ត)

- ❑ កម្មវិធីប្រើសម្រាប់ចតុបដោយស្វ័យប្រវត្តិដើម្បីផលិតផែនទីពីលើអាកាស (បន្ត)
 - ជ្រើសរើស Create a Route/KML import

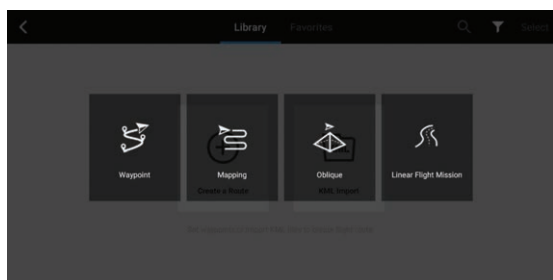


68

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីពីលើអាកាស (បន្ត)

ការបង្កើតផែនការហោះហើរ (បន្ត)

- ❑ កម្មវិធីប្រើសម្រាប់ចតុបដោយស្វ័យប្រវត្តិដើម្បីផលិតផែនទីពីលើអាកាស (បន្ត)
 - ជ្រើសរើសផែនការហោះហើរ Mapping/Waypoint/Linear Flight Mission



69

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីពីលើអាកាស (បន្ត)

ការបង្កើតផែនការហោះហើរ (បន្ត)

- ❑ កម្មវិធីប្រើសម្រាប់ចតុបដោយស្វ័យប្រវត្តិដើម្បីផលិតផែនទីពីលើអាកាស (បន្ត)
 - ឧទាហរណ៍៖ ជ្រើសរើស Mapping

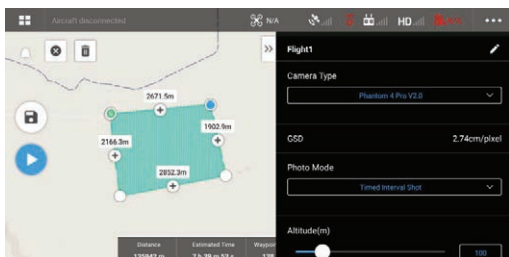


70

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីពីលើអាកាស (បន្ត)

ការបង្កើតផែនការហោះហើរ (បន្ត)

- ❑ កម្មវិធីប្រើសម្រាប់ចតុបដោយស្វ័យប្រវត្តិដើម្បីផលិតផែនទីពីលើអាកាស (បន្ត)
 - ច្នៃ edit
 - ជ្រើសរើស Camera type
 - កំណត់ប៉ារ៉ាម៉ែត្រហោះហើរ (កម្ពស់ការហោះហើរ, កាតត្រួតស៊ីគ្នានៃរូបភាព)



71

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីពីលើអាកាស (បន្ត)

សុវត្ថិភាពនៅកន្លែងហោះហើរ

- មុនពេលហោះហើរ៖ ហោះហើរនៅកន្លែងវាលជានិច្ច ប្រុងប្រយ័ត្ននៅពេលហោះហើរនៅឆ្ងាយ កុំហោះហើរនៅពេលអាកាសធាតុធំជាង 40 អង្សាសេ កុំហោះហើរនៅពេលល្បឿនខ្យល់លឿនជាង 10m/s
- ការត្រួតពិនិត្យមុនការហោះហើរ៖ ត្រួតពិនិត្យថ្មបញ្ចូលបានពេញ ស្លាបទាំងបួននៅគុណភាពល្អ ម៉ូទ័រមិនមានឧបសគ្គ ធ្វើការ calibrate ទិសនៅពេលកម្មវិធី DJI GO 4 តម្រូវ និងការម៉ោមិន
- ពេលហោះហើរ៖ សូមនៅអោយឆ្ងាយពីស្ថាប័នរបស់រដ្ឋ មិនត្រូវឆ្លើយតបទូរសព្ទ អ្នកហោះហើរមិនត្រូវមានជាតិស្រវឹង កុំទ្រង់ពេលត្រឡប់មកវិញអ្នកបញ្ជាអាចដំឡើងបន្ថយកម្ពស់ដើម្បីគេចពីឧបសគ្គ កុំហោះនៅជិតទីកន្លែងសុវត្ថិភាពនៅពេលថ្ងៃអស់ពេក និងពេលបញ្ជាត្រឡប់មកវិញកម្ពស់ជ្រួនត្រូវខ្ពស់ជាងឧបសគ្គ។

72

ការបង្កើតផែនការហោះហើរជូនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

សុវត្ថិភាពនៅកន្លែងហោះហើរ (បន្ត)

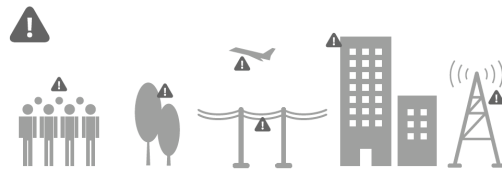
- ការថែទាំ៖ សូមកុំប្រើប្រាស់ស្លាបបែកបាក់ អាកាសធាតុដែលណែនាំអោយហោះហើរគឺ ចន្លោះ 22 ដល់ 28 អង្សាសេ
- ស្វែងយល់ពីកន្លែងដែលត្រូវហោះហើរពីច្បាប់និងការហាមឃាត់ផ្សេងៗ



73

ការបង្កើតផែនការហោះហើរជូនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

សុវត្ថិភាពនៅកន្លែងហោះហើរ (បន្ត)



មិនត្រូវហោះនៅកន្លែងដែលមានអ្នករស់នៅ ទីតាំងដែលមានមនុស្សច្រើន ជិតបង្គោលខ្សែភ្លើង ដើមឈើ និងទឹក

