

カンボジア国環境省自然保全・保護総局（GDNPA）
カンボジア国農林水産省森林局（FA）
ストゥントレン州環境局、ストゥントレン州農林水産局

カンボジア国 持続的自然資源管理能力強化 プロジェクト

業務完了報告書

2024 年 12 月

独立行政法人
国際協力機構（JICA）

アジア航測株式会社

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プロジェクト対象地 位置図



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略語表

AAS	Asia Air Survey Co., Ltd	アジア航測株式会社
AGB	Above Ground Biomass	地上部バイオマス
AIP	Action and Investment Plan for implementation of the National REDD+ Strategy	国家 REDD+戦略実施のための行動投資計画
APO	Annual Plan of Operation	年次活動実施計画
APO2020-2021	APO for 2020 to 2021	2020 年～2021 年年次活動実施計画
APO2022	APO for 2022	2022 年年次活動実施計画
APO2023	APO for 2023	2023 年年次活動実施計画
APO2024	APO for 2024	2024 年年次活動実施計画
BGB	Below Ground Biomass	地下部バイオマス
CAM-REDD	Project for Facilitating the Implementation of REDD+ Strategy and Policy	カンボジア国 REDD+戦略政策実施支援プロジェクト
CEMIS	Cambodia Environmental Management Information System	カンボジア環境管理情報システム
CF	Community Forestry	コミュニティ林業
CI	Conservation International	コンサベーション・インターナショナル
CJCC	Cambodian-Japan Cooperation Center	カンボジア日本人材開発センター
COVID-19	Coronavirus disease 19	新型コロナウイルス感染症
CPA	Community Protected Area	コミュニティ保護区
DBH	Diameter at Breast Height	胸高直径
DFC	Department of Forest and Community Forest	森林コミュニティ林業部
DG	Director General	局長
DGIS	Department of Geographical Information Service	地理情報サービス部
DoA	Department of Agriculture, Forestry and Fisheries	農林水産局
DoE	Department of Environment	環境局
DP	Development Partners	開発パートナー
DPS	Data Product Specifications	データ製品仕様書
DSM	Digital Surface Model	数値表層モデル
DTM	Digital Terrain Model	数値地形モデル
EO	Earth Observation	地球観測
EF	Emission Factor	排出係数
FA	Forestry Administration	森林局
FAC	Forestry Administration Cantonment	森林管理事務所
FRL	Forest Reference Level	森林参照レベル

GCF	Green Climate Fund	緑の気候基金
GDANCP	General Directorate of Administration for Nature Conservation and Protection	自然保全・保護総局
GDEKI	General Directorate of Environmental Knowledge and Information	知識環境情報総局
GDLC	General Directorate of Local Communities	地域コミュニティ総局
GDNPA	General Directorate of Nature Protected Area	自然保全・保護総局
GIS	Geographical Information System	地理情報システム
GNSS	Global Navigation Satellite System	衛星測位システム
GPL	Greening Prey Lang	グリーンング・プレイロン
GPS	Global Positioning System	全地球測位システム
HQ	Headquarters	本部
JAXA	Japan Aerospace Exploration Agency	国立研究開発法人宇宙航空研究開発機構
JCC	Joint Coordinating Committee	合同調整委員会
JCC1	The 1st JCC	第1次合同調整委員会
JCC2	The 2nd JCC	第2次合同調整委員会
JCC3	The 3rd JCC	第3次合同調整委員会
JCC4	The 4th JCC	第4次合同調整委員会
JCC5	The 5th JCC	第5次合同調整委員会
JCM	Joint Crediting Mechanism	二国間クレジット制度
JICA	Japan International Cooperation Agency	独立行政法人国際協力機構
JJ-FAST	JICA-JAXA Forest Early Warning System in the Tropics	JICA-JAXA 熱帯林早期警戒システム
LULC	Land Use and Land Cover	土地利用土地被覆
MAFF	Ministry of Agriculture, Forestry and Fisheries	農林水産省
ML	Machine Learning	機械学習
MLMUPC	Ministry of Land Management, Urban Planning and Construction	国土管理・土地計画・建設省
M/M	Minutes of Meetings	会議議事録
MoE	Ministry of Environment	環境省
MRV	Measurement, Reporting and Verification	測定・報告・検証
M&E	Monitoring and Evaluation	モニタリングと評価
NDC	Nationally Determined Contribution	国が決定する貢献
NFI	National Forest Inventory	国家森林インベントリ
NFMS	National Forest Monitoring System	国家森林モニタリングシステム

NGO	Non-governmental Organization	非政府組織
NICFI	Norway's International Climate and Forest Initiative	ノルウェー国際気候・森林イニシアティブ
NP	National Park	国立公園
NPASMP	National Protected Area Strategic Management Plan	国家保護区戦略管理計画
NRT	National REDD+ Taskforce	国家レッドプラスタスクフォース
OVI	Objectively Verifiable Indicators	客観的証明可能な指標
PaFF	Partnership for Forestry and Fisheries in Cambodia	
PaFF3	PaFF Phase 3	PaFF フェーズ 3
PC	Personal Computer	パーソナルコンピュータ
PCA	Principal Component Analysis	主成分分析
PCM	Project Cycle Management	プロジェクト・サイクル・マネジメント
PDF	Portable Document Format	ポータブル・ドキュメント・フォーマット
PDM	Project Design Matrix	プロジェクト・デザイン・マトリックス
PDOE	Provincial Department of Environment	州政府環境局
PFSP	Production Forest Strategic Plan	生産林戦略計画
PMU	Project Management Unit	プロジェクト管理ユニット
PO	Plan of Operation	活動計画
POI	Point of Interest	地図上の特定地点
QA/QC	Quality Assurance / Quality Control	品質保証/品質管理
R/D	Record of Discussions	政府間技術協力プロジェクト合意文書
RECOFTC	The Regional Community Forestry Training Centre	地域コミュニティフォレストリー研修センター
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	途上国における森林減少・森林劣化に由来する排出の抑制、ならびに森林保全、持続可能な森林経営、森林炭素蓄積の増強
RGC	Royal Government of Cambodia	カンボジア政府
RTS	REDD+ Taskforce Secretariat	REDD+タスクフォース事務局
RUA	Royal University of Agriculture	カンボジア王立農業大学
SATREPS	Science and Technology Research Partnership for Sustainable Development	地球規模課題対応国際科学技術協力プログラム
SEA	Southeast Asia	東南アジア

SDC	Swiss Agency for Development and Cooperation	スイス開発協力庁
SEPAL	System for Earth Observation Data Access, Processing and Analysis for Land Monitoring	土地モニタリングのための地球観測衛星データ提供・解析・分析システム
SLMS	Satellite Land Monitoring System	衛星土地モニタリングシステム
SNRM	The Project for National and Sub-National Capacity Development for Sustainable Natural Resource Management	持続的自然資源管理能力強化プロジェクト
SNS	Social Networking Service	ソーシャルネットワークサービス
tC	Ton of Carbon	炭素トン
tCO₂	Ton of Carbon dioxide	二酸化炭素トン
ToT	Training of Trainers	指導者育成研修
TWG-FR	Technical Working Group on Forestry Reform	林業改革にかかる技術ワーキンググループ
UNDP	United Nations Development Programme	国連開発計画
UNFCCC	United Nations Framework Convention on Climate Change	気候変動に関する国際連合枠組条約
USAID	United States Agency for International Development	アメリカ合衆国国際開発庁
UXO	Unexploded Ordnance	不発弾
WB	World Bank	世界銀行
WG	Working Group	ワーキンググループ
WS	Wildlife Sanctuary	野生生物保護区

要約

持続的自然資源管理能力強化プロジェクト（SNRM）は、カンボジア側カウンターパートと JICA 専門家との協力の下、2020 年 10 月から 2024 年 10 月まで実施された。日本人専門家は、JICA 長期専門家及びアジア航測株式会社から派遣された JICA 短期専門家チームで構成される。短期専門家チームは主に「成果 1-3-2：国家森林モニタリングシステム（NFMS）の質的向上を支援する」と「成果 2-1-1：州職員の能力向上のための訓練計画を策定し実施する」を担当した。

本報告書では、主に成果 1-3-2 及び成果 2-1-1 に関連する活動の結果及び指標の達成状況を報告する。これらの成果において、短期専門家チームはカンボジア NFMS の質的向上支援、特に衛星土地モニタリングシステム（SLMS）における森林減少アラート機能の開発支援、ならびにストゥントレン州での州レベルの森林インベントリ情報の提供を通じた測定・報告・検証（MRV）機能の強化に向けた活動を実施した。さらに、衛星画像・ドローン画像を用いた土地利用被覆情報の収集やその変化の分析、ドローンやスマートフォンアプリを用いた森林減少劣化箇所の現地検証、ならびに収集した土地利用被覆情報の地図化や標準仕様のジオデータベースとして整備することで、違法伐採に係る法執行や保護区・生産林の効果的なモニタリング・管理を含む中央政府・地方政府の所掌業務の実施能力の向上に向けた活動を実施した。

I プロジェクトの基本情報

1 対象国

カンボジア王国（以下、カンボジア）

2 プロジェクト名

和名：持続的自然資源管理能力強化プロジェクト（以下、本プロジェクト）

英名：The Project for National and Sub-National Capacity Development for Sustainable Natural Resource Management (SNRM)

3 プロジェクト期間（計画と実績）

計画：2020 年 10 月 14 日から 2023 年 10 月 13 日（3 年間）*

*当初のプロジェクト期間は 3 年間であったが、その後正式に 4 年間に延長された。

実績：2020 年 10 月 14 日から 2024 年 10 月 13 日（4 年間）

4 背景

カンボジアは国土の約半分が森林で覆われており、常緑林、落葉林、内陸浸水林、海岸マングローブ林等の多様なタイプの森林が存在する。これらの森林は、多くの希少な野生動植物の生息地として、地球温暖化防止に貢献する二酸化炭素吸収源として、また森林に暮らす人々の生存に欠かすことのできない食料や生活物資の供給源として、その持続的な管理を実現する重要性が広く認識されている。

しかし、カンボジアの森林は周辺メコン諸国と比較しても減少傾向が著しく、国土に占める森林の割合は 2006 年の 59%から 2018 年の 47%（カンボジア環境省、2020 年）へと大きく減少した。その主な原因は、換金作物生産のための土地利用転換、違法伐採、非持続的な森林資源の収奪であり、森林の減少は、土壌流出や生物多様性の損失を引き起こし、人口の約 8 割が暮らす農村の生活に負の影響を与え始めている。また、大きな視点に立つと、森林の減少・劣化に伴う炭素排出の増加は地球温暖化を加速させるリスクとなっている。

カンボジア政府は、国際社会の支援を受けながら、困難な状況にある自国の貴重な森林資源を適切に管理するための努力を続けている。JICA はカンボジア政府森林セクターの主要ドナーの一つとして、重要な役割を果たしてきた。1999 年の個別専門家派遣を初めとして、2001 年からは 10 年間にわたり森林分野の人材育成プロジェクトを実施した。2010 年からは、機材供与や技術協力プロジェクトを通じ、主に森林分野の気候変動対策である「途上国における森林減少・劣化に由来する排出の削減等（REDD+）」を実施するための準備フェーズに対する支援を行ってきた。

本プロジェクトは、JICA が森林分野の協力で積み重ねてきた知見を踏まえながら、中央政府及び地方政府レベルにおける持続的な自然資源管理の政策支援と実行支援を通じて、保護区及び森林の管理を担当する国・地方政府のスタッフの能力を強化することにより、必要な政策・措置が策定、実施され、カンボジアにおける森林減少・劣化が低減されることを目指した。

5 上位目標、プロジェクト目標、成果と活動

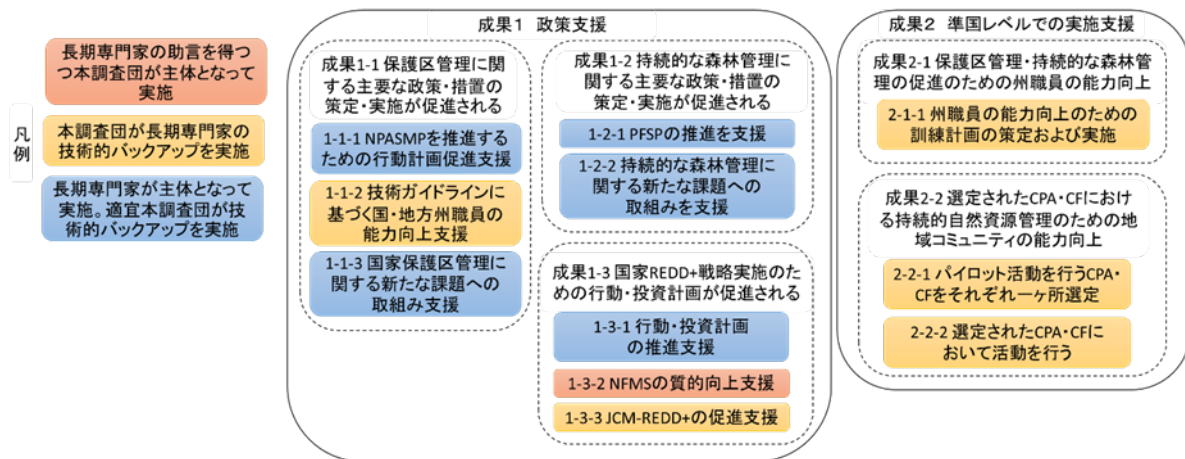
本プロジェクトは、カンボジアにおける森林減少と森林劣化の削減に向けて、持続可能な自然資源管理の促進に貢献することを目的としている。上記の 4 背景を踏まえ、2022 年 5 月に実施された中間レビューで修正されたプロジェクトの上位目標、プロジェクト目標及び、成果と活動を表 1.1 に示す。

表 1.1 プロジェクト上位目標、目標、成果と活動

上位目標	保護区管理及び持続的な森林管理を強化する必要な政策・措置を策定し実施することにより、森林減少・劣化を低減させる。
プロジェクト目標	保護区管理及び持続的な森林管理を担当する国・地方政府のスタッフが、持続的な自然資源管理に必要な技術・知識を修得する。
成果と活動	[成果 1 政策支援] 1-1. 保護区管理に関する主要な政策・措置の策定・実施が促進される。 1-2. 持続的な森林管理に関する主要な政策・措置の策定・実施が促進される。 1-3. 国家 REDD +戦略実施のための行動・投資計画が促進される。 [成果 2 準国レベルでの実施支援] 2-1. 保護区管理及び持続的な森林管理を促進するための州職員の能力が向上する。 2-2. 選定されたコミュニティ保護区（CPA）及びコミュニティ森林（CF）における持続的な自然資源管理のための地域コミュニティの能力が向上する。

出典：SNRM プロジェクト

本プロジェクトは JICA が派遣する長期専門家とアジア航測が JICA との業務実施契約に基づいて派遣する短期専門家チームの連携により実施された。図 1.1 に活動毎の長期専門家と短期専門家チームの役割分担を示す。



出典：SNRM プロジェクト

図 1.1 個々の活動における長期専門家と短期専門家チームの役割

6 カンボジア実施機関

- ・ 環境省自然保全・保護総局
- ・ 農林水産省森林局
- ・ ストゥントレン州環境局
- ・ ストゥントレン州農林水産局

II プロジェクト結果

1 プロジェクト結果

1.1 日本側の投入

1.1.1 短期専門家の投入状況

短期専門家の投入状況を表 2.1 に示す。

表 2.1 短期専門家投入実績（2020 年 12 月 - 2024 年 10 月）

氏 名	担当業務	M/M
古谷 透	業務主任/森林情報管理 1	13.38
稲田 徹	副業務主任/森林情報管理 2	3.55
瀧本 麻子	組織連携	1.77
三塚 直樹	森林モニタリング 1	4.42
吉野 健太（前任） 浅井 樹（後任）	森林モニタリング 2/業務調整	6.20
谷口 しおり	森林モニタリング 3	4.33
古谷 透	森林モニタリング 4	6.50
佐藤 嘉彦	森林インベントリ調査	4.68
合計		44.83

出典：SNRM プロジェクト

1.1.2 機材の投入状況

短期専門家チームによる機材投入計画と実績を表 2.2 に示す。

表 2.2 短期専門家チームによる機材投入状況

No.	物品名称	規格・品番	個数	納入検査日	事業終了後の 取扱い
1	50m 巻き尺	ハヤマキ 14 066-1281	12	2021/3/4	以下機関に譲渡済み。 環境省：6 個 （譲渡日：2023/10/11） 森林局：6 個 （譲渡日 2023/12/14）
2	土壌試料採取 用円筒	ステンレス製コア 6 個/組	2	2021/3/4	以下機関に譲渡済み。 環境省：1 個 （譲渡日：2023/10/11） 森林局：1 個

No.	物品名称	規格・品番	個数	納入検査日	事業終了後の 取扱い
					(譲渡日 2023/12/14)
3	360 度撮影カメラ	Ricoh Theta SC2	6	2021/3/18	以下機関に譲渡済み。 環境省：3 個 (譲渡日：2023/10/11) 森林局：3 個 (譲渡日 2023/12/14)
4	逆目盛検測桿 (8m)	AT-8	6	2021/3/4	以下機関に譲渡済み。 環境省：3 個 (譲渡日：2023/10/11) 森林局：3 個 (譲渡日 2023/12/14)
5	直径割付巻尺 (10m)	ミリオンダイヤメーター D3M	12	2021/3/4	以下機関に譲渡済み。 環境省：6 個 (譲渡日：2023/10/11) 森林局：6 個 (譲渡日 2023/12/14)
6	直径割付巻尺 (2m)	F10-02DM	12	2021/3/4	以下機関に譲渡済み。 環境省：6 個 (譲渡日：2023/10/11) 森林局：6 個 (譲渡日 2023/12/14)
7	コンパス付き 斜面計	SUUNTO Tandem	6	2021/6/29	以下機関に譲渡済み。 環境省：3 個 (譲渡日：2023/10/11) 森林局：3 個 (譲渡日 2023/12/14)
8	樹高計測器	Haglof Vertex Geo	4	2021/6/29	以下機関に譲渡済み。 環境省：2 個 (譲渡日：2023/10/11) 森林局：2 個 (譲渡日 2023/12/14)
9	GPS ロガー	Garmin GPSMAP 66s	4	2021/6/29	以下機関に譲渡済み。 環境省：2 個 (譲渡日：2023/10/11) 森林局：2 個 (譲渡日 2023/12/14)
10	ラップトップ	Dell Mobile Precision 7550	4	2021/10/4	以下機関に譲渡済み。

No.	物品名称	規格・品番	個数	納入検査日	事業終了後の 取扱い
	PC				環境省：2 台 (譲渡日：2023/10/11・ 2024/10/10) 森林局：2 台 (譲渡日 2023/9/20・ 2024/9/25)
11	デスクトップ PC	Desktop Dell Precision T7820	2	2021/10/4	以下機関に譲渡済み。 ストゥントレン州環境 局：1 台 (譲渡日：2023/6/26) ストゥントレン州森林 局：1 台 (譲渡日 2024/9/20)
12	ワークステー ション	Desktop Dell Precision T7810	3	2021/11/1	以下機関に譲渡済み。 ストゥントレン州環境 局：1 台 (譲渡日：2023/6/26) 森林局：2 台 (譲渡日 2023/9/20・ 2024/9/25)
13	画像処理ソフ ト	Pix4D Mapper Pro	3	2021/11/5	以下機関に譲渡済み。 ストゥントレン州環境 局：1 ライセンス (譲渡日：2023/6/26) 森林局：2 ライセンス (譲渡日 2023/9/20・ 2024/9/25)
14	固定翼ドロー ン本体と GPS 機材	eBee Geo	2	2021/11/24	以下機関に譲渡済み。 環境省：1 台 (譲渡日：2023/10/11) 森林局：1 台 (譲渡日 2024/9/25)

出典：SNRM プロジェクト

1.2 カンボジア側の投入

C/P 職員一覧を表 2.3 に示す。

表 2.3 C/P 職員一覧

No.	氏名			職名	備考
1	H.E.	Srey	Sunleang	環境省自然保全・保護総局 (GDNPA)・局長	プロジェクト・ ダイレクター
2	Mr.	Chan	Ponika	農林水産省森林局 (FA)・副局長	
3	Mr.	Sou	Sontara	環境省自然保全・保護総局査察法執行 部・副部長	
4	Mr.	Long	Ratanakoma	農林水産省森林局森林コミュニティ林 業部・副部長	
5	H.E.	Chivin	Leng	環境省環境知識情報総局 (GDEKI)・ 局長	
6	Mr.	Uy	Kamal	環境省環境知識情報総局・副局長	
7	Mr.	Kim	Sarin	環境省地域コミュニティ総局 (GDLC) コミュニティ生計部・副部 長	
8	Mr.	Sok	Vuthin	環境省自然保全・保護総局陸域保護区 保全部 (北部トンレサップ川)・室長	
9	Mr.	Hour	Thanith	環境省自然保全・保護総局淡水湿地地 区保全部・室長	
10	Mrs.	Huot	Naborey	環境省環境知識情報総局地理情報サー ビス部・室長	
11	Mr.	Menh	Khidorang	環境省環境知識情報総局地理情報サー ビス部・副室長	
12	Mr.	Net	Norint	環境省環境知識情報総局地理情報サー ビス部・副室長	
13	Mr.	Hean	Sereypheap	環境省環境知識情報総局地理情報サー ビス部・副室長	
14	Mr.	Mouerng	Sovan	環境省自然保全・保護総局管理計画財 務部・副室長	
15	Mr.	Tim	Yean	環境省自然保全・保護総局陸域保護区 保全部 (東部メコン川)・副室長	
16	Mr.	Tip	Sophea	環境省環境知識情報総局地理情報サー ビス部・副室長	
17	Mr.	Nhong	Votey	環境省環境知識情報総局地理情報サー ビス部・副室長	森林インベント リ調査参加者
18	Mr.	Leng	Serey Odom	環境省環境知識情報総局地理情報サー ビス部・職員	ドローン研修参 加者
19	Mr.	Mean	Naro	環境省自然保全・保護総局陸域保護区 保全部 (東部メコン川)・副室長	GIS・ドローン 研修参加者
20	Mr.	Song	Bonith	環境省自然保全・保護総局査察法執行 部・副室長	
21	Mrs.	Chea	Sodaneth	環境省自然保全・保護総局陸域保護区 保全部 (東部メコン川)・職員	
22	Mr.	Eng	Sereyvathana	環境省自然保全・保護総局陸域保護区 保全部 (東部メコン川)・職員	
23	Mr.	Meng	Sokmean	環境省自然保全・保護総局海岸海洋地 区保全部・職員	
24	Mr.	Keth	Saren	環境省自然保全・保護総局淡水湿地地 区保全部・副室長	
25	Mr.	Koem	Nith	環境省自然保全・保護総局管理計画財 務部・職員	

No.	氏名			職名	備考
26	Mr.	Lay	Darith	環境省自然保全・保護総局陸域保護区保全部（東部メコン川）・室長	
27	Mr.	Heng	Namyi	環境省自然保全・保護総局陸域保護区保全部（北部トンレサップ川）・職員	
28	Mr.	Hean	Phanny	環境省自然保全・保護総局陸域保護区保全部（北部トンレサップ川）・職員	
29	Mr.	Path	Sokunvath	環境省自然保全・保護総局陸域保護区保全部（南部トンレサップ川）・職員	
30	Mr.	Ven	Bros	環境省自然保全・保護総局査察法執行部・職員	
31	Mr.	Tieng	Bunna	環境省自然保全・保護総局管理計画財務部・副室長	中・上級 GIS 研修参加者
32	Mr.	Oeun	Koemoun	環境省自然保全・保護総局陸域保護区保全部（南部トンレサップ川）・副室長	
33	Mr.	Sokha	Sophorn	環境省自然保全・保護総局管理計画財務部・副部長	
34	Mr.	Mom	Sethera	環境省自然保全・保護総局陸域保護区保全部（北部トンレサップ川）・ボランティア職員	
35	Mrs.	Eang	Phallis	環境省自然保全・保護総局淡水湿地地区保全部・副室長	
36	Mr.	Pin	Chanratana	環境省自然保全・保護総局陸域保護区保全部（東部メコン川）・室長	
37	Mr.	Tan	Thara	環境省自然保全・保護総局陸域保護区保全部（東部メコン川）・室長	
38	Mr.	Yub	Chanborey	環境省自然保全・保護総局査察法執行部・副部長	
39	Mr.	Eng	Srereyathana	環境省自然保全・保護総局陸域保護区保全部（東部メコン川）・副室長	
40	Mr.	Than	Monokumrith	環境省自然保全・保護総局海岸海洋地区保全部・副室長	
41	Mr.	Yoeung	Visal	環境省自然保全・保護総局淡水湿地地区保全部・副室長	
42	Mrs.	Thao	Chanthearyradh	環境省自然保全・保護総局陸域保護区保全部（南部トンレサップ川）・職員	
43	Mr.	Sum	Dara	環境省自然保全・保護総局海岸海洋地区保全部・副室長	
44	Mr.	Seng	Sopanha	環境省自然保全・保護総局管理計画財務部・副室長	中・上級 GIS 研修参加者
45	Mr.	Chhun	Delux	農林水産省森林局林産国際協力部・副部長	
46	Mr.	Lim	Bunna	環境省自然保全・保護総局管理計画財務部・副部長	
47	Mrs.	Im	Maredi	農林水産省森林局森林コミュニティ林業部・室長	
48	Mr.	Y	Chhaly	農林水産省森林局林産国際協力部・職員	
49	Mrs.	Koh	Sotheavy	農林水産省森林局森林境界面画定登録森林土地利用室・副室長	ドローン研修参加者
50	Mr.	Chheav	Sophoan	農林水産省森林局登録訴訟室・副室長	
51	Mr.	Pich	Sovathara	農林水産省森林局貿易森林認証室・副	

No.	氏名			職名	備考
				室長	
52	Mr.	Hem	Senghong	農林水産省森林局森林境界画定登録森林土地利用室・職員	
53	Mr.	Chan	Ratana	農林水産省森林局登録訴訟室・職員	
54	Mr.	As	Brosden	農林水産省森林局森林コミュニティ林業部・職員	
55	Mrs.	Bun	Sokleng	農林水産省森林局森林コミュニティ林業部・職員	
56	Mr.	Sreng	Cheaheng	ストウントレン州環境局・局長	
57	Mr.	Lay	Laro	ストウントレン州環境局・副局長	
58	Mr.	Heng	Teklay	ストウントレン州環境局野生生物保護区室・室長	
59	Mr.	Sorn	Chanmonyphalla	ストウントレン州環境局コミュニティ保護区室・室長	
60	Mr.	Eng	Somatra	ストウントレン州環境局・職員	
61	Mr.	Pich	Putra	ストウントレン州環境局・GIS 職員	
62	Mr.	Chhoung	Chhorn	ストウントレン州環境局ラムサール湿地室・副室長	
63	Mr.	Ti	Tetsya	ストウントレン州環境局・レンジャー職員	
64	Mr.	Sang	Rithsa	ストウントレン州環境局保護区室・副室長	
65	Mr.	Sang	Andy	ストウントレン州環境局 Anlung Chrey 管理事務所・室長	
66	Mr.	Kean	Kimsan	ストウントレン州環境局 Anlung Chrey 管理事務所・副室長	
67	Mr.	Orn	Chansocheat	ストウントレン州森林局・局長	
68	Mr.	Rey	Raksmey	ストウントレン州森林局・副局長	ToT 研修参加者
69	Mr.	Chhum	Monycheat	ストウントレン州森林局 Division 管理室・副室長	
70	Mr.	Tith	Vy	ストウントレン州森林局 Kbal Romes-SreKor Triage 管理室・副室長	ToT 研修参加者
71	Mr.	Hun	Samoeun	ストウントレン州森林局 Oh Pongmoin Triage 管理室・副室長	
72	Mr.	Thoeung	Linin	ストウントレン州森林局・職員	
73	Mr.	Ly	Korn	ストウントレン州森林局 Division 管理室・副室長	
74	Mr.	Va	Sokha	ストウントレン州森林局 Division 管理室・副室長	
75	Mr.	Sok	Somnang	ストウントレン州森林局 Division 管理室・副室長	

出典：SNRM プロジェクト

1.3 活動結果

1.3.1 全般的な活動

(1) 業務計画書の作成

業務計画書案を作成して JICA 担当者と協議を行い最終化したうえで、2020 年 12 月に業務計画書

を提出した。カンボジアへの渡航後に環境省・森林局とワークプラン検討会議を実施し、C/P に業務計画書の内容説明及び協議を実施したうえで、2021 年 1 月に業務計画書を最終化した。



出典：SNRM プロジェクト

図 2.1 環境省・森林局でのワークプラン検討会議の開催

さらに C/P との協働によりプロジェクト期間の全ての年次について年次活動実施計画（APO）の取りまとめを行い、合同調整委員会（JCC）にて承認を受けている。

表 2.4 作成された年次活動実施計画

年次活動実施計画の対象年	年次活動実施計画の承認を受けた 合同調整委員会
2020 年 – 2021 年	第 1 回合同調整委員会（2021 年 4 月）
2022 年	第 2 回合同調整委員会（2022 年 2 月）
2023 年	第 3 回合同調整委員会（2022 年 11 月）
2024 年	第 4 回合同調整委員会（2023 年 9 月）

出典：SNRM プロジェクト



出典：SNRM プロジェクト

図 2.2 合同調整委員会の開催

(2) 会議の開催/出席

短期専門家チームは、プロジェクト全体の進捗を管理するための JCC やプロジェクト管理ユニット（PMU）の会合、技術セミナーの開催及びステークホルダーとの会議開催・出席を通じてプロジェクトの状況や進捗についての報告・共有・協議を行った。表 2.5 に開催・出席した会議一覧を示す。



出典：SNRM プロジェクト

図 2.3 技術セミナーの開催

表 2.5 開催・出席した会議一覧

日付	会場	会議の開催・出席
2020 年 11 月 19 日	オンライン	環境省（DGIS）と会議を開催し、短期専門家チームのワークプランについて協議を実施。
2020 年 11 月 26 日	オンライン	GPL プロジェクトと会議を開催し、当プロジェクトで支援する NFMS 機能について協議を実施。
2021 年 1 月 13 日	森林局	森林局 PMU メンバーと会議を開催し、短期専門家チームのワークプランについて協議を実施。
2021 年 1 月 15 日	森林局	森林局 PMU メンバーと追加の会議を開催し、短期専門家チームのワークプランについて協議を実施。
2021 年 1 月 19 日	環境省	環境省 PMU メンバーと会議を開催し、短期専門家チームのワークプランについて協議を実施。
2021 年 1 月 21 日	森林局	森林局長・森林局 PMU メンバーへの表敬訪問を実施。
2021 年 1 月 29 日	オンライン	GPL プロジェクト・JCM REDD+プロジェクトと会議を開催し、当プロジェクトで支援する NFMS 機能について協議を実施。
2021 年 2 月 3～5 日	Mayura Resort and Hotel、ケップ州	「Planning the NFMS to Support the REDD+ Implementation Technical Retreat」ワークショップに出席。詳細は 2)関係機関が開催するワークショップ、に記載。
2021 年 4 月 21 日	オンライン	第 1 回合同調整委員会（JCC1）を開催。
2021 年 2 月 8 日	環境省	「カンボジア国が決定する貢献（NDC）の更新」の発表式典に出席。
2021 年 2 月 16 日	森林局	TWG-FR に出席。
2021 年 2 月 26 日	オンライン	「カンボジアにおける JCM-REDD+プロジェクト及び REDD+ネスティング」に関するワークショップに参加。
2021 年 3 月 4 日	オンライン	「CF に焦点を当てたカンボジアにおける持続可能な森林融資メカニズム」オンライン会議に出席。
2021 年 3 月 16 日	オンライン	SATREPS プロジェクト「トンレサップ湖における環境保全基盤

日付	会場	会議の開催・出席
		の構築」と会議を開催し、プロジェクトの情報共有を実施。
2021年3月30日	オンライン	JCM-REDD+プロジェクトと会議を開催。
2021年6月23日	オンライン	AIPの進捗状況についてRTSと会議を開催。
2021年7月15日	オンライン	UNDP主催のFRL配分研修に出席。
2021年7月19日	オンライン	PMU合同月例ワークショップを開催。
2021年8月13日	森林局・オンライン	パイロットCF選定に係る会議を開催。
2021年8月19日	オンライン	PaFFフェーズ2総括とフェーズ3のワークショップに出席。
2021年8月27日	オンライン	PMU合同月例ワークショップを開催。
2021年9月17日	オンライン	森林モニタリング技術の情報共有に係るREDD Copernicusとの会議を開催。
2021年9月23日	オンライン	「Geospatial technology for sustainable landscape management and REDD+ implementation in Cambodia.」会議に出席。
2021年10月11日	オンライン	PMU合同月例ワークショップを開催。
2021年12月22日	環境省	CEMIS関係者協議イベントに出席。
2022年1月13日	ストゥントレン州	Stung Treng州DoE・FACと森林インベントリ事前調査に係る会議を開催。
2022年1月14日	環境省	CEMISに関するコンサルテーション・ワークショップに出席。
2022年1月27日	ストゥントレン州	JCM REDD+プロジェクトと森林モニタリング技術に関する会議を開催。
2022年2月7日	オンライン	第2回合同調整委員会（JCC2）を開催。
2022年3月25日	森林局	ストゥントレン州で森林インベントリ調査の中間報告セミナーを開催。
2022年3月31日	オンライン	PMU合同月例ワークショップを開催。
2022年4月1日	環境省	CEMISプロジェクトチームと会議を開催。
2022年6月29日	カンボジア日本人材開発センター、Angkor Meas Hotel、オンライン	第1回技術セミナーを開催。詳細は1) 技術セミナー、に記載。
2022年8月3日	オンライン	PMU合同月例ワークショップを開催。
2022年9月1日	オンライン	PMU合同月例ワークショップを開催。
2022年11月25日	Himawari Hotel	第3回合同調整委員会（JCC3）を開催。
2022年12月26日	オンライン	日系スタートアップ企業・JICA本部と森林パトロールのスマートフォンアプリに関する会議を開催。
2023年1月18日	ストゥントレン州環境局	ストゥントレン州政府向けストゥントレン州森林インベントリ報告会を開催。
2023年1月23日	環境省、オンライン	中央政府・ステークホルダー向けストゥントレン州森林インベントリ報告会を開催。
2023年1月26日	FAO カンボジア	FAO専門家と将来のNFI実施方法の協議に係る会議を開催。
2023年1月27日	環境省	RTSと将来のNFI実施方法の提言に係る会議を開催。
2023年2月2日	環境省、森林局、REDD+タスクフォース事務局	環境省、森林局、RTS、JICA本部ミッションとプロジェクトの中間レビューに係る会議を開催。
2023年5月22日	Himawari Hotel	SERVIR SEAのコンサルテーション・ワークショップに出席。
2023年5月24日	Phnom Penh Hotel	PaFF3クロージングセミナー「カンボジアにおける林業・漁業コミュニティのためのパートナーシップの10年：経験、教訓、革新」に出席。
2023年6月2日	環境省	CEMISにおける空間データ基盤（SDI）の設計に関するコンサルテーション・ワークショップに出席。
2023年7月6日	オンライン	PMU合同月例ワークショップを開催。
2023年8月14日	オンライン	PMU合同月例ワークショップを開催。
2023年9月15日	Hotel Sunway Phnom Penh	第4回合同調整委員会（JCC4）を開催。
2023年9月21日	環境省	環境大臣への表敬訪問に出席。
2023年10月9日	プノンペン	RECOFTCと本プロジェクトの進捗報告に係る会議を開催。

日付	会場	会議の開催・出席
2023 年 10 月 10 日	プノンペン	SDC・CI と本プロジェクトの進捗報告に係る会議を開催。
2024 年 2 月 29 日	プノンペン	九州大学と将来の SATREPS プロジェクトでの支援内容の検討に係る会議を開催。
2024 年 4 月 22 日～25 日	Hotel Sunway Phnom Penh	「Geospatial Technology for Sustainable Landscape Management and Information Dissemination in Cambodia And Training on Geospatial Application for Crop Mapping」ワークショップに出席。 詳細は 2) 関係機関が開催するワークショップ、に記載。
2024 年 5 月 20 日～24 日	Paulo Wai Hotel & Apartments	「Comparing State-of-the-Art Methods and Artificial Intelligence for Mapping Deforestation and Estimating Forest Degradation」技術ワークショップに出席。 詳細は 2) 関係機関が開催するワークショップ、に記載。
2024 年 7 月 10 日	オンライン	課題別研修「森林リモートセンシング」JFY2024 のアクションプラン発表会に出席。
2024 年 8 月 28 日	カンボジア日本人材開発センター、Angkor Meas Hotel、オンライン	第 2 回技術セミナーを開催。詳細は 1)技術セミナー、に記載。
2024 年 10 月 16 日	Himawari Hotel	第 5 回合同調整委員会（JCC5）を開催。

出典：SNRM プロジェクト

1) 技術セミナー

日付	2022 年 6 月 29 日	会場	カンボジア日本人材開発センター、 Angkor Meas Hotel、オンライン
会議名	第 1 回技術セミナー	主催者	短期専門家チーム
参加者	PMU メンバー、関係機関、JICA 専門家を含む 56 名		
内容	・ SNRM プロジェクトの概要 ・ ストゥントレン州で実施された森林インベントリの結果報告 ・ 森林管理・森林モニタリングのためのドローン運用の進捗報告 ・ ディスカッション 添付資料 8 に発表資料を添付。		
結果	本セミナーでは、国家森林モニタリングシステム（NFMS）の質的向上支援として実施中の「ストゥントレン州で実施された森林インベントリ」及び「森林管理・森林モニタリングにおけるドローン運用の進捗状況」について報告を行った。さらに当プロジェクトの成果が持続可能な自然資源管理の強化に向けた中央政府、州政府、関連プロジェクト、関係機関の活動にどのように貢献できるかについて議論を行った。 ディスカッション・セッションでは、セミナー参加者全員により、当プロジェクトの 2 つの課題について議論を行った。その課題と参加者からのコメントは以下の通り。 課題 1：将来の NFI の実施：いつ、誰が、どのように実施するのか。 ➤ 誰が：FA・MoE の 2 者が主体。学術機関、研究機関、NGO、開発パートナー、その他関係者についても参加促進を図る。 ➤ いつ：FAO ガイドラインでは 4～5 年間隔。ただし、地理的条件や気象条件によって期間は異なる。したがって、柔軟な対応が必要。 ➤ どのように：NFI を完全に実施するための提案書を作成し、すべてのアクターとその責任、予算計画が必要。さらに、データ収集者・分析者の能力確保が重要になる。 課題 2：ドローンの今後の活用 - どの用途を優先すべきか。 ➤ カンボジア SNRM において優先すべきドローンの用途は「LULC マップと森林被覆マップの作成・更新」、「違法伐採と森林破壊の監視」、「保護区（PA）と生産林の境界画定」、「PA のゾーニング」、「土地利用計画」、「樹冠被覆、樹冠高、樹冠密度などの森林状態の把握」、「動物相調査（野生生物のインベントリ／調査／追跡等）」、「植物相調査（森林インベントリ、森林病害（病理学）等）」の 8 つ。		

日付	2024 年 8 月 28 日	会場	カンボジア日本人材開発センタ
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			一、 Angkor Meas Hotel、オンライン
会議名	第2回技術セミナー	主催者	短期専門家チーム
参加者	PMU メンバー、関係機関、JICA 専門家を含む 50 名		
内容	・ SNRM プロジェクト、NFMS 質的向上支援活動、中央・州政府職員の能力強化活動の概要 ・ 中央・州政府職員の能力向上支援のための研修資料の導入 ・ GIS 研修の成果及び研修成果の保護区管理への活用に関する報告 ・ ドローン操作研修、ドローンデータ処理研修の成果報告と研修成果の生産林管理への活用 ・ コミュニティ森林の管理のための研修実施の成果と研修成果の活用に関する報告 ・ 保護区管理のための研修実施の成果と研修成果の活用に関する報告 ・ ディスカッション 添付資料 9 に発表資料を添付。		
結果	本セミナーでは、森林モニタリング関連研修において開発・活用されている研修資料の概要、研修実施の成果及び研修成果の業務への活用について、中央・州政府職員から報告された。発表の後、参加者全員により SNRM の成果が中央・州政府の所掌業務にどのように貢献できるか、また持続可能な自然資源管理に関する今後の支援ニーズについて議論した。 ディスカッション・セッションでは、参加者全員により、当プロジェクトの成果をどのように活用するかについて議論を行った。議論のテーマとコメントは以下の通り。 テーマ 1：SNRM の成果を中央・州政府の様々な所掌業務にどのように効果的に活用・統合できるか。 ➢ SNRM の成果の活用について、参加者から「データの正確性の確保」、「より効率的な PA、CPA、CF の管理計画作成」、「CPA・CF のモニタリングと評価」、「中央・地方政府職員の知識向上」、「データ収集と現地検証」、「現地調査と研究」、「州政府職員への知識の共有」、「GIS・リモートセンシングによる保護区ゾーニングと管理計画の作成」、「野生生物の分布図作成」、「より効果的な法執行の支援」、「保護地域の土地利用被覆マップ作成」への活用について議論が交わされた。 テーマ 2：SNRM に関する将来の支援ニーズ。 ➢ 参加者から、「衛星画像をより少ないファイルサイズでダウンロードする方法」、「SNRM に関連した研修の拡充」、「日本・カンボジアでの短期研修」、「土地利用被覆のモニタリングプラットフォームの確立」、「英語・クメール語の技術資料とビデオ資料の準備」、「データポータル設立」、「森林炭素蓄積インベントリ」、「保護区管理技術」、「森林・保護区管理に関する日本との交流プログラム」、「森林・自然犯罪の調査」、「保護区における流域・景観管理」について支援ニーズが挙げられた。		

2) 関係機関が開催するワークショップ

日付	2021 年 2 月 3 日～5 日	会場	Mayura Resort and Hotel、ケップ州
会議名	Planning the NFMS to Support the REDD+ Implementation Technical Retreat	主催者	主催：UNDP 資金提供：Forest Carbon Partnership Facility II
参加者	MRV/FRL 技術チーム、RTS、FCPF-II プロジェクト、開発パートナー、REDD+に係る NGO		
内容	異なるスケールでの REDD+の実施に必要な技術的・制度的・財政的要件を分析し、NFMS の新たな目標を設定する。		
結果	参加者全員と以下の協議を実施した。 ➢ MRV 技術チームの現在及び将来の要求に基づく能力のギャップ分析。 ➢ MRV チームの制度構築と役割・責任範囲の見直し。 ➢ REDD+実施のための NFMS ロードマップの作成。		

日付	2024 年 4 月 22 日～25 日	会場	Sunway Hotel
会議名	Workshop on Geospatial Technology for Sustainable Landscape Management and Information Dissemination in Cambodia And Training on Geospatial Application for Crop Mapping	主催者	SERVIR SEA
参加者	NGO、カンボジア政府機関、Open Development Cambodia、USAID プロジェクト、開発パートナー		
内容	SERVIR SEA の取り組みが紹介され、参加者全員と以下の活動実施における関係機関との連携		

	について協議を実施した。 ➤ 既存の保護区警報システムのアップグレードを行い、カンボジア国内の他の地域に拡大させる。 ➤ カシューナッツ、マンゴー、ゴム、コショウ、米、キャッサバを含む主要作物の分布を定期的に取得・更新するための作物マップ作成ツールを開発する。 ➤ 意思決定を支援するため、生物物理学的状態の年次評価報告書を発表し、主要関係者への普及を図る。
結果	ワークショップでは以下の成果が得られた。 ➤ カンボジア生物物理学的 M&E ダッシュボードに対する認識と理解の向上 ➤ 関係者の関与と協力の強化 ➤ 持続可能な開発のための地理空間データの利用改善 ➤ ダッシュボードの継続的な開発と活用のための行動計画の作成

日付	2024 年 5 月 20 日～24 日	会場	Poulo Wai Hotel & Apartment
会議名	Technical Workshop on Comparing State-of-the-Art Methods and Artificial Intelligence for Mapping Deforestation and Estimating Forest Degradation	主催者	UNDP
参加者	政府機関（環境省、農林水産省、土地管理都市計画建設省）、開発パートナー		
内容	本ワークショップの主な目的は、参加者が森林減少モニタリングのための高度なモデリング技術を導入するために必要な知識と技術を習得することである。具体的な目的は以下の通り。 ➤ 森林減少モニタリングに用いる複数のモデル候補について検討を行い、その長所と適用可能性を評価する。 ➤ カンボジア政府によって利用されている現在の土地利用被覆変化マッピング手法を精査し、改善点を特定する。 ➤ 機械学習（ML）アルゴリズムと環境モニタリングへの適用について理解を深めるための実践的な演習を行う。 ➤ 森林減少・劣化マッピングに利用可能なデータとその現状を確認し、初期テストにおいて適切なモデルを選択するための議論を促進させる。		
結果	ワークショップを通じて以下の成果が得られた。 ➤ 森林減少モニタリングに用いる複数のモデリング手法とその実用的な応用について包括的な理解が得られた。 ➤ 既存のマッピング手法の改善点及びより高度なモデルを統合するための計画作成を行い、入手可能なデータの分析に基づき、森林減少・劣化の初期解析モデルの候補を 3 つ選定した。 ➤ 森林減少・劣化マッピングのために選定したモデルの性能をテストするために、異なる森林生態系タイプを含む検証サイトの候補を選定した。		

(3) モニタリングシートの作成

モニタリングシートを用いて半年ごとに長期専門家、C/P と各活動のモニタリングを行った。作成されたモニタリングシートはプロジェクトを通じて JICA へ提出された。表 2.6 に各モニタリングシートの対象期間を示す。

表 2.6 モニタリングシート提出状況

バージョン	合意日	対象期間
Ver.1	2021 年 5 月 7 日	2020 年 11 月 - 2021 年 4 月
Ver.2	2022 年 2 月 7 日	2021 年 5 月 - 10 月
Ver.3	2022 年 5 月 30 日	2021 年 11 月 - 2022 年 4 月
Ver.4	2022 年 12 月 20 日	2022 年 5 月 - 10 月
Ver.5	2023 年 5 月 31 日	2022 年 11 月 - 2023 年 4 月

Ver.6	2023 年 10 月 31 日	2023 年 5 月 - 10 月
Ver.7	2024 年 4 月 30 日	2023 年 11 月 - 2024 年 4 月
Ver.8	2024 年 10 月 14 日	2024 年 5 月 - 10 月

出典：SNRM プロジェクト

(4) 機材調達に係る業務

本プロジェクトでは、表 2.2 に示す資機材を「業務委託契約における資機材の調達・管理要領（2017 年 6 月）」及び「国際協力機構カンボジア事務所現地調達内規（2016 年 2 月）」に基づき調達した。事前確認では、C/P が使用する関連機材との互換性・親和性、メンテナンスの容易性、機材の持続可能性などを短期専門家チームで検討した。事前確認の情報に基づき機材リスト案を作成して、JICA との協議を踏まえて最終化した。調達にあたっては、入札図書、契約書及び発注書案、機材仕様書、参考見積書を付した予定入札額書類を準備して、入札者から提案書を評価・決定のうえ調達を行い、調達完了後に調達物品を検収した。

(5) 広報活動

短期専門家チームの活動を、カンボジアの持続可能な自然資源管理に対する認識を広めるため、JICA ホームページのプロジェクトニュースで報告した。また、本事業の概要と NFMS の強化に関する活動を、技術誌「海外の森林と林業」に寄稿した。

JICA ホームページ：<https://www.jica.go.jp/Resource/project/cambodia/031/news/index.html>

- ✓ ストゥントレン州で森林資源調査に取り組んでいます（2022 年 4 月）Forest Inventory in Stung Treng is going on, April 2022
- ✓ ストゥントレン州で固定翼ドローンの研修を実施しました（2022 年 5 月）Fixed-wing drone training in Stung Treng, May 2022
- ✓ 第 1 回技術セミナーを開催しました（2022 年 7 月）The first technical seminar, July 2022

海外の森林と林業：120 巻（2024 年）

https://www.jstage.jst.go.jp/article/jjiiff/120/0/120_8/_article/-char/ja

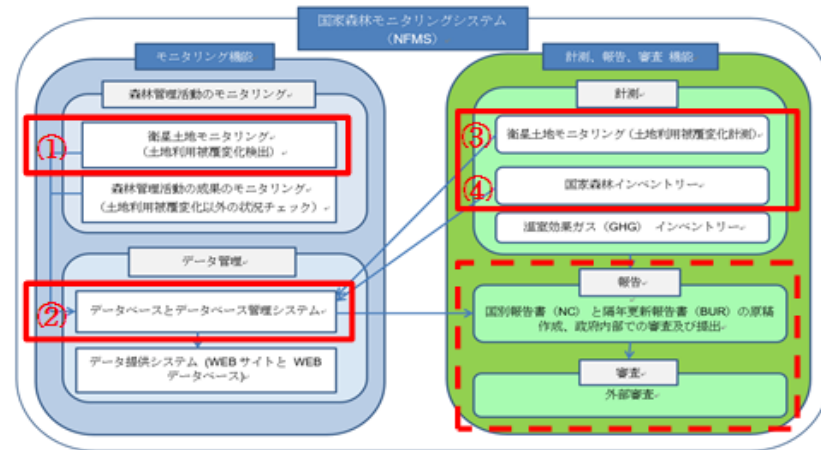
- ✓ カンボジアの森林モニタリングにおけるリモートセンシングの活用状況 - 国家森林モニタリングシステムの運用に向けて（Situation of Utilizing Remote Sensing for Forest Monitoring in Cambodia, For the Operation of National Forest Monitoring System, July 2024）