74

ការបង្កើតផែនការហោះហើរជូនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

សុវត្ថិភាពនៅកន្លែងហោះហើរ (បន្ត)

NOT FOR CHILDREN UNDER THE AGE OF 18. THIS IS NOT A TOY



សូមកុំហោះហើរនៅពេលភ្លៀង

នៅអោយឆ្ងាយពីស្លាបរបស់ជន

75

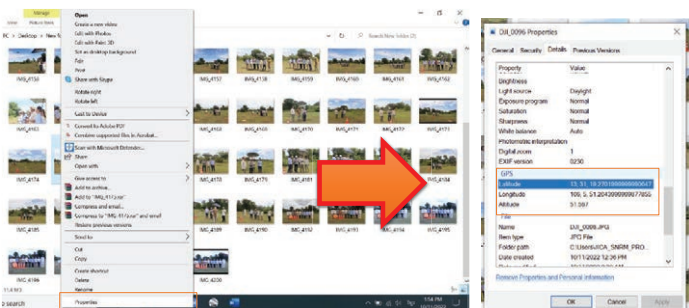
សម្រាប់ការសិក្សាបន្ថែម៖

DJI Phantom 4 Pro V2.0 Specs: <https://www.dji.com/phantom-4-pro-v2/specs>

DJI Phantom 4 Pro V2.0 Video: <https://www.dji.com/phantom-4-pro-v2/video>

DJI Phantom 4 Pro V2.0 User Manual: <https://www.dji.com/phantom-4-pro-v2/downloads>

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី

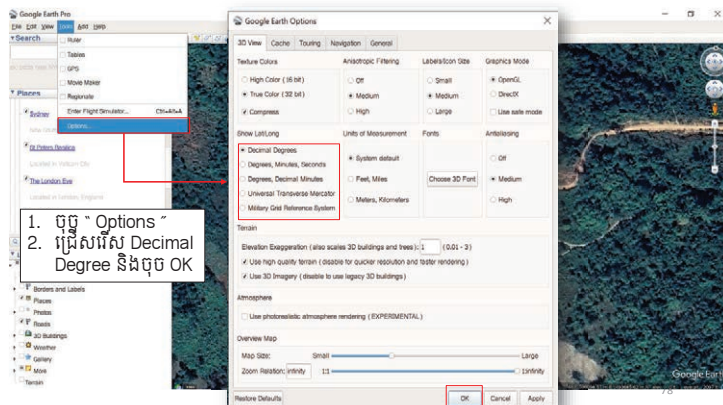


1. ចូល "Properties"
2. កត់ត្រាទីតាំងភូមិសាស្ត្រ

77

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

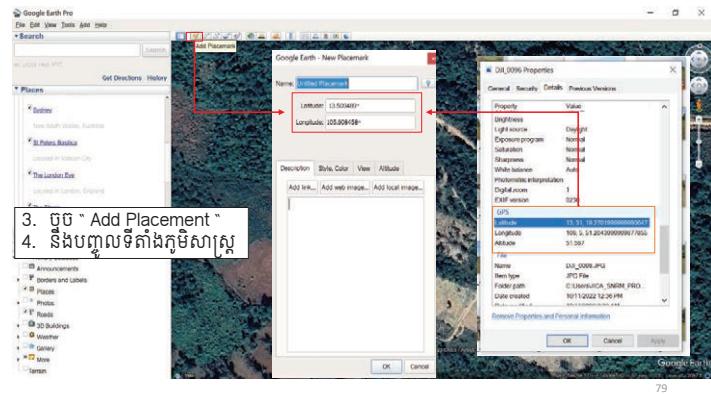
ការប្រើប្រាស់និយាមការ



1. ចូល "Options"
2. ជ្រើសរើស Decimal Degree និងចុច OK

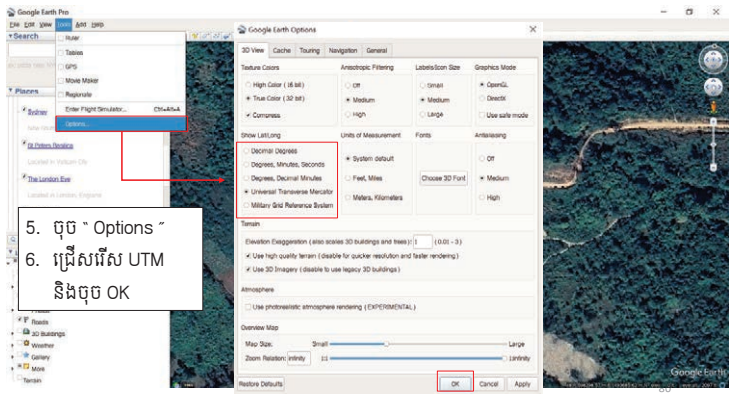
ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបម្លែងនិយាមការ (បន្ត)



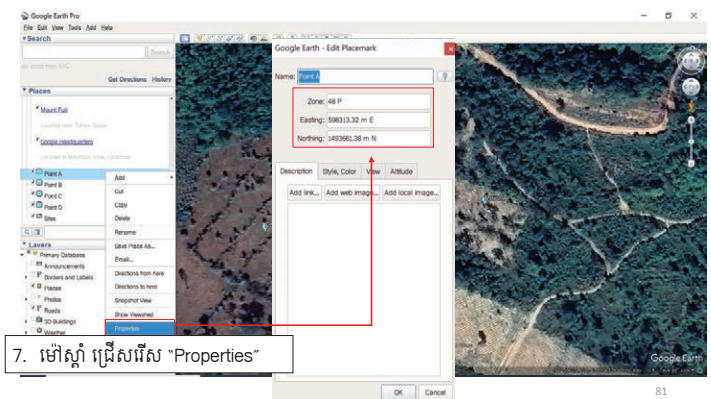
ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបម្លែងនិយាមការ (បន្ត)



ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបម្លែងនិយាមការ (បន្ត)



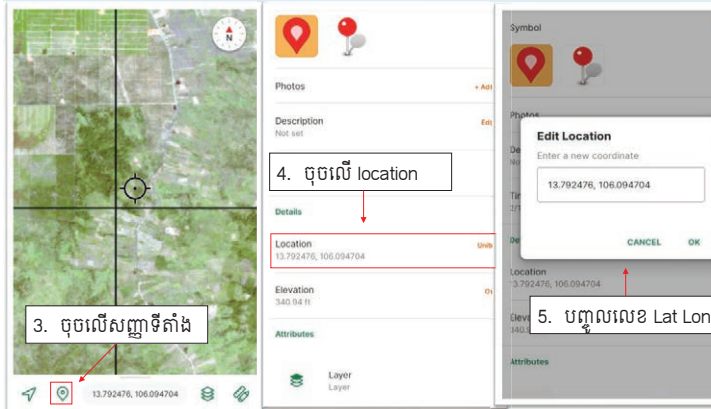
ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបម្លែងនិយាមការ (បន្ត)



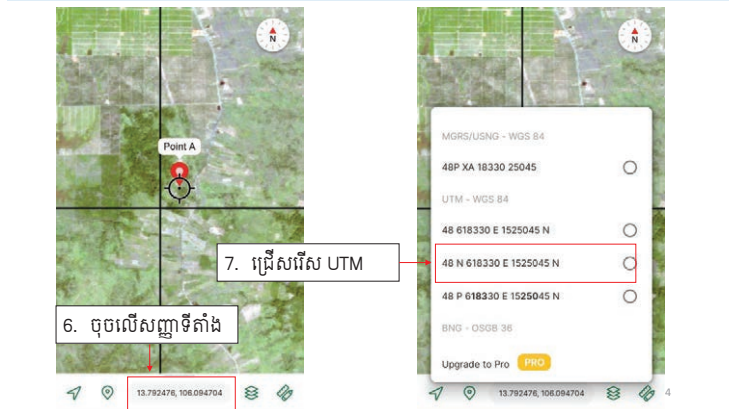
ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបម្លែងនិយាមការ (បន្ត)



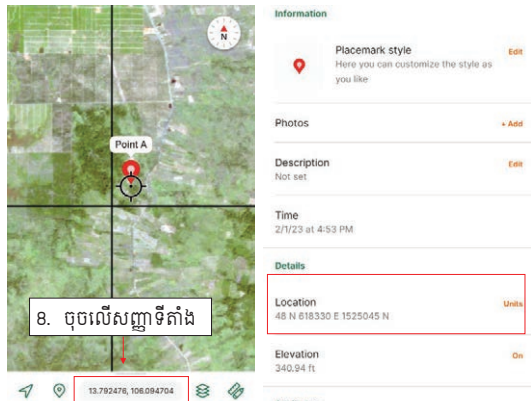
ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបម្លែងនិយាមការ (បន្ត)



ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបង្កើននិយាមការ (បន្ត)



8. ចុចលើសញ្ញាទីតាំង

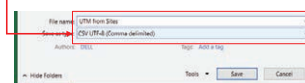
85

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបញ្ចូលទិន្នន័យទៅក្នុងកម្មវិធី GIS

Point ID	X	Y
1	609561.63	1495532.94
2	609627.25	1495732.77
3	609401.18	1495827.93
4	609328.05	1495629.51

1. បញ្ចូលទីតាំងភូមិសាស្ត្រទៅក្នុងកម្មវិធី excel
2. និងរក្សាទុកជាទម្រង់ CSV



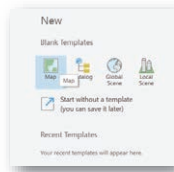
86

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបញ្ចូលទិន្នន័យទៅក្នុងកម្មវិធី GIS (បន្ត)



3. ដំណើរការកម្មវិធី ArcGIS Pro

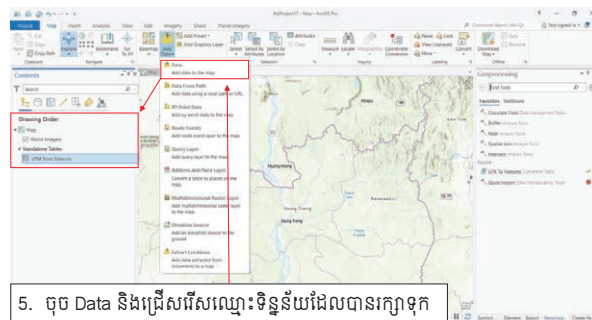


4. ជ្រើសរើស Map និងសរសេរឈ្មោះផែនទី

87

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបញ្ចូលទិន្នន័យទៅក្នុងកម្មវិធី GIS (បន្ត)

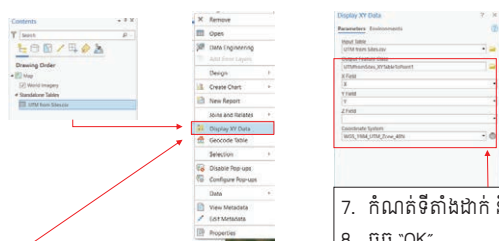


5. ចុច Data និងជ្រើសរើសឈ្មោះទិន្នន័យដែលបានរក្សាទុក

88

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបញ្ចូលទិន្នន័យទៅក្នុងកម្មវិធី GIS (បន្ត)