1.3.2 成果 1-3-2-1 にかかる活動：中央政府と州政府のそれぞれの役割と責任を考慮しつつ、国家森林モニタリングシステム（NFMS）の運用について支援する

(1) NFMS の質的向上支援の内容の明確化

NFMS の質的向上支援の第一歩として、カンボジアの NFMS（図 2.4）の全体枠組みをもとに、環

境省・森林局とのワークプラン検討会を通じ、当プロジェクトにおける活動内容の明確化を行った。結果として、図 2.4 に示す①衛星土地モニタリング（変化抽出）、②データベース・データベース管理システム、③衛星土地モニタリング（変化計測）、④国家森林インベントリ（以下、NFI）への協力ニーズが確認された。図 2.4 の点線で囲まれた報告及び検証（Report and Verification）については、必要に応じて技術支援を行った。



出典：SNRM プロジェクト

図 2.4 カンボジア国家森林モニタリングシステム (NFMS)

(2) 中央政府・地方政府・自然保護区・関連プロジェクトの組織連携調査

NFMS の運用には関係機関における情報共有が必要不可欠である。本項目では、特に①中央政府と州政府、②中央政府内各省庁間、③州政府内各部門間、④政府と関係プロジェクト間を対象として、組織間での情報共有体制を強化するための組織連携調査を実施した。2021 年 1 月下旬から 2 月上旬にかけてストゥントレン州政府のベースライン調査を実施し、環境省、森林局、ストゥントレン州政府環境局、ストゥントレン州森林局、国立公園事務所、ラムサール湿地管理事務所の組織・人員、所掌業務、パトロール情報の情報収集・共有体制等の基礎情報の収集を行った。

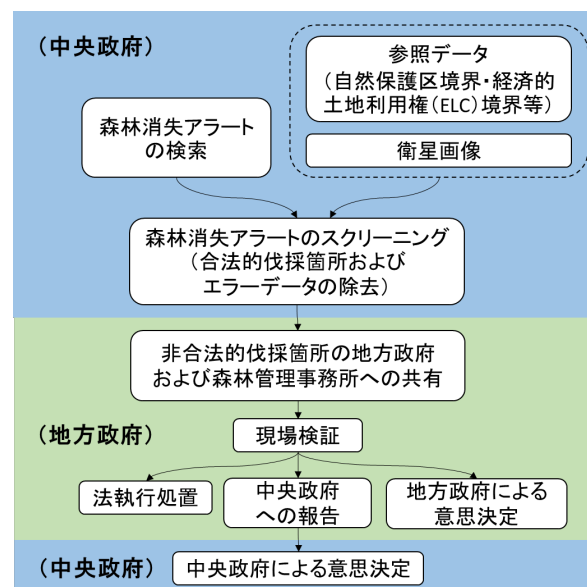


出典：SNRM プロジェクト

図 2.5 ラムサール湿地管理事務所でのベースライン調査の実施

(3) 衛星土地モニタリング（土地利用被覆変化検出）機能の現況調査

図 2.6 は中央政府と州政府の組織連携を前提とした SLMS（土地利用被覆変化検出）の運用概念図である。中央政府においては、標準的な運用として、森林アラートをスクリーニングする体制構築（所掌及び組織）、及び州政府に対するスクリーニング済みの森林アラートの共有を行う。州政府においては、標準的な運用として、共有された森林アラートを用いた現場検証体制の構築、及び現場検証結果のとりまとめと中央政府に対する報告を行う。



出典：SNRM プロジェクト

図 2.6 SLMS（土地利用被覆変化検出）の運用概念図

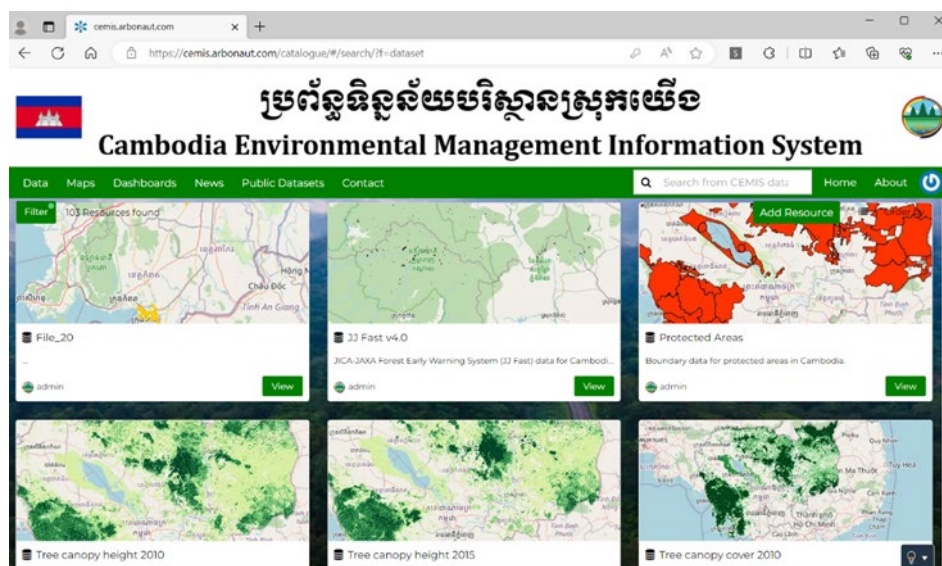
2021 年 12 月 22 日に開催された UNDP 主催の CEMIS ステークホルダーミーティングへの参加、ならびに環境省 DGIS や UNDP MRV 専門家、SERVIR SEA プロジェクト、USAID によるグリーンング・プレイロン（GPL）プロジェクトとの打合せを通じて NFMS の衛星土地モニタリング（土地利用被覆変化検出）機能の現況調査を実施した。

図 2.7 に 2021 年 12 月から UNDP が開発を進める CEMIS の全体構成を示す。CEMIS は GIS サービス（GIS 解析・データベース・ポータル機能）と Decision Support Systems の 2 つの柱により構成され、NFMS は Decision Support Systems の一つの機能として組み込まれる予定である。2023 年 5 月に CEMIS の Ver. 1.0（図 2.8）が公開された。CEMIS Ver. 1.0 にはデータ管理機能として、データのアップロード・ダウンロード機能やデータ閲覧に用いるダッシュボード機能が構築されている。さらに、CEMIS Ver.1.0 には森林アラート機能として JICA-JAXA 熱帯林早期警戒システム（以下、JJ-FAST）データが自動的にアップロードされる機能が備わっており、CEMIS を用いて JJ-FAST データの検索やダウンロードが可能となっている。



出典：SNRM プロジェクト

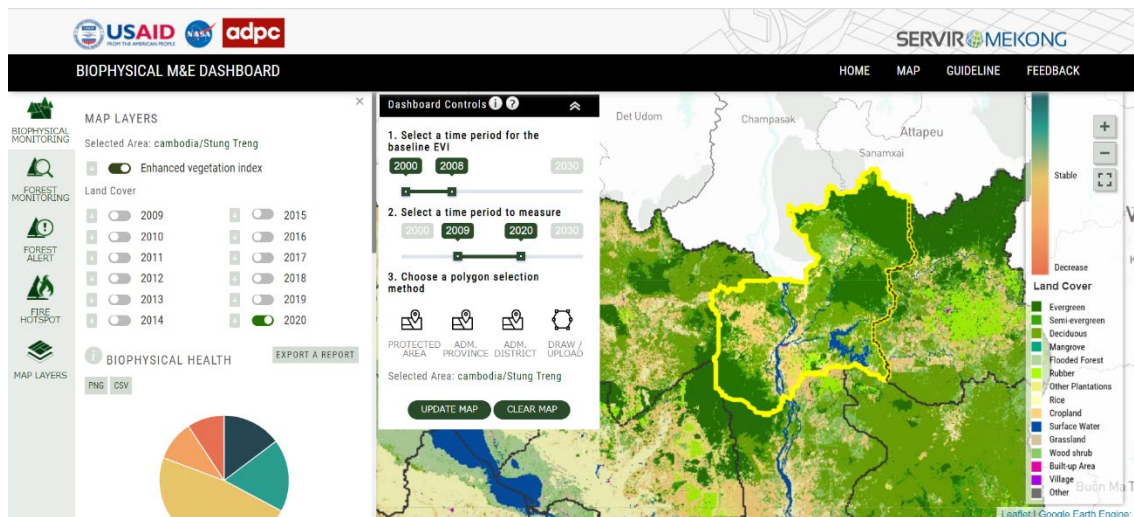
図 2.7 CEMIS の全体構成



出典：SNRM プロジェクト

図 2.8 CEMIS Version 1.0 のインターフェース

NFMS の衛星土地モニタリング（土地利用被覆検出）機能については、SERVIR SEA プロジェクトにより図 2.9、図 2.10 に示すオンラインシステムが既に構築されている。さらに JCM-REDD+ プロジェクトの現場活動を担う Conservation International（CI）やその他の自然保護区管理を支援する多くの NGO は違法伐採パトロールの情報収集や帳票・レポート作成のツールとして SMART を運用している（図 2.11）。CEMIS の開発においては、これらの既存システムと連携する形でシステム設計が検討される予定である。



出典：SERVIR SEA

図 2.9 SERVIR SEA プロジェクトが開発した森林被覆状況のモニタリングと評価のためのオンラインシステム



出典：SERVIR SEA

図 2.10 SERVIR SEA プロジェクトが開発した森林変化アラートシステム



Prey Lang Wildlife Sanctuary Law Enforcement Report



2020-03-01 to 2020-03-31
Patrol Effort by Ranger

Date	X	Y	Land Clearance Type	Area (Ha)	Crop Planting	Action Taken
Mar 16, 2020	562258	1497527	Land Cleared	1		Minute and data collection
Mar 17, 2020	560024	1484549	Land Cleared	1		Minute and data collection
Mar 9, 2020	587183	1477305	Land Cleared	2.38		Contract to return the land back to the State
Mar 10, 2020	559136	1487999	Land Cleared	5.16		Minute and data collection
Mar 14, 2020	592086	1461317	Land Cleared	5	Cashew	Minute and data collection
Mar 14, 2020	598135	1461248	Land Clearing	10		Minute and data collection
Mar 14, 2020	592412	1461813	Land Cleared	4	Cashew	Minute and data collection
Mar 10, 2020	565915	1511468	Land Clearing	2		Minute and data collection
Mar 21, 2020	563709	1514028	Land Cleared	5		Minute and data collection
Mar 21, 2020	563710	1514831	Land Cleared	1		Minute and data collection
Mar 20, 2020	566384	1516175	Land Cleared	1		Minute and data collection
Mar 15, 2020	566815	1487354	Land Cleared	5		Minute and data collection
Mar 15, 2020	565150	1486551	Land Cleared	4		Minute and Data collection
Mar 13, 2020	580140	1482256	Land Cleared	5		Contract to return the land back to the State
Mar 4, 2020	571897	1514279	Land Cleared	15		Contract to return the land back to the State

出典：CI

図 2. 11 JCM-REDD+プロジェクトにおいて CI が運用を支援する SMART システム

また、JCM-REDD+プロジェクトにおいては小型の回転翼ドローンを用いて森林伐採地の空中写真を撮影し、パトロール報告書で現場状況を示す資料として使っている。しかしながら、地図や衛星画像と重ね合わせることで伐採地境界の把握や土地境界の画定などが可能となるオルソ画像は作成されていない。



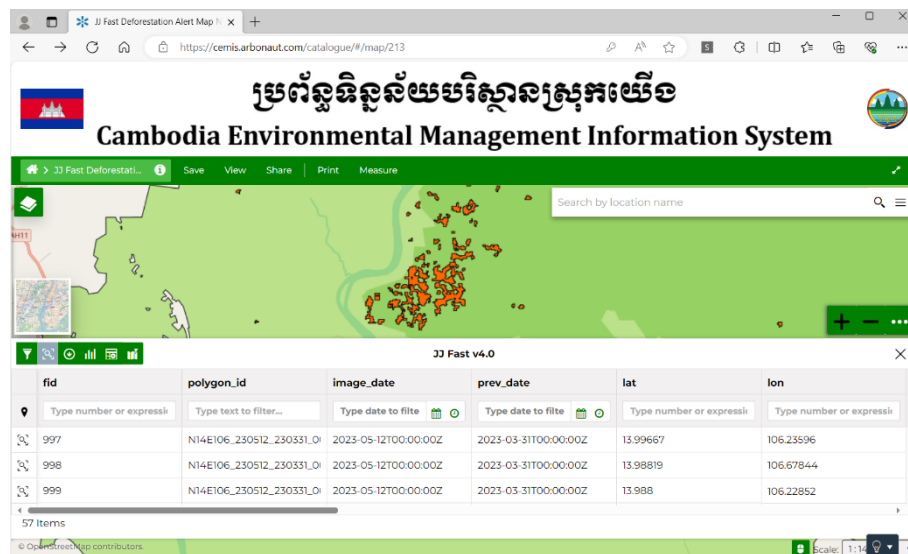
出典：CI

図 2. 12 JCM-REDD+プロジェクトでのドローンを用いた森林伐採地の現場確認

(4) 森林・水源林の効果的なモニタリングに向けた森林アラートデータや衛星画像の利用及びドローンの運用に関する支援内容の明確化・支援計画・研修計画作成

衛星土地モニタリング（土地利用被覆変化検出）機能の現況調査結果に基づき、NFMS への森林アラートデータの取り込みに係るニーズが確認されたため、UNDP と連携して CEMIS への JJ-FAST データの取り込みに係る支援を決定した。UNDP への JJ-FAST の技術情報の提供や協力を経

て、2023 年 5 月に公開された CEMIS Ver.1.0 では CEMIS に JJ-FAST データが自動的にアップロードされる機能が構築され、CEMIS を用いた JJ-FAST データの閲覧、時期や境界データ等を用いたクエリ機能によるデータ抽出、抽出されたデータのダウンロードが可能となった。



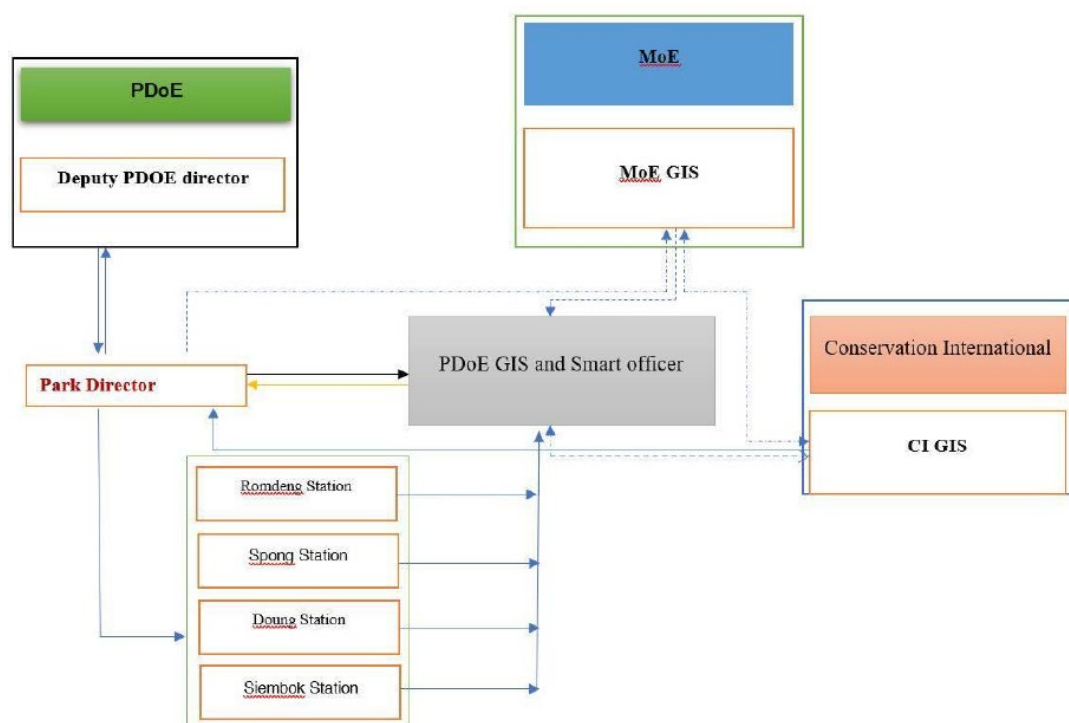
出典：SNRM プロジェクト

図 2.13 CEMIS を用いた JJ-FAST データの閲覧

(5) 情報共有現況調査

2021 年 1 月下旬から 2 月上旬にかけて実施されたストゥントレン州政府のベースライン調査を通じて、中央政府と地方政府の情報共有現況調査を実施した。図 2.14 に JCM-REDD+プロジェクトにおける環境省、州環境局、環境局のレンジャーステーション、及び JCM-REDD+の現場活動を担当する CI との情報共有体制を示す。

ストゥントレン州環境局（図中の PDoE GIS and Smart officer）では GPL プロジェクトが導入した EarthRanger システムを用いて定期的に森林変化アラート情報を確認している。その上でストゥントレン州環境局の担当者が違法伐採の可能性が高く、現場確認が必要と判断した箇所について Park Director を通じてその地域を管轄するレンジャーステーションに指示を出している。レンジャーステーションでは SMART Mobile（SMART のスマートフォンアプリ）を用いて森林伐採地の現場情報を収集し、そのデータをストゥントレン州環境局に送信する。ストゥントレン州環境局ではレンジャーステーションからのデータを受信後にデスクトップ版の SMART を用いてパトロール報告書を作成し、Park Director を通じて環境省 GDNPA の担当者や州環境局の副局長に報告を上げている。これらの情報共有の全てに SNS のアプリケーションである Telegram を用いている。



出典：CI

図 2.14 JCM-REDD+プロジェクトにおける環境省、州環境局、レンジャーステーション、CI との情報共有体制

(6) 全国土地利用被覆図・森林被覆図作成にかかる技術支援

2022 年 5 月から 9 月にかけて森林局で作業を進めている 2022 年森林被覆図作成の作業手法の確認を行い、その上で FAO SEPAL を用いた LANDSAT8・9 画像や Sentinel-2 画像の全国モザイク画像の作成、ならびに NICFI Planet 衛星画像のダウンロードや Global Forest Canopy Height 2019 の活用に係る技術支援を実施した。

(7) 森林インベントリ調査（森林層化）

1.3.2(1) NFMS の質的向上支援の内容の明確化において、国家森林インベントリ（NFI）への協力ニーズが確認された。ストゥントレン州をパイロット州として、現行の NFI マニュアルをもとに調査を計画・実施した。

はじめに、2018 年に FAO の支援を受けて森林局が作成した国家森林インベントリフィールドマニュアル（FAO (2018): Field Manual for the National Forest Inventory of Cambodia）及び 2015 年に CAM-REDD で作成された補助マニュアル（Working Paper #15_Supplementary_NFI-manual）を参考にして、2021 年 1 月に環境省職員とともに表 2.7 に示す手順に沿って森林層化を実施した。なお、ストゥントレン州の森林インベントリ調査地点間の間隔は 6km である。

表 2.7 森林層化の手順

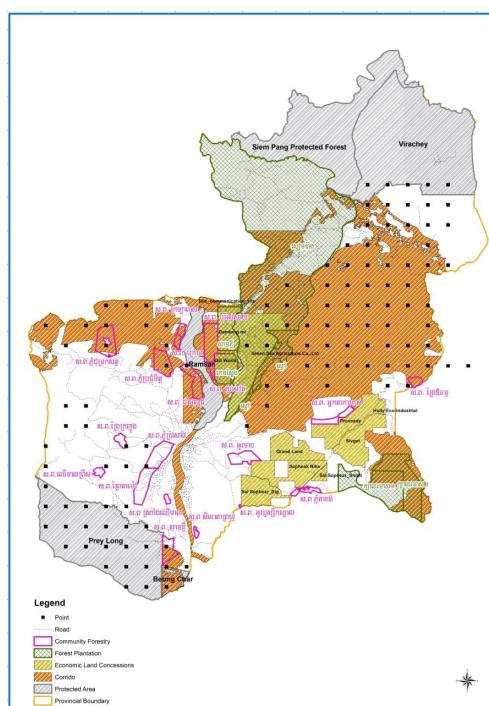
前処理	NFI 調査地点データに 2018 年全国土地利用被覆図データ（環境省作
-----	--

	成)と2019年樹冠被覆データ (SERVIR SEA プロジェクト作成) の関連付けを実施
	2020年12月のNICFI Planet 衛星画像を用いて伐採または農地転用された可能性のあるNFI調査地点を除外
層化1	主な森林タイプであるEvergreen forest、Semi-evergreen forest、Deciduous forest の区域内のNFI調査地点を抽出
層化2	2019年樹冠被覆データを用いて樹冠率が10%以下のNFI調査地点を除外 2019年樹冠被覆データを用いて3つの樹冠区分：疎 10%-40%、中 40%-70%、密 70%-100%に分類

出典：SNRM プロジェクト

(8) 森林インベントリ調査（調査プロット設定）

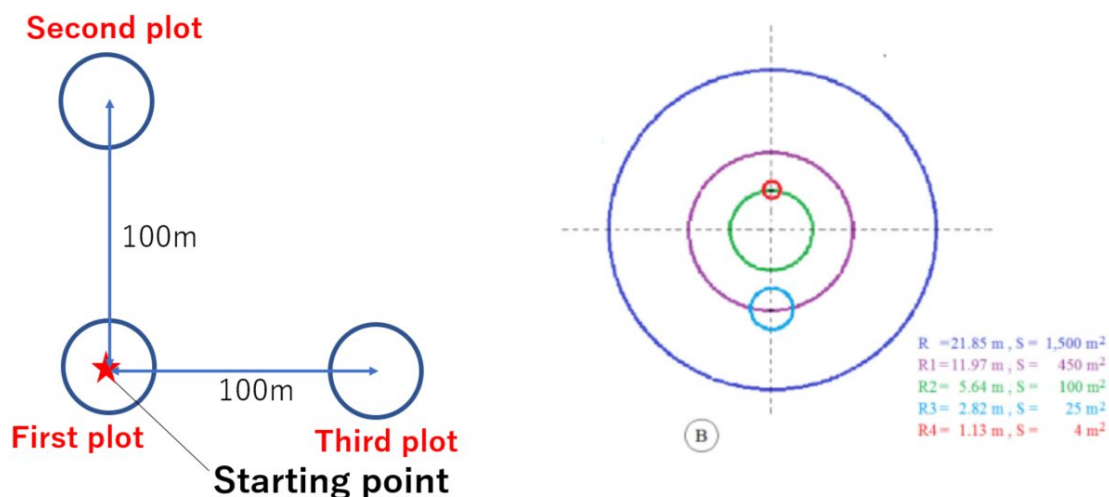
2021年2月に環境省、森林局との協議を通じて安全リスクの高い地雷不発弾汚染地域や国境付近のNFI調査地点を除外し、さらに森林層化結果を考慮して最終的に120クラスター、360プロットの調査プロットを設定した。



出典：SNRM プロジェクト

図 2.15 森林インベントリ調査の調査プロット配点図

またFAO 専門家との協議を通じて、プロット形状は円形を採用し、1つのクラスターに3つの円形プロットを配置する設定とした。



出典：SNRM プロジェクト

図 2.16 調査プロットの設定

(9) 森林インベントリ調査（現地再委託契約）

2021 年 2 月から 3 月にかけてカンボジア国内において入札を実施し、選定されたカンボジア王立農業大学（以下、RUA）と 2021 年 3 月に森林インベントリ調査の実施に係る現地再委託契約を締結した。

(10) 森林インベントリ調査実施

2021 年 3 月にオンラインで森林インベントリ調査手法研修を実施し、環境省、森林局の森林インベントリ調査の担当者を対象に、ストゥントレン州で実施する森林インベントリ調査手法の概要や使用する機材の使用方法に関する講義を実施した。講義資料は FAO が設計した国家森林インベントリフィールドマニュアル（FAO (2018): Field Manual for the National Forest Inventory of Cambodia）を参照した。同研修に FAO 担当者をオブザーバーとして招集して、調査手法の詳細について確認するとともに、同担当者による QA/QC 手法について講義を実施した。

2022 年 1 月にストゥントレン州内の 1 つの調査プロットにて、本調査の全ての関係機関（環境省、森林局、RUA 調査チーム、短期専門家チーム）から担当者を招集してプレ・インベントリ調査を実施し、現場にて調査手法や測定器具の使用方法等の確認を行った。



図 2.17 プレ・インベントリ調査実施状況

2022 年 1 月中旬から 3 月にかけて現地調査が実施され、合計 360 プロットの森林インベントリ調査が行われた。



図 2.18 現地調査の実施

現地調査後、2022 年 4 月から 6 月にかけてバイオマス計測及び森林炭素蓄積量の解析が実施され、その結果を取りまとめて 2022 年 6 月に森林インベントリ調査報告書が作成された(添付資料 1)。

報告書では、森林インベントリ調査結果として、森林タイプ毎の地上部バイオマス (AGB)、地下部バイオマス (BGB)、枯死木、リター及び土壌の 5 つの炭素プールについてそれぞれの炭素蓄積量が報告された。森林タイプ別の総炭素蓄積量は Evergreen forest (234.53 tC/ha) が最も多く、続いて Semi-evergreen forest (159.97 tC/ha)、Deciduous forest (115.39 tC/ha)、Non forest (61.30 tC/ha) となった(表 2.8)。

表 2.8 森林タイプ毎及び炭素プール毎の炭素蓄積量

森林タイプ	AGB (tC/ha)	BGB (tC/ha)	枯死木 (tC/ha)	リター (tC/ha)	土壌 (tC/ha)	総炭素 蓄積量 (tC/ha)	CO ₂ 量 (tCO ₂ /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

出典：SNRM プロジェクト

カンボジアの 2021 年第 2 次森林参照レベル (FRL) 設定では、森林バイオマスの炭素プールとして AGB と BGB を対象として、CO₂ 量で算出される。このため、ストゥントレン州森林インベントリ調査結果から FRL を算出するにあたり、リター、枯死木、土壌の森林バイオマス量は除外した。調査結果に基づく各森林タイプ別の CO₂ 量 (AGB と BGB の合計) は、Evergreen forest で 577.10 tCO₂/ha、Semi-evergreen で 316.69 tCO₂/ha、Deciduous forest で 164.08tCO₂/ha であり、Evergreen forest が最も多い値を示した (表 2.9)。一方で、第 2 次 FRL では Semi-evergreen forest の CO₂ 量が最も高く、続いて Evergreen forest、Deciduous forest であり、今回の調査結果と異なった。

表 2.9 FRL 設定方法に基づくスタントレン州の森林タイプ別の森林バイオマス量及び炭素量 (AGB と BGB)

森林タイプ	プロット数	AGB (t/ha)	BGB (t/ha)	合計 バイオマス (t/ha)	合計 炭素量 (t/ha)	合計 CO ₂ 量 (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%

出典：SNRM プロジェクト

報告書では、ストゥントレン州森林インベントリ調査の経験を踏まえた、以下の教訓が提言された。

1. 違法に伐採された木材の林地残材を測定する方法を、国家森林インベントリフィールドマニュアルに組み込む必要がある。
2. 森林タイプ別の AGB と BGB の CO₂ 量は、FRL と異なる傾向を示した。国レベルの FRL を検証するためには、全国レベルまたは追加の森林インベントリ調査が必要と考えられる。
3. 今回のストゥントレン州森林インベントリ調査データは FRL 精度の改善や、正確な資源量の把握に基づく持続可能な森林管理にも有効と考えられる。
4. 定期的な森林インベントリ調査を通じて、学術研究における試験研究、人材育成を継続するとともに、調査データの学術利用を広く促すことが重要である。

5. ストゥントレン州森林インベントリ調査結果は、全国レベルの GHG インベントリデータとして蓄積されるとともに、BUR や GHG モニタリングに資する。

(11) NFI 設計書の見直し

ストゥントレン州森林インベントリ調査を通して得られた知見や特定された課題に基づき、REDD+タスクフォース、FAO、UNDP、カンボジア王立農業大学を含む関係者との協議を通じて 2023 年 9 月までに将来の NFI 実施に向けた提言書を取りまとめた。



出典：SNRM プロジェクト

図 2.19 将来の NFI 実施に係る提言書取りまとめに係る協議実施

この提言は、NFI のサンプリング設計方法とともに、排出係数（EF）算出方法の見直し及び調査実施における教訓を取りまとめた。

(a) NFI サンプリング設計

[課題] 国家森林インベントリ（NFI）調査の実施に向けた必要サンプル数の見直し

カンボジアの国家森林インベントリ（NFI）調査は現在の設計では NFI サンプリング計画数が多く、一度に実施するのは困難な状況が続いている。現在の NFI サンプリング計画数と、今回のストゥントレン州森林インベントリ調査結果に基づく統計的必要サンプル数を比較して、今後の NFI 実施に向けた必要サンプル数を検討した。

- ✓ **現在の NFI サンプリング計画：**表 2.10 に、現在の国家森林モニタリングシステム（NFMS）における NFI 必要サンプル数を示す。ストゥントレン州は NFI サンプリング設計の層化において、Uplands に含まれる。同サンプリング設計におけるストゥントレン州の必要サンプル数は、カンボジア全国面積とストゥントレン州面積の比率から、約 600 プロット（約 200 クラスター）と推計した。

スタンントレン州 11,000km²/カンボジア全国 152,000km² (Uplands) * 2,751 クラスター = 約 200 クラスター (* 3 プロット = 約 600 プロット)

表 2.10 NFMS 層化における NFI 必要サンプル数

層化	面積 (km ²)	必要サンプル数(森林区域内のクラスター数、 2 nd phase)
Uplands	152,751.3	2,751
Wetlands	27,742.0	322
Mangrove	1,207.6	97
合計	181,700.9	3,170

出典：SNRM プロジェクト

- ✓ 今回のストゥントレン州森林インベントリ調査結果に基づく統計的必要サンプル数：統計的必要サンプル数は、許容可能な信頼区間と目標誤差率に基づいて算出される（数式 1）。ストゥントレン州の必要サンプル数は、ストゥントレン州森林インベントリ調査データの ha 当たりの平均バイオマス量と標準偏差にもとに、NFMS 層化別（表 2.11）と、FRL の土地利用/被覆分類体系別（表 2.12）の 2 つの分類体系で算出した。

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

ここで、n は必要とされるサンプル数、t_{0.05} は許容可能な信頼区間（95%）に対応する信頼区間係数（t=1.96）、C_v は変動係数であり調査結果の標準偏差を平均値で除したものの、e は目標誤差率である。

今回は、目標誤差率 e を 10%、信頼区間を 95% として必要サンプル数を算出した。

表 2.11 NFMS 層化における必要サンプル数

層化	調査プロット数	バイオマス量合計 (t)	ha 当たりバイオマス量平均 Ave. (t/ha)	標準偏差 SD	標準誤差 SE	誤差 e	誤差率 e (%)	変動係数 C _v (SD/Ave.)	必要サンプル数 n (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

出典：SNRM プロジェクト

表 2.12 FRL 土地利用/被覆分類体系における必要サンプル数

森林タイプ	調査プロット数	バイオマス量合計 (t)	ha 当たりバイオマス量平均 Ave. (t/ha)	標準偏差 SD	標準誤差 SE	誤差 e	誤差率 e (%)	変動係数 C _v (SD/Ave.)	必要サンプル数 n (10%)
Evergreen	117	28,597.33	244.42	161.75	14.95	29.31	12%	0.66	168

forest									
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

出典：SNRM プロジェクト

- ✓ 現行の NFI サンプル計画数（600 プロット）と比較して、今回のストゥントレン州森林インベントリ調査データに基づく統計的必要サンプル数は、NFMS 層化（270 プロット）と FRL 土地利用/被覆分類体系（519 プロット）となり、両方とも現行計画数より少なかった。

[提言]

- ✓ 統計的手法を用いることで、NFI 必要なサンプル数を軽減できる可能性が示唆された。また、統計的必要サンプル数は、目標誤差率に基づいて算出されることから FRL の正確性の改善に資すると期待される。
- ✓ 最終的な必要サンプル数の検討にあたっては、得られる森林インベントリ調査データの信頼性と、NFI 実施に伴うコストの両方を考慮することが重要である。
- ✓ また必要サンプル数には、事前に補助サンプルを追加しておくことが望ましいと考えられる。これは、実際の森林インベントリ調査において、調査地にアクセスできない危険性を考慮するものである。ストゥントレン州森林インベントリ調査では、地形、障害物、水域、その他の理由により、アクセスが非常に困難なクラスターが確認され、当初目的とした調査地にたどり着けないケースが発生した。このような場合に備え、必要サンプル数の 20% を補助サンプルとして追加することを提案する。実際の調査において、当初目的の調査地にアクセスできない場合は、補助サンプルで必要サンプル数を補完するものである。

(b) EF 算出方法と AGB 算出方法の見直し、並びに調査実施における教訓

[課題] EF と AGB の計算方法、並びに現地調査実施

FRL 報告書とその参考文献では、EF の計算方法と計算方法の選択に関する詳細な情報は提供されていない。また、今回のストゥントレン州森林インベントリ調査を通して、現地調査の実施にはいくつかの課題が確認された。

- ✓ 一つのプロット内に複数の土地利用/被覆タイプが存在する場合の AGB の集計方法が明確にされていない。また、現在、EF 算出において計上されていない、低木とつる性植物の AGB 取扱いは不明瞭である。
- ✓ タケ類の AGB の計算方法が明確にされていない。
- ✓ 現地調査において、特異な樹幹形をした樹木の測定方法が不明瞭である。(図 2. 20)



出典：SNRM プロジェクト

図 2. 20 特異な樹幹形をした樹木の例 (*Ficus* tribe)

- ✓ ストゥントレン州森林インベントリ調査では、調査地で電波が届かず携帯電話が使えない地域があった。森林内の調査チーム間の通信手段として用意されたトランシーバーは、森林内の約 100～300 メートルの範囲でしか使用できなかった。トランシーバーは同じクラスター内プロット間（100m 間隔）では有効だが、クラスター間（6km 間隔）の通信には不十分だった。

[提言]

- ✓ FRL バイオマス計算の再現性・透明性を確保するためには、EF 算出方法のマニュアルを作成して、算出方法の取り決めに明示することが重要である。
- ✓ カンボジアに生育するタケ類樹種のアロメトリ式の開発が必要である。アロメトリ式が開発されるまでは、近隣諸国で使用される算出方法を参考にすることが可能と考えられる。

参考事例を下記に示す。

○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

- ✓ 現地調査では武装した違法伐採者との遭遇、地雷・不発弾などのリスクが伴う。現地調査において調査員の通信手段を確保するため、現地における通信状況等を確認して、必要な資機材を事前準備することが重要である。
- ✓ 森林内では樹木の樹冠が電波の伝達を妨害するため、今後の NFI では衛星電話の導入について検討する必要がある。森林内でトランシーバーを長距離通信に使用する場合は、アンテナ延長ケーブルなどを使って、林冠より高い位置までアンテナを伸ばすことが望ましいと考えられる。

1.3.3 成果 1-3-2-2 にかかる活動：NFMS 実施にかかる研修材料の開発を支援する

図 2. 21 は NFMS の運用を支援する研修教材の開発にかかる基本概念を示す。開発される研修教材は NFMS の主要な構成要素である森林モニタリング、持続的な自然資源管理活動のモニタリング、計測・報告・検証（MRV）の実施に係る中央政府・地方政府職員の能力強化に利用される必要がある。



出典：SNRM プロジェクト

図 2. 21 NFMS の運用を支援する研修教材の開発にかかる基本概念

短期専門家チームは環境省・森林局との協議を重ね、研修教材の開発を行った。最終的に、表 2. 13 に示す 5 つの研修教材が開発された。

表 2. 13 中央政府職員の NFMS 運用に関連して開発された研修教材

研修教材	内容	特記事項
1. GIS 研修資料 (初級)	地図及び GIS の概要と作成方法にかかる研修資料	クメール語 (添付資料 3)
2. GIS 研修資料 (中上級)	データ標準化の概要とルール作り、及びジオデータベース・製品仕様書の作成、トポロジーやリレートなどの設定方法にかかる研修資料	英語 (添付資料 4)

3. 固定翼ドローン操作研修資料	固定翼ドローン（Sensefly eBee Geo）の機能、飛行準備、飛行、データのダウンロードまでの一連の操作に関する研修資料	クメール語 (添付資料 6)
4. 固定翼ドローン操作の eLearning 教材	固定翼ドローン（Sensefly eBee Geo）の機能、飛行準備、飛行、データのダウンロードまでの一連の操作に関する eLearning 教材   https://www.youtube.com/playlist?list=PLrH1jDKShKr01MgOH89DrYXdORb6Kpw	クメール語、英語字幕
5. 衛星画像解析・判読研修	衛星画像検索及びダウンロード、土地被覆変化抽出、土地利用被覆変化抽出のための衛星画像判読、ドローンによる撮影画像のデータ処理にかかる研修資料	クメール語・英語 (添付資料 7)

出典：SNRM プロジェクト

1.3.4 成果 1-3-2-3 にかかる活動：NFMS 運用に関連する政府職員（主に中央政府職員）の訓練実施

土地利用被覆や森林インベントリデータ収集、及び収集した GIS データの標準化、地図作成にかかる能力を向上させるため、環境省 GDNPA と DGIS 及び農林水産省森林局の中央政府職員を対象として、NFMS に関する研修が実施された。また、森林モニタリングの現場作業における地雷・不発弾の危険性を考慮して、安全な場所から効率的に広範囲のモニタリングを行うための固定翼ドローン操作研修を実施した。研修は、中央政府職員の習熟度に応じて複数回実施した。さらに、ドローン空中写真処理研修や森林インベントリ調査集計プログラム操作研修、初級・中上級の GIS 研修、衛星画像解析及び判読にかかる研修を実施した。

表 2.14 NFMS 運用に関連する中央政府職員への研修実施

研修名	目的	対象機関	実施期間
1. 固定翼ドローン操作研修	固定翼ドローンを用いた安全で効率的な森林モニタリングにかかる能力強化	環境省 DGIS	2021 年 12 月 27 日から 29 日 2022 年 4 月 20 日から 21 日 2022 年 8 月 27 日
		森林局	2021 年 12 月 27 日から 29 日 2022 年 4 月 26 日から 27 日 2022 年 6 月 14 日から 16 日 2023 年 4 月 17 日から 20 日 2024 年 9 月 16 日から 19 日

2. ドローン空中写真 処理研修	地図作成のためのド ローン空中写真処理 にかかる能力強化	森林局	2022 年 5 月 4 日 2023 年 6 月 19 日
3. 森林インベントリ 調査集計プログラ ム操作研修	森林インベントリ調 査集計及びバイオマ ス計測、森林炭素蓄 積量解析にかかる能 力強化	環境省 DGIS	2023 年 4 月 5 日
		森林局	2023 年 4 月 7 日
4. GIS 研修（初級・ 中上級）	GIS データの標準化 にかかる能力強化	環境省 GDNPA	<初級> 2024 年 4 月 23 日から 26 日 <中上級> 2024 年 7 月 15 日から 19 日 2024 年 8 月 19 日から 23 日
5. 衛星画像解析及び 判読研修	衛星画像を用いた土 地利用被覆及びその 変化の抽出にかかる 能力強化	環境省 GDNPA	2024 年 9 月 4 日から 5 日
		森林局	2024 年 9 月 2 日から 3 日

出典：SNRM プロジェクト

(1) 固定翼ドローン操作研修

表 2.15 に固定翼ドローン操作研修の研修内容を示す。

表 2.15 固定翼ドローン研修の研修内容

研修	研修内容
固定翼ドローン操作研修	➤ Sensefly eBee Geo の操縦（離着陸） ➤ GeoBase の設置（GNSS 固定局） ➤ 飛行計画、飛行シミュレーション ➤ データのダウンロード ➤ データの品質検査

出典：SNRM プロジェクト

固定翼ドローン操作研修の準備として、固定翼ドローン本体と GNSS 機材を調達した。また、ドローンの飛行計画のプログラミングやドローン写真の処理に必要なコンピュータ機材の調達を実施した。



出典：SNRM プロジェクト

図 2.22 「固定翼ドローン本体と GPS 機材」の受け入れ検査

さらに、中央政府（環境省・森林局）で森林モニタリングを担当する職員を対象として、2021 年から 2024 年にかけて研修参加者の習熟度に応じて複数回の研修を実施した。



出典：SNRM プロジェクト

図 2.23 環境省（DGIS）職員を対象とした固定翼ドローン操作研修の実施



出典：SNRM プロジェクト

図 2.24 森林局職員を対象とした固定翼ドローン操作研修の実施

固定翼ドローン操作研修の実施を通じて、環境省及び森林局においてドローンを用いて効率的に広範囲の空中写真を取得できる能力が形成された。今後は自然保護区やコミュニティ森林での境界画定やゾーニング、コミュニティ森林管理計画作成、ならびに違法伐採や違法な土地転用の現

状把握への活用や、カンボジアの土地・森林管理における大きなリスクである地雷・不発弾の汚染地域ならびに浸水林や湿地などのアクセスが困難な地域においてドローンを用いた効率的な森林モニタリングの実施が期待される。

(2) ドローンデータ処理研修

表 2.16 にドローンデータ処理研修の研修内容を示す。

表 2.16 ドローンデータ処理研修の研修内容

研修	研修内容
ドローンデータ処理研修	➤ Pix4Dmapper ソフトを用いたデータ品質レポート、オルソ画像、数値表層モデル（DSM）、数値地形モデル（DTM）、等高線データの作成 ➤ 作成データと GIS データとの重ね合わせ、地図レイアウト作成

出典：SNRM プロジェクト

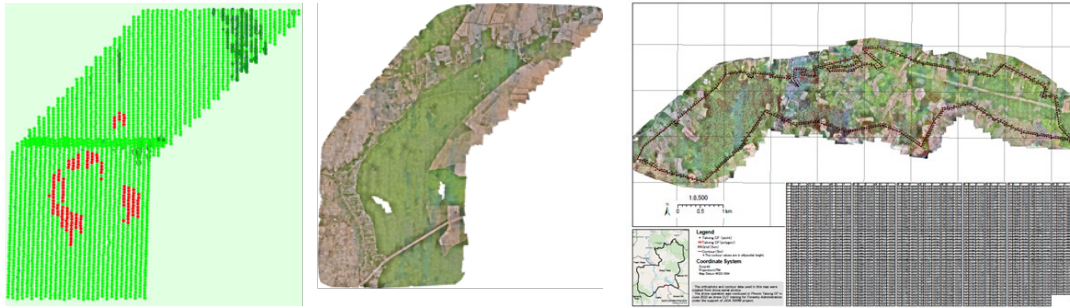
ドローンデータ処理研修は 2023 年、2024 年に森林局職員を対象として実施された。



出典：SNRM プロジェクト

図 2.25 森林局職員を対象としたドローンデータ処理研修の実施

研修において、Pix4Dmapper ソフトを用いてドローンデータ品質レポート、オルソ画像、DSM、DTM、等高線データが作成された。さらに GIS ソフトを用いてこれらのデータを活用したコミュニティ森林のための地図を作成した。研修を通じて作成された地図を Geo-PDF ファイルへのエクスポートを行い、スマートフォンの地図アプリ（Avenza Maps）に背景図としてインポートしたうえで、スマートフォンを用いたコミュニティ森林活動に利用された。



出典：SNRM プロジェクト

図 2.26 ドローンデータ処理研修の成果

ドローンデータ処理研修を通じて、森林局においてドローンデータからオルソ画像や地形データ、さらにオルソ画像を地図化したオルソフォトマップを作成できる能力が形成された。今後は森林局においてオルソ画像や地形データを活用したコミュニティ森林管理計画作成の迅速化による効果的な森林管理の実施が期待される。

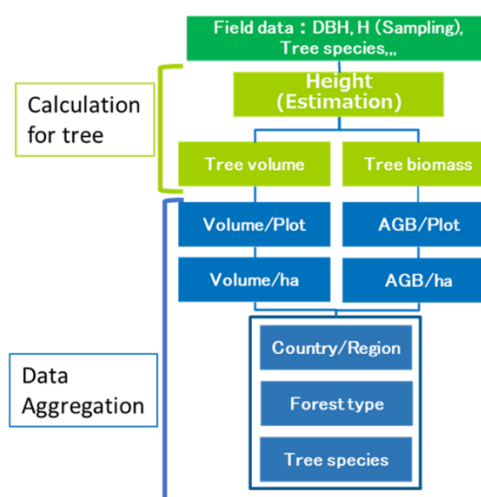
(3) 森林インベントリデータ計算プログラム研修

表 2.17 に森林インベントリデータ計算プログラム研修の研修内容を示す。

表 2.17 森林インベントリデータ計算プログラム研修の研修内容

研修	研修内容
森林インベントリデータ計算プログラム研修	➤ 国家森林インベントリ（NFI）マニュアルの方法論に基づくバイオマス・材積の計算 ➤ Excel マクロ（VBA）による森林バイオマス計算プログラムの操作

出典：SNRM プロジェクト



出典：SNRM プロジェクト

図 2.27 森林バイオマスの計算方法

2023 年に環境省（DGIS）及び森林局において森林インベントリデータ計算プログラム研修を実施した。



出典：SNRM プロジェクト

図 2.28 環境省（DGIS）・森林局職員を対象とした森林インベントリデータ計算プログラム研修の実施

森林インベントリデータ計算プログラム研修の実施を通じて、環境省及び森林局で森林インベントリデータから森林バイオマスを NFI 方法論に則り効率的に算出するための能力が形成された。また算出工程全体を確認することで、NFI 方法論における EF 算出方法等に用いられる係数設定、各工程における今後の課題等の理解が促進された。この能力等を活かして環境省・森林局が主導する形で更なる森林インベントリの推進や将来の NFI の実施が期待される。

(4) GIS 研修（初級・中上級）

表 2.18 に GIS 研修（初級・中上級）の研修内容を示す。

表 2.18 GIS 研修（初級・中上級）の研修内容

研修	研修内容
GIS 研修（初級）	➤ GIS の基礎及び一般的な GIS 機能の理解 ➤ GIS データの作成及び GIS データのダウンロード ➤ GIS データの編集及び地図作成におけるデータの準備 ➤ ベクターデータの切り取り及びラスター画像のくり抜き ➤ 地形解析と GIS シンボルの適用 ➤ 地図レイアウト作成、Geo-PDF へのエクスポート、スマートフォン地図アプリ（Avenza Maps）へのインポート
GIS 研修（中上級）	➤ データ標準化の理解 ➤ GIS ソフトと Excel を用いたジオデータベースの作成・更新（サブタイプ・ドメイン設定、データ統合、データ編集） ➤ データ製品仕様書の作成 ➤ 保護区管理に用いるジオデータベースの作成

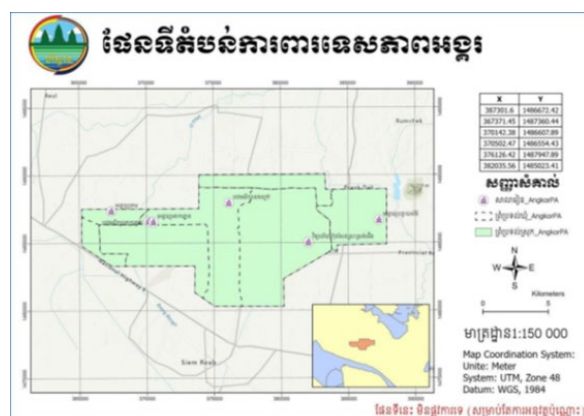
出典：SNRM プロジェクト

2024 年に環境省（GDNPA）職員を対象として、GIS 研修（初級・中上級）を実施した。



出典：SNRM プロジェクト

図 2.29 環境省（GDNPA）職員を対象とした GIS 研修（初級・中上級）の実施



出典：SNRM プロジェクト

図 2.30 GIS 研修（初級）で作成されたアンコールワットの主題図

GIS 研修（初級）の実施を通じて、環境省において自然保護区で収集された現場情報を一般公開の GIS データと組み合わせる形で主題図や位置図を作成する能力が形成された。また、GIS 研修（中上級）の実施を通じて、データ標準化の基礎知識と、標準化のために GIS ツールを活用する能力が形成された。今後は環境省内での円滑なデータ共有や利活用を視野にデータの標準化を意識した上でデータ整備を行い、それぞれの自然保護区で収集した現場情報を地図として可視化することで、自然保護区管理に係る課題の分析が可能となり、より効果的な自然保護区管理に繋がることが期待される。

(5) 衛星画像処理・判読研修

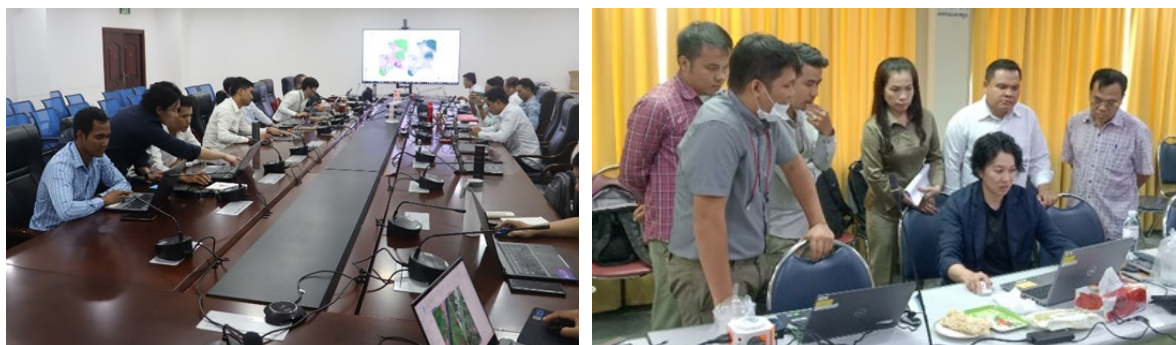
表 2.19 に衛星画像処理・判読研修の研修内容を示す。

表 2.19 衛星画像処理・判読研修の研修内容

研修	研修内容
衛星画像処理・判読研修	➤ 地球観測衛星の理解 ➤ 自然資源管理への地球観測データの適用 ➤ 衛星画像判読の要素 ➤ 衛星画像分類及び変化抽出の理解 ➤ Sepal 及び ArcGIS Pro のアドインを用いた地球観測データのダウンロード ➤ 演習 1：衛星画像の教師付分類を用いた土地利用被覆分類 ➤ 演習 2：主成分分析（PCA）を用いた土地利用被覆変化抽出

出典：SNRM プロジェクト

2024 年 9 月に環境省（GDNPA）職員及び森林局職員を対象として衛星画像処理・判読研修を実施した。



出典：SNRM プロジェクト

図 2.31 環境省（GDNPA）・森林局職員を対象とした衛星画像処理・判読研修の実施

衛星画像処理・判読研修を通じて、環境省及び森林局において衛星画像を用いた広域の土地利用被覆状況の把握ならびに森林減少域を含む土地利用被覆変化箇所の抽出が可能となった。今後は環境省・森林局が主導する形で全国の自然保護区及びコミュニティ森林において衛星画像を用いた森林モニタリングを定期的の実施し、抽出された森林減少域について州政府と連携した現場確認の実施に係る体制整備の推進が期待される。

1.3.5 成果 2-1-1-1 にかかる活動：NFMS 関連の研修を含む研修計画を策定する

はじめに、ストゥントレン州環境局及び森林局において PCM 形式のワークショップを開催し、ワークショップ参加者との議論を通じて、それぞれの組織の所掌業務や業務実施上の課題、課題解決のための方策案の特定を行った。その結果を表 2.20 に示す。



出典：SNRM プロジェクト

図 2.32 ストゥントレン州環境局・森林局にて実施されたワークショップ

表 2.20 ストゥントレン州政府の業務実施上の課題と課題解決のための方策案

組織	業務実施上の課題	課題解決のための方策案
ストゥントレン州環境局	1. 地図作成能力の不足 2. 地図作成に必要な機材の不足 3. ドローン操作能力の不足（写真撮影は可能だが、地図作成のための撮影能力はない） 4. 予算不足（ワークショップ開催費など） 5. ドローンの不足（既存のドローンは特定のプロジェクト範囲内のみ使用可能） 6. レンジャーからのデータにエラーがある 7. 生物多様性モニタリングにかかる能力不足	1. GIS、リモートセンシング、ドローンを活用した地図作成に係る研修の実施 2. SMART（Desktop 版・Mobile 版）に係る研修の実施 3. 地図の利活用に係る研修の実施
ストゥントレン州森林局	1. 地図作成能力の不足 2. ドローン操作能力の不足 3. 事務所機材の不足 4. パトロールに必要な機材の不足 5. 輸送機材の不足 6. 人材不足 7. 予算不足 8. 野生生物の違法狩猟 9. 違法伐採 10. 違法な土地転用 11. ドローンを用いたパトロール能力の不足 12. 犯罪者の法律の理解・遵守の欠如	1. 地図作成に係る研修の実施 2. レポート作成（月例報告、犯罪記録）に係る研修の実施

出典：SNRM プロジェクト

それぞれの組織の所掌業務、業務実施上の課題、課題解決のための方策案を特定したうえで、NFMS 関連研修に係る研修ニーズを明らかにした（表 2.21）。そのうえで、短期専門家チームから地図利活用研修、回転翼ドローン操作研修、衛星画像処理研修を含む NFMS 関連研修実施の提案を行い、研修内容についてストゥントレン州政府と合意された。

表 2.21 特定されたストゥントレン州政府の研修ニーズ

研修ニーズ	提案された研修プログラム
1. 地図の利用 2. 地図判読（方位、縮尺、地図記号、距離、高さ） 3. 現場における地図の使い方 4. 地図作成 5. 無償の衛星画像及び GIS データのダウンロード 6. 紙地図のジオレファレンス 7. ダウンロードした衛星画像、GIS データ、ジオレファレンスした紙地図の GIS へのインポート 8. ポイント、ライン、ポリゴンによる地物の図化 9. 属性テーブルの編集 10. 現地調査地図の編集と PDF への変換 11. スマホアプリへの PDF 地図のインポート 12. スマホアプリによる現地調査データの収集（区域界及び POI） 13. 現地調査データの GIS へのインポート 14. SNS（Telegram）を用いた現地調査データの共有	1. 地図利活用研修
15. 回転翼ドローンの自動飛行 16. オルソモザイク画像作成のためのドローン空中写真処理	2. 回転翼ドローン操作研修
17. ドローンのオルソモザイク画像及び衛星画像を用いた土地利用被覆分類	3. 衛星画像処理研修

出典：SNRM プロジェクト

1.3.6 成果 2-1-1-2 にかかる活動：研修素材の準備

州政府職員の NFMS 運用に係る研修実施の準備として、表 2.22 に示す研修資料が開発された。

表 2.22 州政府職員の NFMS 運用にかかる研修資料

開発された研修材料	内容	特記事項
1. 地図利活用研修資料	地図の縮尺や方位、地図記号、等高線等の地図の基礎知識や、カンボジア 1:100,000 地形図の内容や読み方にかかる研修資料	クメール語（添付資料 2）
2. 回転翼ドローン操作	回転翼ドローンの操作方法及びドローンオルソ	クメール語（添

研修資料	画像作成にかかる研修資料	付資料 5)
3. 衛星画像処理研修資料	衛星画像検索及びダウンロード方法、衛星画像及びドローンオルソ画像を用いた土地被覆変化抽出にかかる研修資料	クメール語（添付資料 7)

出典：SNRM プロジェクト

1.3.7 成果 2-1-1-3 にかかる活動：研修の実施

地方政府職員向けの NFMS 運用に関連する研修として、ストゥントレン州環境局・森林局職員を対象に、衛星画像を用いた森林減少及び劣化の可能性があるエリアの抽出や、地図や回転翼ドローンを用いた現地確認、収集したデータを用いた地図作成にかかる能力強化のための研修（表 2.23）を実施した。

表 2.23 NFMS 運用に関連する地方政府職員への研修実施

研修名	目的	対象機関	実施期間
1. 回転翼ドローン操作研修	回転翼ドローンを用いた安全かつ効率的な森林モニタリングのための能力強化。	ストゥントレン州環境局	2022 年 8 月 22 日から 24 日 2023 年 2 月 7 日から 8 日 2023 年 3 月 28 日から 30 日 2024 年 1 月 24 日から 26 日
		ストゥントレン州森林局	2022 年 10 月 10 日から 12 日 2023 年 2 月 9 日から 11 日 2023 年 3 月 22 日から 24 日 2024 年 1 月 18 日から 23 日
2. 地図利活用研修	現地調査を含む森林モニタリングのための地図利活用にかかる能力強化。	ストゥントレン州環境局	2022 年 12 月 7 日から 8 日 2022 年 12 月 19 日から 20 日
		ストゥントレン州森林局	2022 年 12 月 6 日から 7 日 2022 年 12 月 21 日から 22 日 2023 年 5 月 26 日
3. 衛星画像処理研修	土地利用被覆及びその変化抽出にかかる衛星画像利活用能力強化。	ストゥントレン州環境局	2023 年 11 月 22 日
		ストゥントレン州森林局	2023 年 11 月 21 日

出典：SNRM プロジェクト

(1) 回転翼ドローン操作研修

表 2.24 に回転翼ドローン操作研修の研修内容を示す。

表 2.24 回転翼ドローン操作研修の研修内容

研修	研修内容
回転翼ドローン操作研修	➤ 回転翼ドローン（DJI Phantom 4 Pro・DJI Mavic 3 Pro）の手動・自動操縦 ➤ 飛行計画・飛行シミュレーション ➤ データのダウンロード ➤ データ処理（オルソ画像作成、地図レイアウト作成）

出典: SNRM プロジェクト

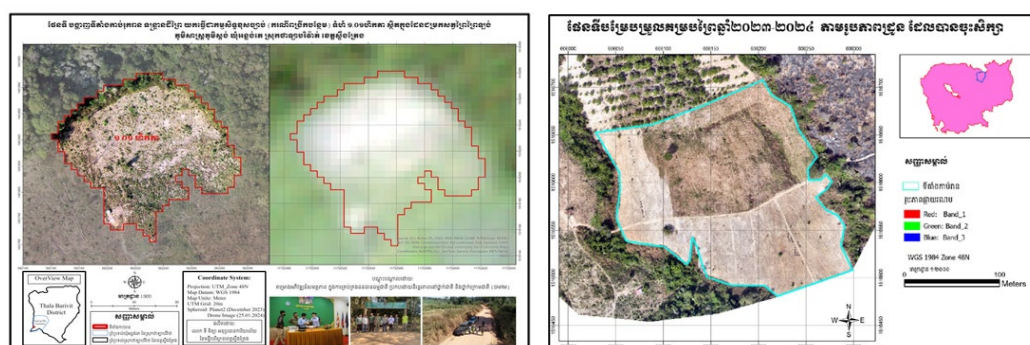
2022 年 8 月から 2024 年 1 月にかけてストゥントレン州環境局・森林局職員を対象として、研修参加者の習熟度に応じて複数回の研修を実施した。



出典: SNRM プロジェクト

図 2.33 ストゥントレン州環境局・森林局職員を対象とした回転翼ドローン操作研修の実施

回転翼ドローンを用いて空中写真を取得した後に空中写真の処理を行いオルソ画像が作成された。作成されたオルソ画像を用いて森林減少箇所の状況や伐採面積の特定がなされた。研修の成果として、森林減少箇所の状況を表す図面が作成された（図 2.34）。



出典: SNRM プロジェクト

図 2.34 回転翼ドローン操作研修の成果

回転翼ドローン操作研修を通じて、ストゥントレン州環境局・森林局においてドローンを用いて

空中写真を撮影し、土地利用被覆状況の詳細確認や土地の面積計測に係る能力が形成された。今後はこの能力を活用し、ドローンを用いて違法伐採及び違法な土地転用箇所の詳細情報を収集することで、法執行に必要な調書への詳細情報の反映が可能となり、適切な森林管理が推進されることが期待される。

(2) 地図利活用研修

表 2.25 に地図利活用研修の研修内容を示す。

表 2.25 地図利活用研修の研修内容

研修	研修内容
地図利活用研修	➤ 地形図の判読方法（地形図の内容、等高線、縮尺、方位、座標系、地図記号等） ➤ コンパスと紙地図を用いたオリエンテーリング（野外演習） ➤ スマートフォンの地図アプリ（Avenza Maps）の操作

出典: SNRM プロジェクト

2022 年 10 月から 2023 年 5 月にかけてストゥントレン州環境局・森林局職員を対象として地図利活用研修を実施した。



出典: SNRM プロジェクト

図 2.35 ストゥントレン州環境局・森林局職員を対象とした地図利活用研修の実施

地図利活用研修の実施を通じて、ストゥントレン州環境局・森林局において地形図の読図やスマートフォンの地図アプリの利用に係る能力が形成された。現在はレンジャーや森林官が森林内で遭難するケースも生じていることから、今後は地形図や地図アプリを用いて目的地までのルート・距離や地形条件を把握したうえで安全にパトロールを実施されることが期待される。

(3) 衛星画像処理研修

表 2.26 に衛星画像処理研修の研修内容を示す。

表 2. 26 衛星画像処理研修の研修内容

研修	研修内容
衛星画像処理研修	➤ SEPAL を用いた LANDSAT ・ Sentinel-2 衛星画像のダウンロード ➤ NICFI Planet 衛星画像のダウンロード ➤ 主成分分析（PCA）を用いた土地利用被覆変化抽出

出典: SNRM プロジェクト

2023 年 11 月にストゥントレン州環境局・森林局職員を対象として衛星画像処理研修を実施した。



出典: SNRM プロジェクト

図 2. 36 ストゥントレン州環境局・森林局職員を対象とした衛星画像処理研修の実施

衛星画像処理研修を通じて、ストゥントレン州環境局・森林局において衛星画像を用いた広域の森林被覆状況の把握ならびに森林減少劣化候補地の抽出が可能となった。今後はストゥントレン州環境局・森林局が主導する形でストゥントレン州内の自然保護区及びコミュニティ森林において衛星画像を用いた森林モニタリングを定期的の実施し、抽出された森林減少劣化候補地について違法伐採のスクリーニングを行い、違法伐採の可能性が高い箇所について効率的に現場確認が実施されることが期待される。

1.3.8 成果 2-1-1-4 : 研修結果の効果のとりまとめ

ToT 研修に係る研修結果の効果のとりまとめとして、2024 年 9 月にストゥントレン州環境局及び森林局を対象としてワークショップを開催した。



出典：SNRM プロジェクト

図 2.37 研修結果の効果のとりまとめに係るストゥントレン州環境局・森林局とのワークショップの開催

ワークショップでは ToT 研修参加者全員を対象としてアンケート調査を実施し、ToT 研修の受講を通じてストゥントレン州環境局・森林局職員の所掌業務実施に係る能力の向上度合いについて評価を行った。調査結果を表 2.27 に示す。

表 2.27 ToT 研修前後におけるストゥントレン州政府職員的能力レベル

組織	業務における課題	ToT 研修前の 能力レベル (Level 1-5)	ToT 研修後の 能力レベル (Level 1-5)
ストゥント レン州環境 局	1. 地図作成能力の不足	1	4
	2. 地図作成に必要な機材の不足	1	4
	3. ドローン操作能力の不足(写真撮影は可能だが、地図作成のための撮影能力はない)	2	4
	4. 予算不足(ワークショップ開催費など)	2	5
	5. ドローンの不足(既存のドローンは特定のプロジェクト範囲内のみ使用可能)	2	5
	6. レンジャーからのデータにエラーがある	2	4
	7. 生物多様性モニタリングにかかる能力不足	2	3
ストゥント レン州森林 局	1. 地図作成能力の不足	1	3
	2. ドローン操作能力の不足	1	3
	3. 事務所機材の不足	1	4
	4. パトロールに必要な機材の不足	1	4
	5. 輸送機材の不足	1	1
	6. 人材不足	1	1
	7. 予算不足	1	1
	8. 野生生物の違法狩猟	2	2
	9. 違法伐採	2	3

	10.違法な土地転用	2	3
	11. ドローンを用いたパトロール能力の不足	1	3
	12.犯罪者の法律の理解・遵守の欠如	1	3

出典：SNRM プロジェクト

2 コンポーネントの成果

コンポーネントの成果について、指標の達成状況を4つの評価レート（非常に高い、高、中、低）に基づき評価を行った。

2.1 成果と指標

2.1.1 指標 3-2 森林モニタリング及び測定・報告・検証の観点で NFMS が質的に向上する。

<達成度: 高>

NFMS における森林モニタリング及び測定・報告・検証（MRV）の能力が向上した。具体的に、森林モニタリングについては、ドローン、GIS、衛星画像判読に係る研修の実施ならびに CEMIS への JJ-FAST 機能の搭載により、森林データの収集・編集に係る能力が向上した。MRV については、州レベルでの森林インベントリ調査が初めて実施され、同調査を通じた経験及び教訓の積み重ねにより、将来の国家森林インベントリ（NFI）の実施にかかる能力が向上した。

2.1.2 指標 4-1 保護区管理及び持続的な森林管理のための NFMS 運用にかかるストゥントレン州職員の能力が向上する。

<達成度：高>

ストゥントレン州における保護区管理及び持続的な森林管理のための NFMS 運用能力が向上した。具体的には、ストゥントレン州職員を対象とした衛星画像処理や地図利活用、回転翼ドローン運用に関する ToT 研修を通じ、潜在的な森林減少と森林劣化の特定と現場検証に係る能力が向上した。

2.2 プロジェクト目標と指標

目標：保護区管理及び持続的な森林管理を担当する国・地方政府のスタッフが、持続的な自然資源管理に必要な技術・知識を修得する。

2.2.1 指標 1-1 環境省及びストゥントレン州環境局職員の保護区管理に必要な技術・知識が向上する。

<達成度: 中 >

環境省及びストゥントレン州環境局の関係職員に対し、知識・技術の強化が行われ、特に NFMS における森林モニタリング及び MRV について知識・技術が向上した。

2.2.2 指標 1-2 農林水産省森林局及びストゥントレン州森林局職員の持続的な森林管理に必要な

技術・知識が向上する。

<達成度：中>

農林水産省森林局及びストゥントレン州農林水産局の関係職員に対し、知識・技術の強化が行われ、特に NFMS における森林モニタリングについて知識・技術が向上した。

3 PDM の変更

当初の PDM の指標が達成度を評価するに適切でないと判断されたため、中間評価（2023 年 2 月実施）において PDM の指標の変更が推奨され、プロジェクトとして助言通りに PDM を変更した。変更された指標は PDM 第 3 版に反映され、2023 年 6 月に署名された。

表 2.28 指標の変更と変更理由

概要	指標	変更後の指標	変更理由
上位目標 保護区管理及び持続的な森林管理を強化する必要な政策・措置を策定し実施することにより、森林減少・劣化を低減させる。	森林減少率が 2006～2014 年の減少率と比べて半減する。	1-1. 2026 年までの森林減少率が 2006 年から 2014 年の減少率と比べて半減する。 1-2. NPASMP（2026 年目標）、PFSP（第二期目標）及び行動・投資計画（AIP）で設定した目標が達成される。	1-1：目標年の記載がなかったため 2026 年を追記。 1-2：1-1 は森林減少削減の上位目標の指標としては妥当であるが、本プロジェクトの成果だけで達成可能なわけではなく、上位目標自体「保護区管理及び持続的な森林管理を強化する必要な政策・措置を策定し実施することにより」との記載もあるため、プロジェクト終了後の NPASMP、PFSP、AIP の実施状況に関する指標も 1-2 として設定した。
プロジェクト目標 保護区管理及び持続的な森林管理を担当する国・地方政府のスタッフが、持続的な自然資源管理に必要な技術・知識を修得する。	NPASMP 及び PFSP で設定された目標が達成される。	1-1. 環境省及びストゥントレン州環境局職員の保護区管理に必要な技術・知識が向上する。 1-2. 農林水産省森林局及びストゥントレン州森林局職員の持続的な森林管理に必要な技術・知識が向上する。	実際のプロジェクトの活動は NPASMP や PFSP の達成に大きく貢献するものではなく、プロジェクト目標も「国・地方政府のスタッフが、持続的な自然資源管理に必要な技術・知識を修得する」であり政策・措置の実施までは求めているため、よりプロジェクト目標と活動内容を測る指標として、MoE と FA それぞれの「技術・知識の習得」を評価できる指標を設定した。

概要	指標	変更後の指標	変更理由
成果 [成果 1. 政策支援] 1-1. 保護区管理に関する主要な政策・措置の策定・実施が促進される。	1. NPASMP の行動計画（2018～2022 年）で設定された目標が達成される。	1-1. NPASMP 更新案が提出される。 1-2. 中央及び準国レベルの職員の保護区管理計画策定能力が向上する。	指標 1-1 及び 1-2：実際のプロジェクトの活動は NPASMP 全体の達成に貢献するものではなく、NPASMP 行動計画の進捗モニタリング、結果のとりまとめ、これに基づく NPASMP のレビューと更新、及び NPASMP と行動計画の極一部である「保護区管理計画の策定」を達成するための能力強化である。そのため活動 1-1-1-4「NPASMP 更新を支援する」を評価するため指標 1-1 を設定し、活動 1-1-2 の保護区管理計画策定の能力向上支援を評価するため指標 1-2 を設定した。
1-2. 持続的な森林管理に関する主要な政策・措置の策定・実施が促進される。	2. PFSP 第一期（2018～2022 年）で設定された目標が達成される。	2. PFSP が最終化される。	指標 2：実際のプロジェクトの活動は PFSP 全体の達成に貢献するものではなく、PFSP の最終化と理解の促進である。そのため PFSP の最終化を評価するため指標 2 を設定した。
1-3. 国家 REDD+戦略実施のための行動・投資計画が促進される。	3. プロジェクト期間中の国家 REDD+戦略実施のための行動・投資計画で設定された目標が達成される。	3-1. 国家 REDD+戦略実施のための行動・投資計画の進展が実施促進のために定期的にモニタリングされる。 3-2. 森林モニタリング及び MRV の観点で NFMS が質的に向上する。	指標 3-1 及び 3-2：実際のプロジェクトの活動は REDD+行動・投資計画全体の達成に貢献するものではなく、同計画の実施支援と進展のモニタリング、及び同計画の極一部である「NFMS の質的向上」である。そのため REDD+行動・投資計画の実施支援を評価するため指標 3-1 を設定し、NFMS の質的向上支援を評価するため指標 3-2 を設定した。
[成果 2. 準国レベルでの実施支援] 2-1. 保護区管理及び持続的な森林管理を促進するための州職員の能力が向上す	4. ストゥントレン州における森林減少・劣化率が?%減少する。	4-1. 保護区管理及び持続的な森林管理のための NFMS 運用にかかるストゥントレン州職員の能力が向上する。 4-2. プロジェクトを通じて能力強化されたストゥントレン州森林局職員及び環境局レンジャーにより、CF 及び CPA における持続的な自然資源管	実際のプロジェクト活動はストゥントレン州全体の森林減少・劣化を食い止めるものではなく、州政府向けの NFMS 関連の研修や CP における持続的な自然資源管理のための地域コミュニティの能力と、CPA における持続的な自然資源管理のため

概要	指標	変更後の指標	変更理由
る。 2-2. コミュニティ森林（CF）における持続的な自然資源管理のための地域コミュニティの能力と、コミュニティ保護区（CPA）における持続的な自然資源管理のための地域コミュニティを支援するための州レンジャーの能力が向上する。		理が向上する。	の地域コミュニティを支援するための州レンジャーの能力向上支援のため、NFMS 関連の訓練等による州職員の能力向上支援を評価するため指標 4-1 を設定し、CF/CPA の自然資源管理実施支援を評価するため指標 4-2 を設定した。

出典：SNRM プロジェクト

4 その他

4.1 環境・社会配慮の結果

特記事項なし。JICA 指標のカテゴリーC に該当。

4.2 ジェンダー／平和構築／貧困削減の配慮にかかる結果

プロジェクトの実施にあたっては、ジェンダーへの配慮が必要なため（JICA 指標のカテゴリーC に該当）、女性の参加・参画が促進された。例えば、2022 年 8 月に本プロジェクトの研修の開催地に関するパイロット CF 委員会メンバーとの協議において、本プロジェクトは女性の意見を十分に考慮するため、州都に招待するのではなく、村のパゴダを開催地として選定した。その結果、研修参加者 26 名中 14 名が女性という高い女性参加比率に繋がった。さらに、2023 年 2 月に実施された村の家畜ボランティアの研修では、参加者 5 名中 3 名が女性であった。

III ジョイント・レビューの結果

1 DAC 評価指標に基づくレビュー結果

DAC 指標に基づくレビュー結果については、本プロジェクトの事業完了報告書で評価していることから、同報告書を参照されたい。

2 実施と成果に影響を与えた主な要因

1) GDNPA、森林局及びストゥントレン州政府が十分な職員を配置し、必要な予算を配分する。

十分な職員は配置されたが、必要な予算の殆どは JICA 側が負担した。従って、予算不足により、いくつかの活動は中止せざるを得なかった。

2) 保護区管理及び持続可能な森林管理のための国家政策に変更がない。

持続的な自然資源管理は、カンボジア政府の国家政策である五角形戦略の第 4 角において、継続して言及された。

3) REDD+にかかる国家政策に変更がない。

環境の持続可能性の確保と気候変動対策への備えについて、カンボジア政府の国家政策である五角形戦略の第 4 角において、継続して言及された。

IV プロジェクト終了後の上位目標の達成に向けて

1 上位目標達成の見通し

上位目標：保護区管理及び持続的な森林管理を強化する必要な政策・措置を策定し実施することにより、森林減少・劣化を低減させる。

OVI 1-1. 森林減少率が 2006～2014 年の減少率と比べて半減する。

OVI 1-2. NPASMP（2026 年目標）、PFSP（第二期目標）及び行動・投資計画（AIP）で設定した目標が達成される。

OVI 1-1 は本プロジェクトの成果のみで達成できるものではないため、OVI 1-2 が追加された。NPASMP（2021 年目標）の達成度は限定的であることから、本プロジェクトで実施した NPASMP 行動計画の実施状況にかかる評価を踏まえ、NPASMP（2026 年目標）を着実に達成した上で、NPASMP（2031 年目標）を実現するための新たな行動計画を策定すべきである。可能であれば、最新の準国・国家レベル、及び国際的な状況や目標を考慮し、合理的な 2031 年目標が設定されるよう、NPASMP を修正すべきである。また修正された 2031 年目標を着実に達成するための実現可能なマイルストーンとして、2026 年目標を修正すべきである。NPASMP（2026 年目標）は GDNPA によって新たな行動計画が策定され、確実に実施されれば達成される見込みである。

PFSP については、森林局の PFSP ワーキンググループが立ち上がっていないことから、PFSP は最終化されておらず、「第二期マイルストーン」は草案段階である。従って、森林局は PFSP ワーキンググループを立ち上げ、JICA による研修で得た成果を活用しながら、PFSP を最終化すべきである。さらに、今後最終化される PFSP の第二期マイルストーン（2023～2027 年）は、行動計画が確実に実施されれば達成される見込みである。

行動・投資計画については、現時点では組織及び予算面で課題があるが、RTS 再編の手続きが完了し、GCF により SAP 申請が承認されることで、組織・予算が拡充されると期待される。従って、行動・投資計画を達成するためには、環境省及び農林水産省の共同決定によって RTS を再編し、カンボジア政府及び援助機関による GCF 資金を有効化した上で、全関係省庁や援助機関を巻き込み、年次計画及びレビューのためのワークショップの開催など、実質的な措置を通じ、RTS が行動・投資計画の実施及び進捗モニタリングを行わなければならない。

また、上位目標の達成に影響するプロジェクトの成果の持続性はリスクの一つであり、予算及び能力面での持続可能性にかかる革新的な変化が重要であることを JICA 及びカンボジア側の双方が提案・認識した。

本プロジェクトの実施を通じ、中央政府及び準国レベルにおける持続的な自然資源管理にかかる能力強化について、本プロジェクトの成果の維持につながる変化がみられた。この変化は手戻りをなくし、この変化を確実なものとし、流れを維持することで上位目標は達成できるといえる。

2 上位目標達成のカンボジア側の実施体制と運用計画

NPASMP を実施するための第2次行動計画、PFSP 草案、及びカンボジア国家 REDD+戦略を実施するための行動・投資計画は、上位目標の達成に向けたカンボジア政府の計画であり、これらの計画には、NRT として RTS、環境省（GDNPA、GDLC、GDEKI）、農林水産省森林局、ならびに全国の州政府環境局と森林局が実施体制に含まれる。

環境省 GDNPA 及び農林水産省森林局は、本プロジェクト終了後3年間で上位目標を達成するための計画を策定し、2024年10月16日に開催された最終JCCで共有した。

表4.1にはGDNPAによる上位目標達成のための活動計画を示す。項目1：政策支援、項目2：準国レベルでの実施、の両方で活動計画が設定されている。

表 4.1 GDNPA による上位目標達成のための活動計画

項目	内容	成果	活動		
			2025	2026	2027
項目 1: 政策支援	1-1. 保護区の管理計画の開発にかかる技術ガイドラインに基づき、活動実施のため、中央政府及び準国レベルの職員の活動実施に係る能力強化を行う。	技術ガイドラインに基づき、保護区管理計画が策定される。	保護区管理計画の策定・実施にかかる研修・ワークショップの開催（1回）	保護区管理計画の策定・実施にかかる研修・ワークショップの開催（1回）	保護区管理計画の策定・実施にかかる研修・ワークショップの開催（1回）
項目 2: 準国レベルでの実施	1-2. 州政府環境局職員及びレンジャーを対象として、保護区管理にかかる法の執行及び制度に関する研修を行う。	環境・自然資源法及び関連制度の知識を持つべき州政府環境局職員及びレンジャーが裁判のための自然資源にかかる犯罪を記録・整理できる。	自然資源犯罪にかかる資金洗浄（の取締り）に関する標準作業手順書の研修実施（1回）	自然資源犯罪にかかる資金洗浄（の取締り）に関する標準作業手順書の研修実施（1回）	自然資源犯罪にかかる資金洗浄（の取締り）に関する標準作業手順書の研修実施（1回）
			自然資源犯罪にかかる法の執行及び裁判のための報告書整理に関する研修の実施（1回）	自然資源犯罪にかかる法の執行及び裁判のための報告書整理に関する研修の実施（1回）	自然資源犯罪にかかる法の執行及び裁判のための報告書整理に関する研修の実施（1回）
			環境・自然資源法及び関連制度を周知するための研修・	環境・自然資源法及び関連制度を周知するための研修・	環境・自然資源法及び関連制度を周知するための研修・

			ワークショ ップの開催 (1 回)	ワークショ ップの開催 (1 回)	ワークショ ップの開催 (1 回)
	1-3. 地方自治体 やコミュニティ の能力強化にか かる研修計画を 策定・実施す る。	環境・自然資 源法及び関連 制度が保護区 に関連する地 方自治体及び コミュニティ に周知され る。	環境・自然 資源法及び 関連制度を 周知するた めの研修・ ワークショ ップの開催 (1 回)	環境・自然 資源法及び 関連制度を 周知するた めの研修・ ワークショ ップの開催 (1 回)	環境・自然 資源法及び 関連制度を 周知するた めの研修・ ワークショ ップの開催 (1 回)

出典：SNRM プロジェクト

一方、森林局による上位目標達成のための本プロジェクト終了後の活動計画は以下のとおりである。

- (1) CF 管理計画の策定及び実施を促進する。
- (2) CF における森林再生及び植林を拡大する。
- (3) CF におけるアグロフォレストリーの実施を拡大する。
- (4) 紛争解決及びモニタリング・評価にかかるメカニズムを強化する。
- (5) CF 戦略計画を策定する。

上記活動の進捗については、森林局で四半期ごとに開催される林業改革のための技術委員会（TWG-FR）で報告されることとなっている。

3 カンボジア側への提言

短期専門家チームによって支援を行った NFMS に関連する活動にかかる提言は、以下 4 点である。

- (1) UNDP の支援の下、CEMIS（初版）が開発されたが、CEMIS の運用は開始されていない。持続的な自然資源管理のための CEMIS の適用及び効果的な活用には、環境省の DGIS 及び GDNPA、環境省と農林水産省森林局、さらに中央政府及び州政府間の緊密な連携が必要である。
- (2) ドローンや PC、ドローン画像処理ソフトといった NFMS に関連する活動のために調達された機材は、環境省、農林水産省森林局、ストゥントレン州環境局及び森林局に譲渡された。これらの機材については、森林モニタリングにかかる活動において良好な状態で機材を使用するため、定期的な保守（特にドローン及びバッテリー）を行うべきである。
- (3) 本プロジェクトにおいて、環境省、農林水産省森林局、ストゥントレン州環境局及び森林局を対象に ToT 研修が実施され、本プロジェクト期間中に講師が育成された。本プロジェクト終了後、育成された講師はプロジェクトの成果を維持するために、身に着けた知識を研修を受けていない

職員に対して共有すべきである。

(4) NFMS に関連する研修において、地図利活用、衛星画像処理及び判読、GIS、ドローン操作及びドローンデータ処理にかかる研修資料が作成された。一般的に、GIS やリモートセンシングにかかる技術進歩は非常に早いため、短期専門家チームはカウンターパートに、プロジェクト終了後は定期的に研修資料を見直し、必要があれば最新の GIS やリモートセンシング技術を含め更新を行うことを要請する。

添付資料

添付資料 1: ストゥントレン州森林インベントリ調査報告書

添付資料 2: 地図利活用研修資料

添付資料 3: GIS 研修資料（初級）

添付資料 4: GIS 研修資料（中上級）

添付資料 5: 回転翼ドローン操作研修資料

添付資料 6: 固定翼ドローン操作研修資料

添付資料 7: 衛星画像処理判読研修資料

添付資料 8: 第 1 回技術セミナー発表資料

添付資料 9: 第 2 回技術セミナー発表資料

添付資料 1: ストゥントレン州森林インベントリ調査報告書



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
RUJA	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).

1

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

1 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).

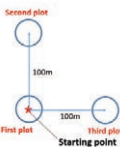


Figure 2. Cluster with circular plots



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 m²	dbh ≥ 30 cm	F2, F3, F5
Subplot 1	11.97 m	450 m²	dbh ≥ 10 cm	F5
Subplot 2	5.64 m	100 m²	dbh ≥ 5 cm	F5
Subplot 3 for samplings, shrubs and climbers	2.62 m	25 m²	- Trees: 1cm< dbh < 5 cm	F4A

			- Shrubs, climbers: dbh ≥ 5cm	
Subplot 4 for seedlings, small shrubs and climbers	1.13 m	4 m²	- Trees: dbh < 1 cm or no dbh	F4B
Subplot 1 for dead wood (lying) and stumps	11.97 m	450 m²	- Shrubs, climbers: 1cm< dbh < 5 cm	F6
Subplot 1 for bamboo	11.97 m	450 m²	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).

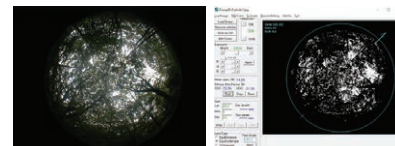


Figure 4. Image by 360 camera and User interface of Canopon2

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

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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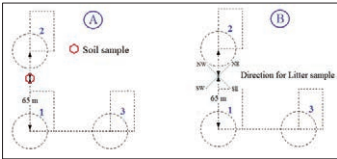


Figure 5. Soil profile location and litter location for uplands

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).

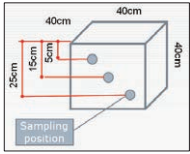


Figure 6. Soil sampling position in the pits

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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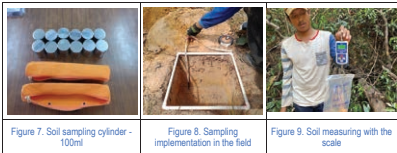


Figure 7. Soil sampling cylinder - 100ml

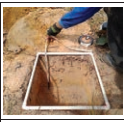


Figure 8. Sampling implementation in the field



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	$AGB = 0.0607 \cdot DBH^{*2} \cdot 2.692 \cdot H^{*0.5122} \cdot WD^{*0.3183}$	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	$H = 1.3 + 21.286 \cdot (1 - \exp(-0.0407 \cdot DBH^{0.8198}))$
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 * 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 * WD decomposition class $V = \frac{1}{6} \cdot \pi \cdot (d1^2 + d1 \cdot d2 + d2^2) \cdot L$	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)

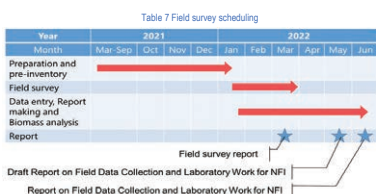
2.3.3 Calculation of Soil and Litter Carbon Pools

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 ^a	# Inaccessible plot ^{**}
Evergreen forest	117	11
Semi-evergreen forest	90	10
Deciduous forest	108	0
Non forest	45	3
Total	360	24

^a Recorded in the fields

^{**} Based on the classification of 2018 Forest Cover Map

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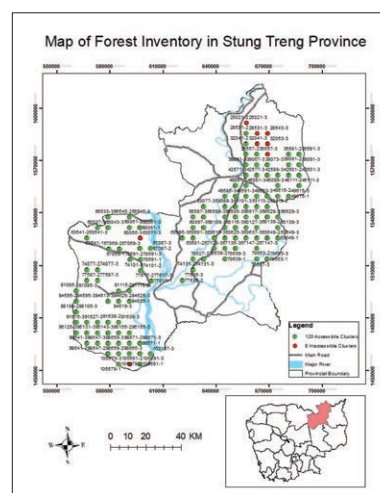


Figure 11. Map of accessible and inaccessible clusters in Stung Treng Province

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*, *Mimocylon 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>Mimocylon 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.

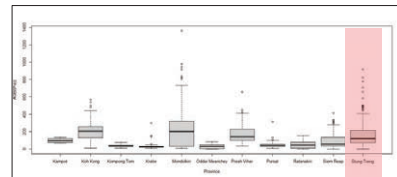


Figure 12. Comparison of AGB between study site and other provinces

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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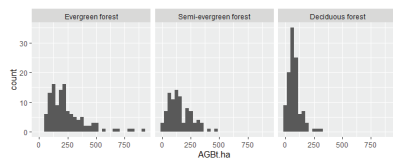


Figure 13. Frequency of AGB in each forest types

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

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

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 (99.97 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

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%

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 C/ha) was higher than that of Semi-evergreen forest (159.97 C/ha), Deciduous forest (115.39 C/ha) and Non-forest (69.31 C/ha) 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 C/ha for Evergreen forest, 93.19 C/ha for Semi-evergreen, 39.97 C/ha for Deciduous forest and 41.30 C/ha 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 C/ha), equivalent to 859.94 t/ha, 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 t/ha, 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 *Vietnamomassa 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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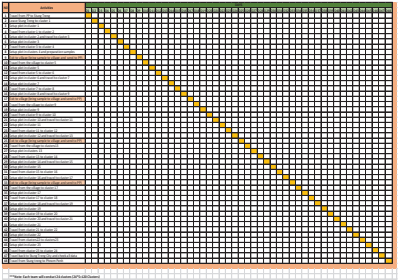
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Appendix 1 Detail Schedule



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										NUMBER OF CANDIDATES APPEARING FOR THE 3	
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No	Species name	Frequency
46	Dehaasia cuneata	36
47	Diospyros pilosanthera	36
48	Gluta lacifera, 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 anamensis	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	Stereospermum cylindricum	24
72	Cereya arborea	23
73	Garcinia fereae	23
74	Spondias pinnata	23
75	Anacardium occidentale	22
76	Bromolowia 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 glabra Mq.	20
86	Lagerthoemia speciosa	19
87	Terminalia chebula	19
88	Lophopetalum duperreanum	18
89	Terminalia latata	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	Pterospermum semisagittatum	14
105	Cananga latifolia	13
106	Dillenia ovata	13
107	Fagraea fragrans	13
108	Hopea pierrei	13
109	Mitragyna sp.	13
110	Atalantia monophylla	12
111	Callicarpa brevipes	12
112	Ficus microcarpus	12
113	Hydrocarpus annamensis	12
114	Krema globulata	12
115	Methuca cambodiana	12
116	Pterospermum 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 varicosa	10
125	Garcinia oliveri	10
126	Pinus kesiya	10
127	Suregada multiflora	10
128	Syzygium litorium	10
129	Vernanoxia 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 philastreana	9
139	Abutilon indicum	8

36

No	Species name	Frequency
140	Alstonia scholaris	8
141	Bauhinia variegata	8
142	Dalbergia enteloides	8
143	Diospyros buxifolia	8
144	Aglaia edulis	7
145	Bauhinia viridescens	7
146	Calumangum tomentosa	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	Aglaia cambodiana	6
155	Albizia thorelii	6
156	Antidesma phassambilla	6
157	Boehavia chinensis	6
158	Chrysophyllum roxburghii	6
159	Cittoria ternatea	6
160	Daphniphyllum meus	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 hypochra	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	Adenanthura pectinata	4
185	Crutia chrysantha	4
186	Dasymaschalon macrocalyx	4

37

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	Nephellium melliferum	4
196	Ochna integerrima	4
197	Pternandra caerulea	4
198	Shorea thorelii	4
199	Spondias 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 dicoccum	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 sinata	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 litorium	3
232	Pterospermum 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>Villex 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>Asadrachia indica</i>	2
252	<i>Bauhinia harmsiana</i>	2
253	<i>Bauhinia pottsi</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 seiffertum</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>Decrydium 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 sp1</i>	1
320	<i>Flacourtia indica</i>	1
321	<i>Garcinia schomburgkiana</i>	1
322	<i>Garderia 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

40

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

41

No	Species name	Frequency
375	Unknown94	1
376	Unknown95	1
377	Unknown96	1
378	Unknown97	1
379	Unknown98	1
380	<i>Ventilago harmandiana</i>	1
381	<i>Xylocopa pierrei</i>	1
382	<i>Xylocopa 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 18 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

添付資料 2: 地図利活用研修資料



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 គឺជាសំដៅលើផែនទីមានរាងកូនមួយដែលត្រូវបានបង្កើនពីភពផែនដី។ វាបានបង្ហាញពីទំហំ ចម្ងាយ រូបរាង និងទីសំដៅនៃភពផែនដី។
- តែងតែមិនអាចមើលដោយឃើញទាំងមូលដោយការមើលតែមួយភ្លែតបានដែរ វាអាចមើលឃើញពេញបានដោយការបង្វិល។

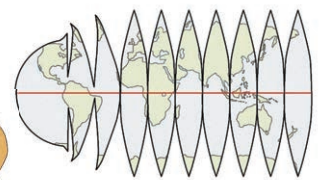
ការស្វែងយល់អំពីការបង្កើនរបស់ផែនទីទៅជាផែនទី (ត)

- ផែនទីពិភពលោក ខុសគ្នាបន្តិចបន្តួច ទាំងរូបរាង ចម្ងាយ ទំហំ និងទីតាំងធៀបទៅនឹងភូគោលតែងតែងាយស្រួលយកទៅតាមខ្លួនជាង។



ការស្វែងយល់អំពីការបង្កើនរបស់ផែនទីទៅជាផែនទី (ត)

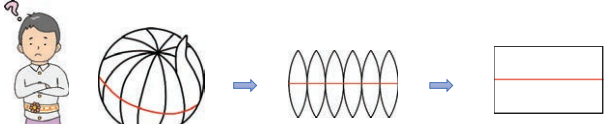
- ផែនទីពិភពលោកអាចបង្កើតបានដោយប្រើប្រាស់វិធីសាស្ត្របង្កើន (Projection) ដើម្បីធ្វើផែនទីរាងមូលក្លាយទៅជាផែនទីសំប៉ែត។ វិធីសាស្ត្របង្កើនមានច្រើនប្រភេទ អ្នកផលិតផែនទីអាចជ្រើសរើសអាស្រ័យលើគោលបំណង។



ការប្រៀបធៀបការបង្កើនផែនទីទៅជាផែនទី

ការស្វែងយល់អំពីការបង្កើនរបស់ផែនដីទៅជាផែនទី (ត)

- ខាងក្រោមនេះជា រូបភាពត្រូវបានឆ្លាក់
- ដើម្បីបំបាត់គម្លាតទាំងនេះ រូបរាងដើមនៃផែនដី និងមហាសមុទ្រនឹងផ្លាស់ប្តូរខុសពីស្ថានភាពដើម។



- ក្នុងការទទួលបានភាពត្រឹមត្រូវនៃផែនទី អ្នកផលិតផែនទីត្រូវជ្រើសរើសវិធីសាស្ត្របង្កើនជាក់លាក់ និងព័ត៌មានដែលចង់ឲ្យបាន។

ការស្វែងយល់អំពីការបង្កើនរបស់ផែនដីទៅជាផែនទី (ត)

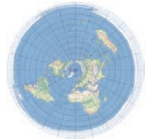
- វិធីសាស្ត្របង្កើនដែលត្រូវបានប្រើប្រាស់សម្រាប់ការផលិតផែនទីមាន Mercator, Mollweide, និង Azimuthal ៖



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

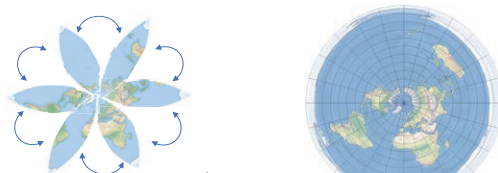
ភ្ជាប់ចុងទូកទាំងនេះចូលគ្នាតែមួយ



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

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

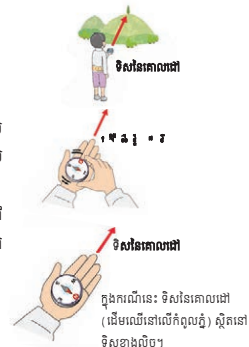
ការស្វែងយល់អំពី Azimuth (ត)

របៀបប្រើប្រាស់ត្រីវិស័យ

- ត្រីវិស័យត្រូវបានប្រើប្រាស់ដើម្បីស្វែងរក azimuths/ទិស៖

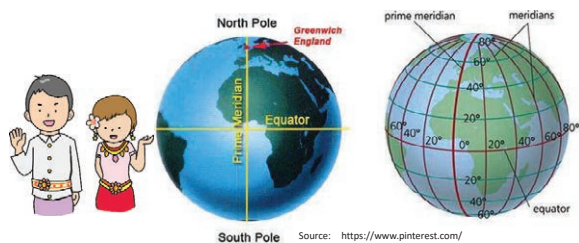


1. បែរមុខទៅកាន់ទិស ដែលត្រូវសិក្សា និងដាក់ត្រីវិស័យផ្នែកលើបាតដៃរបស់អ្នក។
2. នៅពេលមូលម៉ាញ៉េទិចឈប់ដើរ សូមបង្វិល ត្រីវិស័យ ដើម្បីឱ្យផ្នែកណាមួយចង្អុល ទៅកាន់ "N" នៅលើត្រីវិស័យ។
3. ពេលនេះ ត្រីវិស័យស្ថិតនៅទីតាំងត្រឹមត្រូវ ហើយ។ សូមពិនិត្យមើលទិសដែលអ្នកបែរ ទៅ នៅលើត្រីវិស័យ។



ការស្វែងយល់អំពី Azimuth សាកល

- ភាគច្រើនទិសខាងជើងរបស់ផែនដីត្រូវបានដាក់នៅផ្នែកខាងលើ (ដាក់ផែនទីនៅលើផ្នែកប)។



ខ្សែពណ៌លឿងបង្ហាញ ទិសខាងជើង ត្បូង កើត និងលិច។

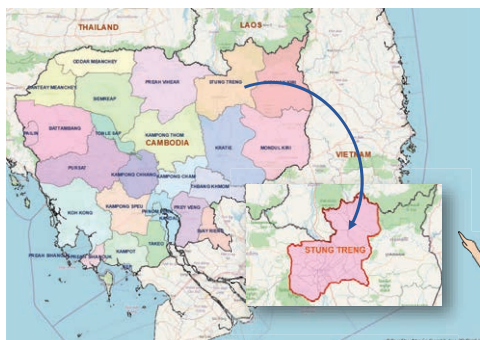
ខ្សែពណ៌ក្រហមបង្ហាញ ទិសខាងជើង និងត្បូង។ ខ្សែពណ៌បៃតងដែលជួបប្រសព្វគ្នាជាមួយនឹងខ្សែ ពណ៌ក្រហមនៅមុំត្រឹមត្រូវតំណាងឱ្យទិសខាង កើត និងលិច។

ការស្វែងយល់អំពី Azimuth សាកល (ត)

- ខ្សែវេទ្យចម្បង (Primer Meridian) នៅ Greenwich៖ វាគឺជាខ្សែវេទ្យ ដែលឆ្លងកាត់លើចំណុច កណ្តាលវាជាតំបន់ជាយក្រុងមួយនៃទីក្រុងឡុង។ ខ្សែនេះត្រូវបានប្រើប្រាស់ជាខ្សែវេទ្យគោល សម្រាប់រយៈបណ្តោយ ០ដឺក្រេ ០នាទី ០វិនាទី ហើយខ្សែនេះត្រូវបានប្រើជាអន្តរជាតិ។
- ខ្សែអេក្វាទ័រ៖ វាគឺជាស្តង់ដារមួយនៃស្តង់ដាររយៈទទឹង និងបង្ហាញរយៈទទឹងកម្រិត ០ដឺក្រេ។ វាគឺជា រង្វង់ធំបំផុតនៅក្នុងខ្សែរយៈទទឹង។ អន្តរគោលខាងជើងស្ថិតនៅកាតខាងជើងនៃខ្សែអេក្វាទ័រ និង អន្តរគោលខាងត្បូងស្ថិតនៅកាតខាងត្បូងនៃខ្សែអេក្វាទ័រ។

ការស្វែងយល់អំពីទីតាំងរបស់ខេត្តស្ទឹងត្រែងនៅលើផែនទី

តើខេត្តស្ទឹងត្រែងស្ថិតនៅកន្លែងណា?