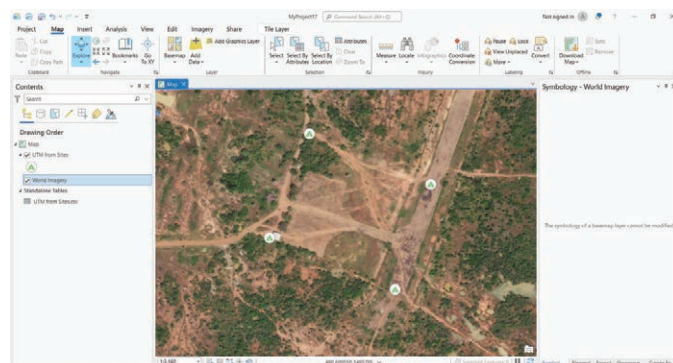
6. មើលទិន្នន័យ រួចជ្រើសរើស Display XY Data

7. កំណត់ទីតាំងដាក់ និងជ្រើសរើស UTM
8. ចុច "OK"

89

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

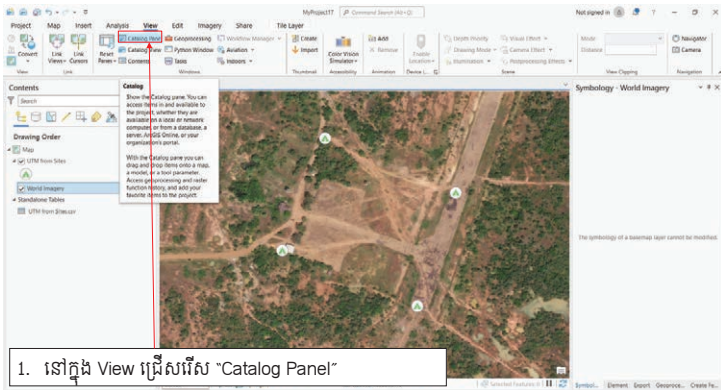
ការបញ្ចូលទិន្នន័យទៅក្នុងកម្មវិធី GIS (បន្ត)



90

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

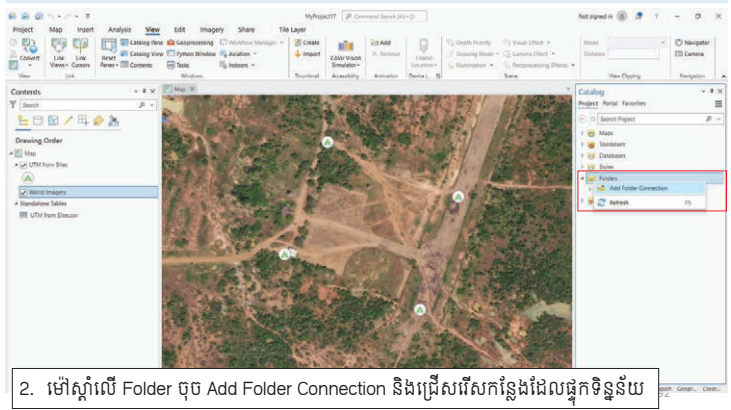
ការបង្ហាញពីទំហំនៃទីតាំងដែលបានថតរូប



1. នៅក្នុង View ជ្រើសរើស "Catalog Panel"

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

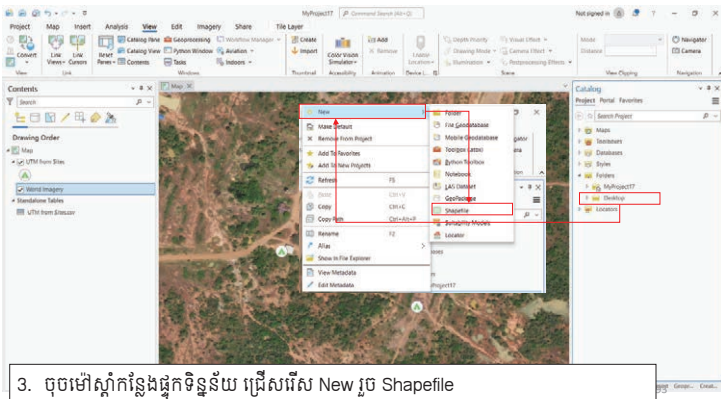
ការបង្ហាញពីទំហំនៃទីតាំងដែលបានថតរូប (បន្ត)



2. មើលស្តារបើ Folder ចុច Add Folder Connection និងជ្រើសរើសកន្លែងដែលផ្ទុកទិន្នន័យ

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបង្ហាញពីទំហំនៃទីតាំងដែលបានថតរូប (បន្ត)



3. ចុចមើលស្តារកន្លែងផ្ទុកទិន្នន័យ ជ្រើសរើស New រួច Shapefile

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

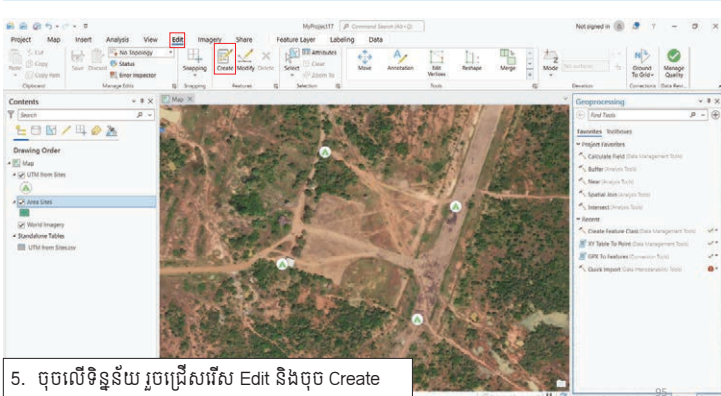
ការបង្ហាញពីទំហំនៃទីតាំងដែលបានថតរូប (បន្ត)