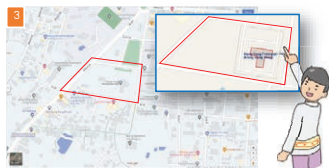
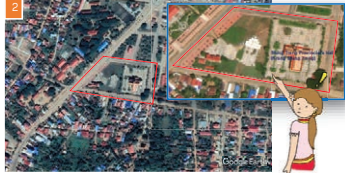
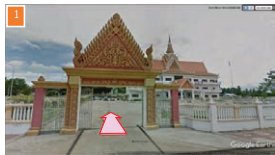
ការស្វែងយល់អំពីទីតាំងរបស់ខេត្តស្ទឹងត្រែងនៅលើផែនទី (ត)

តើខេត្តស្ទឹងត្រែងមានប៉ុន្មានស្រុក? ប៉ុន្មានឃុំ?



ការស្វែងយល់អំពីទីតាំងរបស់ខេត្តស្ទឹងត្រែងនៅលើផែនទី (ត)

ការបង្ហាញអំពីរូបភាពនៃទីតាំងមួយនៅលើផែនទី



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

20

ការស្វែងយល់អំពីខ្សែវណ្ណវង្ស និងសណ្ឋានដី

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



21

ការស្វែងយល់អំពីខ្សែវណ្ណវង្ស និងសណ្ឋានដី (ត)

ការអានខ្សែវណ្ណវង្ស

- ពេលដាក់ម្រាមដៃចូលគ្នា វាដូចគ្នានឹងបន្ទាប់វណ្ណវង្សនៃផ្ទៃភ្នំដ៏ធំមួយ



- ពេលអ្នកបំបែកមេដៃរបស់អ្នកចេញពីម្រាមដៃដទៃទៀត ចន្លោះរវាងមេដៃ និងម្រាមចង្អុលដែលរបស់អ្នកដូចគ្នានឹងជ្រលងភ្នំ។



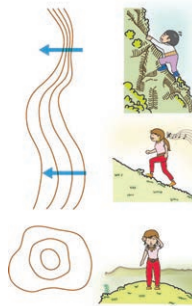
- ពេលអ្នកបំបែកម្រាមដៃរបស់អ្នកចេញពីគ្នា អ្នកអាចទទួលបានរូបភាពមួយនៃសណ្ឋានដីជាមួយនឹងជ្រលងភ្នំនៅចន្លោះសណ្ឋានដីទាំងនោះ



22

ការស្វែងយល់អំពីខ្សែវណ្ណវង្ស និងសណ្ឋានដី (ត)

ការអានខ្សែវណ្ណវង្ស (ត)

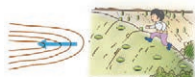


- ខ្សែវណ្ណវង្សកាន់តែចង្អៀត សណ្ឋានដីកាន់តែចោត។ អ្នកមិនអាចដើរនៅកន្លែងបែបនេះបានឡើយ ដោយសារវាពិបាកឡើង និងគ្រោះថ្នាក់។
- ខ្សែវណ្ណវង្សមានចន្លោះដែលបង្ហាញថា ទីជម្រាលមិនចោត។ វាងាយស្រួលឡើង/ដើរ និងមិនសូវមានហានិភ័យ។
- ខ្សែវណ្ណវង្សជាចង្អៀត វាមានន័យថា ជាកន្លែងខ្ពស់។ អ្នកអាចមើលឃើញយ៉ាងល្អអំពីកន្លែងជុំវិញនោះ។

23

ការស្វែងយល់អំពីខ្សែវណ្ណវង្ស និងសណ្ឋានដី (ត)

ការអានខ្សែវណ្ណវង្ស (ត)



- សញ្ញាញពណ៌ខៀវបង្ហាញថា ការដើរនៅលើផ្ទៃភ្នំហើយវាស្ថិតនៅទីតាំងខ្ពស់ជាងកន្លែងជុំវិញ



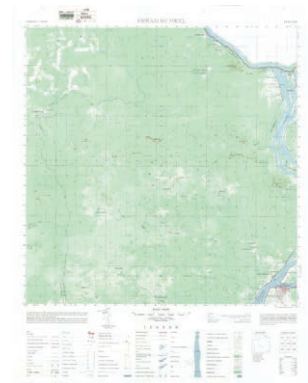
- បន្ទាត់ពណ៌ខៀវនៅទីនេះបង្ហាញថា អ្នកកំពុងដើរចុះទៅតាមចង្អុលនោះ។ វាជាទីតាំងទាបជាងទីតាំងជុំវិញ និងពិបាកដើរដោយសារវាហាក់ដូចជាផ្លូវចង្អៀត។



- ផែនទីនេះបង្ហាញថា កន្លែងនេះមិនអាចឡើងបានឡើយ។ ចំនួនខ្សែវណ្ណវង្ស ដែលឆ្លងកាត់តាមសញ្ញាចំណោតបង្ហាញនូវកម្ពស់ប្រហាក់ប្រហែលនៃចំណោតនោះ។

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ការស្វែងយល់អំពីផែនទីសណ្ឋានដី



ផែនទីសណ្ឋានដី 1:100,000 ផលិតឆ្នាំ ២០០៣ ដោយ JICA និងMPYT

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

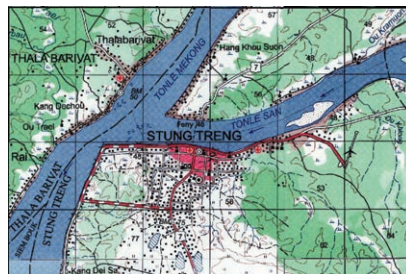
25

ការស្វែងយល់អំពីសញ្ញាប្រើប្រាស់លើផែនទី

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

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ការស្វែងយល់អំពីសញ្ញាប្រើប្រាស់លើផែនទី (ត)

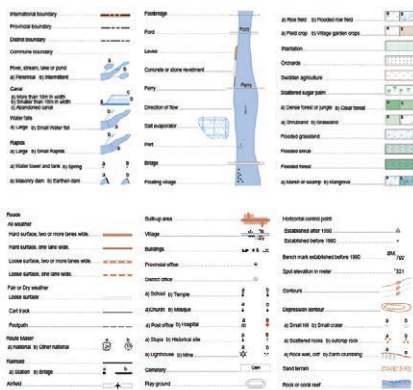


- រូបភាពដកស្រង់នៃផ្នែកកណ្តាលរបស់ក្រុងខេត្តស្ទឹងត្រែងពីផែនទីសណ្ឋានដី 1:100,000 ។
- អ្នកអាចមើលឃើញវត្ថុនានា ដែលត្រូវតំណាងដោយសញ្ញា សម្គាល់។ សម្រាប់ទំហំ វាមានចម្ងាយ ២គីឡូម៉ែត្រ សម្រាប់មួយការ។

24

ការស្វែងយល់អំពីសញ្ញាប្រើប្រាស់លើផែនទី (ត)

រូបភាពខាងក្រោមបង្ហាញនូវ សញ្ញាសម្គាល់នៃផែនទីសណ្ឋានដីរបស់កម្ពុជា៖



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ការស្វែងយល់អំពីព័ត៌មានបន្ទាប់បន្សំនៃផែនទី

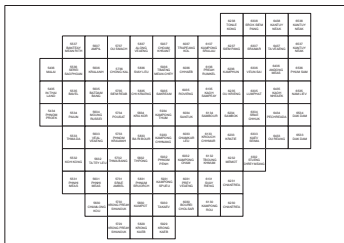
- នៅជុំវិញនៃផែនទីសណ្ឋានដី មានចន្លោះមួយ សម្រាប់ការបន្ថែមព័ត៌មាន ដែលគេហៅថា ព័ត៌មានបន្ទាប់បន្សំ។
- ព័ត៌មានដែលត្រូវបានបង្ហាញ មាន៖
 - ឈ្មោះ និងលេខផែនទី
 - ប្រភពដើមនៃផែនទី
 - ព័ត៌មានអំពីការវាស់វែងដើម្បីបង្កើតទិន្នន័យផែនទី
 - បង្គុំសន្លឹកផែនទី
 - សន្ទស្សន៍ព្រំប្រទល់រដ្ឋបាល
 - អក្សរកាត់
 - តម្លៃរយៈបណ្តោយ និងរយៈទទឹង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

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ការអនុវត្តន៍៖ ការប្រើប្រាស់ត្រីវិស័យនៅទីវាល

ការពន្យល់លម្អិត៖

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



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ការអនុវត្តន៍៖ ការប្រើប្រាស់ត្រីវិស័យនៅទីវាល

ការពន្យល់លម្អិត (ត)៖

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

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ការអនុវត្តន៍៖ ការប្រើប្រាស់ត្រីវិស័យនៅទីវាល

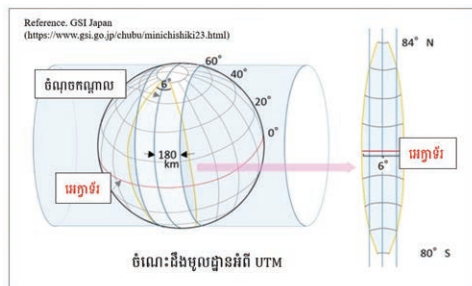
ការពន្យល់លម្អិត (ត) ៖

- រយៈបណ្តោយ និងរយៈទទឹង តម្លៃក្រឡាចក្រត្រង់ UTM កំណត់ត្រាអំពីគោលដៅ៖
 - ផែនទីសណ្ឋានដី 1:100,000 តម្លៃរយៈបណ្តោយ និងរយៈទទឹងត្រូវបានបង្ហាញនៅជ្រុងទាំងបួននៃផែនទីសណ្ឋានដី គម្លាតរវាងខ្សែរយៈបណ្តោយ និងខ្សែរយៈទទឹង គឺ៣០នាទី។
 - តម្លៃក្រឡាចក្រត្រង់ UTM ត្រូវបានបង្ហាញជាឯកតាជាម៉ែត្រ។ ផែនទីសណ្ឋានដី 1:100,000 ប្រើប្រាស់ទទឹងក្រឡាចក្រត្រង់ប្រវែង ២គីឡូម៉ែត្រ។ ប្រព័ន្ធកូអរដោនេ UTM ផ្តល់កូអរដោនេលើផែនទីលើក្រឡាចក្រត្រង់នៃភាពសំប៉ែតរបស់ផែនទីដើម្បីងាយស្រួលក្នុងការគណនា។ ប្រព័ន្ធកូអរដោនេ UTM បែងចែកជា ៦០ តំបន់ដែលគ្រប់រយៈបណ្តោយចាប់ផ្តើមនៅ ៦ដឺក្រេ និង៧ជ្រុងពី ៨០ដឺក្រេនៃរយៈទទឹងភាគខាងត្បូង ទៅ ៨៤ដឺក្រេនៃរយៈទទឹងភាគខាងជើង។ ប្រទេសកម្ពុជាស្ថិតនៅក្នុងតំបន់ ៤៨។

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ការអនុវត្តន៍៖ ការប្រើប្រាស់ត្រីវិស័យនៅទីវាល

ការពន្យល់លម្អិត (ត) ៖



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ការអនុវត្តន៍៖ ការប្រើប្រាស់ត្រីវិស័យនៅទីវាល

ការពន្យល់លម្អិត (ត) ៖

- រយៈបណ្តោយ និងរយៈទទឹង តម្លៃក្រឡាចក្រត្រង់ 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) ក្រឡាចក្រត្រង់ទិសខាងជើង (Grid North) និងម៉ាញ៉េទិចទិសខាងជើង (Magnetic North) ។

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

35

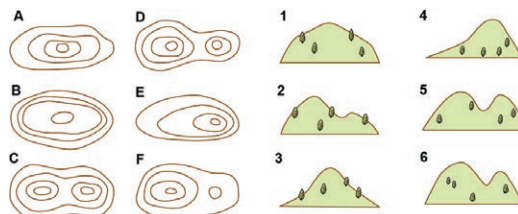
ការអនុវត្តន៍៖ សំណួរពិភាក្សា

- 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 ។

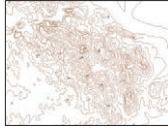
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ការអនុវត្តន៍៖ សំណួរពិភាក្សា (ត)

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



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- បោះឆ្នោតអ្នកជំនាញដើម្បីជ្រើសរើសមេធាវីសម្រាប់ប្រតិភូក្រុមការងារស្រាវជ្រាវ។

- ដេរីវេនេត្រីកដាក់ប្រកាសដៃចូលគ្នា វាជូនគ្នាដឹងបន្ទាប់វេលាដេរីវេនេត្រីកដាក់ប្រកាសដៃចូលគ្នា។



- នៅពេលអ្នកបំបែកនៅលើរបស់អ្នកចេញពីក្រោមដៃដទៃទៀត ចន្លោះដាច់ដៃ និងក្រោមចង្កូលដៃ របស់អ្នកផ្ទុកនឹងជ្រួលចង្ហា។



- ប្រសិនបើអ្នកចម្លែកគ្រាន់តែជាមិត្តភក្តិ អ្នកអាចទទួលបានរូបភាពមួយនៃសណ្ឋានដី ជាមួយនឹងជ្រលងភ្នំនៅចន្លោះសណ្ឋានដីទាំងនោះ



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- បង្កាច់ស្មៅស្ទឹងកាន់តែចង្អៀត សណ្ឋានដីកាន់តែចោង។ អ្នកមិនអាចដើរនៅកន្លែងបែបនេះបានឡើយ ដោយសារវាពិបាកឡើង និងគ្រោះថ្នាក់។

- ចេញ្ច្រាវទូលាយរវាងបង្កាត់វ៉ាល្លេដ្ឋបង្កាត់
ថា ទីជម្រកលមិនចោត។ វាងាយស្រួលឡើងវិញ
និងមិនសូវមានហានិភ័យ។

- ខេត្តពេលដែលបុគ្គលដែលបានបង្កើតឡើង វាមាន
ដើមថា វាបានកើនឡើង ឬក៏ពុំទាន់ដើមថា ឬក៏
អាចបើកឃើញយ៉ាងណាដែលបានកើនឡើងដូច្នេះ។

- នៅពេលអ្នកដើរទៅតាមការបង្ហាញសញ្ញា ព្រលួញពណ៌ផ្សេងៗ វាមានន័យថា ការដឹកនាំលើផ្លូវ ក្នុង ភោគី ទីតាំងខ្ពស់ជាងកន្លែងជុំវិញ។ ជួរជុំ ជួរជុំ

- ប្រយ័ត្ន។
- ការទៅតាមបន្ទាត់ពណ៌នៅក្នុងរូបនេះ មានន័យថា កំពុងដើរចុះទៅតាមចន្លងគោរ។ វាជាកំពុងទាបជាងទីតាំងជុំវិញ និងវិបាកដើរ ដោយសារវាបកកំពុងផ្តាច់ផ្លូវឡើង។

- ឡើងវិញ។ ក្នុងកំឡុងពេលនេះ យើងបានឃើញថា ការកើនឡើងនៃចំណាត់ថ្នាក់នេះ គឺជាលទ្ធផលនៃការកើនឡើងនៃចំណាត់ថ្នាក់នេះ។ ចំណាត់ថ្នាក់នេះ ដែល

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មានបន្ទាត់វល្លវង្សច្រើនឆ្លងកាត់ មានន័យថា វាជាចំណោទឥតសង្ស័យ។

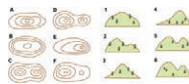
សំណួរសោកស្ស័យ

- ① ផែនទីសាស្ត្រធនធានរុក្ខជាតិ ដែលត្រូវបានប្រើប្រាស់ សម្រាប់ផែនទីសណ្ឋានឧស្សាហកម្ម
1:100,000
សូមពិនិត្យមើលការពន្យល់ (Legend) នៅលើផែនទី។

- ② តើ “ទិសទៅដើម” មួយណា ដែលត្រូវបានប្រើប្រាស់ សម្រាប់ផែនទីសណ្ឋានខ្ទឹមស្ទាត់ 1:100,000?
- សូមជិតគ្រឿងសរសេរឈ្មោះ (Legend) នៅលើផែនទី។

- ③ ដោយជំនួយពីគម្រោងសហប្រតិបត្តិការរវាងក្រុមហ៊ុន និងអង្គភាពពាក់ព័ន្ធ នៃក្រសួងសេដ្ឋកិច្ច និងហិរញ្ញវត្ថុ របស់កម្ពុជា។

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



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- ⑤ ផែនការនីមួយៗនឹងត្រូវកំណត់ឈ្មោះដោយអង្គការក្រៅរដ្ឋបាលស្របច្បាប់ និងស្វ័យប្រវត្តិ។



ផែនទីនេះចង្អុលទៅទិសបាត់ដំបង ដោយសារវាគ្មានសញ្ញា *azimuth* នៅក្នុងផែនទីនេះឡើយ។

18

添付資料 3: GIS 研修資料（初級）



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.)

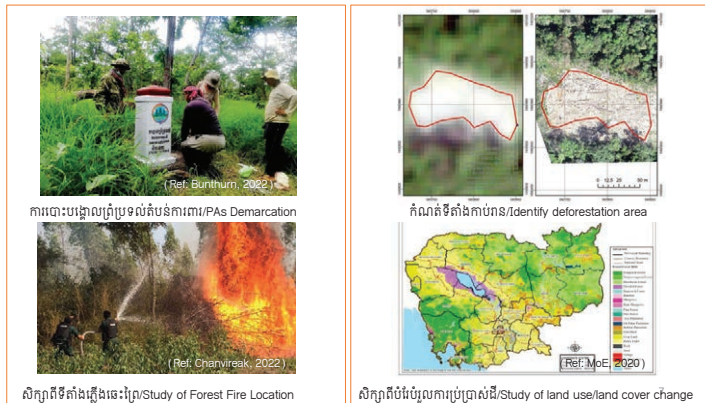
- ការប្រើប្រាស់ក្នុងការគ្រប់គ្រងធនធានទឹក/Application in Water Resource Management
- ការប្រើប្រាស់ក្នុងការត្រួតពិនិត្យតាមដានគុណភាពទឹក/ Application in Water Quality Monitoring
- ការប្រើប្រាស់ក្នុងការគ្រប់គ្រងព្រៃឈើ និងវិភាគជម្រកសត្វព្រៃ/ Forest Management and Wildlife Habitat Analysis
- ការប្រើប្រាស់ក្នុងការគ្រប់គ្រងគ្រោះមហន្តរាយ/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



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 និងទីតាំងរៀបចំនិងភូគោល តែវាងាយស្រួលយកទៅតាមខ្លួនជាង។

9

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

- ផែនទីពិភពលោកអាចបង្កើតបានដោយប្រើប្រាស់វិធីសាស្ត្របម្លែង (Projection) ដើម្បីធ្វើផែនទីក្នុងមូលក្លាយទៅជាផែនទីសំប៉ែត។ វិធីសាស្ត្របម្លែងមានច្រើនប្រភេទ អ្នកផលិតផែនទីអាចជ្រើសរើសអាស្រ័យលើគោលបំណង។



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

10

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

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

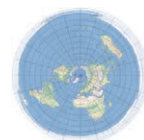
- វិធីសាស្ត្របម្លែងដែលត្រូវបានប្រើប្រាស់សម្រាប់ការផលិតផែនទីមាន Mercator, Mollweide, និង Azimuthal ៖



ត្រូវបានបង្កើតឡើងនៅឆ្នាំ១៥៦៩
ដោយ Gerardus Mercator



ត្រូវបានបង្កើតឡើងនៅឆ្នាំ១៨០៥
ដោយ Karl B. Mollweide



គេជឿជាក់ថា វិធីនេះត្រូវបាន
បង្កើតដោយជនជាតិអេហ្ស៊ីប

11

12

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

ការបម្លែង Mercator

បំពេញគម្លាតនេះជាមួយនឹងផ្ទៃដី និងផ្ទៃសមុទ្រ



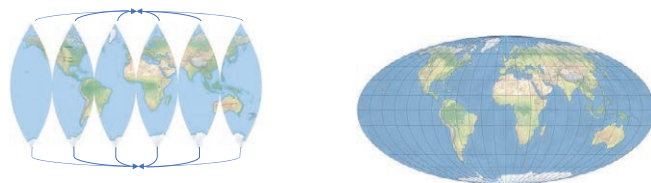
- ចំណុចប្រសព្វរបស់ផែនទីរវាងរយៈទទឹង និងរយៈបណ្តោយនៅមុំត្រឹមត្រូវ។ វិធីសាស្ត្រនេះ មុំម៉ាញ៉េទិចត្រូវបានពណ៌នាជាខ្សែត្រង់ ដែលជាគន្លងនាំផ្លូវ។
- នៅជិតអេក្វាទ័រ រង្វាស់នេះលម្អៀងខ្លាំង ហើយនៅពេលចម្ងាយកាន់តែជិតប៉ូលខាងជើង និងខាងត្បូង ភាពខុសគ្នានៃទំហំកាន់តែធំ។

13

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

ការបម្លែង Mollweide

ភ្ជាប់ចុងទូកទាំងនេះចូលគ្នាតែមួយ



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

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

ការបម្លែង Azimuthal



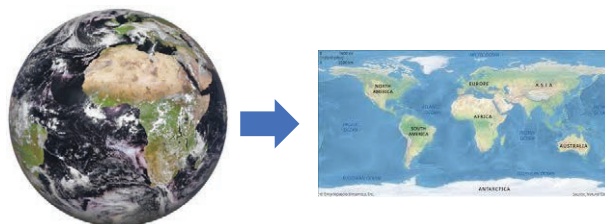
បំពេញគម្លាតនេះជាមួយនឹងផ្ទៃដី និងផ្ទៃសមុទ្រ

- 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.

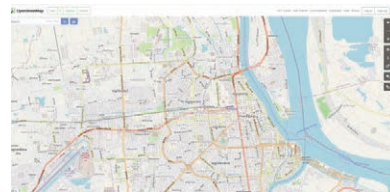


(Ref: MoE, 2020)

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.

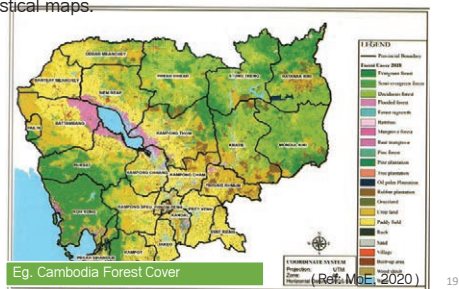


Eg. Open Street Map

18

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

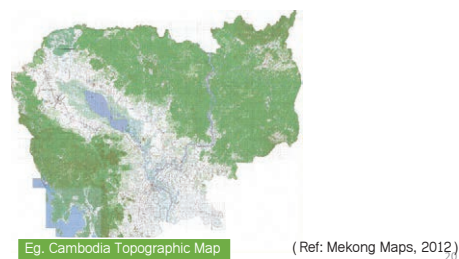
- ប្រភេទនៃផែនទី/Type of Maps (Dutton Institute, 2018):
 - ផែនទីដោយទិច/Thematic maps: ត្រូវបានស្គាល់ថាផែនទីគោលបំណងជាក់លាក់ ផែនទីប្រធានបទមួយ ឬផែនទីបង្ហាញពីស្ថិតិ/Known as special purpose, single topic or statistical maps.



19

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

- ប្រភេទនៃផែនទី/Type of Maps (Dutton Institute, 2018) :
 - ផែនទីខ្នាតមេត្រិក/Cartometric maps: ផែនទីគឺជាកំណត់ដែលបង្កើតឡើងក្នុងគោលបំណងសុក្រិតភាពក្នុងការវាស់វែង ឬការគណនាផ្សេងៗ/More specialized type of map made for accurate measurements.



(Ref: Mekong Maps, 2012)

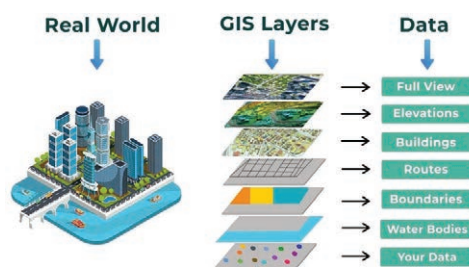
មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី (បន្ត)/Basic Concept of Map Production (Cont.)

- ការបង្កើតផែនទីជួយអោយអាស្រ័យលើ/Making good map depend on:
 - ផ្នែកយល់ពីកម្រិតយល់ដឹងនៃអ្នកប្រើប្រាស់ផែនទី/
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
 - ការប្រើប្រាស់របារមាត្រដ្ឋាន និងសញ្ញាសំគាល់ទិសខាងជើង/
Using scale bars and north arrow correctly

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

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



(Ref: Pedamkar, 2023)

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

មាត្រដ្ឋានស្តង់ដារ/Standard Scale

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

(Ref: Australian Government, 2010)

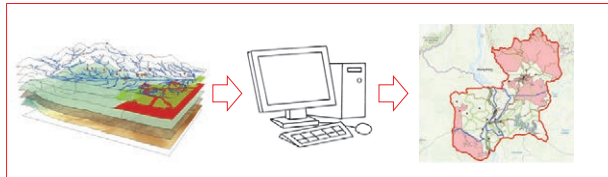
មូលដ្ឋានគ្រឹះនៃការផលិតផែនទី (បន្ត)/Basic Concept of Map Production(Cont.)

- 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/
Environmetal issue blocks accessibility for data collection
 - បរចករិទ្ធភាពនៅមានកម្រិត/Technology limitation

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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.

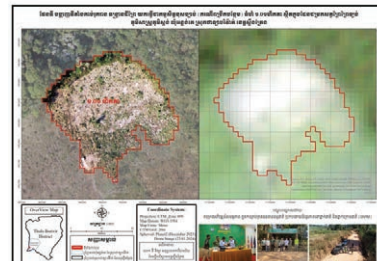


Ref: University of Wisconsin-Madison & UNESCO Bangkok
25

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

- មុខងារប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/GIS Function

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



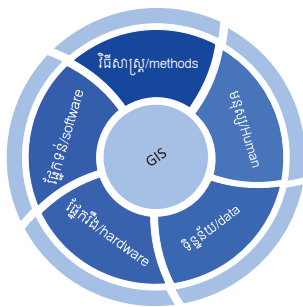
26

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



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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.)

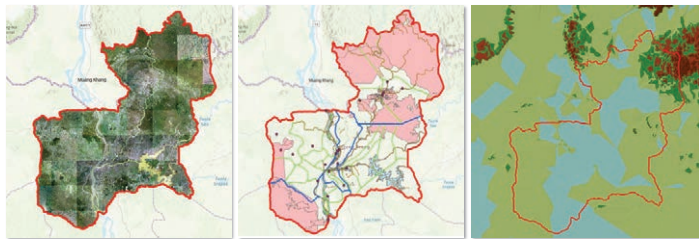
ទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត)/GIS Data (Cont.)

- ❖ ម៉ូដែលទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/GIS data model:
 - ម៉ូដែលទិន្នន័យមាន៣ប្រភេទ/3 types of GIS data model (Esri, 2018) :
 - ម៉ូដែលទិន្នន័យទិន្ន/TIN Data Model: ទិន្នន័យដែលបានបង្កើតពីទិន្នន័យវ៉ិចទ័រ (ឧ. ខ្សែបន្ទាត់រយៈកម្ពស់) សម្រាប់បង្ហាញជាទម្រង់ផ្ទៃ 3D ហើយម៉ូដែលនេះប្រើវិធីសាស្ត្រត្រីកោណដើម្បីភ្ជាប់ពីចំណុចមួយទៅចំណុចមួយទៀត វាត្រូវបានវិស្វកម្មប្រើប្រាស់ដើម្បីសិក្សាពីទីជម្រាល 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

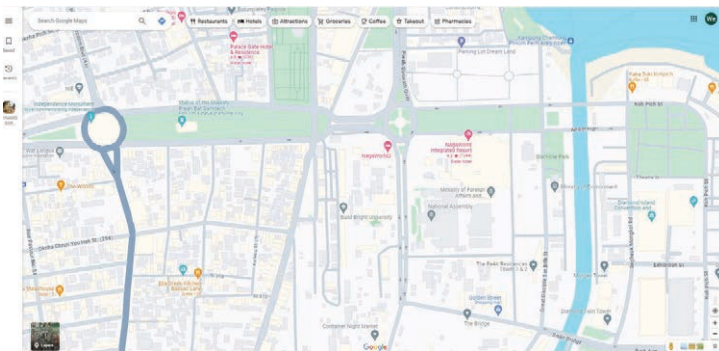
ម៉ូដែលទិន្នន័យទឹក/ TIN Data Model

TIN dataset/.adf

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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: ក្រុមហ៊ុនរបស់លោកបានបង្កើតវិស័យសាស្ត្រផលិតផែនទី 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.)

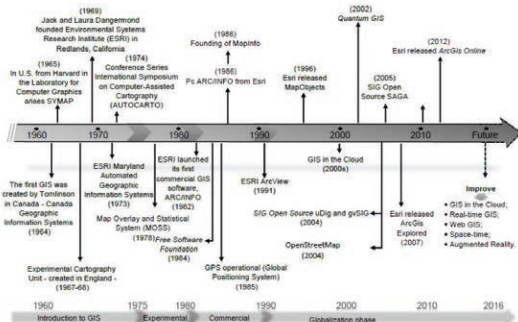
❖ ការវិវត្តន៍របស់ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/Evolution of GIS (Esri, 2018)

- 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 និងចែករំលែកការងាររបស់ពួកគេនៅលើគំនូរឌីជីថល/GIS allow users to create digital map to solve real world issues. Many organization are producing map and share their work.

36

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

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



37

ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS/Common Tools in GIS

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



- QGIS (Free Open Source)

8

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

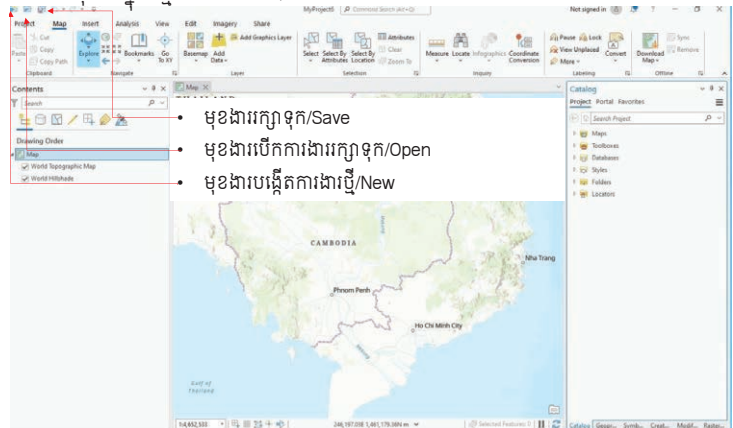
- ❑ មុខងារក្នុងកម្មវិធី ArcGIS Pro/ArcGIS Pro Tools Bars



39

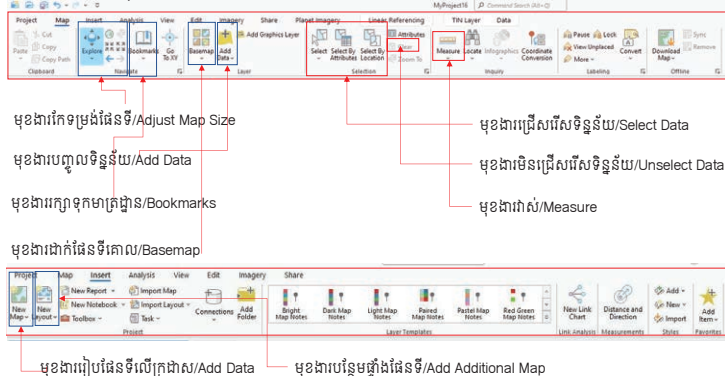
ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS (បន្ត)/Common Tools in GIS(Cont.)

- ❑ មុខងារក្នុងកម្មវិធី ArcGIS Pro/ArcGIS Pro Tools Bars



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

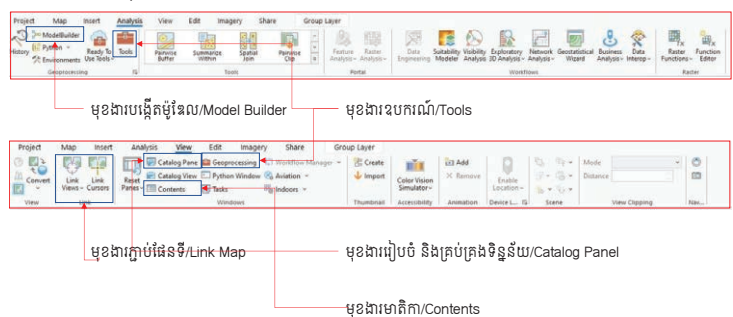
- ❑ មុខងារក្នុងកម្មវិធី ArcGIS Pro/ArcGIS Pro Tools Bars



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

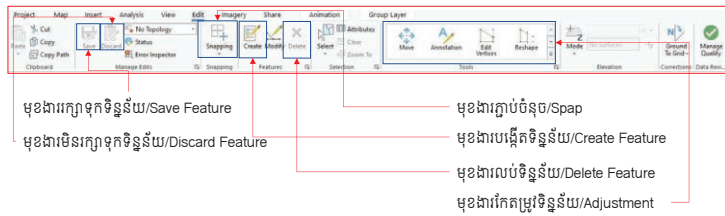
- ❑ មុខងារក្នុងកម្មវិធី ArcGIS Pro/ArcGIS Pro Tools Bars



2

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

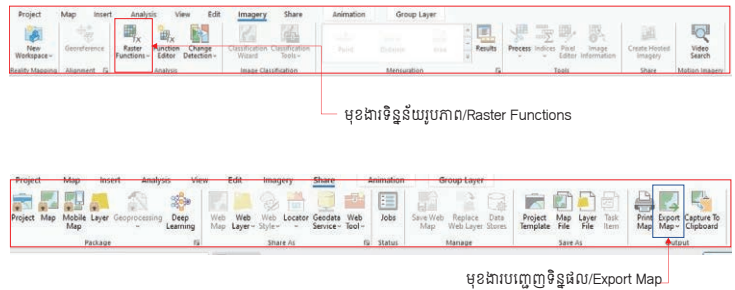
❑ មុខងារក្នុងកម្មវិធី ArcGIS Pro/ArcGIS Pro Tools Bars



43

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

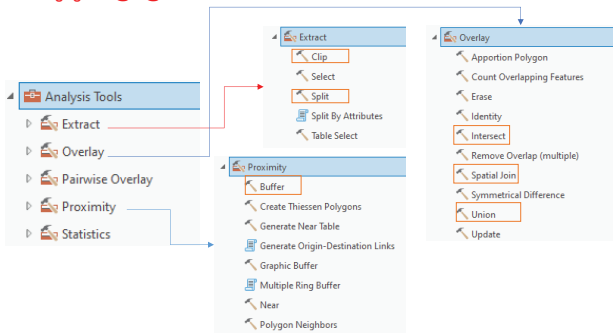
❑ មុខងារក្នុងកម្មវិធី ArcGIS Pro/ArcGIS Pro Tools Bars



44

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

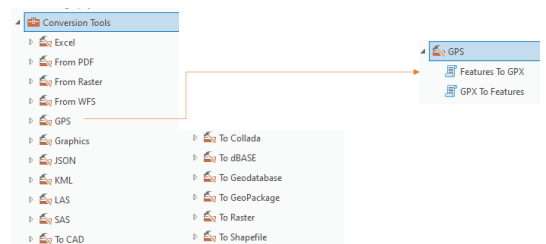
❖ ឧបករណ៍ប្រើប្រាស់ញឹកញាប់/Common Tools



45

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

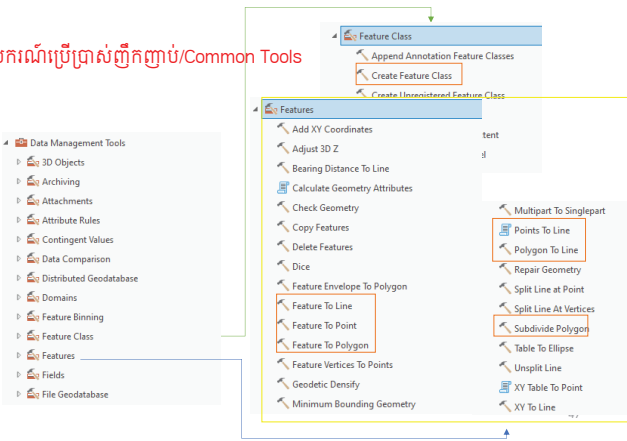
❖ ឧបករណ៍ប្រើប្រាស់ញឹកញាប់/Common Tools



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

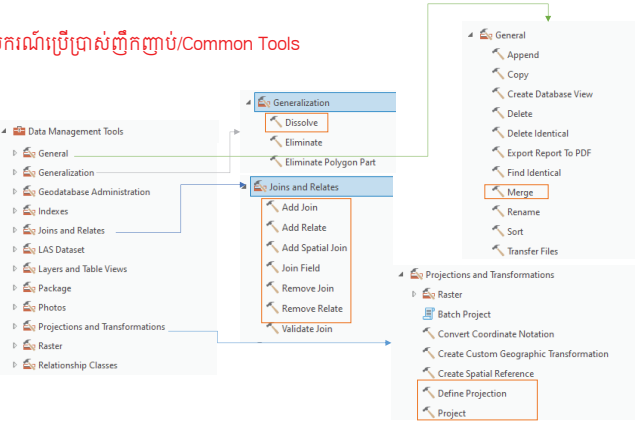
❖ ឧបករណ៍ប្រើប្រាស់ញឹកញាប់/Common Tools



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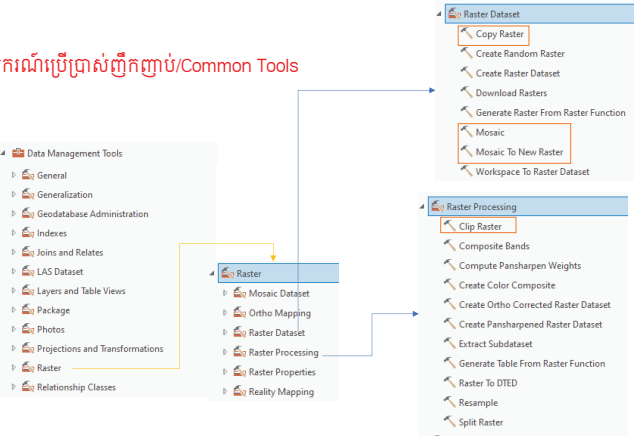
ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS (បន្ត) /Common Tools in GIS(Cont.)

❖ ឧបករណ៍ប្រើប្រាស់ញឹកញាប់/Common Tools



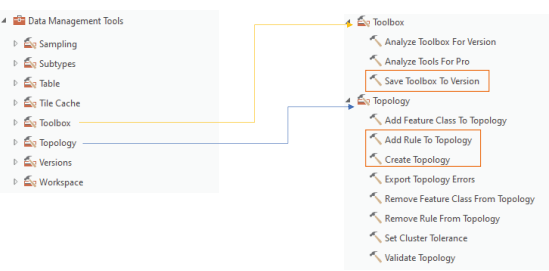
ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS (បន្ត) /Common Tools in GIS(Cont.)

❖ ឧបករណ៍ប្រើប្រាស់ញឹកញាប់/Common Tools



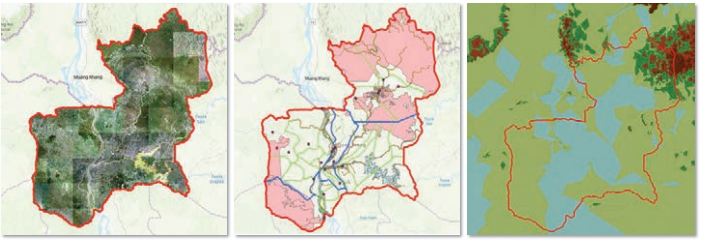
ការណែនាំអំពីឧបករណ៍ប្រើប្រាស់ញឹកញាប់ក្នុង GIS (បន្ត) /Common Tools in GIS(Cont.)

❖ ឧបករណ៍ប្រើប្រាស់ញឹកញាប់/Common Tools



ការបង្កើតទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/GIS Data Creating

❖ ម៉ូដែលទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/GIS data model



ម៉ូដែលទិន្នន័យរូបភាព/
Raster Data Model

GeoTIFF/.tiff

ម៉ូដែលទិន្នន័យវ៉ិចទ័រ/
Vector Data Model

Shapefile/.Shp

ម៉ូដែលទិន្នន័យទឹន/
TIN Data Model

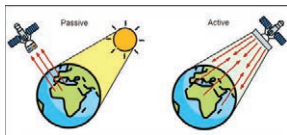
TIN dataset/.adf

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



ម៉ូដែលទិន្នន័យរូបភាព/
Raster Data Model

GeoTIFF/.tiff



ទិន្នន័យរូបភាពដែលត្រូវបានថតដោយវិធីសាស្ត្រ Photogrammetry & Remote Sensing ត្រូវបានប្រើប្រាស់ដើម្បីជាញឹកញាប់ក្នុងកម្មវិធីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រក្នុងការសិក្សា 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។ ទិន្នផលដែលទទួលបានពីការដំណើរការរូបភាពមាន៖ 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

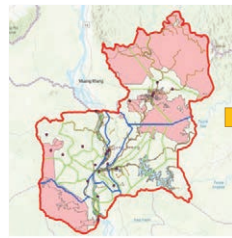
ការបង្កើតទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត)/GIS Data Creating (Cont.)

- វិធីសាស្ត្រ Remote Sensing សំដៅលើបច្ចេកវិទ្យាវិទ្យាសាស្ត្រដែលបានចាប់យករូបភាពលើផ្ទៃដីដោយផ្ទាល់រយៈពេលតាមរយៈការចំណាំងផ្លាស់ និងការបញ្ចេញលេកវិទ្យុដែនម៉ាញ៉េទិច ដែលអាចចាប់យកទាំងពេលយប់ និងពេលថ្ងៃ។ វាត្រូវបានចែកជាពីរ៖ ការដំណើរដោយមិនចាំបាច់មានថាមពលព្រះអាទិត្យ និងការចាំងផ្លាស់ពីផែនដី (Active RS) និងការដំណើរការដោយចាំបាច់មានថាមពលព្រះអាទិត្យ និងការចាំងផ្លាស់ពីផែនដី (Passive RS)។ ទិន្នផលដែលទទួលបានពីការដំណើរការ អាចប្រើប្រាស់លើការងារជាច្រើន៖ ផលិតផែនទី បម្រែបម្រួលការប្រើប្រាស់ដី គម្របព្រៃ ជម្រកសត្វ ភ្លើងចេះព្រៃ... 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

55

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

56

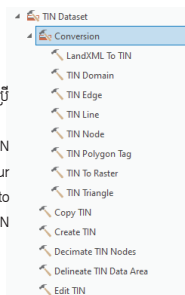
ការបង្កើតទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត)/GIS Data Creating (Cont.)



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/>

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ទំនៀមទម្លាប់ (បន្ត)/Vector data (Cont.)

③ GEOFABRIK



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

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ទិន្នន័យរូបភាព/Raster data

① United States Geological Survey (USGS)



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

② NASA Earthdata



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

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ទិន្នន័យរូបភាព (បន្ទ)/Raster data(បន្ទ)

③ Sentinel Hub EO



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

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



Norway's International Climate and Forest Initiative <https://planet.com/nicfi/>

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ទិន្នន័យរូបភាព(បន្លាស់)/Raster data(បន្លាស់)

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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ទិន្នន័យរូបភាព (បន្លំ)/Raster data (បន្លំ)

⑥ ALOS PALSAR



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

https://www.eorc.jaxa.jp/ALOS/en/dataset/aw3d30/aw3d30_e.htm

ALOS PALSAR 12.5m

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

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ទិន្នន័យរូបភាព(បន្ទ)/Raster data(បន្ទ)

⑦ Global Surface Water



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

⑦ FAO's SEPAL



<https://sepal.io/>

66

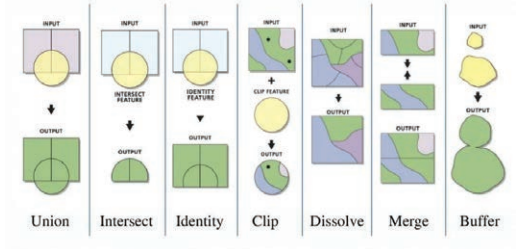
ការកែតម្រូវទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ/GIS Data Editing

- 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

67

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

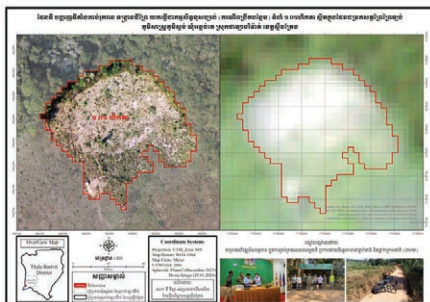
- ទិន្នន័យដែលបានពីការបង្កើត ឬការទាញយក អ្នកប្រើប្រាស់អាចកែតម្រូវវាបាន/
Data created and data downloaded can be edited:
 - និងមុខងារផ្សេងៗ/Additional: Merge, Divide, Split, Buffer, Union, Dissolve...



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ការរៀបចំទិន្នន័យក្នុងការផលិតផលផែនទី/Data Preparation for Mapping

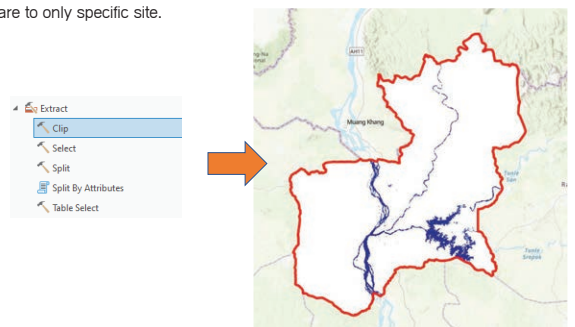
- នៅក្នុងផែនទីនេះទិន្នន័យដែលប្រើប្រាស់រួមមាន៖ រូបភាពផ្កាយរណប រូបភាពផ្ទៃ ព្រំប្រទល់ដី និងរូបភាពផ្ទៃដែលបានដំណើរការរួច/In this map, data used for mapping: satellite image, drone image, polygon of site and drone image processed.



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ការកាត់យកទិន្នន័យវ៉ិចទ័រ/Clipping Vector Data

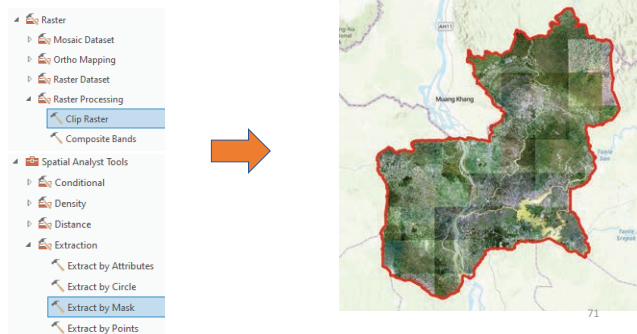
- ក្នុងផែនទីនេះអ្នកផលិតបានប្រើប្រាស់មុខងារកាត់នៅក្នុងកម្មវិធីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ ការកាត់នេះគឺដោយសារគាត់ចង់បង្ហាញតែទីតាំងដី/In this map, map creator applies tool "clip" in GIS software to only specific site.



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ការកាត់យកទិន្នន័យរូបភាព/Masking Raster Data

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

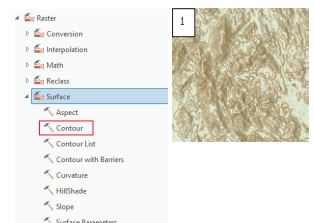


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ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់/Topographic Analysis

- ① Contour: វាបង្ហាញពីខ្សែបន្ទាត់នៃទិន្នន័យរយៈកម្ពស់ដែលដូចគ្នានៅក្នុងទម្រង់វ៉ិចទ័រ ហើយវាក៏ជាផែនទីស្រដៀងគ្នាជាមួយផែនទីស្ថានភាពដី/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.

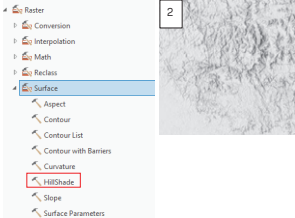


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ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត) /Topographic Analysis(Cont.)

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

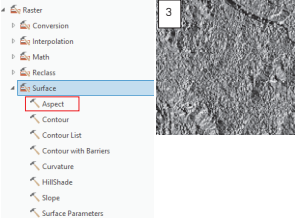
- នៅក្នុងកម្មវិធីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ Hillshade អាចបង្កើតបានដោយប្រើប្រាស់មុខងារ "Hillshade"/ In GIS software Hillshade can be created using "Hillshade" tool.



ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត) /Topographic Analysis(Cont.)

③Aspect: វាបង្ហាញទិសដៅបែរចុះនៃមុខជ្រាល/It indicates direction downhill slope face

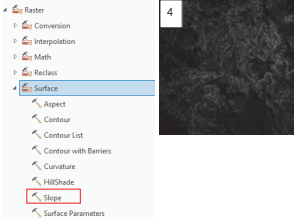
- នៅក្នុងកម្មវិធីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ Aspect អាចបង្កើតបានដោយប្រើប្រាស់មុខងារ "Aspect"/ In GIS software Aspect can be created using "Aspect" tool.



ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត) /Topographic Analysis(Cont.)

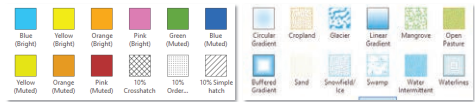
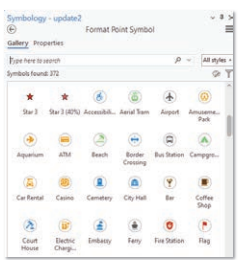
④Slope: វាបង្ហាញពីភាពចោតនៃផ្ទៃដី តម្លៃលេខទិន្នផលកាន់តែតូចសណ្ឋានដីកាន់តែរាប តម្លៃលេខទិន្នផលកាន់តែធំសណ្ឋានដីកាន់តែចត់/It indicates steepness of land surface. The lower slope value, the flatter terrain and the higher slope value, the steeper terrain.

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



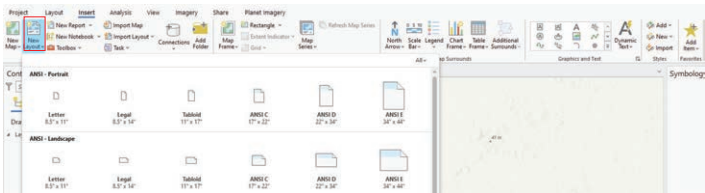
ការប្រើប្រាស់និមិត្តសញ្ញា/Applying GIS Symbols

- 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.



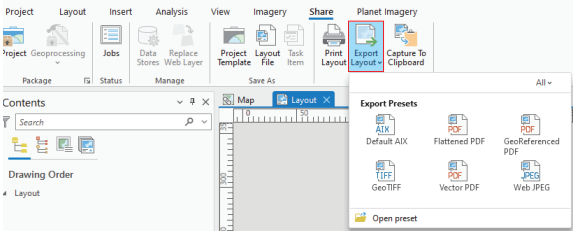
ការរៀបចំផែនទីលើក្រដាស/Map Layout

- 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.



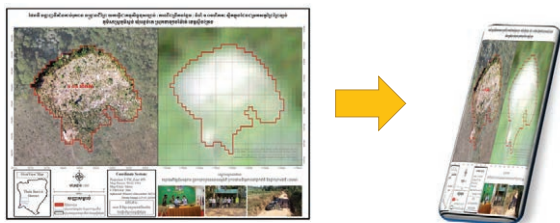
ការបញ្ចេញទិន្នផលផែនទីជាទម្រង់ Geo-PDF

- 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.



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

3

ការណែនាំអំពីវគ្គបណ្តុះបណ្តាល (បន្ត)

គោលបំណង

អ្នកចូលរួមនឹងសិក្សាស្វែងយល់អំពីការប្រើប្រាស់ផែនទីកម្រិតមធ្យម

ការរំពឹងទុក

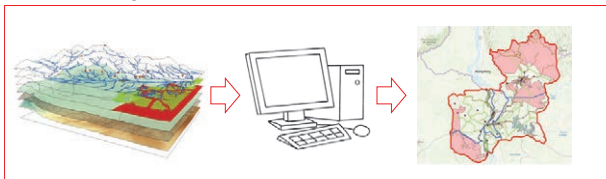
- ស្វែងយល់អំពីប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ និងការទាញយកទិន្នន័យមកប្រើប្រាស់ក្នុងការផលិតផែនទី
- ស្គាល់មុខងារប្រើប្រាស់របស់កម្មវិធី ArcGIS Pro ដើម្បីពិនិត្យមើលទិន្នន័យដែលបានទាញយក
- អាចបញ្ចូលទិន្នន័យភូមិសាស្ត្រចូលទៅក្នុងកម្មវិធី Avenza សម្រាប់ប្រើប្រាស់ការងារទីវាល

4

ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS

និយមន័យ

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



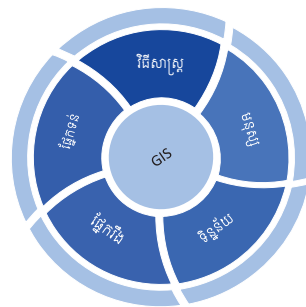
ប្រភព៖ University of Wisconsin-Madison និង UNESCO Bangkok

5

ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS (បន្ត)

ធាតុផ្សំនៃប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ

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

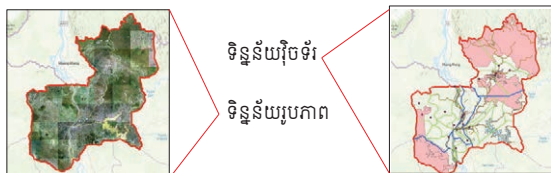


6

ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ GIS (បន្ត)

ទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ

- ប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រមានធាតុផ្សំដែលមានទំនាក់ទំនងគ្នាចំនួន ៥៖
 - ទិន្នន័យរូបវិទ្យា៖ ទិន្នន័យខ្សែបន្ទាត់ ទិន្នន័យចំណុច ទិន្នន័យនិងឯកសារ
 - ទិន្នន័យរូបភាព៖ រូបភាពពីផ្កាយរណប រូបភាពពីជ្រូន រូបភាពពីទូរសព្ទ



ទិន្នន័យរូបវិទ្យា

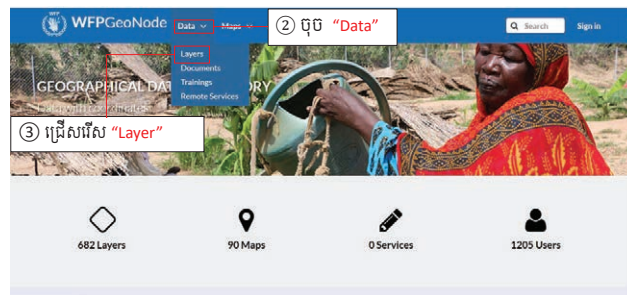
ទិន្នន័យរូបភាព

7

ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ

ទិន្នន័យរដ្ឋបាល

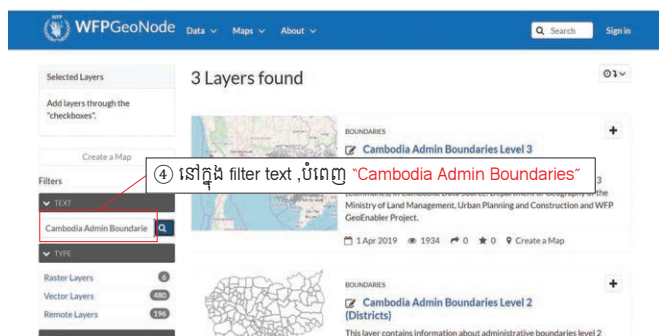
- ចូលទៅកាន់៖ <https://www.geonode.wfp.org>



8

ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត)

ទិន្នន័យរដ្ឋបាល (បន្ត)

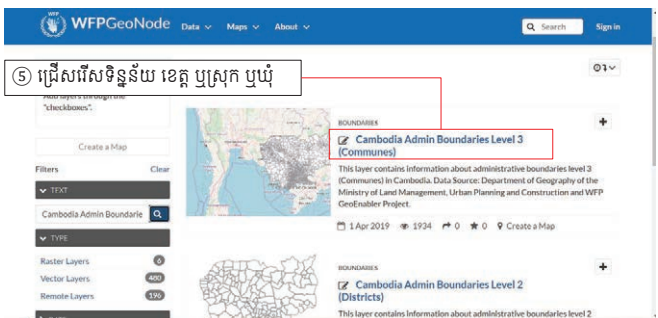


៤ នៅក្នុង filter text ,បំពេញ "Cambodia Admin Boundaries"

9

ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត)

ទិន្នន័យរដ្ឋបាល (បន្ត)

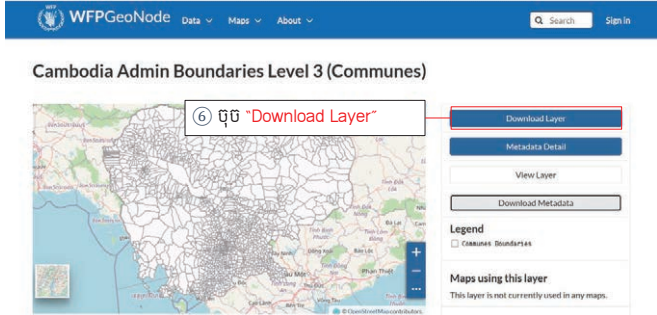


៥ ជ្រើសរើសទិន្នន័យ ខេត្ត ឬស្រុក ឬឃុំ

10

ការទាញយកទិន្នន័យប្រព័ន្ធព័ត៌មានភូមិសាស្ត្រ (បន្ត)

ទិន្នន័យរដ្ឋបាល (បន្ត)



11

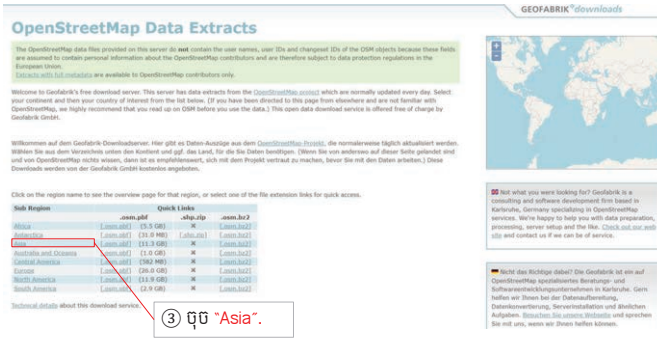
ការទាញយកទិន្នន័យផ្លូវ

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



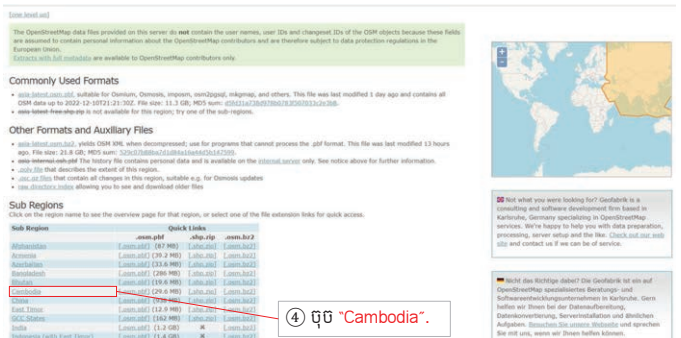
12

ការទាញយកទិន្នន័យផ្លូវ (បន្ត)



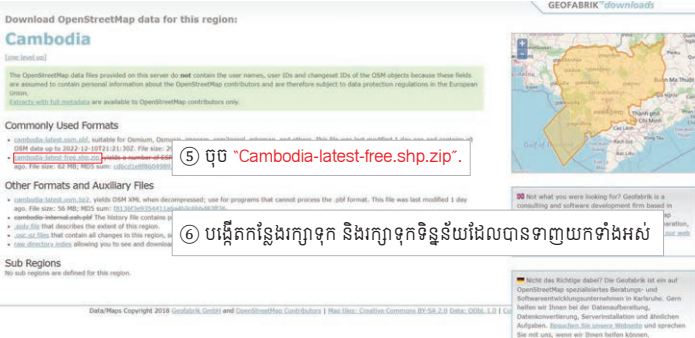
13

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)

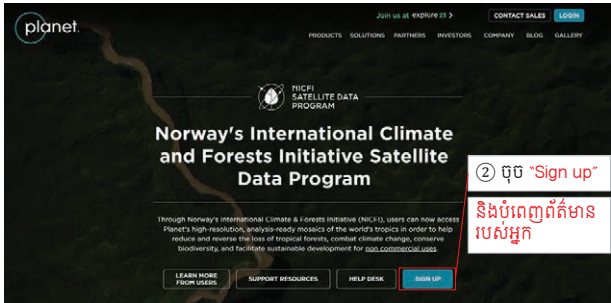
	Category	Name	Data type	Description
13	Transportation	gis_osm_traffic_a_free_1	Polygon	Traffic facility information.
14		gis_osm_traffic_free_1	Point	Traffic facility information.
15		gis_osm_transport_a_free_1	Polygon	Transportation facility information.
16		gis_osm_transport_free_1	Point	Transportation 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

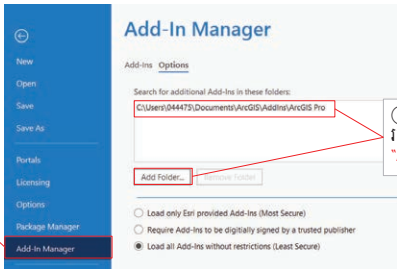
ការទាញយកទិន្នន័យផ្កាយរណប Planet (បន្ត)

ការដំឡើងមុខងារទាញយក

③ ស្វែងរកកន្លែងរក្សាទុកម្យ៉ាងណាដែលបានទាញយក៖

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

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



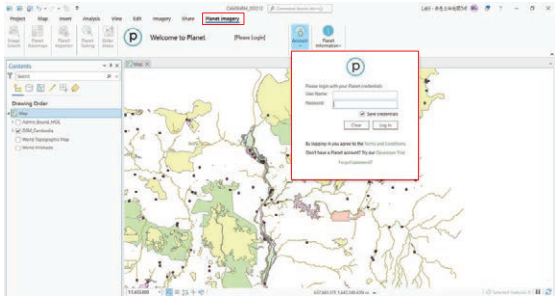
⑤ សរសេរកន្លែង
រក្សាទុក និងចុច
"Add Folder..."

19

ការទាញយកទិន្នន័យផ្កាយរណប Planet (បន្ត)

ការដំឡើងមុខងារទាញយក (បន្ត)

⑥ បើកកម្មវិធី ArcGIS Pro ម្តងទៀត រួចចូលទៅ Planet Imagery និង log in

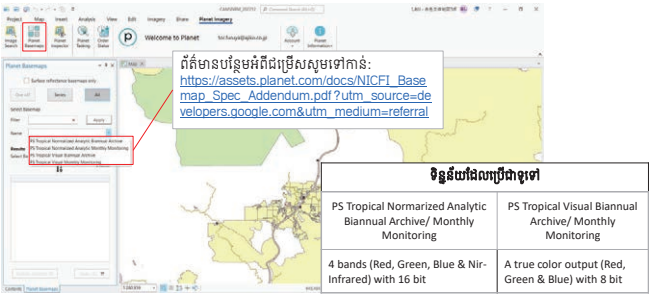


20

ការទាញយកទិន្នន័យផ្កាយរណប Planet (បន្ត)

ការទាញយក

① ចុច "Planet Basemaps" និងជ្រើសរើស "basemaps"

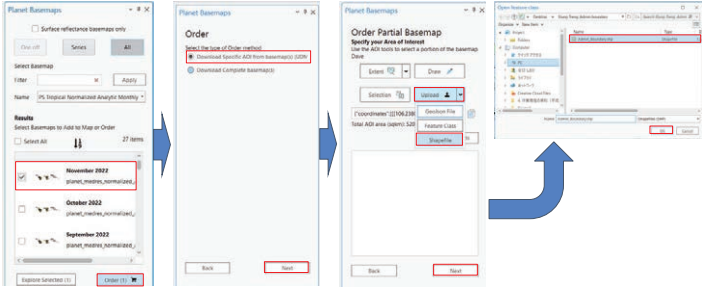


21

ការទាញយកទិន្នន័យផ្កាយរណប Planet (បន្ត)

ការទាញយក (បន្ត)

② ជ្រើសរើស "ជម្រើសទាញយក" និងប្រើប្រាស់ទិន្នន័យរៀបចំ

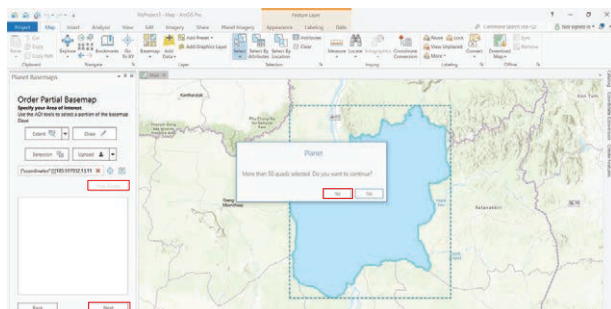


22

ការទាញយកទិន្នន័យផ្កាយរណប Planet (បន្ត)

ការទាញយក (បន្ត)

③ ជ្រើសរើស “YES” និង ចុច “បន្ទាប់”

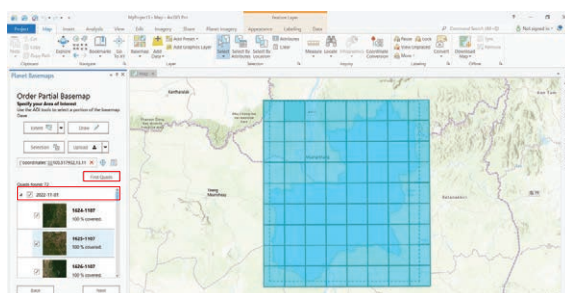


23

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”

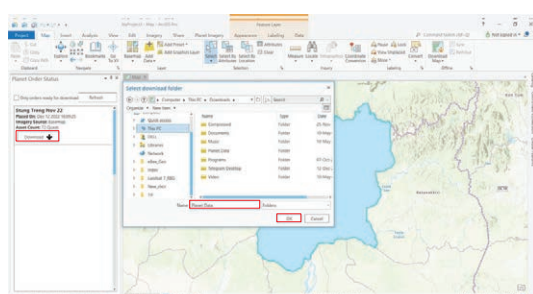


25

ការទាញយកទិន្នន័យផ្កាយរណប Planet (បន្ត)

ការទាញយក (បន្ត)

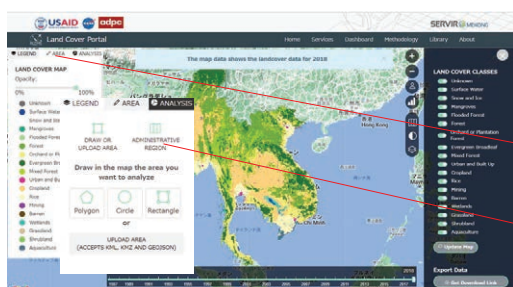
⑥ ចុច “Downloads” និងបំពេញឈ្មោះទិន្នន័យ



26

ការទាញយកទិន្នន័យផែនទីការប្រើប្រាស់ដីពី SERVIR-Mekong

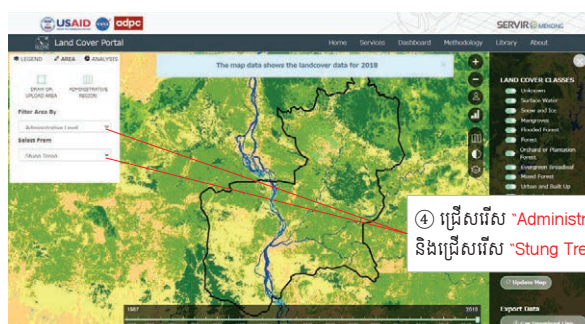
① ចូលទៅកាន់៖ <https://www.landcovermapping.org/en/landcover>



② ចុច “AREA”.

③ ជ្រើសរើស “ADMINISTRATIVE REGION”.

ការទាញយកទិន្នន័យផែនទីការប្រើប្រាស់ដីពី SERVIR-Mekong (បន្ត)

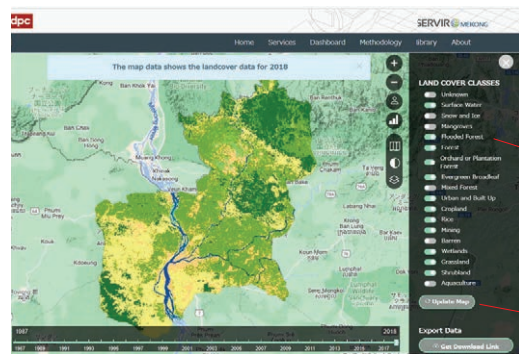


④ ជ្រើសរើស “Administrative Level” និងជ្រើសរើស “Stung Treng”

27

28

ការទាញយកទិន្នន័យផែនទីការប្រើប្រាស់ដីពី SERVIR-Mekong (បន្ត)

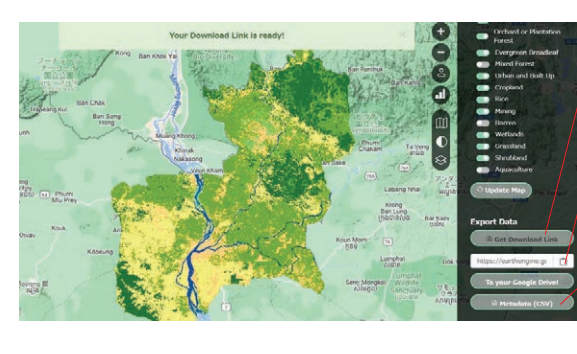


⑤ ទាញប៊ីច "Unknown", "Snow and Ice", "Mangroves", "Mixed Forest", "Barren", និង "Aquaculture", ដែលជាទិន្នន័យដែលមិនតម្រូវសម្រាប់ខេត្តស្ទឹងត្រែង

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)

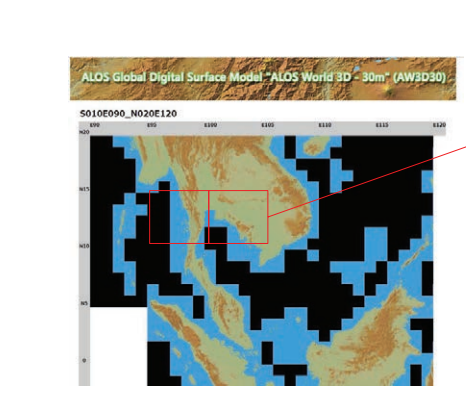
③ ចូលទៅកាន់៖ <https://www.eorc.jaxa.jp/ALOS/en/aw3d30/data/index.htm> និង Log in



④ ជ្រើសរើសក្រឡាចត្រង្គដែលមានប្រទេសកម្ពុជានៅខាងក្នុង

32

ការទាញយកទិន្នន័យរយៈកម្ពស់ (DEM AW3D 30m) (បន្ត)

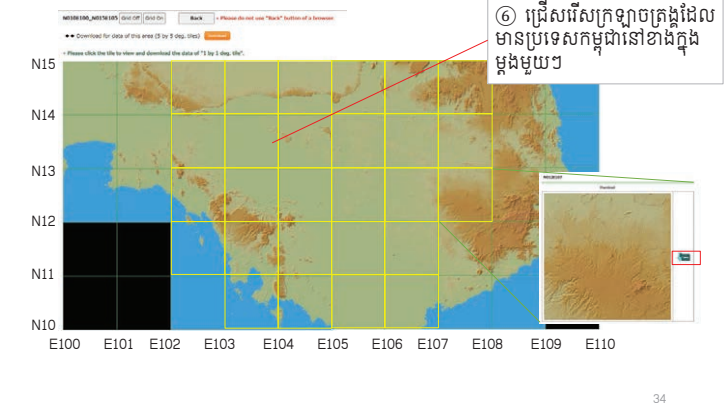


⑤ ជ្រើសរើសក្រឡាចត្រង្គដែលមានប្រទេសកម្ពុជានៅខាងក្នុង៖

- N010E100_N015E105
- N010E105_N015E110

33

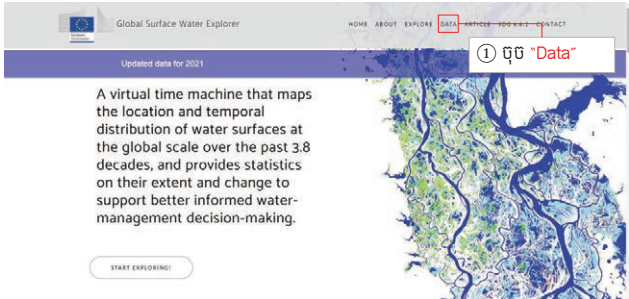
ការទាញយកទិន្នន័យរយៈកម្ពស់ (DEM AW3D 30m) (បន្ត)



⑥ ជ្រើសរើសក្រឡាចត្រង្គដែលមានប្រទេសកម្ពុជានៅខាងក្នុងម្តងមួយៗ

34

ការទាញយកទិន្នន័យទឹកលើពិភពលោក



35

ការទាញយកទិន្នន័យទឹកលើពិភពលោក (បន្ត)



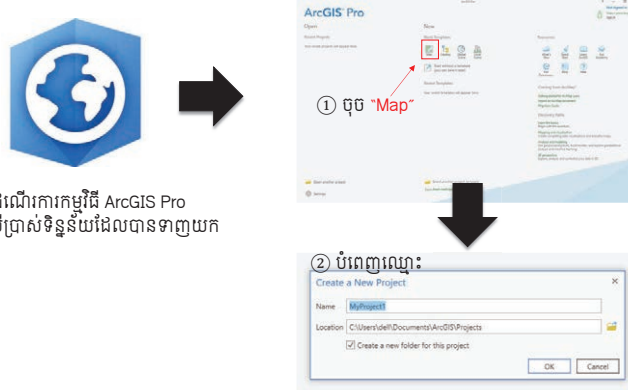
36

ការទាញយកទិន្នន័យទឹកលើពិភពលោក (បន្ត)



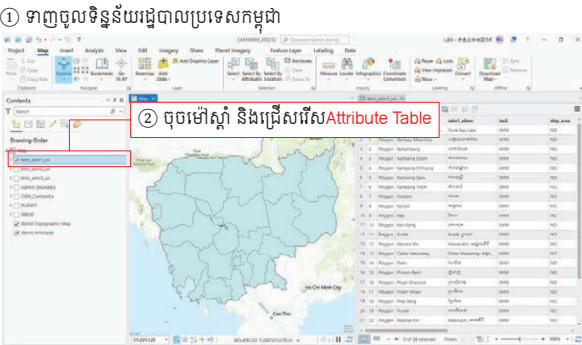
37

ការរៀបចំទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង



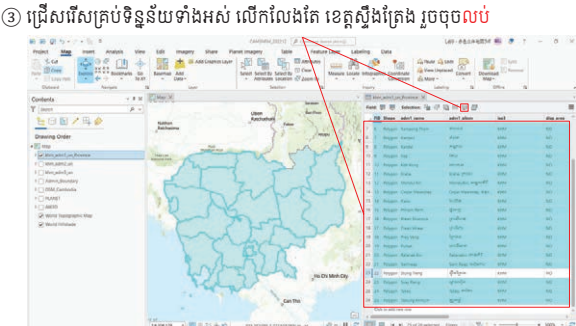
38

ការរៀបចំទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (បន្ត)



39

ការរៀបចំទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (បន្ត)

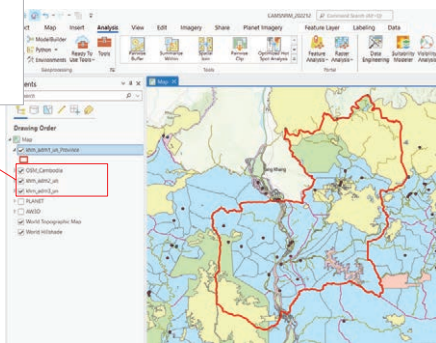


40

ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរ៉ូប៊ីតទ័រ)

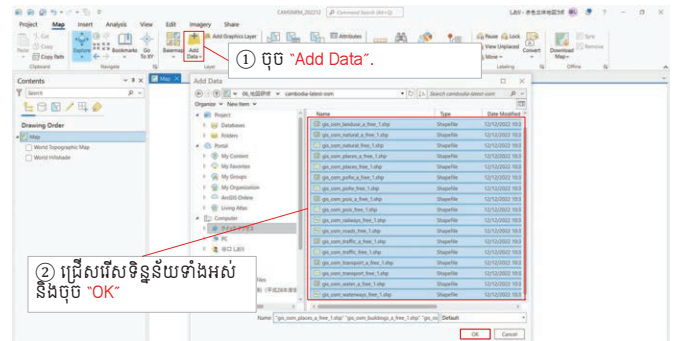
ទាញចូលទិន្នន័យទាំងអស់៖

- ទិន្នន័យរដ្ឋបាលស្រុក
- ទិន្នន័យរដ្ឋបាលឃុំ
- ទិន្នន័យផ្លូវ



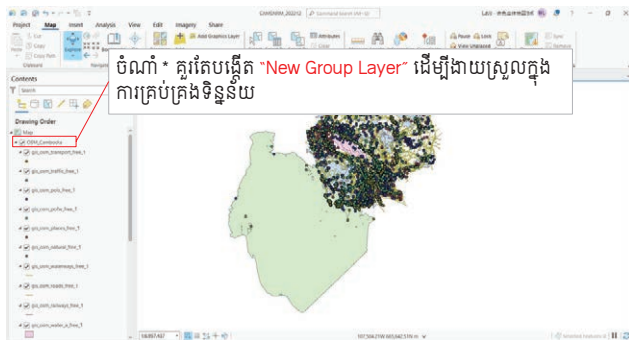
41

ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរ៉ូប៊ីតទ័រ) (បន្ត)



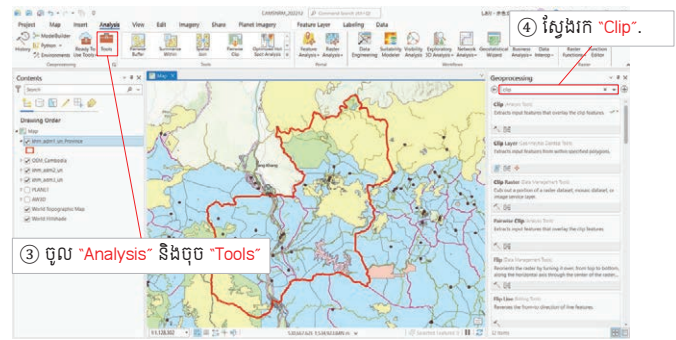
42

ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរ៉ូប៊ីតទ័រ) (បន្ត)



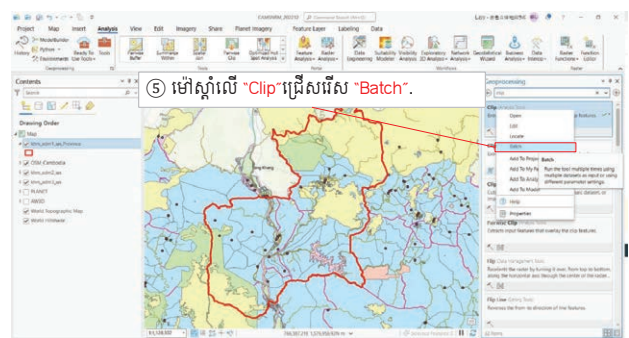
43

ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរ៉ូប៊ីតទ័រ) (បន្ត)



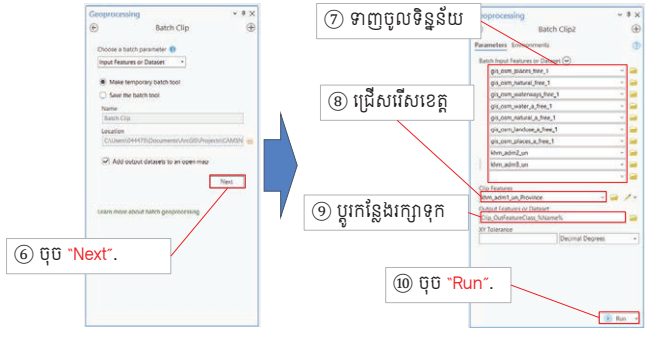
44

ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរ៉ូប៊ីតទ័រ) (បន្ត)



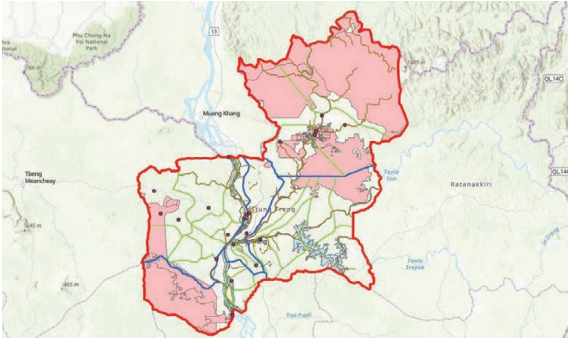
45

ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរ៉ូប៊ីតទ័រ) (បន្ត)



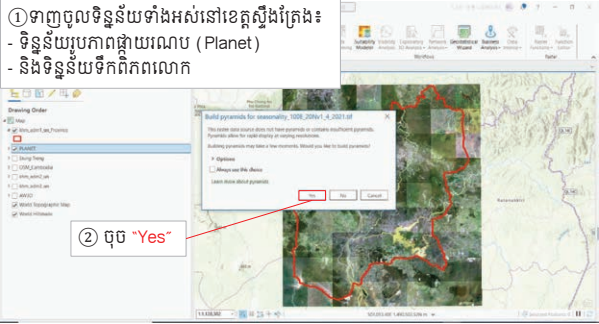
46

ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរ៉ឺម៉ា) (បន្ត)



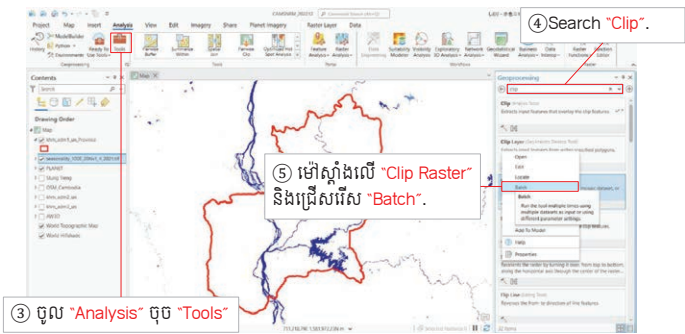
47

ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរូបភាព)



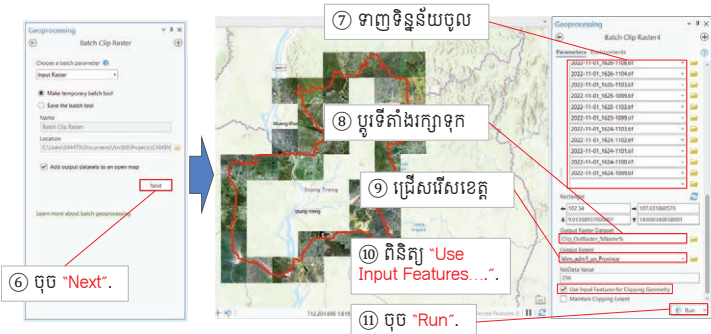
48

ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរូបភាព) (បន្ត)



49

ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរូបភាព) (បន្ត)



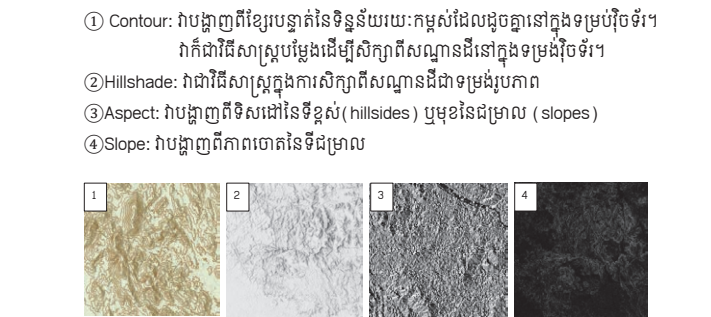
50

ការកាត់យកទិន្នន័យសម្រាប់ខេត្តស្ទឹងត្រែង (ទិន្នន័យរូបភាព) (បន្ត)



51

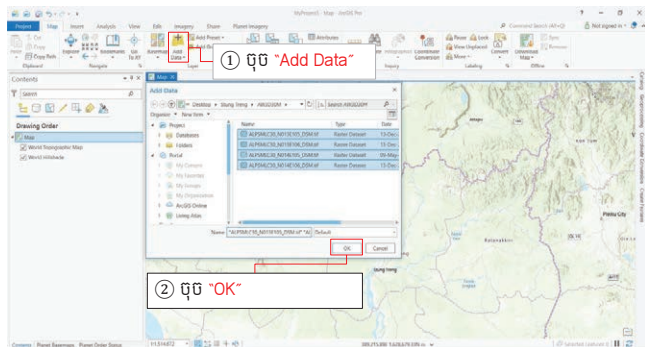
ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់



52

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

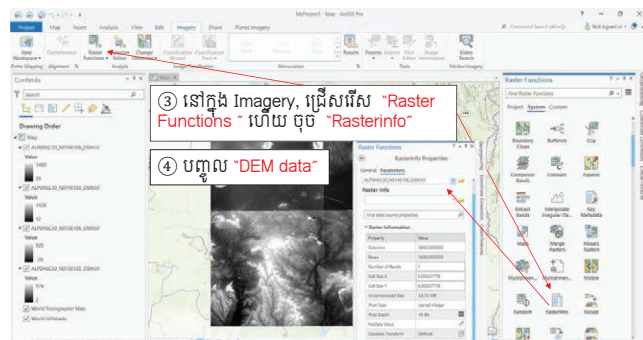
ការរៀបចំទិន្នន័យរយៈកម្ពស់



53

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

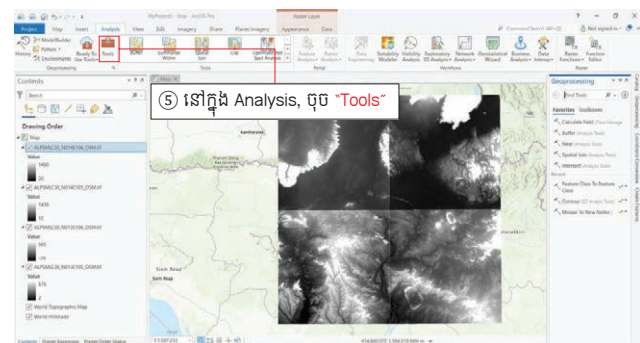
ការរៀបចំទិន្នន័យរយៈកម្ពស់ (បន្ត)



54

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

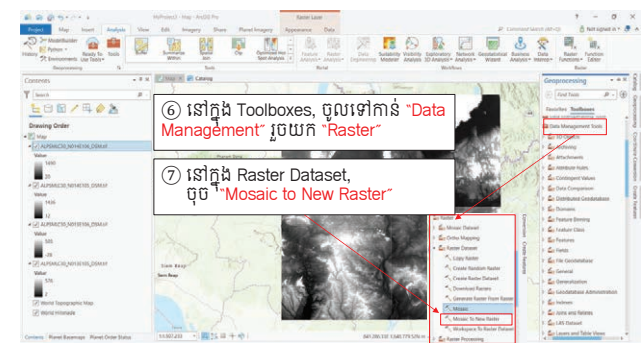
ការរៀបចំទិន្នន័យរយៈកម្ពស់ (បន្ត)



55

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

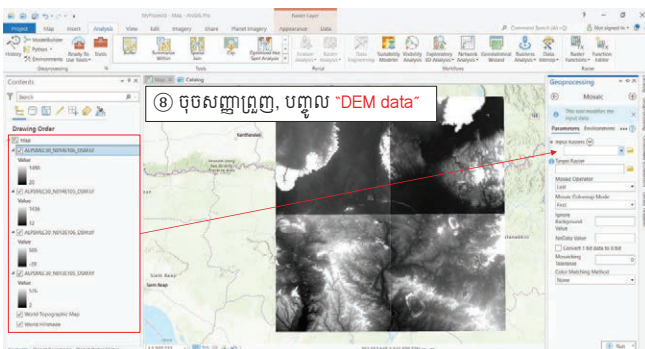
ការរៀបចំទិន្នន័យរយៈកម្ពស់ (បន្ត)



56

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

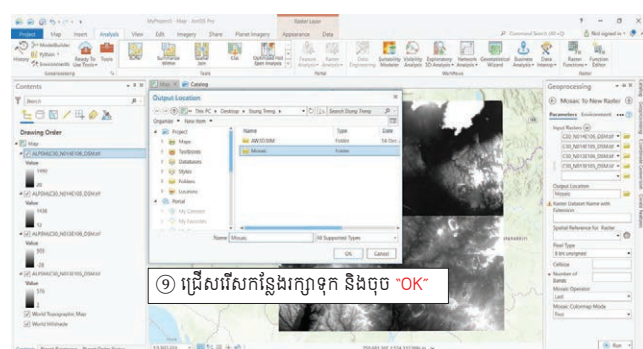
ការរៀបចំទិន្នន័យរយៈកម្ពស់ (បន្ត)



57

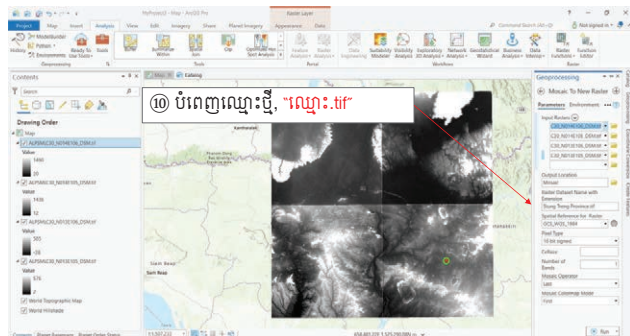
ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

ការរៀបចំទិន្នន័យរយៈកម្ពស់ (បន្ត)



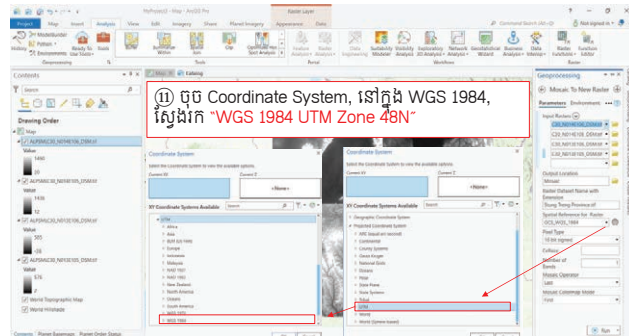
58

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
ការរៀបចំទិន្នន័យរយៈកម្ពស់ (បន្ត)



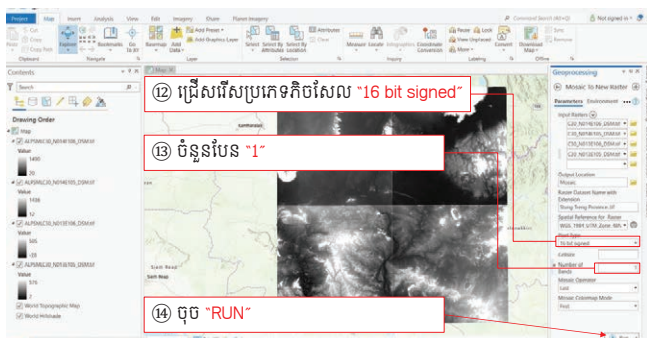
59

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
ការរៀបចំទិន្នន័យរយៈកម្ពស់ (បន្ត)



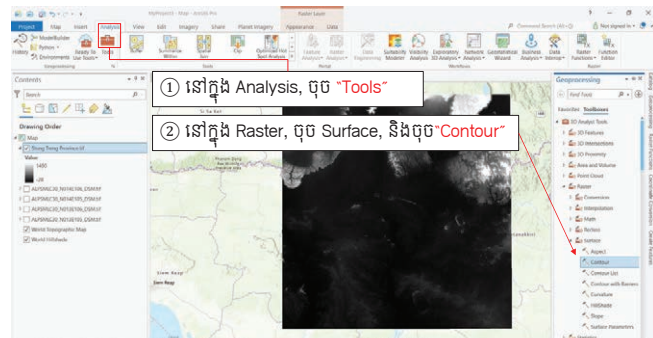
60

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
ការរៀបចំទិន្នន័យរយៈកម្ពស់ (បន្ត)



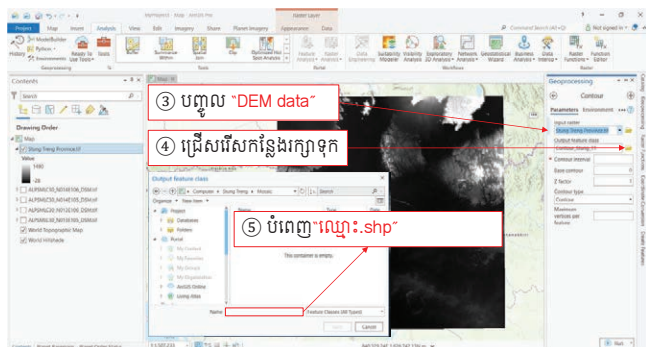
61

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
ការបង្កើតទិន្នន័យខ្សែបន្ទាត់រយៈកម្ពស់



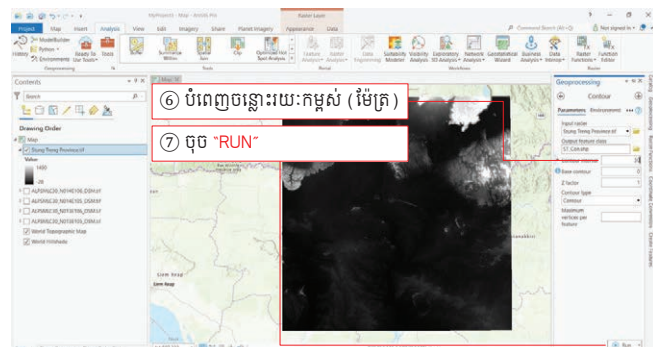
62

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
ការបង្កើតទិន្នន័យខ្សែបន្ទាត់រយៈកម្ពស់ (បន្ត)



63

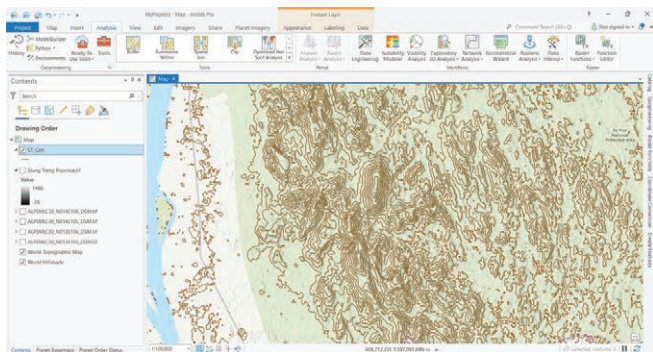
ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
ការបង្កើតទិន្នន័យខ្សែបន្ទាត់រយៈកម្ពស់ (បន្ត)



64

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

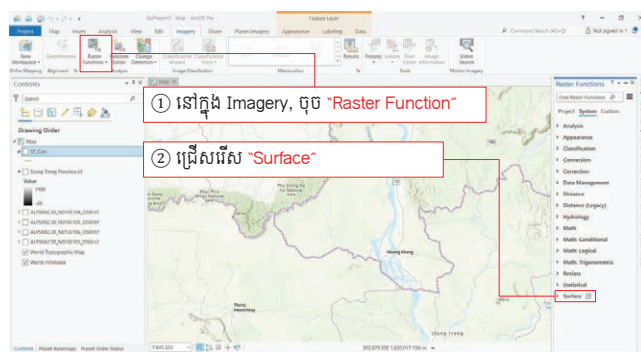
ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញពីរយៈកម្ពស់ (បន្ត)



65

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

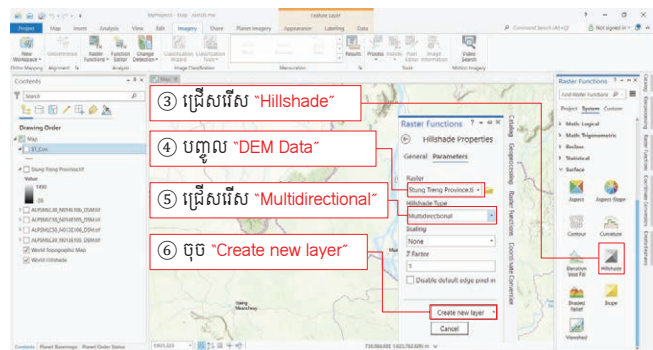
ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញពីរយៈកម្ពស់ (បន្ត)



66

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

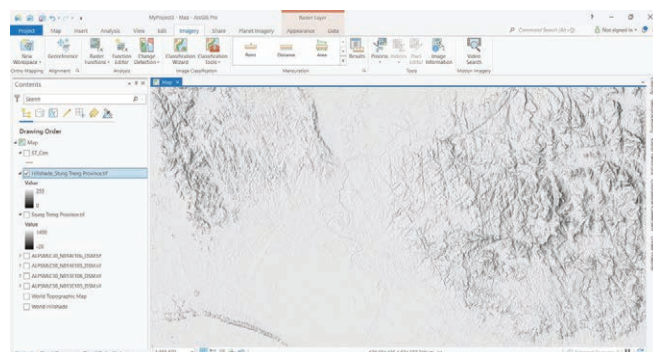
ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញពីរយៈកម្ពស់ (បន្ត)



67

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

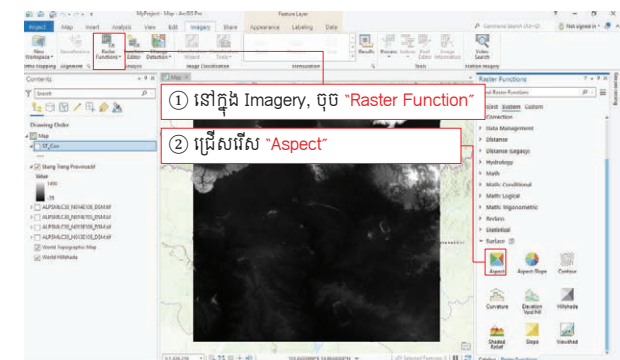
ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញពីរយៈកម្ពស់ (បន្ត)



68

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

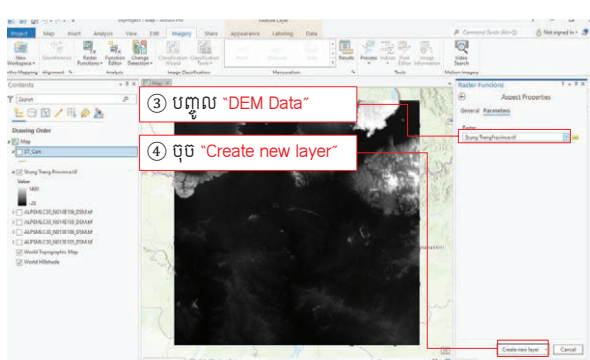
ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញពីរយៈកម្ពស់ (បន្ត)



69

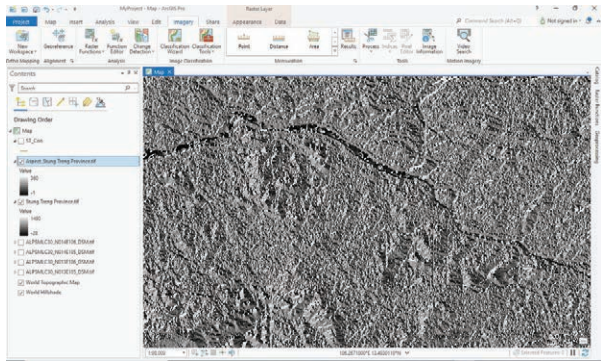
ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)

ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញពីរយៈកម្ពស់ (បន្ត)



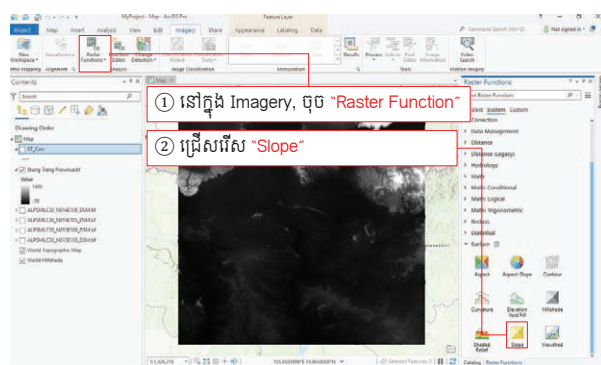
70

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
 ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញទិសដៅទីជម្រាល ឬទីខ្ពស់ (បន្ត)



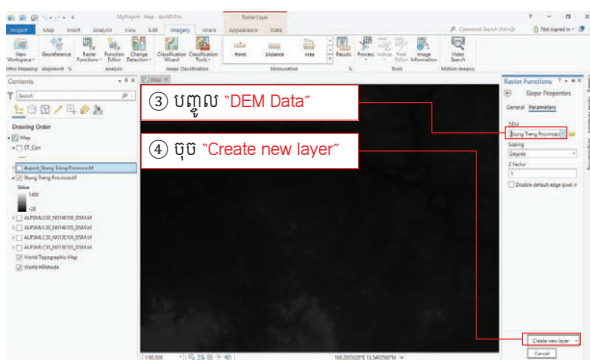
71

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
 ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញទីជម្រាល



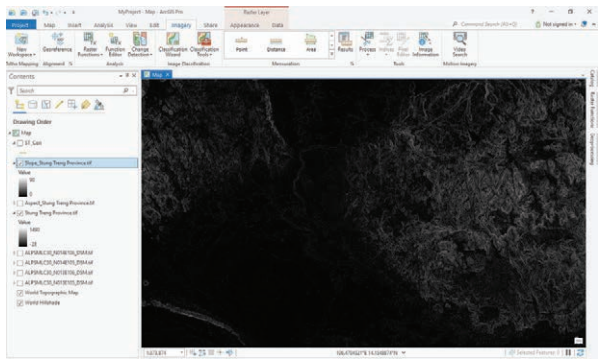
72

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
 ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញទីជម្រាល (បន្ត)



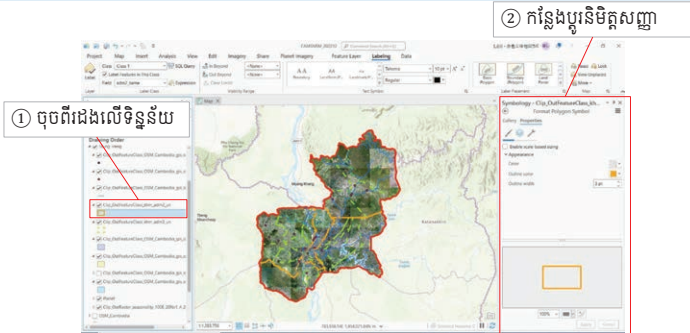
73

ការប្រើប្រាស់ទិន្នន័យសម្រាប់បង្ហាញពីរយៈកម្ពស់ (បន្ត)
 ការបង្កើតទិន្នន័យរយៈកម្ពស់បង្ហាញទីជម្រាល (បន្ត)



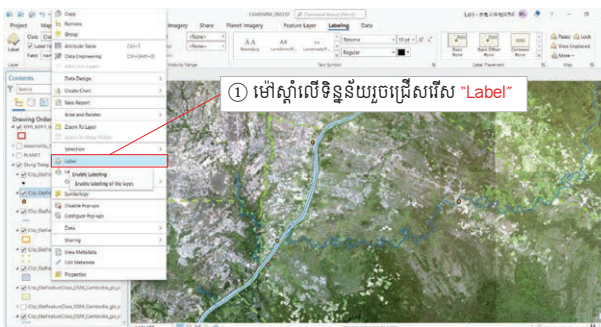
74

ការប្រើប្រាស់មុខងារកែលម្អលើផែនទី
 ការប្រើប្រាស់និមិត្តសញ្ញា (ពណ៌ ទំហំ និងប្រភេទខ្សែបន្ទាត់)



75

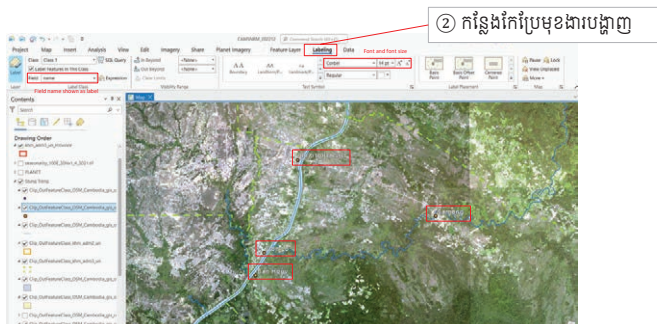
ការប្រើប្រាស់មុខងារកែលម្អលើផែនទី (បន្ត)
 ការប្រើប្រាស់មុខងារបង្ហាញឈ្មោះ



76

ការប្រើប្រាស់មុខងារកែលម្អលើផែនទី (បន្ត)

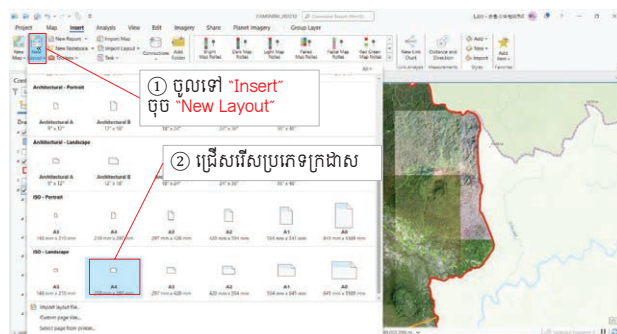
ការប្រើប្រាស់មុខងារបង្ហាញឈ្មោះ: (បន្ត)



77

ការប្រើប្រាស់មុខងារកែលម្អលើផែនទី (បន្ត)

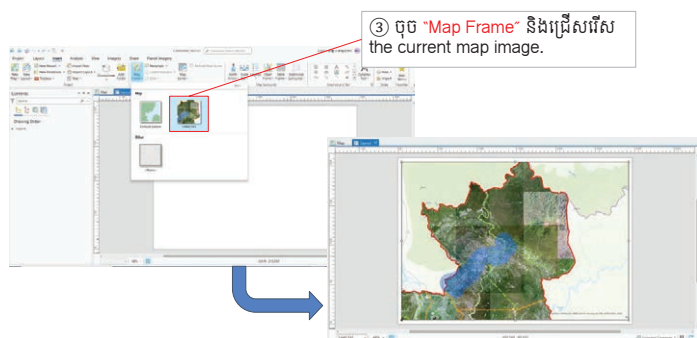
ការប្រើប្រាស់មុខងារកំណត់ផែនទីលើក្រដាស



78

ការប្រើប្រាស់មុខងារកែលម្អលើផែនទី (បន្ត)

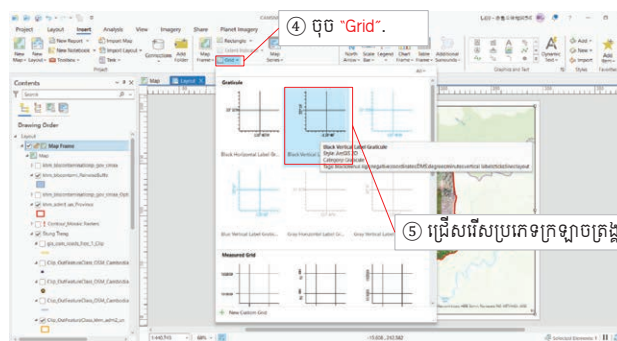
ការប្រើប្រាស់មុខងារកំណត់ផែនទីលើក្រដាស(បន្ត)



79

ការប្រើប្រាស់មុខងារកែលម្អលើផែនទី (បន្ត)

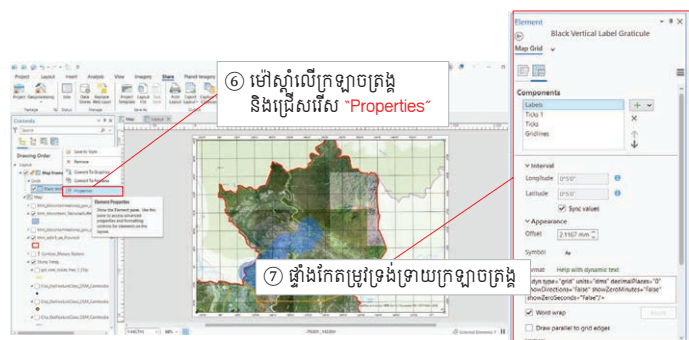
ការប្រើប្រាស់មុខងារកំណត់ផែនទីលើក្រដាស(បន្ត)



80

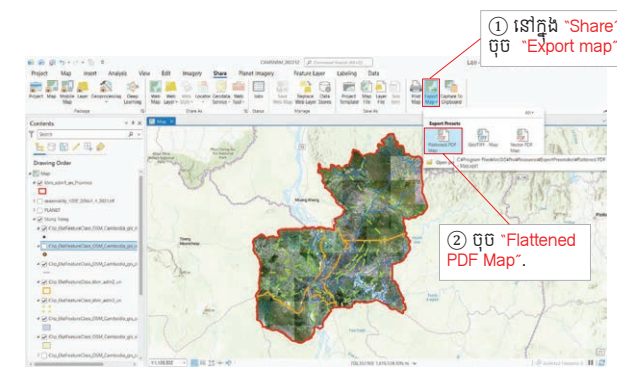
ការប្រើប្រាស់មុខងារកែលម្អលើផែនទី (បន្ត)

ការប្រើប្រាស់មុខងារកំណត់ផែនទីលើក្រដាស(បន្ត)



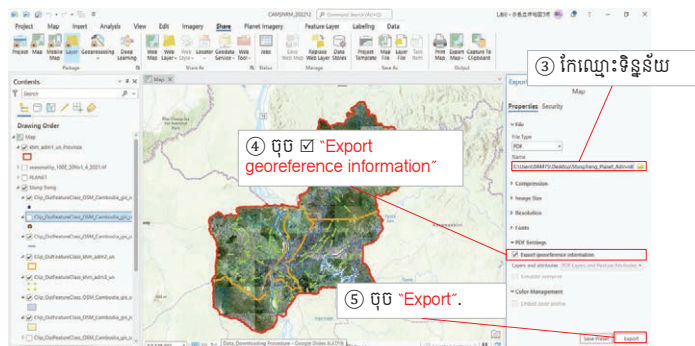
81

ការបញ្ចេញទិន្នផលផែនទីជាទម្រង់ Geo-PDF



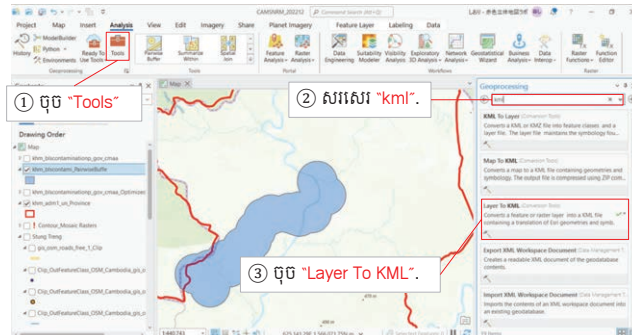
82

ការបញ្ចេញទិន្នផលផែនទីជាទម្រង់ Geo-PDF (បន្ត)



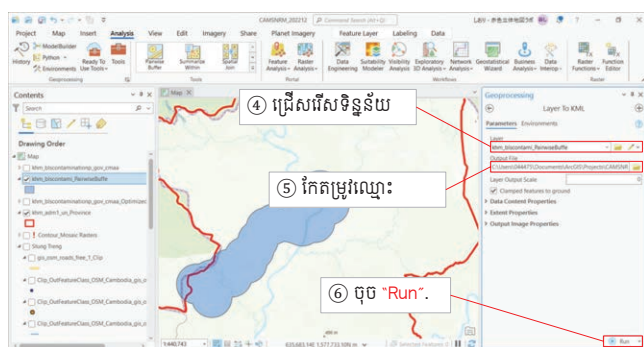
83

ការបង្កើនទិន្នន័យរូបថតជាទម្រង់ KML/KMZ



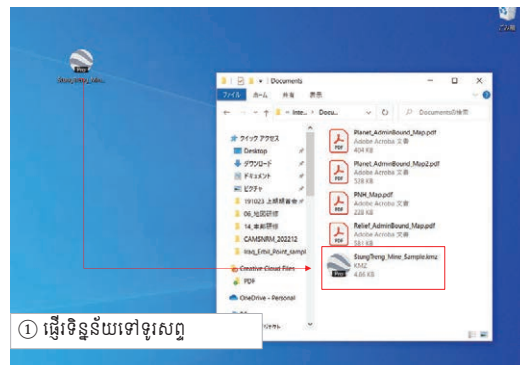
84

ការបង្កើនទិន្នន័យរូបថតជាទម្រង់ KML/KMZ (បន្ត)



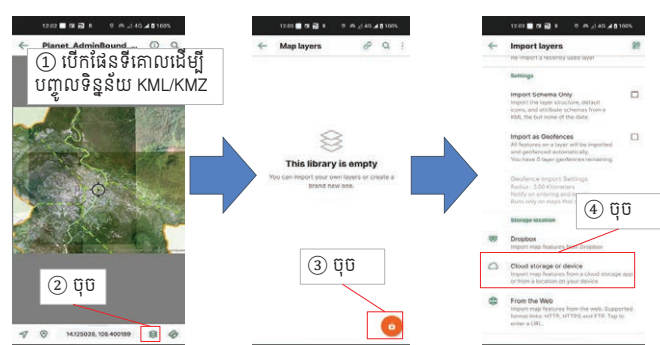
85

ការបញ្ចូលទិន្នន័យ KML/KMZ ទៅកម្មវិធី Avenza



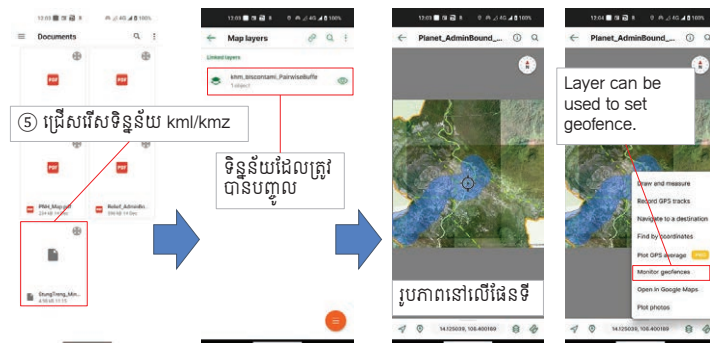
86

ការបញ្ចូលទិន្នន័យ KML/KMZ ទៅកម្មវិធី Avenza (បន្ត)



87

ការបញ្ចូលទិន្នន័យ KML/KMZ ទៅកម្មវិធី Avenza (បន្ត)



88



គម្រោងអភិវឌ្ឍន៍សេដ្ឋកិច្ច
ក្នុងការគ្រប់គ្រងធនធានធម្មជាតិកម្ពុជាដោយប្រកបដោយនិរន្តរភាព នៅក្នុងតំបន់ និងក្នុងប្រទេសកម្ពុជា
JICA SNRM

ការអនុវត្តការប្រើប្រាស់កន្លែងប្រជុំប្រតិបត្តិការប្រកបដោយនិរន្តរភាព
សម្រាប់ការសិក្សាពីការប្រើប្រាស់ប្រព័ន្ធគ្រប់គ្រងព័ត៌មាន
Basic Practice for GIS Mapping



April 2024

ការប្រើប្រាស់ទិន្នន័យ

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



- ប្រើប្រាស់ទិន្នន័យប្រភេទ - Cambodia និង ឡែន - SHP
- ប្រើប្រាស់ទិន្នន័យដែលបានប្រើប្រាស់ក្នុងកម្មវិធី SHP



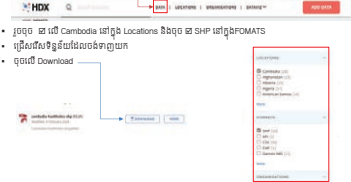
1

អង្គប្រឹក្សាប្រតិបត្តិការ

- 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.bunddata.org/>
- ចុចលើ Data



- ចុចលើ ឆ្នាំ Cambodia ឆ្នាំ 2012 Locations និង ឡែន SHP ឆ្នាំ 2012 FOMATS
- ប្រើប្រាស់ទិន្នន័យដែលបានប្រើប្រាស់ក្នុងកម្មវិធី SHP
- ចុចលើ Download

អង្គប្រឹក្សាប្រតិបត្តិការ

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

3

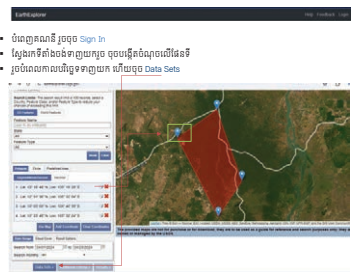
- គេហទំព័រ CCOPAROK
- ចូលទៅកាន់ <https://opendatacambodia.net/>
- ចុចលើ Cambodia latest free shp zip



4

ការប្រើប្រាស់ទិន្នន័យបណ្តាញ

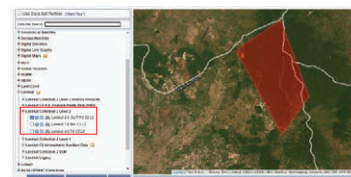
- ការប្រើប្រាស់ទិន្នន័យបណ្តាញ
- គេហទំព័រ [USGS](https://earthexplorer.usgs.gov/)
- ចូលទៅកាន់ <https://earthexplorer.usgs.gov/>
- ចុចលើ Login



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

5

- ប្រើប្រាស់ Landsat កម្រិតច្បាស់ 30m

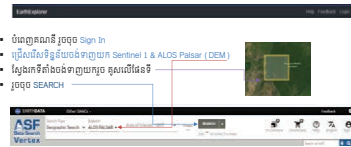


- ប្រើប្រាស់ គេហទំព័រ
- ចុចលើ [Sign In](#) ដើម្បីប្រើប្រាស់បណ្តាញ
- ប្រើប្រាស់ [Sign In](#) ដើម្បីប្រើប្រាស់
- ប្រើប្រាស់ប្រព័ន្ធប្រើប្រាស់ទិន្នន័យបណ្តាញ ប្រើប្រាស់ ឬចុច Sign In

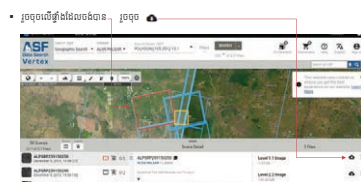


6

- គេហទំព័រ [EarthData](https://earthdata.nasa.gov/)
- ចូលទៅកាន់ <https://earthdata.nasa.gov/>
- ចុចលើ Login



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



7

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



- ប្រើប្រាស់ទិន្នន័យបណ្តាញ ប្រើប្រាស់ទិន្នន័យបណ្តាញ



8

- ចូលមកកាន់ [Earth Explorer](#)
- ចូលមកកាន់ [Data Sets](#) ប្រើប្រាស់ទិន្នន័យបណ្តាញ

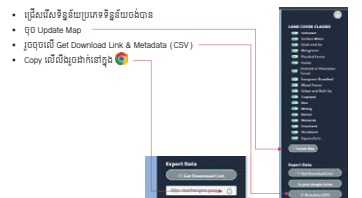


- ចុចលើ [Sign In](#) ដើម្បីប្រើប្រាស់
- ប្រើប្រាស់ទិន្នន័យបណ្តាញ ប្រើប្រាស់ទិន្នន័យបណ្តាញ

ប្រើប្រាស់ទិន្នន័យបណ្តាញ ប្រើប្រាស់ទិន្នន័យបណ្តាញ

9

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



- ប្រើប្រាស់ទិន្នន័យបណ្តាញ ប្រើប្រាស់ទិន្នន័យបណ្តាញ
- ចុច Update Map
- ប្រើប្រាស់ Get Download Link & Metadata (CSV)
- Copy ដើម្បីប្រើប្រាស់ទិន្នន័យបណ្តាញ

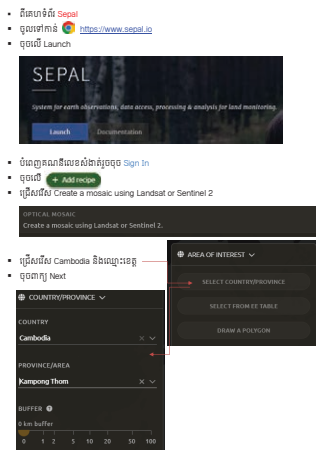
10



11



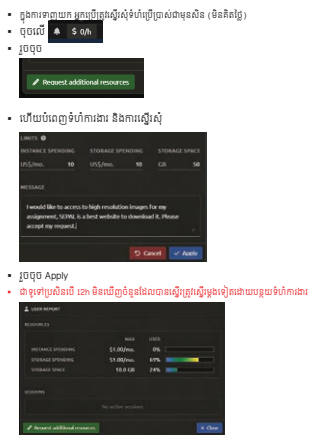
12



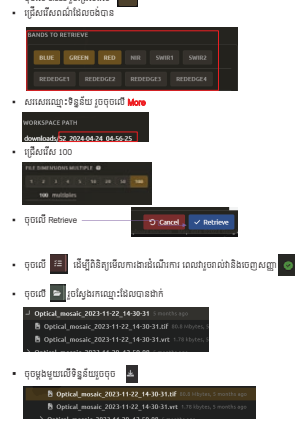
13



14



15



16

ការរៀបចំទិន្នន័យសម្រាប់ផលិតផល

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



17

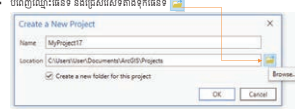


ការរៀបចំទិន្នន័យ

- ចុចលើកន្លែង

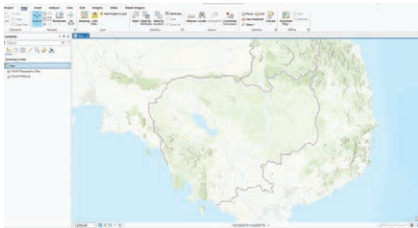


- ប្រើប្រាស់ Map



- ចុច OK

18



សូមប្រើប្រាស់ប្រព័ន្ធបញ្ជាដែលបានផ្តល់អោយ
ដើម្បីស្វែងយល់ពីឈ្មោះព្រំប្រទល់



ការប្រើប្រាស់ទិន្នន័យ

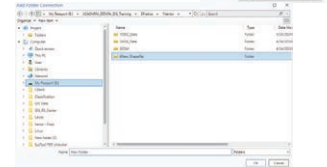
- ការប្រើប្រាស់ទិន្នន័យ (x y z) ដែលត្រូវបានកំណត់ជាមុននៅក្នុងឯកសារ (ឯកសារ 17599)

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 ផ្ទាំងនិងបញ្ចូលទិន្នន័យ

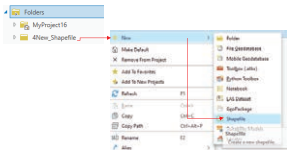


- ដាក់ស្នូលលើ Folders ប្រើប្រាស់ Add Folder Connection
- ប្រើប្រាស់ទិន្នន័យដែលបានបញ្ជូន ចុច OK

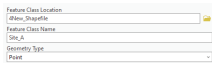


20

- ដាក់ស្នូលលើទិន្នន័យ ប្រើប្រាស់ New ប្រើប្រាស់ Shapefile

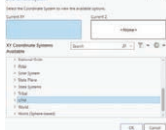


- បំពេញឈ្មោះប្រព័ន្ធបញ្ជា Point



- ការប្រើប្រាស់ប្រព័ន្ធបញ្ជា

- ចុចលើ ប្រព័ន្ធបញ្ជា Project Coordinate System ស្វែងរក UTM



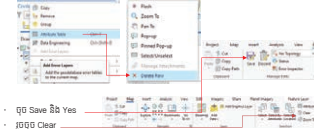
- ដាក់ស្នូល ប្រើប្រាស់ WGS 1984
- ដាក់ស្នូល WGS 1984 ស្វែងរក Northern Hemisphere ប្រើប្រាស់ WGS 1984 Zone 48N
- ចុច OK និង Run
- ចុចលើ Edit និងប្រើប្រាស់ Create និងប្រើប្រាស់ ឈ្មោះទិន្នន័យ



- ដាក់ស្នូលលើផែនទី ប្រើប្រាស់ Absolute X,Y,Z

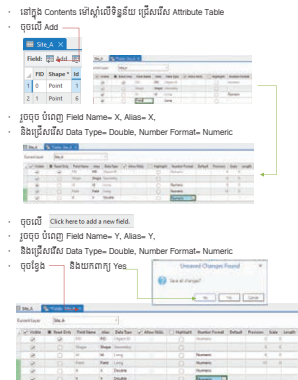


- ប្រើប្រាស់ប្រព័ន្ធបញ្ជា ប្រើប្រាស់ Envis
- ប្រើប្រាស់ប្រព័ន្ធបញ្ជា ប្រើប្រាស់ Attribute Table
- ប្រើប្រាស់ប្រព័ន្ធបញ្ជា ប្រើប្រាស់ Delete Row

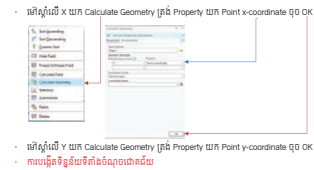


- ចុច Save និង Yes
- ចុច Clear

22



23



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ការបង្កើតទិន្នន័យរូបវន្ត

- ទិន្នន័យរូបវន្ត (x y z) គឺជាស្រទាប់ព័ត៌មានដែលមានលក្ខណៈជាតំលាងរូប (រូបភាព)

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

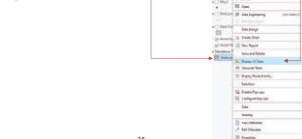
- បញ្ចូលទិន្នន័យទៅក្នុង Excel រួច Save As
- និងប្តូរទិន្នន័យទៅ CSV UTF-8



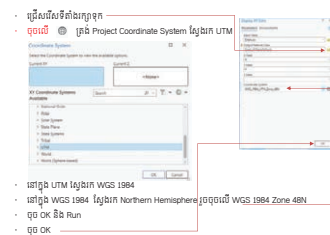
- នៅក្នុង Map ចុច Add Data រួចប្តូរទិន្នន័យ ចុចជិត រួចចុច OK



- នៅក្នុង Contents ប្រសិនបើទិន្នន័យ ប្រើប្រាស់ Display XY Data



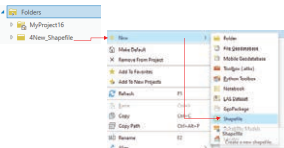
25



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ការបង្កើតទិន្នន័យផ្សេងៗ

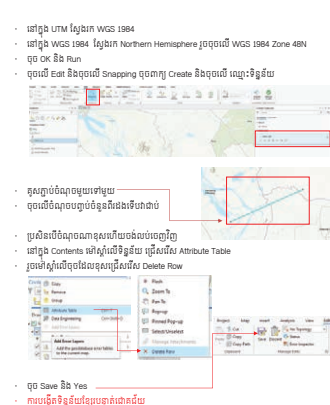
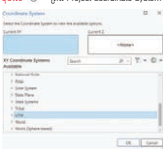
- ទិន្នន័យផ្សេងៗ គឺជាស្រទាប់ព័ត៌មានដែលមានលក្ខណៈជាតំលាងរូប (រូបភាព)
- ប្រើប្រាស់ទិន្នន័យផ្សេងៗ រួមមាន New ប្រភេទ Shapelite



- បំពេញឈ្មោះប្រភេទ Polyline



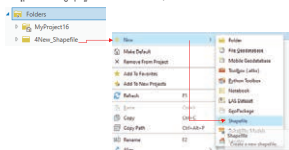
- ការប្រើប្រាស់ប្រភេទផ្សេងៗ
- ចុចជិត ប្រើប្រាស់ Project Coordinate System រួចចុច OK



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ការបង្កើតទិន្នន័យវិទ្យុសញ្ញ

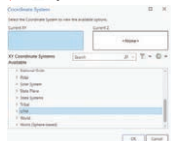
- ទិន្នន័យបញ្ចេញនូវទិន្នន័យដែលបានបង្កើត ឬគណនា
- បង្កើតទិន្នន័យទិន្នន័យទិន្នន័យ ឬបង្កើត New វិធាន



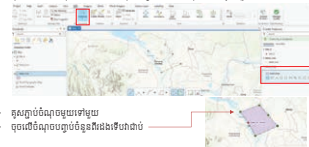
- បង្កើតទិន្នន័យវិទ្យុសញ្ញ Polygon



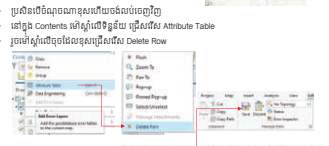
- ការបង្កើតទិន្នន័យវិទ្យុសញ្ញ
- ចុចលើ ប្រព័ន្ធ Project Coordinate System ឱ្យប្រើ UTM



- បង្កើត UTM ឱ្យប្រើ WGS 1984
- បង្កើត WGS 1984 ឱ្យប្រើ Northern Hemisphere ឱ្យប្រើ WGS 1984 Zone 48N
- ចុច OK និង Run
- ចុចលើ ប្រព័ន្ធ Shapeling ឱ្យប្រើ Create និងបង្កើត ឱ្យប្រើ



- បង្កើតទិន្នន័យវិទ្យុសញ្ញ
- បង្កើត Contents ឱ្យប្រើប្រាស់ទិន្នន័យ ឱ្យប្រើ Attribute Table
- បង្កើតទិន្នន័យវិទ្យុសញ្ញ ឱ្យប្រើ Delete Row



- ចុច Save និង Yes
- បង្កើត Clear
- ការបង្កើតទិន្នន័យវិទ្យុសញ្ញ

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ការបង្កើតទិន្នន័យវិទ្យុសញ្ញ

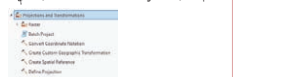
- ការបង្កើតទិន្នន័យវិទ្យុសញ្ញ និងទិន្នន័យ
- ការបង្កើតទិន្នន័យវិទ្យុសញ្ញ ឱ្យប្រើ WGS 1984 Zone 48N
- បង្កើតទិន្នន័យវិទ្យុសញ្ញ



- បង្កើត Geoprocessing ឱ្យប្រើ ឱ្យប្រើ Data Management



- បង្កើត Data Management ឱ្យប្រើ Projection and Transformation
- បង្កើត Projection and Transformation ឱ្យប្រើ Project ឱ្យប្រើ



- បង្កើតទិន្នន័យ ឱ្យប្រើប្រាស់ទិន្នន័យ
- បង្កើតទិន្នន័យ ឱ្យប្រើ WGS 1984 Zone 48N

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បង្កើតទិន្នន័យវិទ្យុសញ្ញ

បង្កើត UTM ឱ្យប្រើ WGS 1984

បង្កើត WGS 1984 ឱ្យប្រើ Northern Hemisphere ឱ្យប្រើ WGS 1984 Zone 48N

ចុច OK និង Run

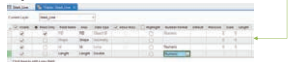
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ការបង្កើតទិន្នន័យវិទ្យុសញ្ញ

- ការបង្កើតទិន្នន័យវិទ្យុសញ្ញ
- បង្កើត Contents ឱ្យប្រើប្រាស់ទិន្នន័យ ឱ្យប្រើ Attribute Table
- ចុចលើ Add



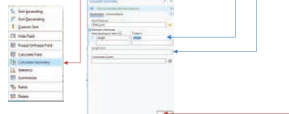
- បង្កើត បង្កើត Field Name= Length, Alias= Length,
- បង្កើត បង្កើត Data Type= Double, Number Format= Numeric



- ចុចលើ បង្កើត Yes



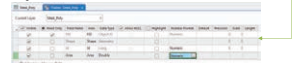
- បង្កើត Length ឱ្យប្រើ Calculate Geometry ឱ្យប្រើ Property ឱ្យប្រើ Length ឱ្យប្រើ ឱ្យប្រើ ឱ្យប្រើ



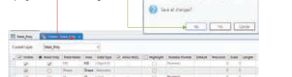
- ការបង្កើតទិន្នន័យវិទ្យុសញ្ញ
- បង្កើត Contents ឱ្យប្រើប្រាស់ទិន្នន័យ ឱ្យប្រើ Attribute Table
- ចុចលើ Add



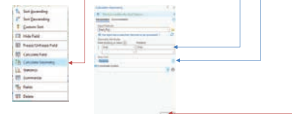
- បង្កើត បង្កើត Field Name= Area, Alias= Area,
- បង្កើត បង្កើត Data Type= Double, Number Format= Numeric



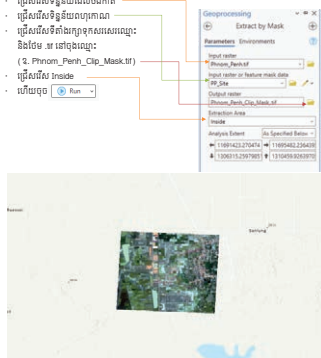
- ចុចលើ បង្កើត Yes



- បង្កើត Length ឱ្យប្រើ Calculate Geometry ឱ្យប្រើ Property ឱ្យប្រើ Area ឱ្យប្រើ ឱ្យប្រើ ឱ្យប្រើ



- ជ្រើសរើសទិន្នន័យដែលចង់កាត់
- ជ្រើសរើសទិន្នន័យបរិមាណ
- ជ្រើសរើសទីតាំងរក្សាទុកសរសេរឈ្មោះ និងថ្ងៃខែ ឆ្នាំ នៅចុងឈ្មោះ
(ឧ. Phnom_Penh_Clip_Mask.tif)
- ជ្រើសរើស Inside
- ហើយចុច 



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- ការជ្រើសរើសទីតាំងដាក់លាក់
(ទិន្នន័យប្រែប្រួល)

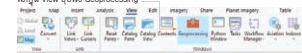
- កាស៊ីដេរ៉េសរឹមទំព័រជាប់កំណត់ ឬកាត់ទិន្នន័យ វិស័យស្រុះឬរឹមវិស័យស្រុះទំព័រជាប់កំណត់
- កាស៊ីដេរ៉េសរឹមរៀបចំ
- ទិន្នន័យត្រូវការ ឈ្មោះអាណាទិច និងទិន្នន័យចំណាត់
- កាស៊ីដេរ៉េសរឹមអាណាទិចស្រុះ ប្រើប្រាស់ Select និង Map
- កាស៊ីដេរ៉េសរឹមដោយ ប្រើប្រាស់ Select
- នៅក្នុងកាស៊ីដេរ៉េសរឹម ទិន្នន័យរឹមទំព័រទិន្នន័យ ខេត្តនៃប្រទេសកម្ពុជា
- បញ្ចូលទិន្នន័យចំណាត់ (ក្នុងកាស៊ីដេរ៉េសរឹមខ្សែបន្តទិន្នន័យ PAs)
- នៅក្នុង Map ប្រើប្រាស់ Add Data



- [illegible]

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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

- **အောက်ပါ Projection and Transformation မြေပုံကိရိယာများကို ဖတ်ရှုပါ။**

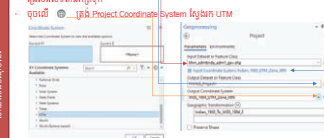


- បញ្ចូលទិន្នន័យ រួចជិតិភូមីលក្ខណៈនោះ
- ក្នុងការបង្ហាញទិន្នន័យកំពុងប្រើប្រាស់ជាទិន្នន័យ UTM ឬ WGS 1984 Zone 48N

- գոլջե

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- ប្រសិនបើមិនចេញ ហាម ឬក្នុងករណីផ្សេង
- បញ្ចូលទិន្នន័យ រួចពិនិត្យមើលក្នុងករណីផ្សេង
- ប្រើសរសេរទិន្នន័យក្នុងករណីផ្សេង



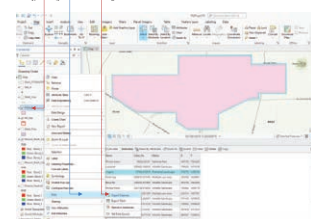
- នៅក្នុង UTM ស្វែងរក WGS 1984
- នៅក្នុង WGS 1984 ស្វែងរក Northern Hemisphere ឬចុចលើ WGS 1984 Zone 48N
- ចុច OK
- និងចុច 

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- នៅក្នុង Contents ម៉ៅស្ត្រាំលើទិន្នន័យ ជ្រើសរើស Attribute Table
- ស្វែងរកតំបន់កំពោលដែលចង់កាត់
- ចុចលើលេខនៅមុខវ៉ារីអ៊ែប៊ីល

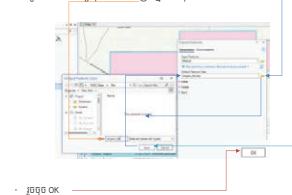


- ម៉ៅស៊ាំលើទិន្នន័យ យក Data ចេញ Export Features

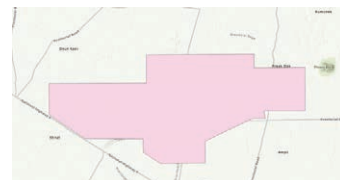


45

- ជ្រើសរើសទីតាំងរក្សាទុក បំពេញឈ្មោះ និងចុច Save



- JGGG OK

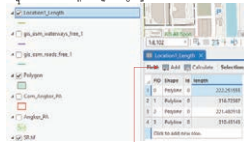


46

ការជ្រើសរើសទីតាំងដាក់លាក់
(ទិន្នន័យប្រែប្រួល)

ការដាក់សញ្ញាសំគាល់ និងការបង្ហាញទិន្នន័យ
ក្នុងផែនទី (ការបង្ហាញទិន្នន័យក្នុងផែនទី)

- ការបង្ហាញទិន្នន័យប្រភេទ (លុះត្រាតែបាន គណនាប្រភេទព័ត៌មាន)
- ការបង្ហាញប្រភេទ
- ដើម្បីបង្ហាញ Contents លើផែនទីទិន្នន័យប្រភេទ យក Attribute Table



- ដោយសារតែការបង្ហាញប្រភេទព័ត៌មាន ក្នុងផែនទី យកប្រភេទព័ត៌មាន
- ដូចនេះប្រភេទព័ត៌មាន អាច ប្រើប្រាស់
- ចូលដើម្បី Add
- ហើយប្រើប្រាស់ File name = length, Alias = length, Double

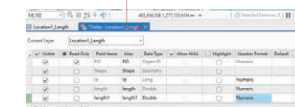


- Number Format យក 2.8 និង Suffix យក m ប្រាប់ OK



53

- ចូលដើម្បី ទ្រង់ និងយក Yes

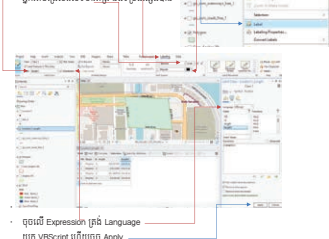


- លើផែនទីបង្ហាញទិន្នន័យ យក Calculate Geometry និងយក OK



54

- លើផែនទីទិន្នន័យប្រភេទ យក Label
- ដើម្បី Labeling
- Field យក length
- ប្រភេទព័ត៌មានប្រភេទព័ត៌មាន និងប្រភេទព័ត៌មាន



- ចូលដើម្បី Expression ក្នុង Language យក VBScript ហើយប្រើ Apply

55

ការដាក់សញ្ញាសំគាល់ និងការបង្ហាញទិន្នន័យ
ក្នុងផែនទី (ការបង្ហាញទិន្នន័យក្នុងផែនទី)

- ការបង្ហាញទិន្នន័យប្រភេទ (លុះត្រាតែបាន គណនាប្រភេទព័ត៌មាន)
- ការបង្ហាញទិន្នន័យប្រភេទ
- ដើម្បីបង្ហាញ Contents លើផែនទីទិន្នន័យប្រភេទ យក Attribute Table



- ដោយសារតែការបង្ហាញប្រភេទព័ត៌មាន ក្នុងផែនទី យកប្រភេទព័ត៌មាន
- ដូចនេះប្រភេទព័ត៌មាន អាច ប្រើប្រាស់
- ចូលដើម្បី Add
- ហើយប្រើប្រាស់ File name = Area, Alias = Area, Double, Number Format យក 2.8 និង Suffix យក ha ប្រាប់ OK

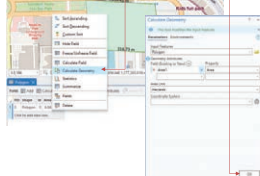


56

- ចូលដើម្បី ទ្រង់ និងយក Yes

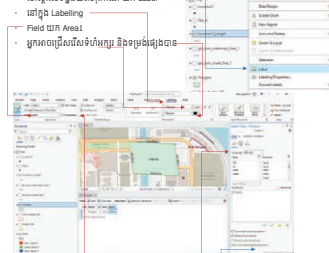


- លើផែនទីបង្ហាញទិន្នន័យ យក Calculate Geometry និងយក OK



57

- លើផែនទីទិន្នន័យប្រភេទ យក Label
- ដើម្បី Labeling
- Field យក Area
- ប្រភេទព័ត៌មានប្រភេទព័ត៌មាន និងប្រភេទព័ត៌មាន



- ចូលដើម្បី Expression ក្នុង Language យក VBScript ហើយប្រើ Apply

58

ការរៀបចំផែនទីឯកត្រាងាយ

- ការរៀបចំផែនទីឯកត្រាងាយ
 - ការប្រើប្រាស់ផែនទីឯកត្រាងាយ
 - ដោយប្រើប្រាស់ Insert ប្រើប្រាស់ New Layout

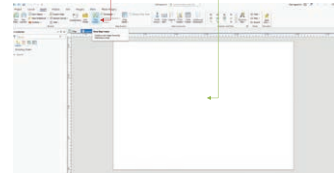


- រូបផែនទី A4 (បញ្ចប់ ប្រព័ន្ធ)

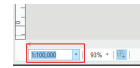


59

- ការដាក់ផែនទីឯកត្រាងាយ
- ដោយប្រើប្រាស់ Insert ប្រើប្រាស់ Map Frame



- ប្រើប្រាស់ប្រព័ន្ធបញ្ជាដោយប្រើប្រាស់



- ដោយប្រើប្រាស់ Layout ប្រើប្រាស់ Map Frame ដោយប្រើប្រាស់ Map Frame ប្រើប្រាស់ Map Frame

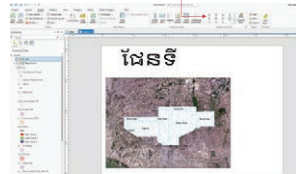


60

- ដោយប្រើប្រាស់ប្រព័ន្ធបញ្ជាដោយប្រើប្រាស់



- ដោយប្រើប្រាស់ប្រព័ន្ធបញ្ជាដោយប្រើប្រាស់

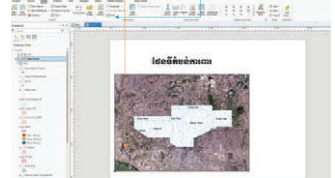


- ការដាក់ប្រព័ន្ធបញ្ជាដោយប្រើប្រាស់

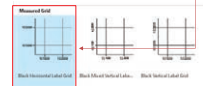


61

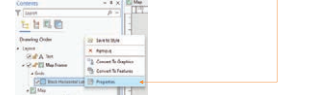
- ការដាក់ប្រព័ន្ធបញ្ជាដោយប្រើប្រាស់



- ដោយប្រើប្រាស់ Map Frame ប្រើប្រាស់ Map Frame

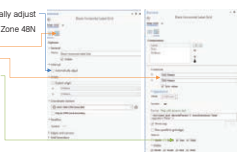


- ដោយប្រើប្រាស់ Map Frame ប្រើប្រាស់ Map Frame



62

- ដោយប្រើប្រាស់ Map Frame ប្រើប្រាស់ Map Frame



- ការដាក់ប្រព័ន្ធបញ្ជាដោយប្រើប្រាស់



- ប្រើប្រាស់ប្រព័ន្ធបញ្ជាដោយប្រើប្រាស់

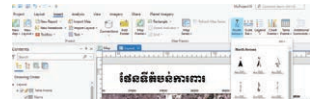


63

- ដោយប្រើប្រាស់ Map Frame ប្រើប្រាស់ Map Frame



- ការដាក់ប្រព័ន្ធបញ្ជាដោយប្រើប្រាស់

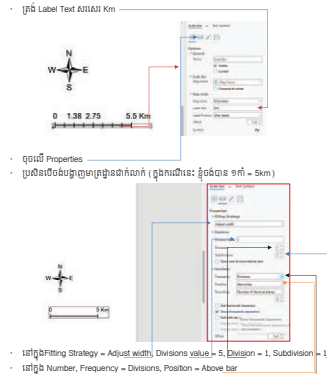


- ការដាក់ប្រព័ន្ធបញ្ជាដោយប្រើប្រាស់



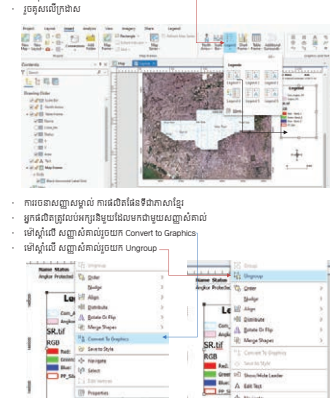
64

- ក្រាហ្វិកស្កេលទីតាំងផែនទី
- ក្រាហ្វិកស្កេលទីតាំងផែនទី
- ក្រាហ្វិកស្កេលទីតាំងផែនទី



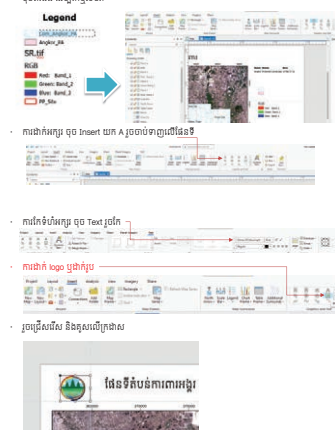
65

- ក្រាហ្វិកស្កេលទីតាំងផែនទី
- ក្រាហ្វិកស្កេលទីតាំងផែនទី
- ក្រាហ្វិកស្កេលទីតាំងផែនទី



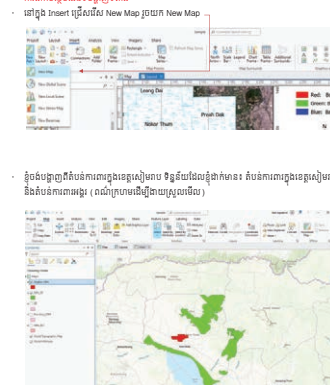
66

- ក្រាហ្វិកស្កេលទីតាំងផែនទី
- ក្រាហ្វិកស្កេលទីតាំងផែនទី
- ក្រាហ្វិកស្កេលទីតាំងផែនទី



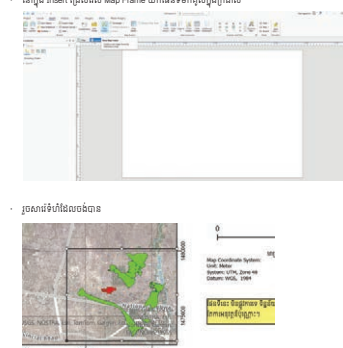
67

- ក្រាហ្វិកស្កេលទីតាំងផែនទី
- ក្រាហ្វិកស្កេលទីតាំងផែនទី
- ក្រាហ្វិកស្កេលទីតាំងផែនទី



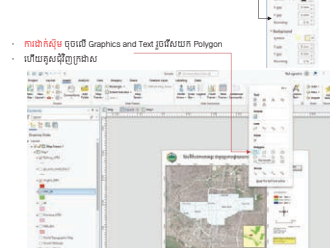
68

- ក្រាហ្វិកស្កេលទីតាំងផែនទី
- ក្រាហ្វិកស្កេលទីតាំងផែនទី
- ក្រាហ្វិកស្កេលទីតាំងផែនទី



69

- ក្រាហ្វិកស្កេលទីតាំងផែនទី
- ក្រាហ្វិកស្កេលទីតាំងផែនទី
- ក្រាហ្វិកស្កេលទីតាំងផែនទី

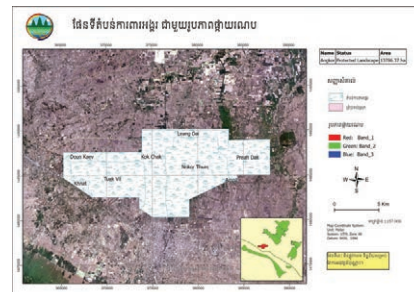


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- ការបញ្ចេញទិន្នន័យជាទម្រង់ Geo-PDF
- ដោយប្រើ Share ឬរៀបចំ Export Layout ហើយយក GeoReferenced PDF
- ឬប្រើសេរីសម្រាប់ផ្ទេរទិន្នន័យទៅក្នុង Geo-PDF



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1. បង្កើតផែនទី

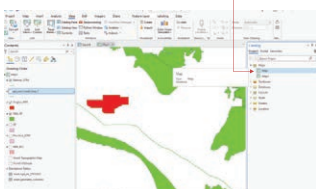
បង្កើតផែនទីជាមួយ



- ផ្ទេរទិន្នន័យ ចូលទៅក្នុង Contents

2. បង្កើតផែនទី

- ផ្ទេរទិន្នន័យ ចូលទៅក្នុង Catalog Pane
- ផ្ទេរទិន្នន័យ ចូលទៅក្នុង ផែនទីដែលបង្កើត



3. បង្កើតផែនទី

- ផ្ទេរទិន្នន័យ ចូលទៅក្នុង Catalog Pane
- ផ្ទេរទិន្នន័យ ចូលទៅក្នុង ផែនទីដែលបង្កើត



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添付資料 4: GIS 研修資料（中上級）

Day 01 Orientation

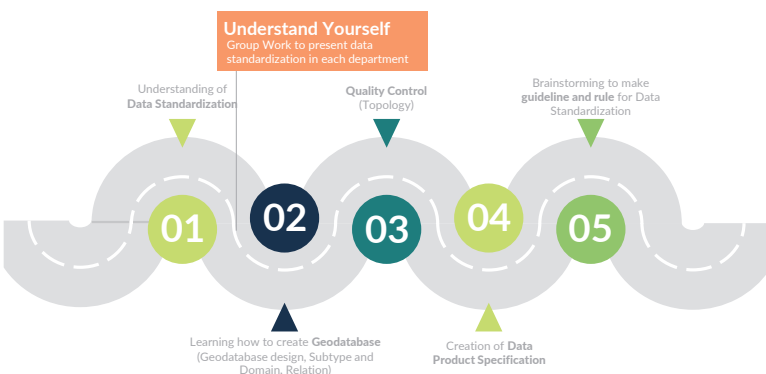
Intermediate and Advanced GIS Training

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

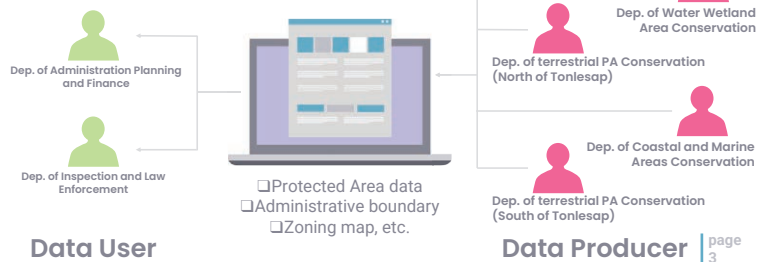
Intermediate and Advanced GIS training

From 15th July to 19th July, 2024

What is Data Standards?