4. ដាក់ឈ្មោះទិន្នន័យ និងជ្រើសរើស UTM រួចចុច RUN

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

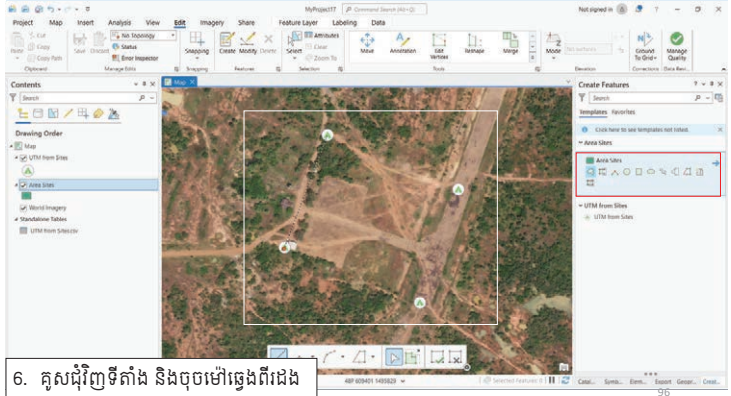
ការបង្ហាញពីទំហំនៃទីតាំងដែលបានថតរូប (បន្ត)



5. ចុចលើទិន្នន័យ រួចជ្រើសរើស Edit និងចុច Create

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

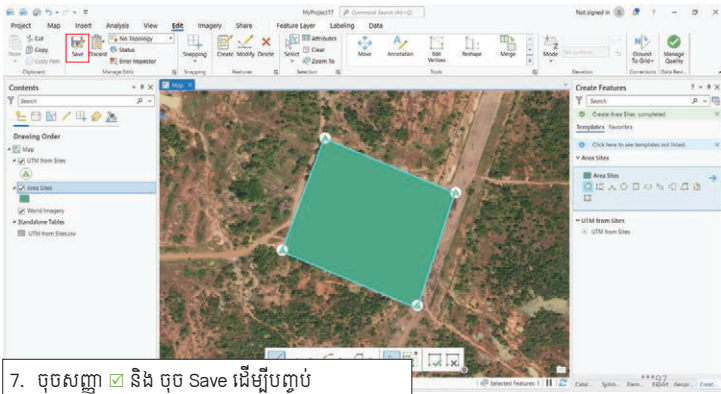
ការបង្ហាញពីទំហំនៃទីតាំងដែលបានថតរូប (បន្ត)



6. គូសរូបរាងទីតាំង និងចុចមើលរូបរាង

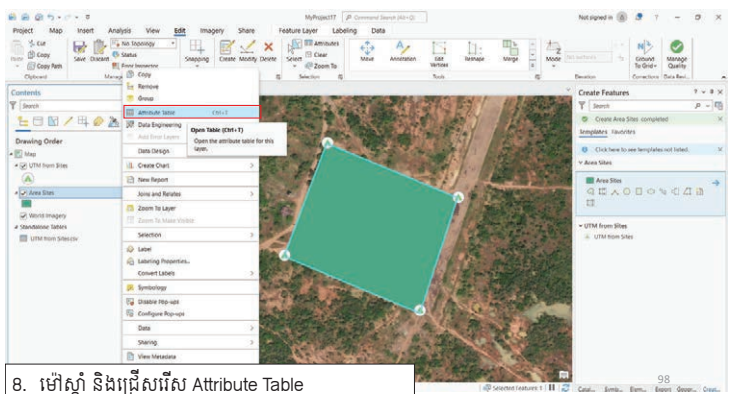
ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបង្ហាញពីទំហំនៃទីតាំងដែលបានចត្សរ (បន្ត)



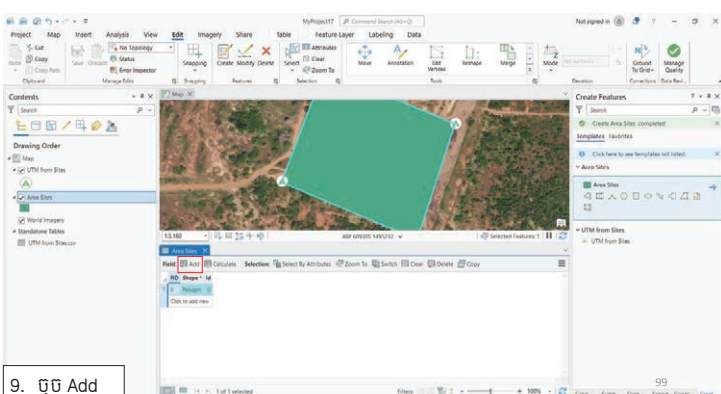
ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបង្ហាញពីទំហំនៃទីតាំងដែលបានចត្សរ (បន្ត)