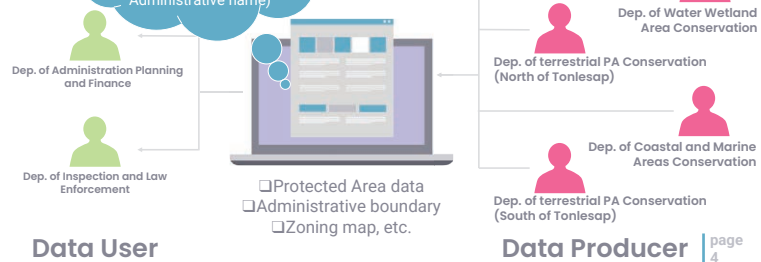
What is "Data Standards"?

Let's start from thinking about GDNPA.



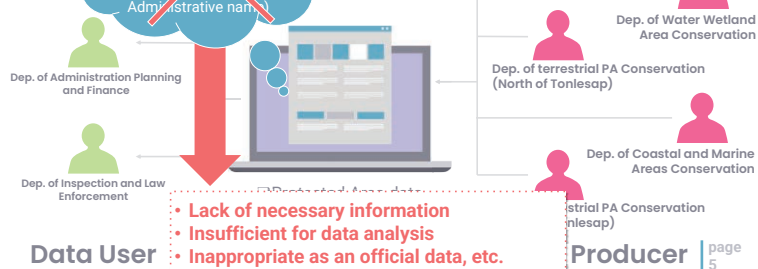
What is

Let's start from thinking about MPA.



What is

Let's start from thinking about MPA.



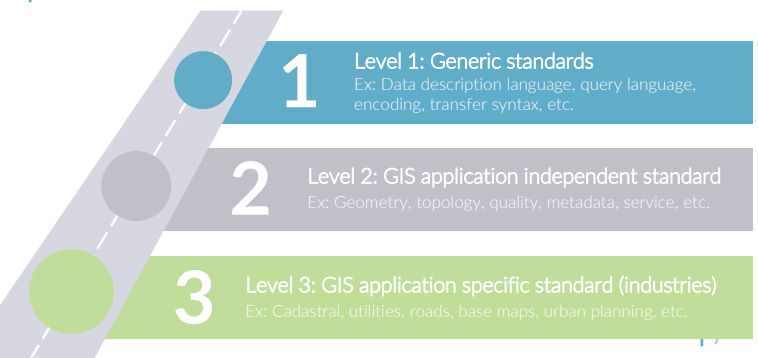
Data standards

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

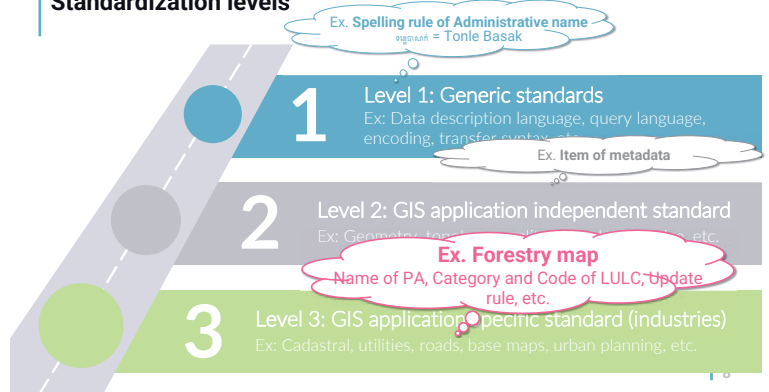
The standards provide definition of data structure, data content and rules that

- Increase **mutual understanding** of the geographic data among the users
- Eliminate the technical problems** of exchanging the data
- 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).

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

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

Day 02 Geodatabase Creation

Intermediate and Advanced GIS Training

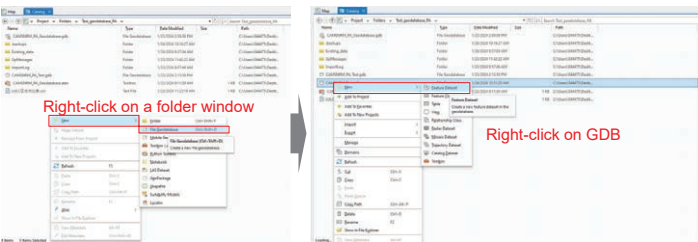
From 15th July to 19th July, 2024

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

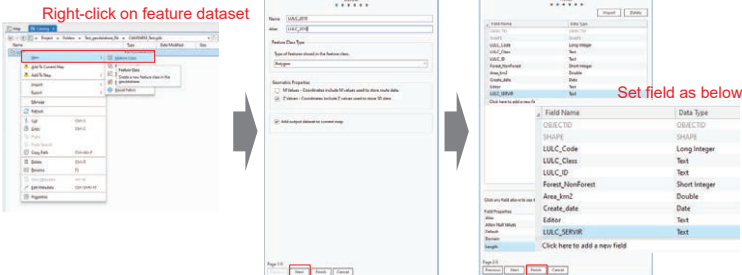
1. Creation of Geodatabase

- 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)



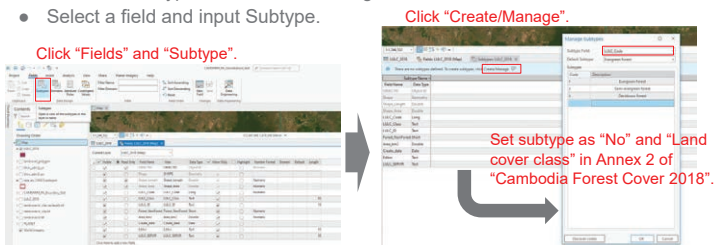
1. Creation of Geodatabase

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



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.

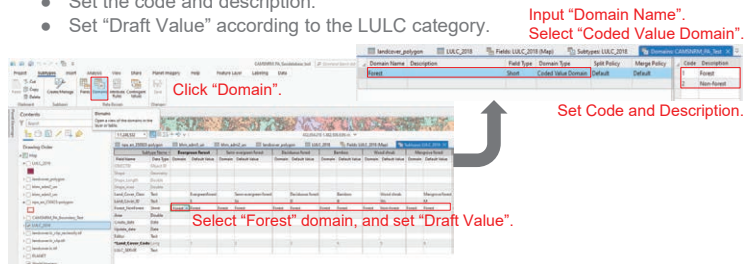
↓ Input LULC category name one by one.

↑ 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 Name	Text	Emergent Forest		Semi-evergreen Forest		Deciduous Forest		Bamboo		Wood Shrub		Mangrove Forest		Rice Mangrove	
Subtype ID	Text	1		2		3		4		5		6		7	
LULC_Class	Text	Emergent Forest		Semi-evergreen Forest		Deciduous Forest		Bamboo		Wood Shrub		Mangrove Forest		Rice Mangrove	
LULC_ID	Text	1		2		3		4		5		6		7	
Creation_date	Date														
Update_date	Date														
Editor	Text														
LULC_Cover_Code	Text	1		2		3		4		5		6		7	
LULC_Shortcut	Text														

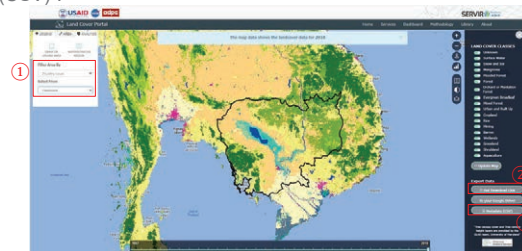
1. Creation of Geodatabase

- 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.



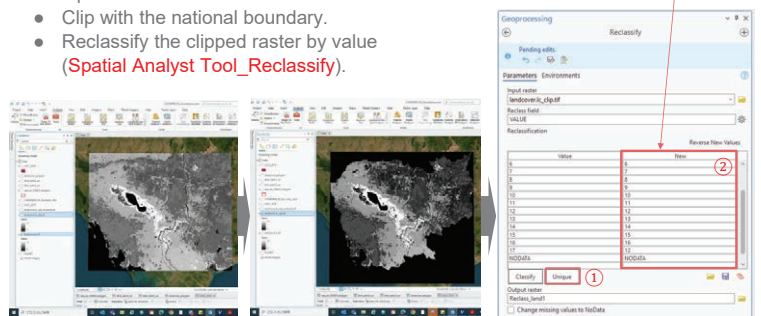
2. Input LULC data_Downloading LULC data from SERVIR SEA

- 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)".



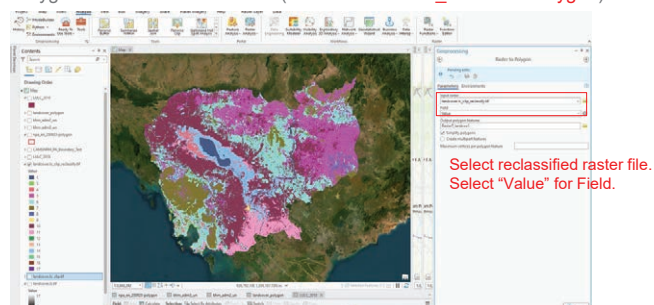
2. Input LULC data_Reclassify the downloaded raster data

- 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).



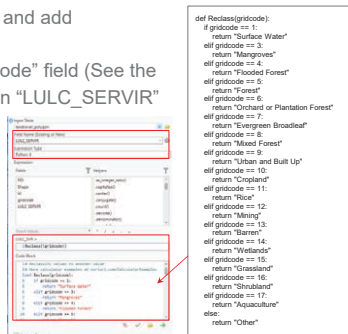
2. Input LULC data_Polygonization of classified data

- 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

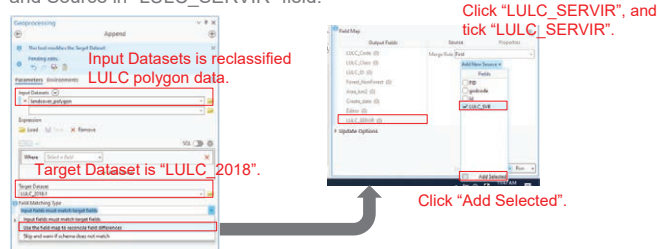
-LULC_SERVIR: Reclass(Igridcode!)

-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
1	012.576407	Deciduous forest	D	Forest	0.071014	1/23/2024	<Null>	<Null>	Forest
2	009.076111	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Mixed Forest
3	4391.270040	Tree plantation	fp	Forest	0.134391	1/23/2024	<Null>	<Null>	Orchard or Plantation...
4	009.780740	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Mixed Forest
5	009.974632	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Mixed Forest
6	009.398108	Grassland	G	Non-forest	0.050899	1/23/2024	<Null>	<Null>	Grassland
7	048.521978	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Forest
8	1798.034188	Deciduous forest	D	Forest	0.101798	1/23/2024	<Null>	<Null>	Forest
9	1798.440241	Broadleaf forest	B	Forest	0.101798	1/23/2024	<Null>	<Null>	Broadleaf forest
10	009.671640	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Mixed Forest
11	1798.556407	Deciduous forest	D	Forest	0.101798	1/23/2024	<Null>	<Null>	Forest
12	2699.805705	Deciduous forest	D	Forest	0.1527	1/23/2024	<Null>	<Null>	Mixed Forest

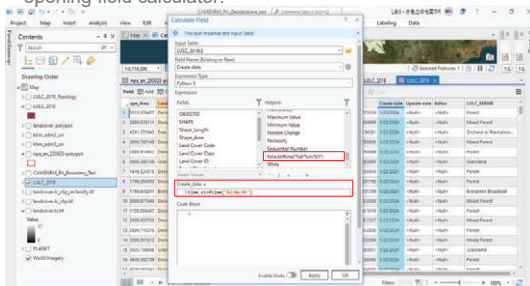
3. Finalize LULC data according to MoE classification

- 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
1	012.576407	Deciduous forest	D	Forest	0.071014	1/23/2024	<Null>	<Null>	Forest
2	009.076111	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Mixed Forest
3	4391.270040	Tree plantation	fp	Forest	0.134391	1/23/2024	<Null>	<Null>	Orchard or Plantation...
4	009.780740	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Mixed Forest
5	009.974632	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Mixed Forest
6	009.398108	Grassland	G	Non-forest	0.050899	1/23/2024	<Null>	<Null>	Grassland
7	048.521978	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Forest
8	1798.034188	Deciduous forest	D	Forest	0.101798	1/23/2024	<Null>	<Null>	Forest
9	1798.440241	Broadleaf forest	B	Forest	0.101798	1/23/2024	<Null>	<Null>	Broadleaf forest
10	009.671640	Deciduous forest	D	Forest	0.050899	1/23/2024	<Null>	<Null>	Mixed Forest
11	1798.556407	Deciduous forest	D	Forest	0.101798	1/23/2024	<Null>	<Null>	Forest
12	2699.805705	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

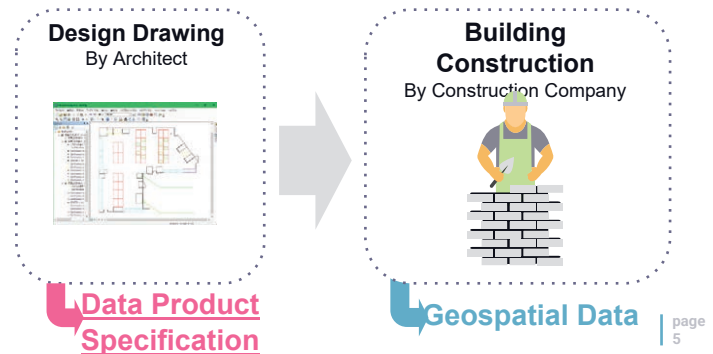
page 3

Role of DPS



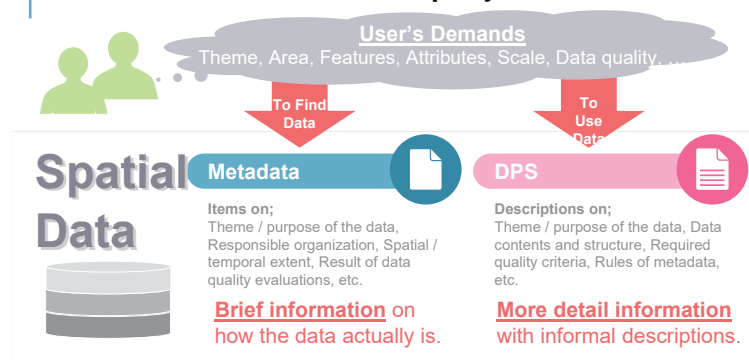
page 4

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

02

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 (SNRMA) 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

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

3. Data Product Identification

3.1. Name

Geodatabase of Sustainable Natural Resources Management Project (SNRMA_data)

3.2. Date of data creation

The SNRMA_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: Manohi, Echa 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 SNRMA_data covers the entire Cambodia.

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10

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 (SNRMA_data)

3.2. Date of data creation

The SNRMA_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: Manohi, Echa 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 SNRMA_data covers the entire Cambodia.

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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	SNRMA_DATA.mxd
Feature dataset name	LULC_C_2018
Feature class name	LULC_C_2018
Feature type	Polygon
Number of record	171,489
Data source	Covered 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	Object ID		Object ID in geodatabase
Shape	Shape	Geometry		
Shape_Length	Shape_Length	Long		
Shape_Area	Shape_Area	Long		
Land_Cover_Code	Land_Cover_Code	Text (50)		Land use category
Land_Cover_ID	Land_Cover_ID	Text (50)		ID of land use category
Forest_NonForest	Forest_NonForest	Short	Forest	Forest or Non-Forest
Area	Area	Double		
Create_date	Create_date	Date		Date of data creation
Update_date	Update_date	Date		Date of data update
Editor	Editor	Text (50)		Name of data editor
Land_Cover_Code	Land_Cover_Code	Long		Subtype is set in this field
LULC_SERVIR	LULC_SERVIR	Text (50)		Land cover information of SERVIR data

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Data content and structure section

Subtype and domain details should be written.

Sample

Subtype Table		Domain Table			
Subtype name	Field	Code	Description	Domain name	Field type
LULC category	Land_Cover_Code	1	Evergreen forest	Forest	Short
		2	Semi-evergreen forest		Coded Value
		3	Deciduous forest		Domain
		4	Bamboo		
		5	Wood shrub		
		6	Mangrove forest		
		7	Rice Mangrove		
		8	Rubber plantation		
		9	Flooded Forest		
		10	Forest Regrowth		
		11	Pine Tree		
		12	Pine plantation		
		13	Old rubber		
		14	Tree plantation		
		15	Paddy field		
		16	Crop Land		
		17	Cropland		
		18	Build-up area		
		19	Village		
		20	Rock		
		21	Sand		
		22	Water		

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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:	Transverse Mercator
Projection parameters:	
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
Semi-major Axis:	6378137.0
Semi-minor Axis:	6356752.314245179
Inverse Flattening:	298.257222583
5.2. Temporal reference system	
Reference system identifier:	Gregorian Calendar

page
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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.

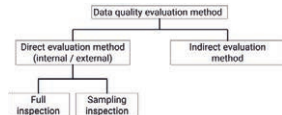
Indirect evaluation method

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 map used:	
If you use vector map data such as topographic maps, etc., please describe details here.	
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.	

Data quality evaluation methods



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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.

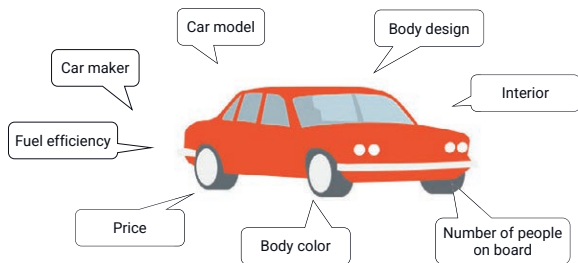
Sample

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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Metadata section

What is Metadata?



Search at car dealer, etc.

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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	Spatial data - Polygon
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.



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

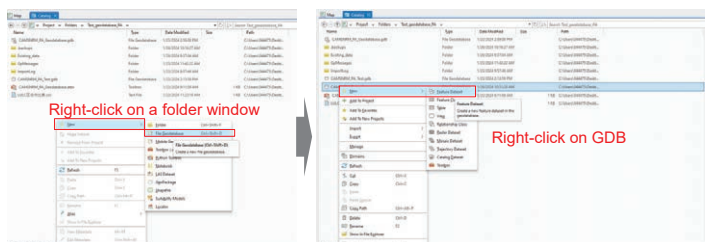
- Geodatabase design_Field

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)

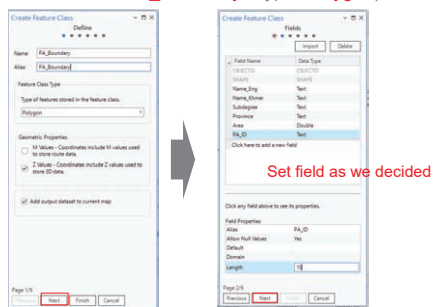


4

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.

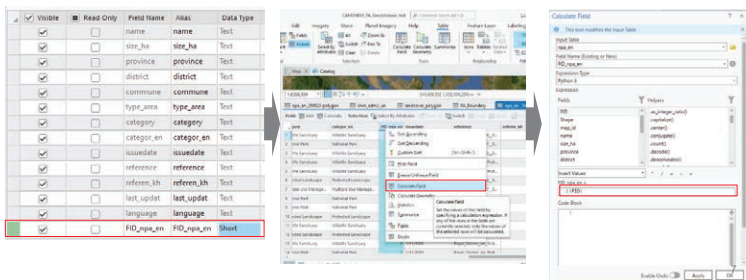
Visible	Read Only	Field Name	Alias	Data Type
☒	☒	OBJECTID	OBJECTID	Object ID
☒	☐	Shape	SHAPE	Geometry
☒	☒	Shape_Length	Shape_Length	Double
☒	☒	Shape_Area	Shape_Area	Double
☒	☐	Name_Eng	Name_Eng	Text
☒	☐	Name_Khmer	Name_Khmer	Text
☒	☐	Subdegree	Subdegree	Text
☒	☐	Province	Province	Text
☒	☐	Area	Area	Double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

6

2. Data integration

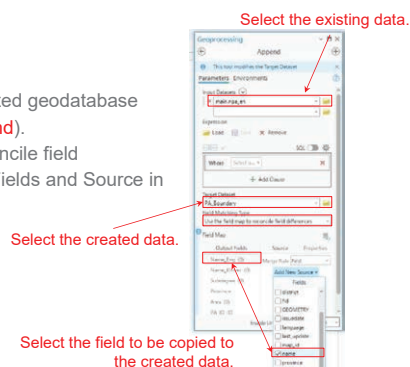
- Data edition of existing data for data integration (Add FID: unique number).

*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.



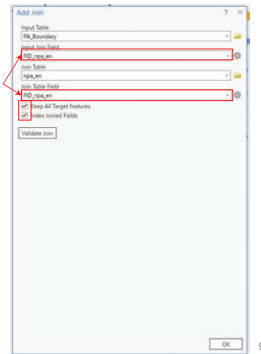
8

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	101	Prey Lang Village Sat...	<Null>	<Null>	43,660	<Null>	0	0	0
3	102	Meun Sac-Sac Village Sat...	<Null>	<Null>	57,660	<Null>	1	1	1
4	103	Prey Lang Village Sat...	<Null>	<Null>	57,660	<Null>	2	2	2
5	104	Prey Lang Village Sat...	<Null>	<Null>	57,660	<Null>	3	3	3
6	105	Prey Lang Village Sat...	<Null>	<Null>	57,660	<Null>	4	4	4
7	106	Prey Lang Village Sat...	<Null>	<Null>	57,660	<Null>	5	5	5
8	107	Prey Lang Village Sat...	<Null>	<Null>	57,660	<Null>	6	6	6
9	108	Prey Lang Village Sat...	<Null>	<Null>	57,660	<Null>	7	7	7
10	109	Prey Lang Village Sat...	<Null>	<Null>	57,660	<Null>	8	8	8

Fields of the created data

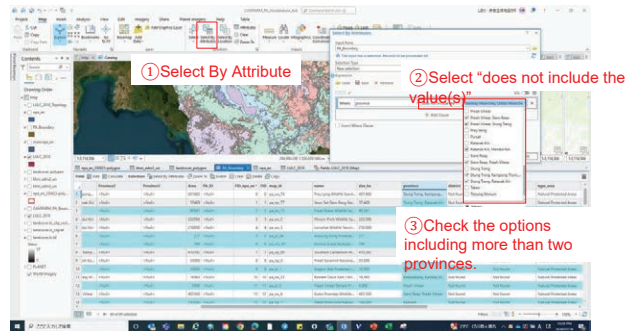
Fields of the existing data

* Additional exercise (Copy "Province" information separately.)

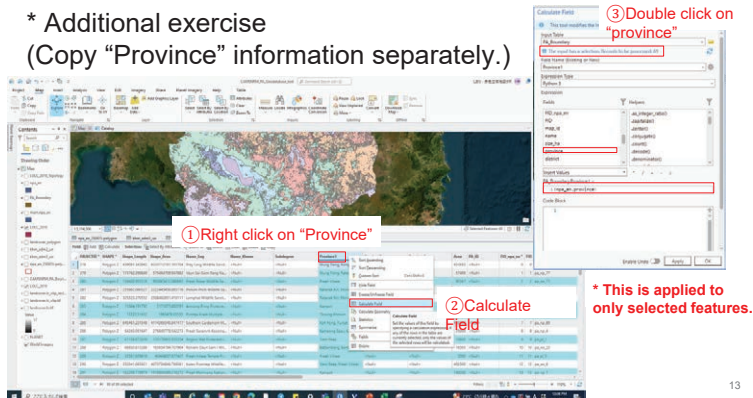
Visible	Read Only	Field Name	Alias	Data Type	Allow NULL	Highlight	Number Format	Domain	Default	Length
☒	☒	OBJECTID	OBJECTID	Object ID	☒	☐	Numeric			
☒	☒	Shape	Shape	Geometry	☒	☐				
☒	☒	Shape_Length	Shape_Length	Double	☒	☐	Numeric			
☒	☒	Shape_Area	Shape_Area	Double	☒	☐	Numeric			
☒	☐	Name_Eng	Name_Eng	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

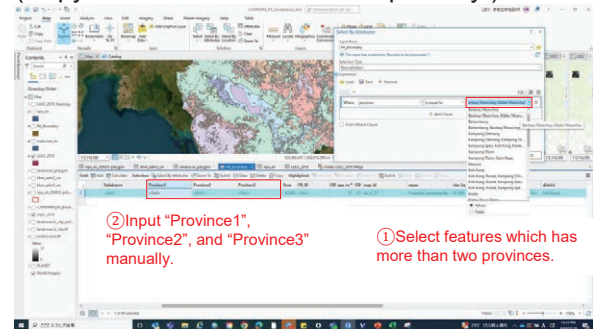
* Additional exercise (Copy "Province" information separately.)



* 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

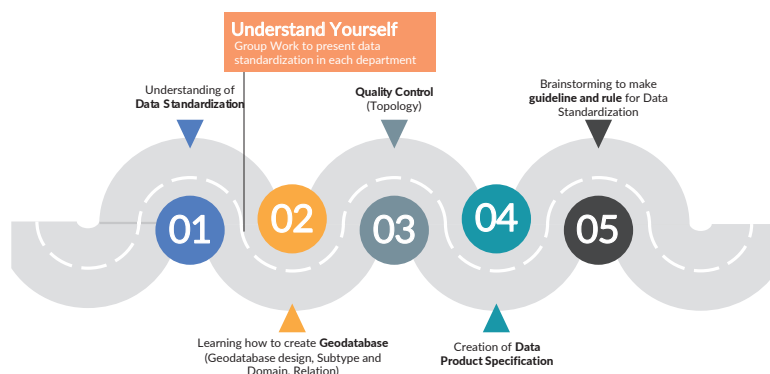
Session No.	Date	Time (JST)		Program outline	Course style	Equipment
1	19-Aug-24	9:00 – 12:00	Mon	9:00 – 9:30 Training orientation and self-introduction	Presentation	–
		9:30 – 12:00		Review of the 1st training	Presentation and Hands-on	PC, ArcGIS Pro
		14:00 – 16:00		Practice: How to combine multiple 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

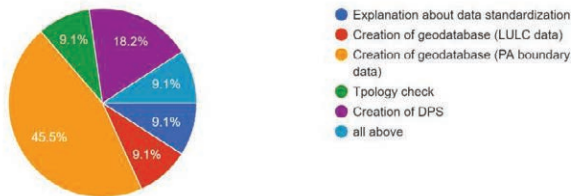
From 19th August to 23rd August, 2024

Overview of the 1st training



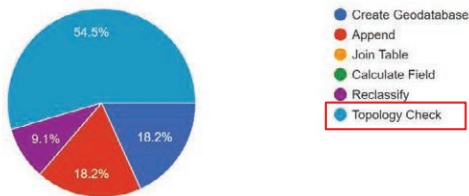
Results of questionnaire

1.2 Which lecture is the most interested?
11 responses



Results of questionnaire

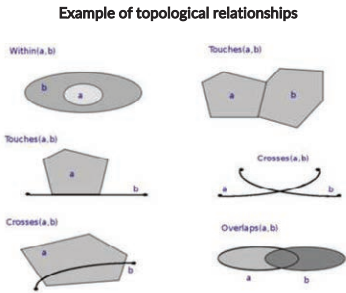
1.3 Which function of ArcGIS is the most difficult?
11 responses



Review of Topology check

What is Topology?

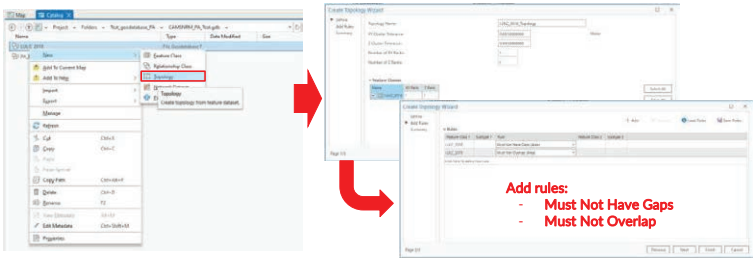
- Qualitative spatial relationships between geographic features.
- Using a topology provides a mechanism to perform integrity checks on your data and helps you validate and maintain better feature representations in your geodatabase.



Review of Topology check

Create a topology

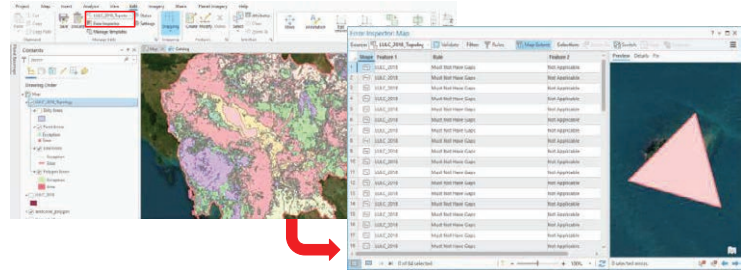
- Create a new topology. Open Catalog View, and right-click on the feature dataset and click on "New" and "Topology".



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

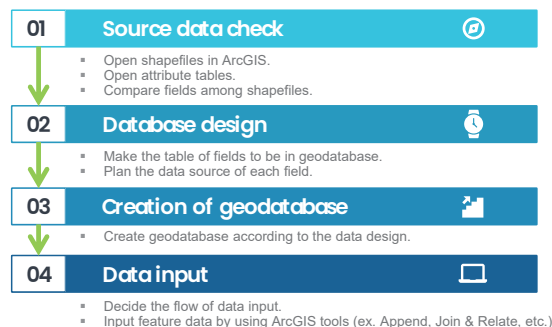
- Combine the following data as geodatabase format;
 - Community protected areas (2006-2021) (English)
 - Community protected areas (2006-2021) (Khmer)
 - Community forestry (2008-2017) (English)
 - Community forestry (2008-2017) (Khmer)

* 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

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.

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

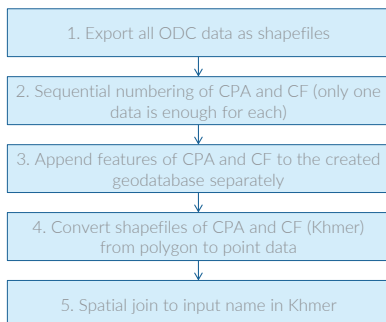
04 Data input

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



3.5. Exercise5:

Decide the flow of data input.



04 Data input

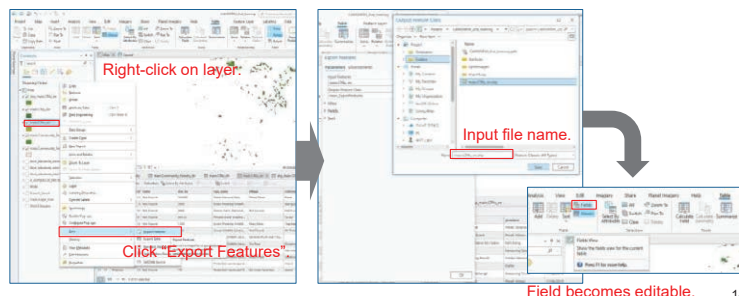
- Decide the flow of data input.
- Input feature data by using ArcGIS tools.

13

3.6. Exercise6:

Input feature data by using ArcGIS.

1. Export all ODC data as shapefiles

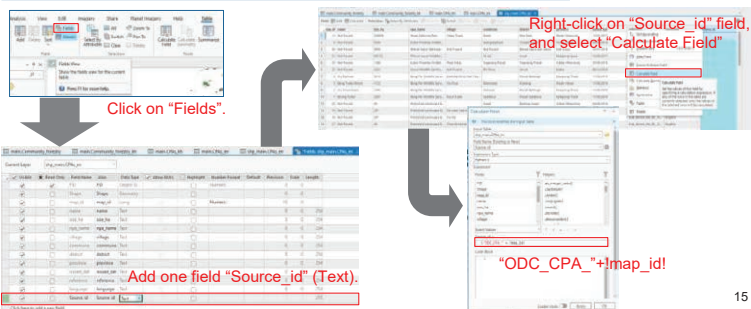


14

3.6. Exercise6:

Input feature data by using ArcGIS.

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

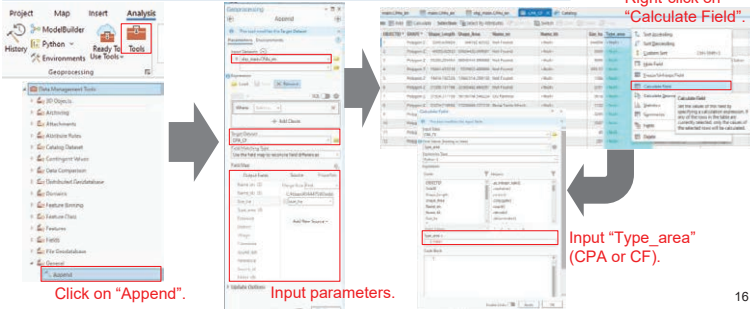


15

3.6. Exercise6:

Input feature data by using ArcGIS.

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

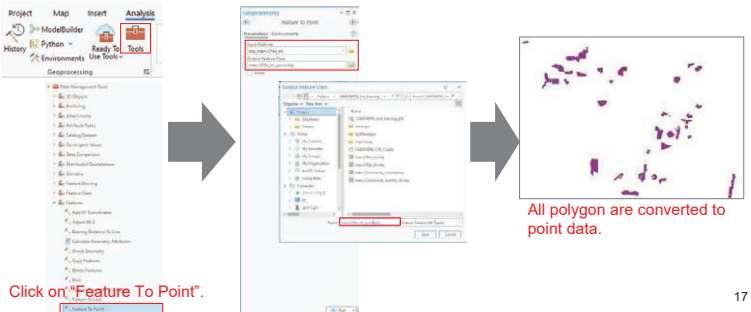


16

3.6. Exercise6:

Input feature data by using ArcGIS.

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

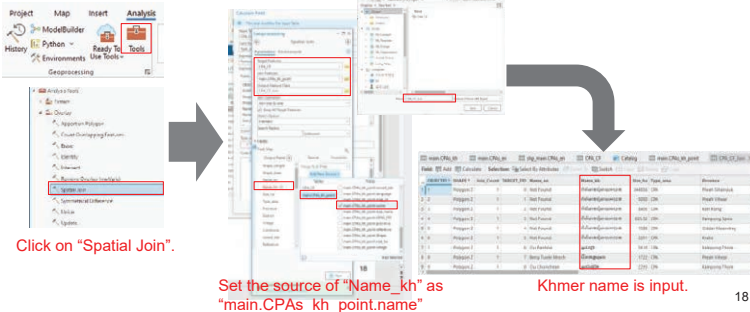


17

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

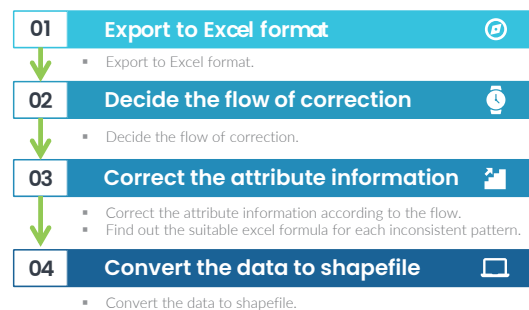
Open the shapefile and attribute table. By checking "com_name", write down the inconsistent pattern in the following table.

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.

Project Map Insert Analysis
History Python Ready To Go
Environments Use Tools
Geoprocessing

Geoprocessing
Table to Excel
Parameters
Input file name (CAMS_NRM_Commune).
Open Excel file.

Click "Table to Excel".

01 Export to Excel format

Export to Excel format.

7

3.2. Exercise2:

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*

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>

#	OBJECTID	LEVEL	TYPECODE	NAME	NAME_CORRECT	DIS_CODE	DIS_CODE	PRJ_CODE
1	0	1	3	KH190001	KH190001	TaVeaengLeu	TaVeaengLeu	190001
2	1	2	3	KH190002	KH190002	TaVeaengLeu	TaVeaengLeu	190002
3	2	3	3	KH190003	KH190003	TaVeaengLeu	TaVeaengLeu	190003
4	3	4	3	KH190004	KH190004	TaVeaengLeu	TaVeaengLeu	190004
5	4	5	3	KH190005	KH190005	TaVeaengLeu	TaVeaengLeu	190005
6	5	6	3	KH190006	KH190006	TaVeaengLeu	TaVeaengLeu	190006
7	6	7	3	KH190007	KH190007	TaVeaengLeu	TaVeaengLeu	190007
8	7	8	3	KH190008	KH190008	TaVeaengLeu	TaVeaengLeu	190008
9	8	9	3	KH190009	KH190009	TaVeaengLeu	TaVeaengLeu	190009
10	9	10	3	KH190010	KH190010	TaVeaengLeu	TaVeaengLeu	190010
11	10	11	3	KH190011	KH190011	TaVeaengLeu	TaVeaengLeu	190011
12	11	12	3	KH190012	KH190012	TaVeaengLeu	TaVeaengLeu	190012
13	12	13	3	KH190013	KH190013	TaVeaengLeu	TaVeaengLeu	190013
14	13	14	3	KH190014	KH190014	TaVeaengLeu	TaVeaengLeu	190014
15	14	15	3	KH190015	KH190015	TaVeaengLeu	TaVeaengLeu	190015
16	15	16	3	KH190016	KH190016	TaVeaengLeu	TaVeaengLeu	190016
17	16	17	3	KH190017	KH190017	TaVeaengLeu	TaVeaengLeu	190017
18	17	18	3	KH190018	KH190018	TaVeaengLeu	TaVeaengLeu	190018
19	18	19	3	KH190019	KH190019	TaVeaengLeu	TaVeaengLeu	190019
20	19	20	3	KH190020	KH190020	TaVeaengLeu	TaVeaengLeu	190020
21	20	21	3	KH190021	KH190021	TaVeaengLeu	TaVeaengLeu	190021
22	21	22	3	KH190022	KH190022	TaVeaengLeu	TaVeaengLeu	190022

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*

① Open Excel Options from "File" tab.

②

③

④

⑤

⑥

⑦

⑧ Input code and save.

Function AddSpace(Vba As String) As String
Update 20140723
Dim xOut As String
xOut = VBA.Left(Vba, 1)
For i = 2 To VBA.Len(Vba)
xOut = xOut & " " & VBA.Mid(Vba, i, 1)
Next i
xOut = xOut & VBA.Mid(Vba, i, 1)
End Function
Setting VBA module.

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3.3. Exercise3:

Correct the attribute information: Add space between words.

#	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*

⑨ Insert a new column "com_name_correct_2".

⑩ Input "=AddSpaces(select "com_name_correct_1")".

⑪ Copy down. "Ctrl+Shift+PgDn" ⇒ "Ctrl+D"

Function AddSpaces(Vba As String) As String
Update 20140723
Dim xOut As String
xOut = VBA.Left(Vba, 1)
For i = 2 To VBA.Len(Vba)
xOut = xOut & " " & VBA.Mid(Vba, i, 1)
Next i
xOut = xOut & VBA.Mid(Vba, i, 1)
End Function
Setting VBA module.

#	OBJECTID	LEVEL	TYPECODE	NAME	NAME_CORRECT_1	NAME_CORRECT_2	DIS_CODE	DIS_CODE	PRJ_CODE
1	0	1	3	KH190001	KH190001	TaVeaengLeu	TaVeaengLeu	190001	190001
2	1	2	3	KH190002	KH190002	TaVeaengLeu	TaVeaengLeu	190002	190002
3	2	3	3	KH190003	KH190003	TaVeaengLeu	TaVeaengLeu	190003	190003
4	3	4	3	KH190004	KH190004	TaVeaengLeu	TaVeaengLeu	190004	190004
5	4	5	3	KH190005	KH190005	TaVeaengLeu	TaVeaengLeu	190005	190005
6	5	6	3	KH190006	KH190006	TaVeaengLeu	TaVeaengLeu	190006	190006
7	6	7	3	KH190007	KH190007	TaVeaengLeu	TaVeaengLeu	190007	190007
8	7	8	3	KH190008	KH190008	TaVeaengLeu	TaVeaengLeu	190008	190008
9	8	9	3	KH190009	KH190009	TaVeaengLeu	TaVeaengLeu	190009	190009
10	9	10	3	KH190010	KH190010	TaVeaengLeu	TaVeaengLeu	190010	190010
11	10	11	3	KH190011	KH190011	TaVeaengLeu	TaVeaengLeu	190011	190011
12	11	12	3	KH190012	KH190012	TaVeaengLeu	TaVeaengLeu	190012	190012
13	12	13	3	KH190013	KH190013	TaVeaengLeu	TaVeaengLeu	190013	190013
14	13	14	3	KH190014	KH190014	TaVeaengLeu	TaVeaengLeu	190014	190014
15	14	15	3	KH190015	KH190015	TaVeaengLeu	TaVeaengLeu	190015	190015
16	15	16	3	KH190016	KH190016	TaVeaengLeu	TaVeaengLeu	190016	190016
17	16	17	3	KH190017	KH190017	TaVeaengLeu	TaVeaengLeu	190017	190017
18	17	18	3	KH190018	KH190018	TaVeaengLeu	TaVeaengLeu	190018	190018
19	18	19	3	KH190019	KH190019	TaVeaengLeu	TaVeaengLeu	190019	190019
20	19	20	3	KH190020	KH190020	TaVeaengLeu	TaVeaengLeu	190020	190020
21	20	21	3	KH190021	KH190021	TaVeaengLeu	TaVeaengLeu	190021	190021
22	21	22	3	KH190022	KH190022	TaVeaengLeu	TaVeaengLeu	190022	190022

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添付資料4-18

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"

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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/proper-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.

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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-a7b0-1e58df3bc332>

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"

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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).

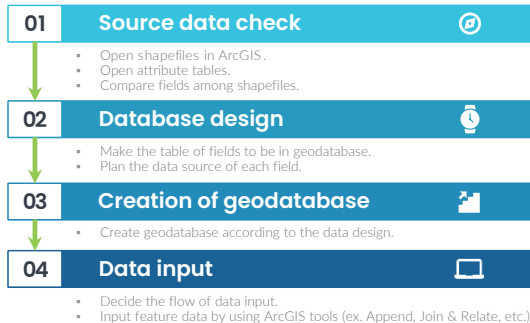


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From 19th August to 23rd August, 2024

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	Length
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	30
7	Name_E	Text	100		Name_E	Text	100		Name_E	Text	100		Name_E	Text	100		Name_E	Text	100
8	Name_Kh	Text	100		Name_Kh	Text	100		Name_Kh	Text	100		Name_Kh	Text	100		Name_Kh	Text	100
9	PA_ID	Text	10		PA_ID	Text	10		PA_ID	Text	10		PA_ID	Text	10		PA_ID	Text	10
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	50
15	Respond	Text	254		Respond	Text	254		Respond	Text	254		Respond	Text	254		Respond	Text	254

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_E	Name_E	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

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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:

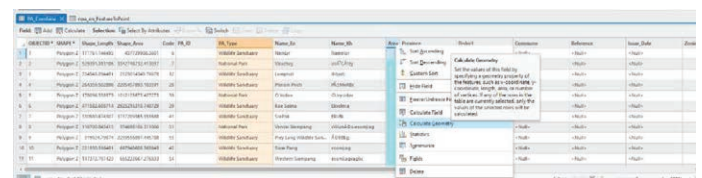
Create the geodatabase according to your database design.

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_E	Name_E	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

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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".

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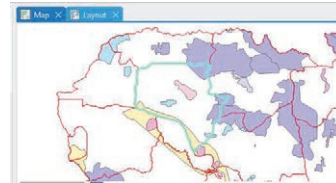
04 Data input

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

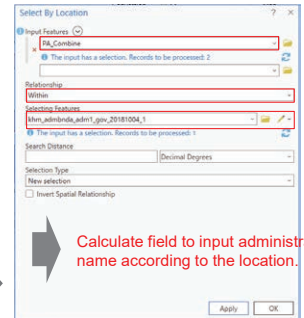


3_4. Exercise4:

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?