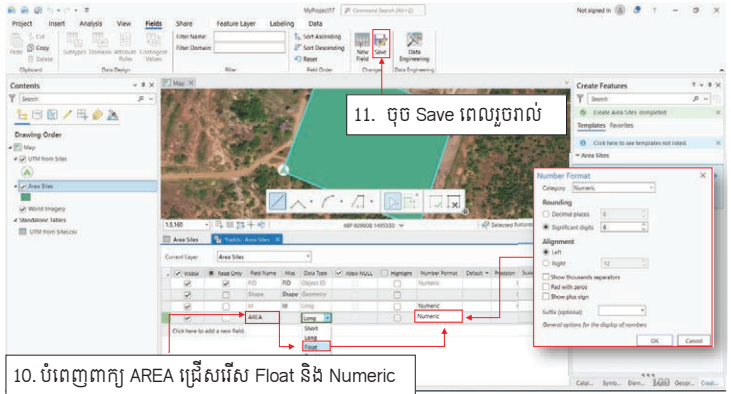
ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបង្ហាញពីទំហំនៃទីតាំងដែលបានចត្សរ (បន្ត)



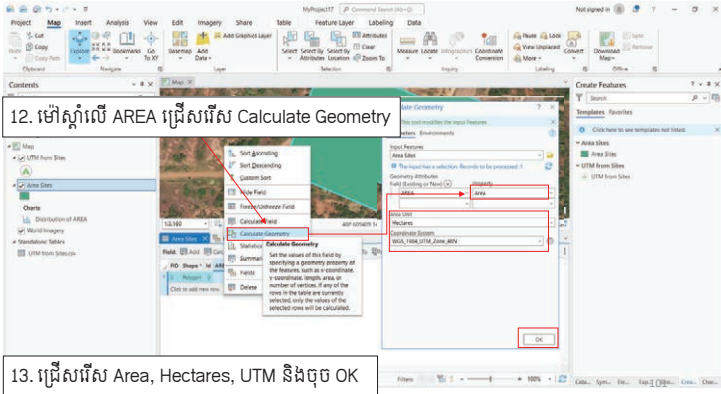
ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបង្ហាញពីទំហំនៃទីតាំងដែលបានចត្សរ (បន្ត)



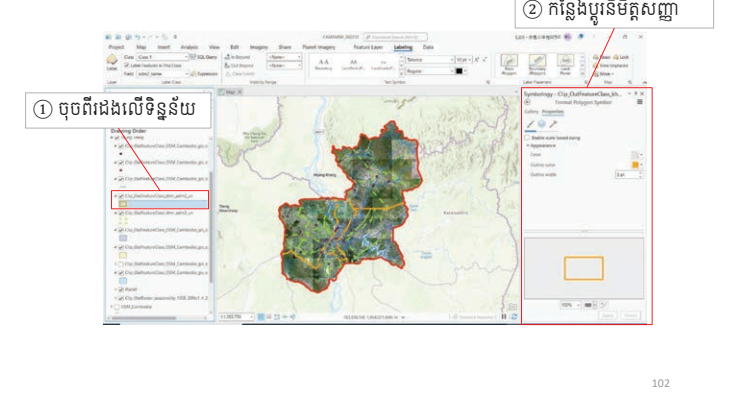
ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបង្ហាញពីទំហំនៃទីតាំងដែលបានចត្សរ (បន្ត)



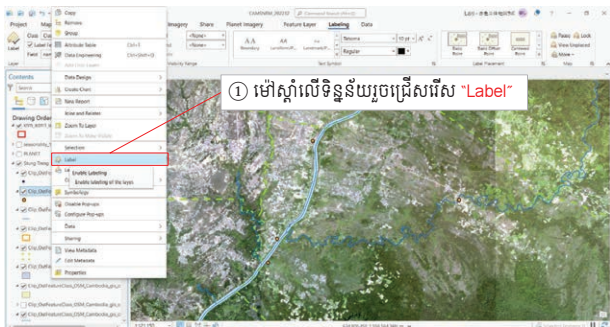
ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការប្រើប្រាស់និមិត្តសញ្ញា (ពណ៌ ទំហំ និងប្រភេទខ្សែបន្ទាត់)



ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

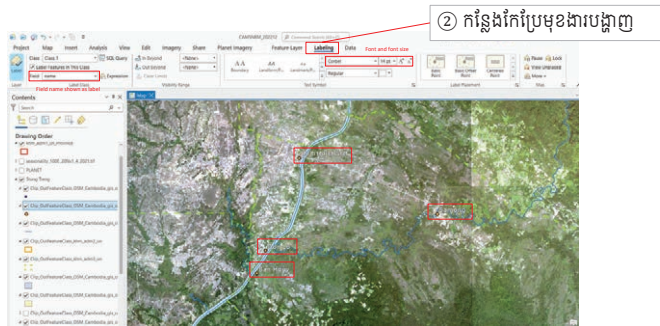
ការប្រើប្រាស់មុខងារបង្ហាញឈ្មោះ:



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ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

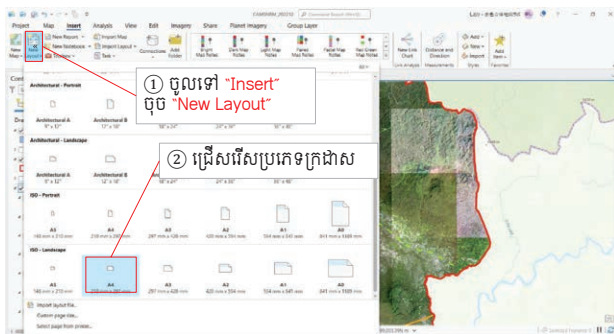
ការប្រើប្រាស់មុខងារបង្ហាញឈ្មោះ: (បន្ត)



104

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

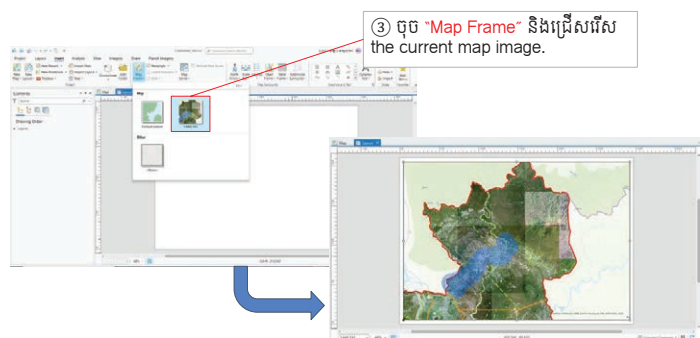
ការប្រើប្រាស់មុខងារកំណត់ផែនទីលើក្រដាស



105

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

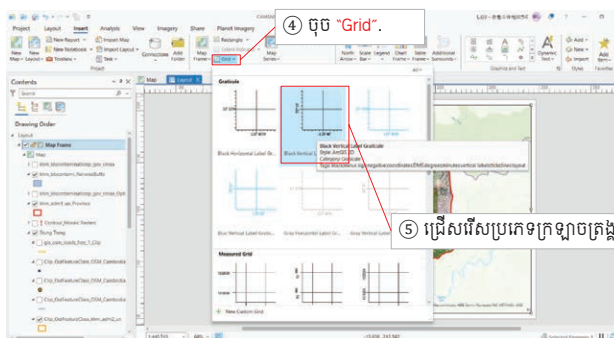
ការប្រើប្រាស់មុខងារកំណត់ផែនទីលើក្រដាស (បន្ត)



106

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

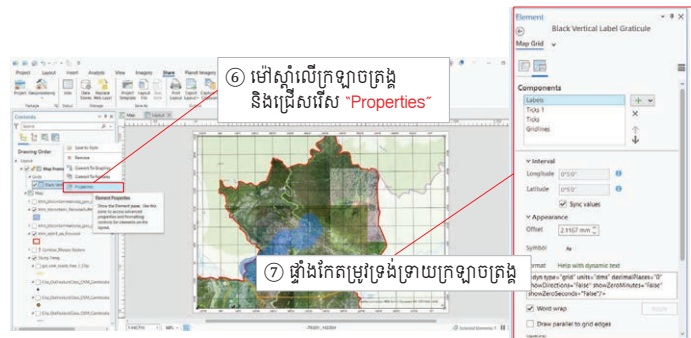
ការប្រើប្រាស់មុខងារកំណត់ផែនទីលើក្រដាស (បន្ត)



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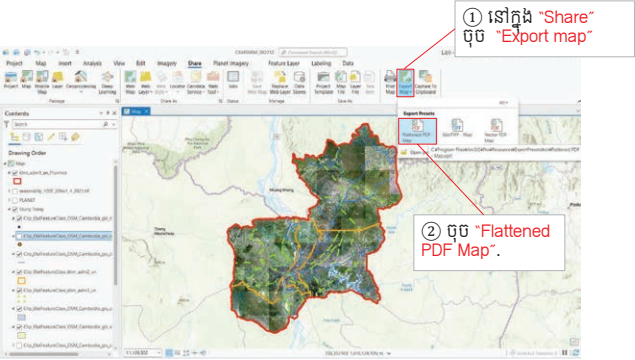
ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការប្រើប្រាស់មុខងារកំណត់ផែនទីលើក្រដាស (បន្ត)



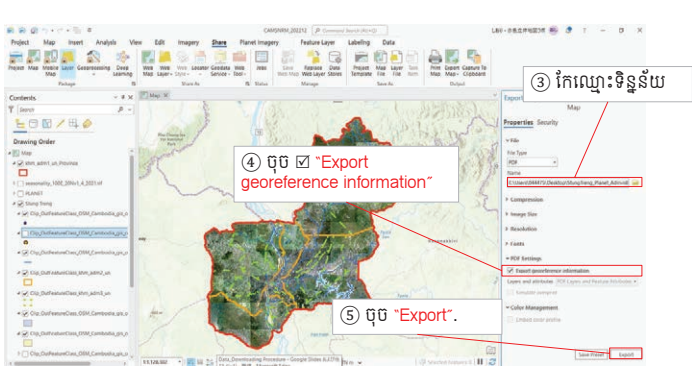
108

ការបញ្ចេញទិន្នផលផែនទីជាទម្រង់ Geo-PDF



109

ការបញ្ចេញទិន្នផលផែនទីជាទម្រង់ Geo-PDF (បន្ត)



110

ការដំណើរការរូបភាព និងការរៀបចំផែនទីរូបភាពពីគ្រួសារ

- ប្រើប្រាស់កម្មវិធី Pix4D និងអនុវត្តតាមការណែនាំ



111

ការដំណើរការរូបភាព និងការរៀបចំផែនទីរូបភាពពីគ្រួសារ (បន្ត)

- គំរូផែនទីដែលនឹងជំនួសដោយរូបភាពគ្រួសារ



112

បទពិសោធន៍ និងការយល់ដឹងបន្ថែមអំពីការអនុវត្តន៍ ការពិនិត្យស្ថានភាពទីតាំងហោះហើរ

- ពិនិត្យមើលឧបសគ្គដែលនៅជុំវិញ មុនពេលហោះហើរ
- ការហោះដោយដៃគឺវិធីសាស្ត្រដែលអាចប្រើប្រាស់ក្នុងការពិនិត្យមើលឧបសគ្គដែលនៅខ្ពស់ជាងផែនការហោះហើរ
- ត្រូវតាមដានផ្លូវពេលកំពុងហោះហើរ
- បើមានឧបសគ្គផ្សេងៗ RTH



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បទពិសោធន៍ និងការយល់ដឹងបន្ថែមអំពីការហោះហើរ(ត) ការបង្កើតផែនការហោះហើរសម្រាប់ការផលិតផែនទី

- ការបង្កើតផែនការតាមរយៈ KML បានដំណើរការនៅក្នុង DJI Pilot បានល្អៗត្រាតែ KML នោះបានរូបរាងមិនបត់បែនច្រើន

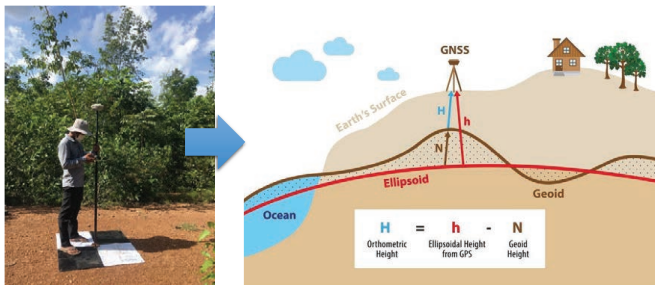


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បទពិសោធន៍ និងការយល់ដឹងបន្ថែមអំពីការហោះហើរ(ត)

ការវាស់វែងចំណុច GCPs

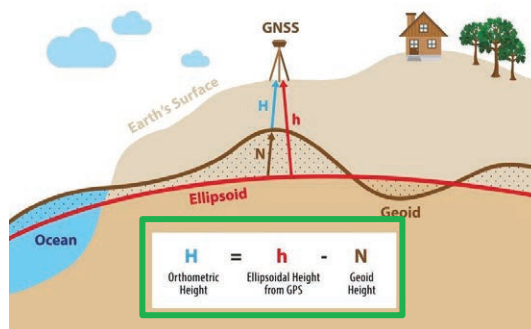
- ស្វែងយល់អំពីទំនាក់ទំនងកំពស់ Z ដែលនឹងទទួលបានបន្ទាប់ពីការវាស់វែង



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បទពិសោធន៍ និងការយល់ដឹងបន្ថែមអំពីការហោះហើរ(ត)

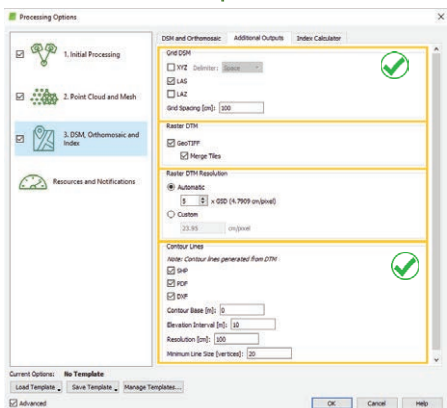
ការវាស់វែងចំណុច GCPs (បន្ត)



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បទពិសោធន៍ និងការយល់ដឹងបន្ថែមអំពីការហោះហើរ(ត)

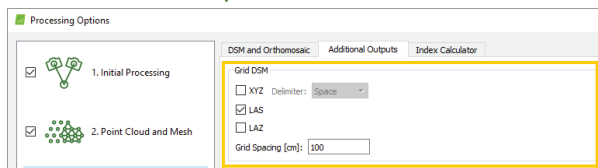
ការកំណត់មុខងារមួយចំនួននៅក្នុងកម្មវិធី Pix4D



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បទពិសោធន៍ និងការយល់ដឹងបន្ថែមអំពីការហោះហើរ(ត)

ការកំណត់មុខងារមួយចំនួននៅក្នុងកម្មវិធី Pix4D

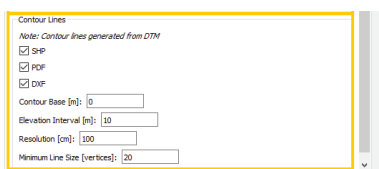


- Grid Spacing ប្រើដើម្បីកំណត់ចម្ងាយរវាង 3D Point Clouds ពីរ
- ប្រសិនបើ Grid Spacing ត្រូវបានកំណត់នៅចំនួន 100cm។ មានន័យថា វាត្រូវបានជ្រើសរើស 3D Point Clouds រៀងរាល់ 100cm

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បទពិសោធន៍ និងការយល់ដឹងបន្ថែមអំពីការហោះហើរ(ត)

ការកំណត់មុខងារមួយចំនួននៅក្នុងកម្មវិធី Pix4D



- Contour Base ជាចំណុចចាប់ផ្តើមនៃ Contour lines។ ប្រសិនបើ Contour Base ត្រូវបានកំណត់នៅចំនួន 0m។ មានន័យថា វាត្រូវបានចាប់ផ្តើមពី 0m ទៅ។
- Resolution សំដៅលើភាពច្បាស់ និងការជ្រើសរើសតាមនៃ Contour lines។ ប្រសិនបើ Contour Base ត្រូវបានកំណត់នៅចំនួន 100cm។ មានន័យថា elevation ត្រូវបានរៀងរាល់ 100cm។
- Minimum Line Size សំដៅលើអប្បបរមានៃការជ្រើសរើសខ្សែបន្ទាត់។ ប្រសិនបើ Minimum Line Size ត្រូវបានកំណត់នៅចំនួន 10m។ មានន័យថា ខ្សែបន្ទាត់ដែលតិចជាង 10m ត្រូវបានលុបចោល។

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ស្វ័យអវត្តមាន