*My contact: Shiori Taniguchi (sor.taniguchi@ajiko.co.jp)

12

添付資料 5: 回転翼ドローン操作研修資料



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

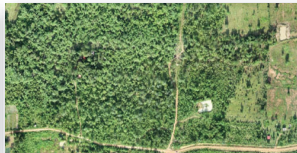
ការណែនាំអំពីវគ្គបណ្តុះបណ្តាល (បន្ត)

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)

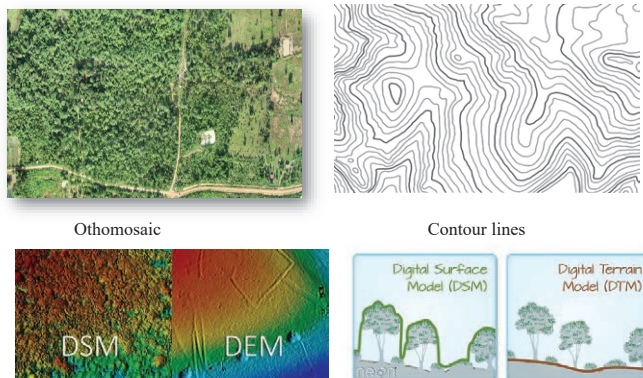
❑ នៅក្នុងកិច្ចការពារធនធានធម្មជាតិ ជ្រុងត្រូវបានប្រើប្រាស់លើមុខងារ៖

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

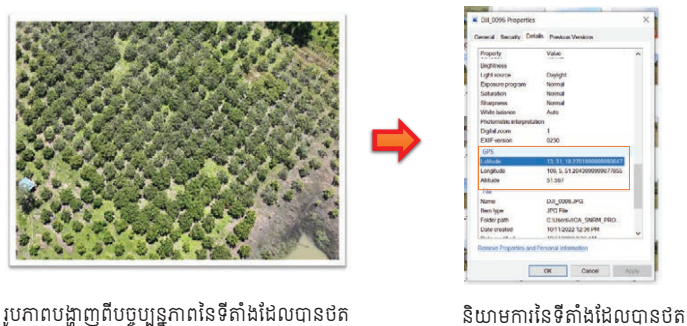


6

លទ្ធផលរំពឹងទុកបន្ទាប់ពីការហោះហើរជ្រួន



លទ្ធផលរំពឹងទុកបន្ទាប់ពីការហោះហើរជ្រួន (បន្ត)



លទ្ធផលរំពឹងទុកបន្ទាប់ពីការហោះហើរជ្រួន (បន្ត)



រូបភាពភាពដែលទទួលបានពីការដំណើរការរូបភាពជ្រួន

ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រួន DJI Phantom 4

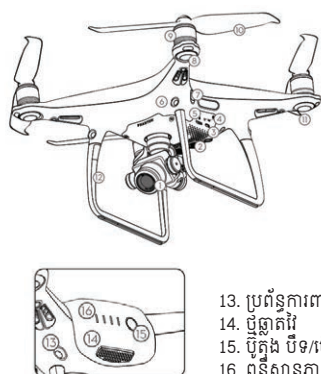
សមត្ថភាពរបស់ជ្រួន

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



ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រួន DJI Phantom 4 (បន្ត)

ផ្នែករបស់ជ្រួន



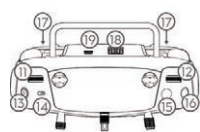
1. ជើងទប់លំនឹង និងការម៉ា
2. ប្រព័ន្ធការពារផ្នែកខាងក្រោម
3. កន្លែងដោត USB
4. ប៊ូតុងភ្ជាប់
5. កន្លែងដាក់មេម៉ូរី
6. ប្រព័ន្ធការពារផ្នែកខាងមុខ
7. ប្រព័ន្ធការពារ Infrared
8. ប្រព័ន្ធការពារផ្នែកខាងមុខ
9. ម៉ូទ័រ
10. ស្លាប
11. ពន្លឺបង្ហាញស្ថានភាពជ្រួន
12. អង្គតែង

13. ប្រព័ន្ធការពារផ្នែកខាងក្រោម
14. ថ្មប្លាត់អ៊ី
15. ប៊ូតុង ប៊ីទ/ប៊ីកថ្ម
16. ពន្លឺស្ថានភាពកម្រិតថ្ម

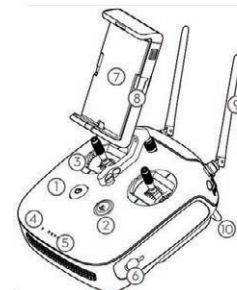
ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រួន DJI Phantom 4 (បន្ត)

មុខងារដៃបញ្ជា

1. ប៊ូតុង ប៊ីទ/ប៊ីកដៃបញ្ជា
2. ប៊ូតុងត្រឡប់មកផ្ទះ
3. ដងបញ្ជា
4. ពន្លឺស្ថានភាពដៃបញ្ជា
5. ពន្លឺស្ថានភាពកម្រិតថ្ម
6. កន្លែងដោតបញ្ចូលថ្ម
7. ដងគៀបទូរសព្ទ
8. ដងទប់ទូរសព្ទ
9. អង្គតែង
10. ដងកាន់



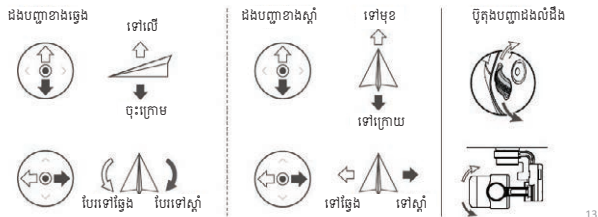
11. ប៊ូតុងបញ្ជាដងទប់ទំនឹង
12. ប៊ូតុងកំណត់ការម៉ា
13. ប៊ូតុងថតវីដេអូ
14. កន្លែងប្តូរមុខងារហោះហើរ
15. ប៊ូតុងថតរូប
16. ប៊ូតុងផ្អាកការហោះហើរបណ្តោះអាសន្ន (Pause)
17. ប៊ូតុងមុខងារកំណត់ C1 និង C2 (customizable)
18. កន្លែងភ្ជាប់ USB
19. កន្លែងភ្ជាប់ USB តូច



ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រុង DJI Phantom 4 (បន្ត)

មុខងារដែលបញ្ជា (បន្ត)

- មុខងារគ្រប់គ្រងការហោះហើរលើស្ទើរដើម្បី Mode 2
- ដងបញ្ជាខាងឆ្វេងប្រើសម្រាប់កំណត់កម្ពស់ជ្រុង និងផ្នែកខាងមុខជ្រុង ចំណែកដងបញ្ជាខាងស្តាំសម្រាប់ហោះទៅមុខ ក្រោយ ឆ្វេង និងស្តាំ។ ប៊ូតុងបញ្ជាដងលំនឹងគឺជាបញ្ជាការហោះហើរឡើងលើ/បែចុះក្រោម។



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ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រុង DJI Phantom 4 (បន្ត)

ការដំឡើងកម្មវិធីសម្រាប់គ្រប់គ្រងការហោះហើរ

❖ ជំហានទី ១៖ ដំឡើង DJI GO 4

❖ ជំហានទី ២៖ រំលឹកអំពីការប្រើប្រាស់



DJI GO 4 App



Tutorial Videos

www.dji.com/phantom-4-pro-v2/info#video

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ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រុង DJI Phantom 4 (បន្ត)

ការដំឡើងកម្មវិធីសម្រាប់ការធ្វើផែនទី

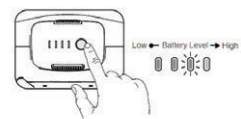
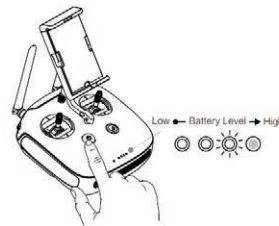


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ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រុង DJI Phantom 4 (បន្ត)

ការត្រួតពិនិត្យថ្នាំ

❖ ជំហានទី ៣៖ ពិនិត្យកម្រិតថ្នាំ



- ❑ ចុចមួយដងដើម្បីពិនិត្យថ្នាំ
- ❑ ចុចម្តងទៀត និងសង្កត់អោយជាប់ ដើម្បីបើក/បិទ

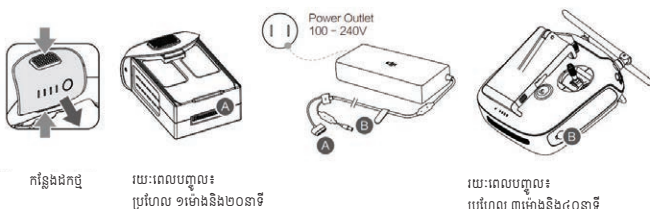
កម្រិតបញ្ចូលកម្រិតបញ្ចូល				កម្រិតបញ្ចូល	កម្រិតបញ្ចូល
LED1	LED2	LED3	LED4	កម្រិតបញ្ចូល	កម្រិតបញ្ចូល
■	■	■	■	0%-25%	0%-25%
■	■	■	■	25%-50%	25%-50%
■	■	■	■	50%-75%	50%-75%
■	■	■	■	75%-100%	75%-100%
■	■	■	■	ថ្នាំពេញ	ថ្នាំពេញ

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ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រុង DJI Phantom 4 (បន្ត)

ការត្រួតពិនិត្យសាកថ្នាំ

❖ ជំហានទី ៤៖ ការបញ្ចូលថ្នាំ



កម្រិតដកថ្នាំ

រយៈពេលបញ្ចូល៖
ប្រហែល ១ម៉ោងនិង២០នាទី

រយៈពេលបញ្ចូល៖
ប្រហែល ៣ម៉ោងនិង៤០នាទី

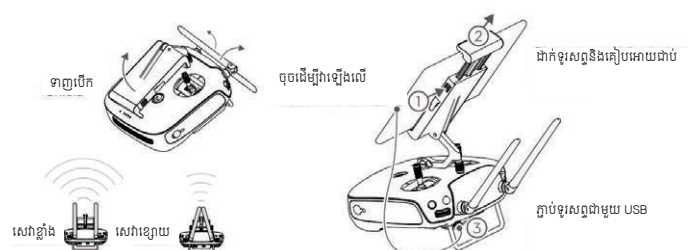
ពេលបញ្ចូលថ្នាំពេញ វានឹងបិទការបញ្ចូលកម្រិតដោយស្វ័យប្រវត្តិ

17

ការស្វែងយល់អំពីការប្រើប្រាស់ជ្រុង DJI Phantom 4 (បន្ត)

ការរៀបចំដៃបញ្ជាជ្រុង

❖ ជំហានទី ៥៖ ការរៀបចំដៃបញ្ជាជ្រុង



ទាញបើក

ចុចដើម្បីរំលឹក

ដាក់ទូរសព្ទនិងភ្ជាប់អោយជាប់

ភ្ជាប់ទូរសព្ទជាមួយ USB

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ការត្រួតមុនពេលហោះហើរ



ចុចដំណើរការកម្មវិធី DJI GO 4

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ការត្រួតមុនពេលហោះហើរ (បន្ត)

A diagram of a cell. It features a large, circular nucleus with a smaller, darker nucleolus inside. A large, clear vacuole is located in the lower right portion of the cell. The cell is bounded by a cell membrane.



ក្លាបស្ថាបដែលមានព័ត៌មាន
ជាមួយម៉ូទ័រពណ៌ខ្មៅ

ភ្ជាប់ស្លាបដែលមាន
ជាមួយម៉ូទ័រពណ៌ទឹក

ការត្រួតមុនពេលហោះហើរ (បន្ត)



21

ការត្រួតមុនពេលហោះហើរ (បន្ត)



2

ការត្រួតមុនពេលហោះហើរ (បន្ត)



23

ការត្រួតមុនពេលហោះហើរ (បន្ត)

4

ការរៀបចំសម្ភារៈសម្រាប់ការហោះហើរជ្រួន DJI Phantom 4

១. ត្រួតពិនិត្យសម្ភារៈនៅក្នុងប្រអប់



25

ការរៀបចំសម្ភារៈសម្រាប់ការហោះហើរជ្រួន DJI Phantom 4 (បន្ត)

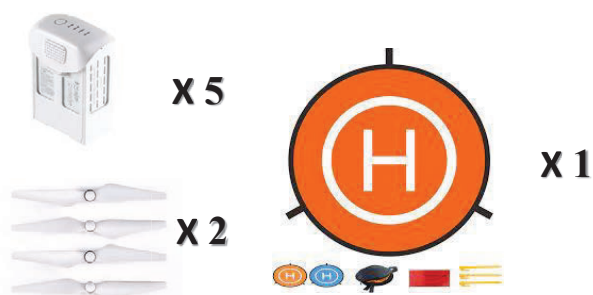
១. ត្រួតពិនិត្យសម្ភារៈនៅក្នុងប្រអប់ (បន្ត)



26

ការរៀបចំសម្ភារៈសម្រាប់ការហោះហើរជ្រួន DJI Phantom 4 (បន្ត)

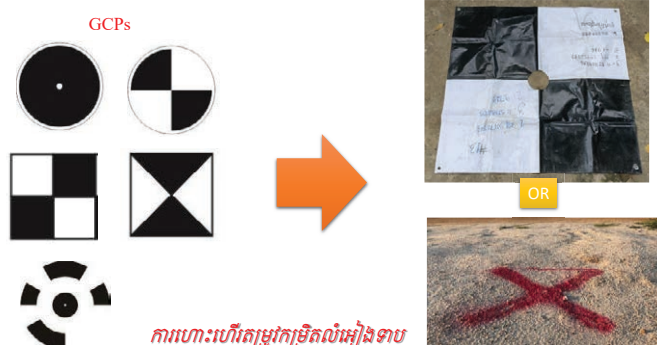
២. សម្ភារៈសម្រាប់ការហោះហើរបន្ថែម



27

ការរៀបចំសម្ភារៈសម្រាប់ការហោះហើរជ្រួន DJI Phantom 4 (បន្ត)

២. សម្ភារៈសម្រាប់ការហោះហើរបន្ថែម (បន្ត)



28

ការរៀបចំសម្ភារៈសម្រាប់ការហោះហើរជ្រួន DJI Phantom 4 (បន្ត)

២. សម្ភារៈសម្រាប់ការហោះហើរបន្ថែម (បន្ត)

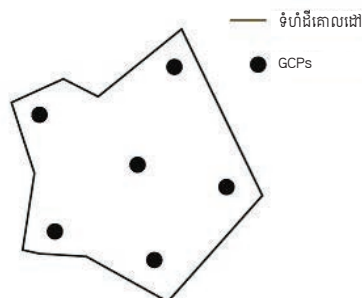


ការវាស់វែង RTK

29

ការរៀបចំសម្ភារៈសម្រាប់ការហោះហើរជ្រួន DJI Phantom 4 (បន្ត)

២. សម្ភារៈសម្រាប់ការហោះហើរបន្ថែម (បន្ត)



ចំណុចដែលត្រូវដាក់ GPCs

30

ការរៀបចំសម្ភារៈសម្រាប់ការហោះហើរជ្រួន DJI Phantom 4 (បន្ត)

ការបញ្ចូលថ្នាំសម្រាប់ហោះហើរ រក្សាទុក និងដឹកជញ្ជូន

ពិន្ទុបង្ហាញពេលកំពុងបញ្ចូល				LED1	LED2	LED3	LED4	
				■	□	□	□	ភាគរយថ្នាំ
				■	□	□	□	0%~25%
				■	■	□	□	25%~50%
				■	■	■	□	50%~75%
				■	■	■	■	75%~100%
				□	□	□	□	ថ្នាំពេញ

- ថ្នាំរបស់ DJI និងបន្ថយដោយស្វ័យប្រវត្តិរហូតដល់ 60% (ជាធម្មតាបន្ថយនៅពេលរក្សាទុកថ្នាំអស់ពេល ១០ ថ្ងៃ)
- ការបញ្ចូលថ្នាំសម្រាប់ហោះហើរត្រូវតែពេញជានិច្ច 100%
- ការរក្សាទុកថ្នាំក្រោម 60%
- ការដឹកជញ្ជូនថ្នាំតិចជាង 50%

31

ការរៀបចំសម្ភារៈសម្រាប់ការហោះហើរជ្រួន DJI Phantom 4 (បន្ត)

គោលការណ៍ណែនាំការប្រើប្រាស់ថ្នាំរបស់ជ្រួនដោយសុវត្ថិភាព



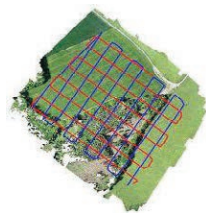
- ពេលប្រើប្រាស់៖** កុំអោយថ្នាំប៉ះទឹក សូមកុំដាក់ថ្នាំផ្សេងក្រៅពីថ្នាំរបស់ DJI សូមកុំប្រើថ្នាំដែលខូច ឬក្រៅពេក (ច្រើនជាង 40 អង្សាសេ)
- ពេលកំពុងសាក៖** សូមកុំប្រើឆ្នាំងសាកថ្នាំជាមួយថ្នាំផ្សេងៗ សូមដកថ្នាំពេលបញ្ចូលពេញ សូមកុំសាកថ្នាំជាមួយពេលហោះហើររួចឬថ្នាំនៅក្តៅ
- ពេលរក្សាទុក៖** សូមទុកនៅជិតដៃក្មេងៗ នៅកន្លែងដែលមានសីតុណ្ហភាពក្តៅ មិនត្រូវដឹកជញ្ជូនថ្នាំជ្រួនដែលខូច ឬក្រអួតថ្នាំនៅច្រើនជាង 30%



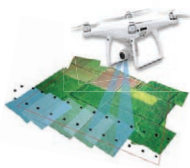
32

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស

ចំណេះដឹងទូទៅនៃការប្រើប្រាស់ជ្រួនដើម្បីប្រមូលទិន្នន័យពីលើអាកាស



ផែនការហោះហើរ



ការចាប់យករូបភាព



រូបភាពដែលបានចាប់យករួម

33

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ចំណេះដឹងទូទៅនៃការប្រើប្រាស់ជ្រួនដើម្បីប្រមូលទិន្នន័យពីលើអាកាស (បន្ត)

ដំណើរការនៃការដំណើរការរូបភាពជ្រួន



ការរៀបចំរូបភាព



កម្មវិធីដំណើរការរូបភាព



លទ្ធផលអាចទទួលបាន

34

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការផលិតផែនទីដែលមានកម្រិតលម្អៀតតិច



OR



RTK Surveying

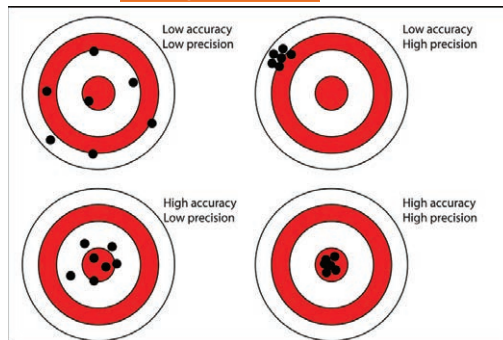
ទិន្នន័យរូបភាពពីជ្រួនគឺមានទាំងទីតាំងរបស់វត្ថុស្ថិតនៅ និងកម្ពស់ ប្រសិនបើការហោះហើរត្រូវការទិន្នន័យកម្ពស់នៅពេលវាស់វែងលើ GCPs ត្រូវប្រមូលទិន្នន័យ X Y និង Z

35

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការផលិតផែនទីដែលមានកម្រិតលម្អៀតតិច (បន្ត)

កម្រិតលម្អៀត និងភាពជាក់លាក់

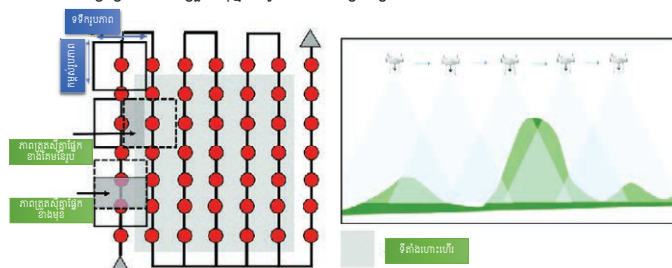


36

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការកំណត់ភាពត្រួតស៊ីគ្នាក្នុងការផលិតផែនទី

- ការប្រើប្រាស់ភាពត្រួតស៊ីគ្នានៃរូបភាពបានគ្រប់គ្រាន់



37

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការកំណត់ភាពត្រួតស៊ីគ្នាក្នុងការផលិតផែនទី (បន្ត)

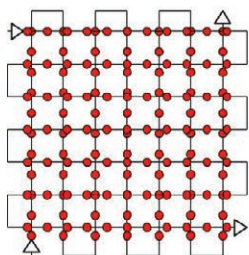
- ការប្រើប្រាស់ភាពត្រួតស៊ីគ្នានៃរូបភាពបានគ្រប់គ្រាន់ (បន្ត)
 - តាមរយៈគោលការណ៍វាស់វែងទីតាំងភូមិសាស្ត្ររបស់ GSI នៅប្រទេសជប៉ុន ភាពត្រួតស៊ីគ្នានៃរូបភាពដែលយ៉ាងតិច side overlap 60% និង frontal overlap 80%
 - នៅក្នុងសៀវភៅណែនាំរបស់ Pix4D ភាពត្រួតស៊ីគ្នានៃរូបភាពដែលអាចប្រើលើការងារភាគច្រើនគឺយ៉ាងតិច overlap 60% 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។

38

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការកំណត់ភាពត្រួតស៊ីគ្នាក្នុងការផលិតផែនទី (បន្ត)

- ការប្រើប្រាស់ភាពត្រួតស៊ីគ្នានៃរូបភាពបានគ្រប់គ្រាន់ (បន្ត)



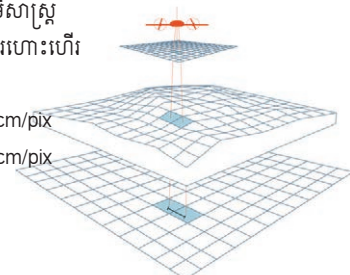
ការថតរូបដំបូលអាកាស ការធ្វើផែនទី 3D នៅក្នុងទីក្រុង តម្រូវឱ្យហោះហើរតាមផែនការហោះហើរក្រឡាចគ្នា

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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



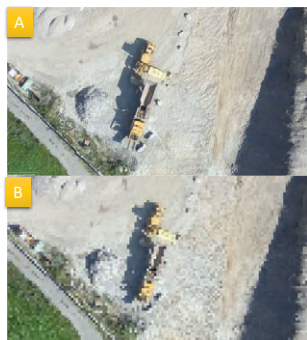
GSD កាន់តែតិចរូបភាពនៃការចាប់យកកាន់តែច្រើន ទិន្នន័យទទួលបានកាន់តែល្អ

40

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការកំណត់ភាពត្រួតស៊ីគ្នាក្នុងការផលិតផែនទី (បន្ត)

- ការគណនាកម្រិតភាពច្បាស់នៃរូបភាព (GSD) សម្រាប់ប្រើលើមាត្រដ្ឋានផែនទីជាក់លាក់



GSD: 5cm/pix

GSD: 30cm/pix

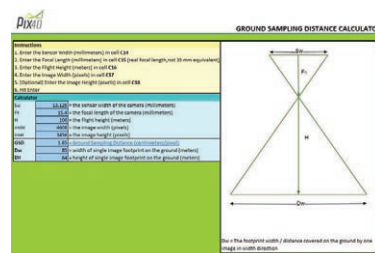
41

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការកំណត់ភាពត្រួតស៊ីគ្នាក្នុងការផលិតផែនទី (បន្ត)

- ការគណនាកម្រិតភាពច្បាស់នៃរូបភាព (GSD) សម្រាប់ប្រើលើមាត្រដ្ឋានផែនទីជាក់លាក់

ប្រសិនបើផលិតផែនទីរូបភាពពីលើអាកាសដែលមានកម្រិតច្បាស់ 5cm/pix តើគួរហោះហើរតាមម៉ូឌុលប៉ុន្មាន?



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

42

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការកំណត់ល្បឿននៃការចាប់យករូបភាព

- ការប្រើប្រាស់ល្បឿនហោះហើរបានត្រឹមត្រូវ



ល្បឿនកាន់តែយឺតកាន់តែច្បាស់តែពេលហោះកាន់តែច្រើន

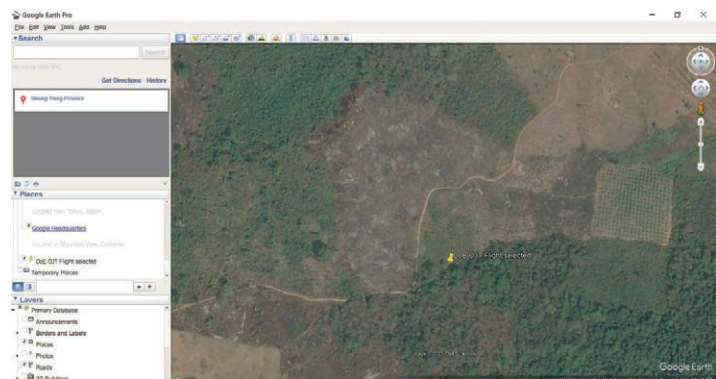
ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការសិក្សាពីទីវាល និងការចុះពិនិត្យទីវាល

- ដើម្បីការហោះហើរប្រកបដោយសុវត្ថិភាពយើងត្រូវ៖
 - កំណត់ទីតាំងហោះហើរច្បាស់លាស់ ដោយពិនិត្យមើលតាមរយៈរូបភាពផ្កាយរណប និងចុះទៅទីតាំងផ្ទាល់
 - សាកសួរអាជ្ញាធរមានសម្ថកិច្ចនៅទីនោះ អនុញ្ញាតិអោយហោះហើរដែរឬទេ
 - ពិនិត្យមើលឧបសគ្គដែលអាចប៉ះពាល់ឬការរំខានដល់ការហោះហើរ
 - ពិនិត្យមើលទីតាំងចុះចតបានត្រឹមត្រូវ
 - ពិនិត្យមើលអាកាសធាតុ ភ្លៀងធ្លាក់ និងល្បឿននៃខ្យល់បក់។

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

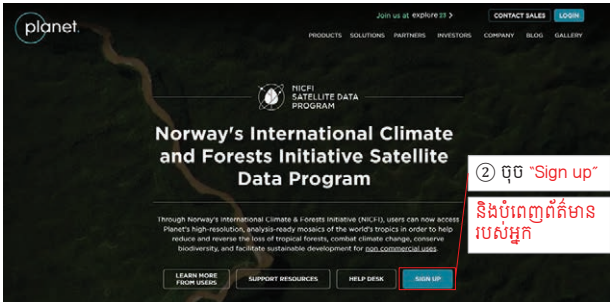
ការសិក្សាពីទីវាល និងការចុះពិនិត្យទីវាល



ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការបង្កើតគណនី

- ចូលទៅកាន់៖ <https://www.planet.com/nicfi/>



② ចុច “Sign up”
និងបំពេញព័ត៌មានរបស់អ្នក

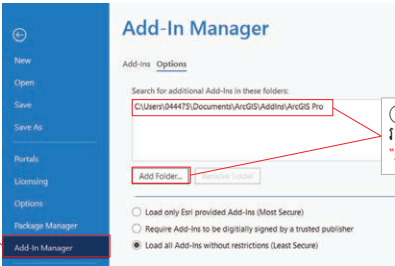
ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការដំឡើងមុខងារទាញយក

- ស្វែងរកកន្លែងរក្សាទុកកម្មវិធីដែលបានទាញយក៖

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

④ បើកកម្មវិធី
ArcGIS Pro, និងចុច
“Add-In Manager”

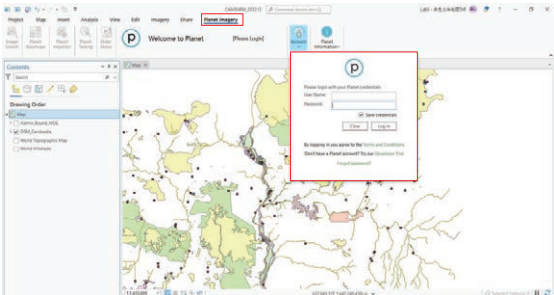


⑤ សរសេរកន្លែង
រក្សាទុក និងចុច
“Add Folder...”

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

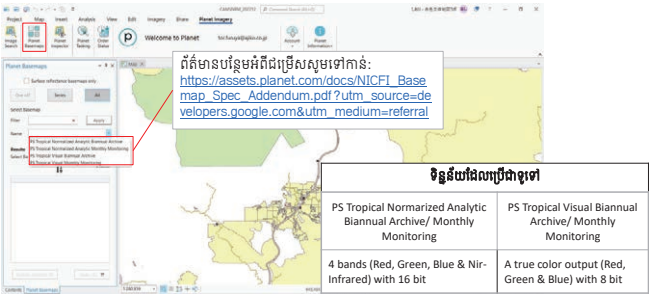
ការដំឡើងមុខងារទាញយក (បន្ត)

- បើកកម្មវិធី ArcGIS Pro ម្តងទៀត រួចចូលទៅ Planet Imagery និង log in



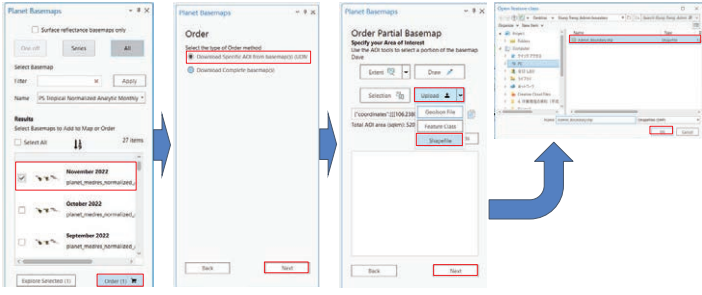
ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)
ការទាញយក

① ចុច “Planet Basemaps” និងជ្រើសរើស “basemaps”



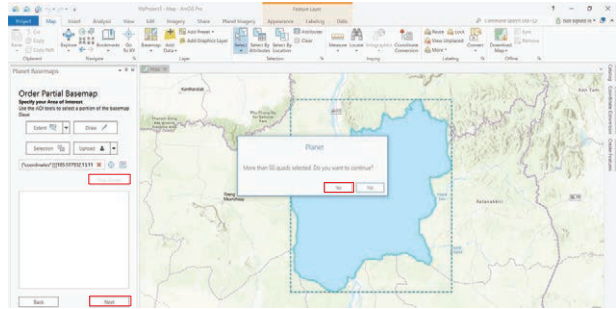
ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)
ការទាញយក (បន្ត)

② ជ្រើសរើស “ជម្រើសទាញយក” និងប្រើប្រាស់ទិន្នន័យរំបែក



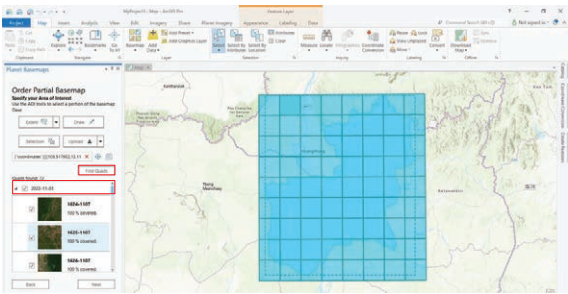
ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)
ការទាញយក (បន្ត)

③ ជ្រើសរើស “YES” និង ចុច “បន្ទាប់”



ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)
ការទាញយក (បន្ត)

④ ចុច “Find Quads” និងជ្រើសរើសរូបដែលចង់ទាញយក



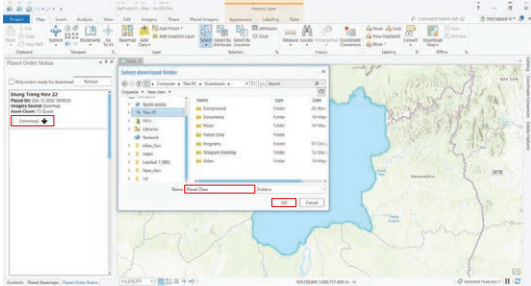
ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)
ការទាញយក (បន្ត)

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



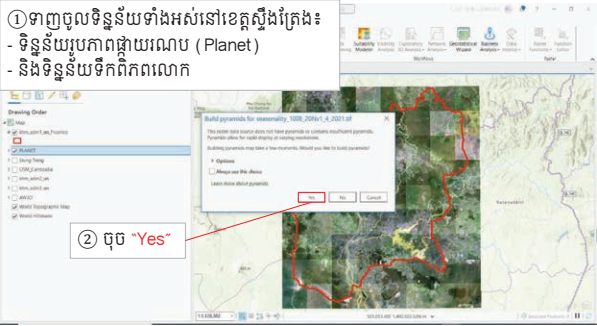
ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)
ការទាញយក (បន្ត)

⑥ ចុច “Downloads” និងបំពេញឈ្មោះទិន្នន័យ



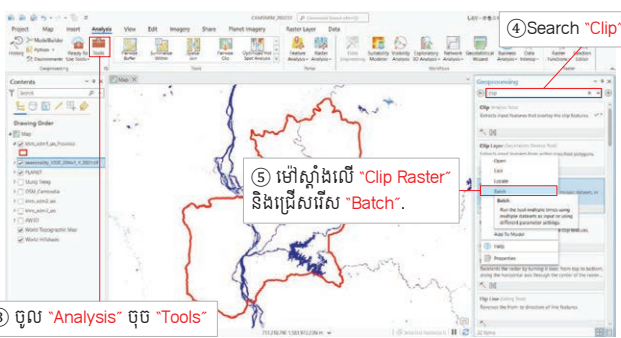
ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

- ① ទាញចូលទិន្នន័យទាំងអស់នៅខេត្តស្ទឹងត្រែង៖
 - ទិន្នន័យរូបភាពផ្កាយរណប (Planet)
 - និងទិន្នន័យទឹកពិភពលោក



② ចុច "Yes"

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)



③ ចូល "Analysis" ចុច "Tools"

⑤ មើលរូបភាព "Clip Raster" និងជ្រើសរើស "Batch".

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)



⑦ ទាញទិន្នន័យចូល

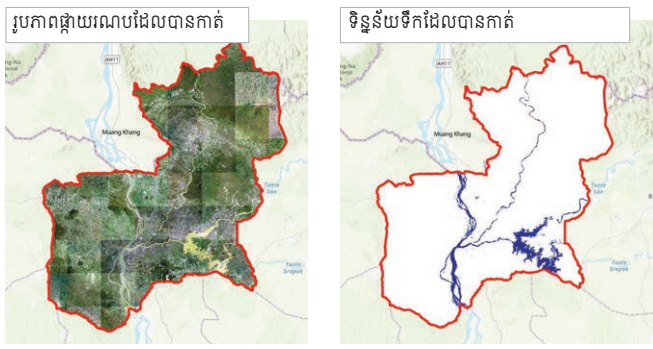
⑧ ប្តូរទីតាំងក្បាច់

⑨ ជ្រើសរើសខេត្ត

⑩ ពិនិត្យ "Use Input Features..."

⑪ ចុច "Run".

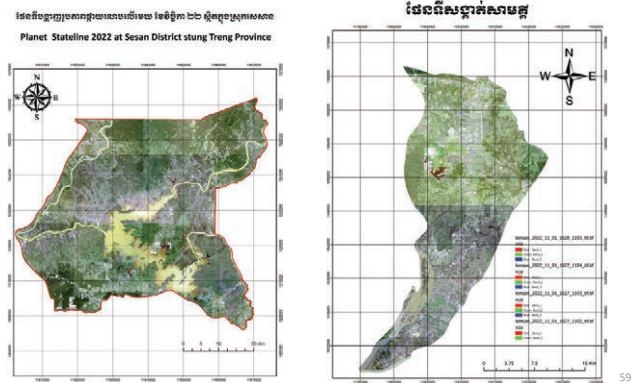
ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)



រូបភាពផ្កាយរណបដែលបានកាត់

ទិន្នន័យទឹកដែលបានកាត់

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)
ការធ្វើផែនទីសម្រាប់ប្រើប្រាស់នៅទីវាល



ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)
ការធ្វើផែនទីសម្រាប់ប្រើប្រាស់នៅទីវាល (បន្ត)



ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការត្រួតពិនិត្យសម្ភារៈហោះហើរឡើងវិញ

1. បញ្ចូលថ្លង្រួន ទុរសត្រង់ដៃបញ្ចូល
2. ពិនិត្យមើលស្លាប
3. ពិនិត្យមើលមេដឹកនាំ
4. ធ្វើបច្ចុប្បន្នភាពសេរីផ្លែ និងដៃបញ្ចូល
5. ពិនិត្យមើលអាកាសធាតុ
6. Calibrate ជ្រួន (ប្រសិនបើតម្រូវឱ្យ)

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការជ្រើសរើសកម្មវិធី

កម្មវិធីគោល



- កម្មវិធីនេះត្រូវបានណែនាំសម្រាប់ការហោះហើរដោយការបញ្ជា ការថតរូប

កម្មវិធីប្រើសម្រាប់ថតរូបដោយស្វ័យប្រវត្តិដើម្បីផលិតផែនទីពីលើអាកាស



DJI PILOT



Pix4Dcapture



Ctrl+DJI

- DJI PILOT ជាកម្មវិធីសម្រាប់ហោះហើរថតរូប ឬផលិតផែនទីរបស់ក្រុមហ៊ុន DJI
- Pix4Dcapture ងាយស្រួលប្រើប្រាស់ប៉ុន្តែមិនមានមុខងារដំណើរការប្រព័ន្ធការពាររបស់ជ្រួន
- Ctrl+DJI ប្រើសម្រាប់ភ្ជាប់ Pix4Dcapture

62

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការជ្រើសរើសកម្មវិធី (បន្ត)

កម្មវិធីគោល (បន្ត)



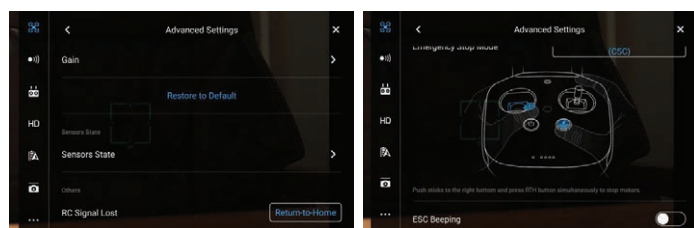
63

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការជ្រើសរើសកម្មវិធី (បន្ត)

កម្មវិធីគោល (បន្ត)

- ការកំណត់ដែលណែនាំអោយប្រើ



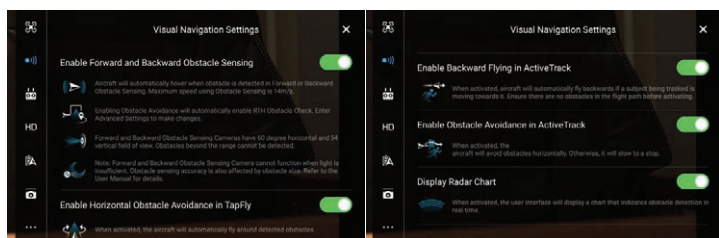
64

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការជ្រើសរើសកម្មវិធី (បន្ត)

កម្មវិធីគោល (បន្ត)

- ការកំណត់ដែលណែនាំអោយប្រើ



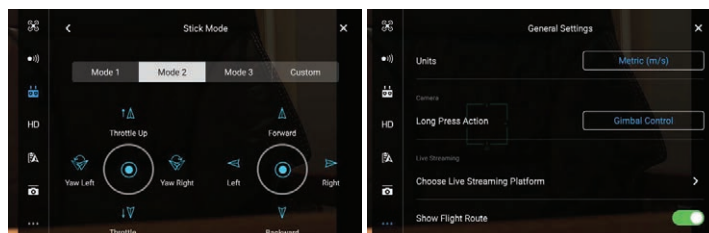
65

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

ការជ្រើសរើសកម្មវិធី (បន្ត)

កម្មវិធីគោល (បន្ត)

- ការកំណត់ដែលណែនាំអោយប្រើ

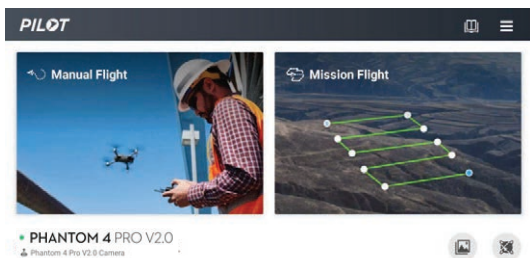


66

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីពីលើអាកាស (បន្ត)

ការបង្កើតផែនការហោះហើរ

- ❑ កម្មវិធីប្រើសម្រាប់ចត្វរបដោយស្វ័យប្រវត្តិដើម្បីផលិតផែនទីពីលើអាកាស
 - ដំណើរការកម្មវិធី DJI Pilot
 - ជ្រើសរើស Mission Flight

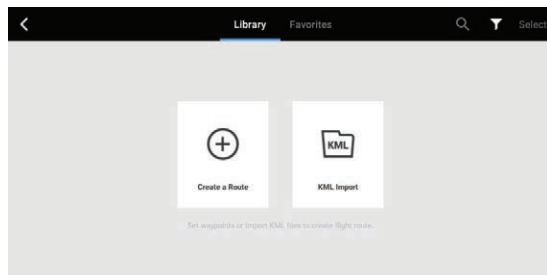


67

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីពីលើអាកាស (បន្ត)

ការបង្កើតផែនការហោះហើរ (បន្ត)

- ❑ កម្មវិធីប្រើសម្រាប់ចត្វរបដោយស្វ័យប្រវត្តិដើម្បីផលិតផែនទីពីលើអាកាស (បន្ត)
 - ជ្រើសរើស Create a Route/KML import

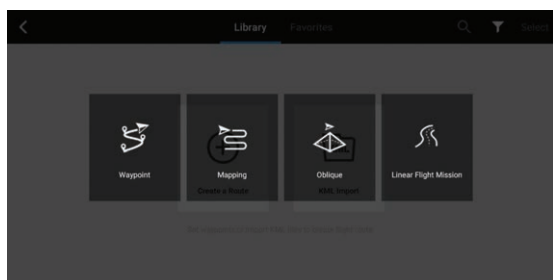


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ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីពីលើអាកាស (បន្ត)

ការបង្កើតផែនការហោះហើរ (បន្ត)

- ❑ កម្មវិធីប្រើសម្រាប់ចត្វរបដោយស្វ័យប្រវត្តិដើម្បីផលិតផែនទីពីលើអាកាស (បន្ត)
 - ជ្រើសរើសផែនការហោះហើរ Mapping/Waypoint/Linear Flight Mission



69

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីពីលើអាកាស (បន្ត)

ការបង្កើតផែនការហោះហើរ (បន្ត)

- ❑ កម្មវិធីប្រើសម្រាប់ចត្វរបដោយស្វ័យប្រវត្តិដើម្បីផលិតផែនទីពីលើអាកាស (បន្ត)
 - ឧទាហរណ៍៖ ជ្រើសរើស Mapping

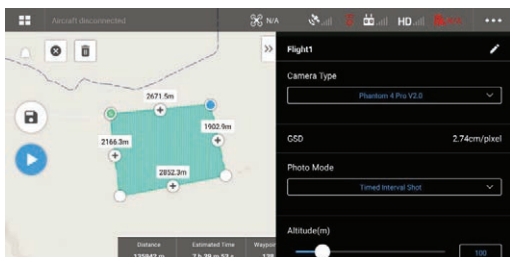


70

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីពីលើអាកាស (បន្ត)

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 - ច្នៃ edit
 - ជ្រើសរើស Camera type
 - កំណត់ប៉ារ៉ាម៉ែត្រហោះហើរ (កម្ពស់ការហោះហើរ, កាតត្រួតស៊ីគ្នានៃរូបភាព)



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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

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

សុវត្ថិភាពនៅកន្លែងហោះហើរ (បន្ត)

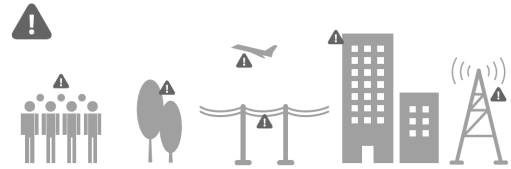
- ការថែទាំ៖ សូមកុំប្រើប្រាស់ស្លាបបែកបាក់ អាកាសធាតុដែលណែនាំអោយហោះហើរគឺចន្លោះ 22 ដល់ 28 អង្សាសេ
- ស្វែងយល់ពីកន្លែងដែលត្រូវហោះហើរពីច្បាប់និងការហាមឃាត់ផ្សេងៗ



73

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

សុវត្ថិភាពនៅកន្លែងហោះហើរ (បន្ត)



មិនត្រូវហោះនៅកន្លែងដែលមានអ្នករស់នៅ ទីតាំងដែលមានមនុស្សច្រើន ជិតបង្គោលខ្សែភ្លើង ដើមឈើ និងទឹក

74

ការបង្កើតផែនការហោះហើរជ្រួនដើម្បីផលិតផែនទីរូបភាពពីលើអាកាស (បន្ត)

សុវត្ថិភាពនៅកន្លែងហោះហើរ (បន្ត)

NOT FOR CHILDREN UNDER THE AGE OF 18. THIS IS NOT A TOY



សូមកុំហោះហើរនៅពេលភ្លៀង

នៅអោយឆ្ងាយពីស្លាបរបស់ជ្រូន

75

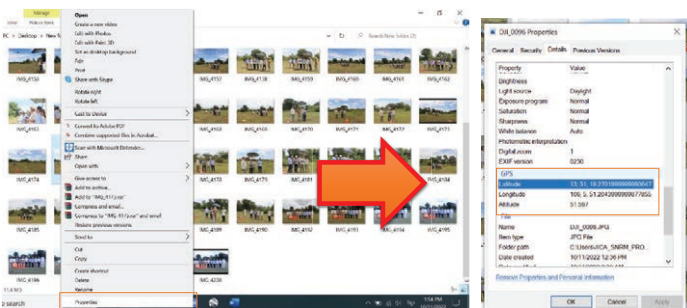
សម្រាប់ការសិក្សាបន្ថែម៖

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

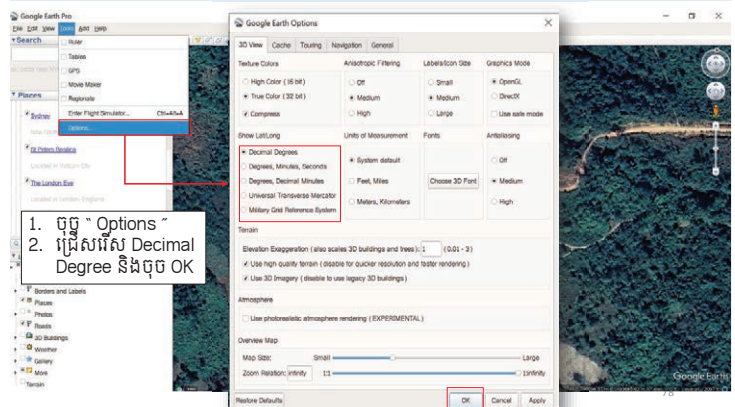


1. ចូល "Properties"
2. កត់ត្រាទុកទីតាំងភូមិសាស្ត្រ

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ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

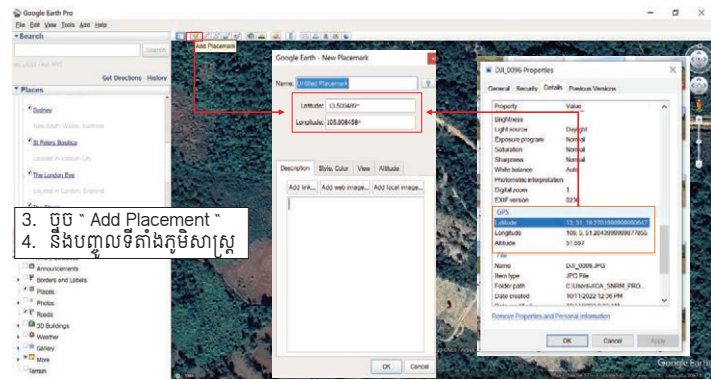
ការប្រើប្រាស់និយាមការ



1. ចូល "Options"
2. ជ្រើសរើស Decimal Degree និងចុច OK

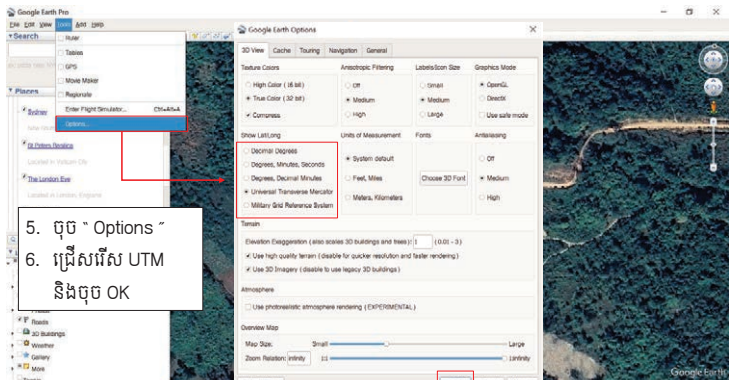
ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបម្លែងនិយាមការ (បន្ត)



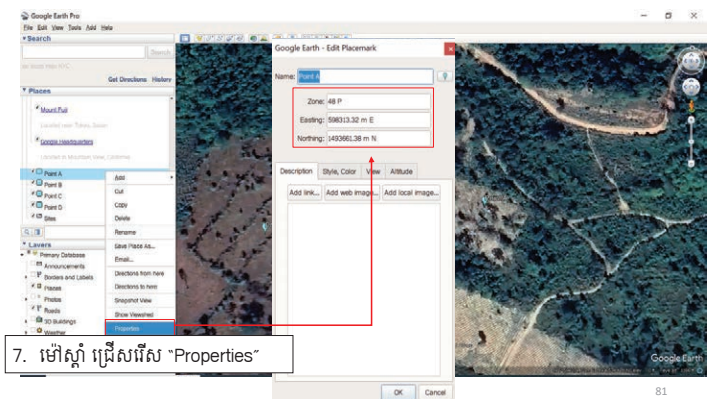
ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបម្លែងនិយាមការ (បន្ត)



ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបម្លែងនិយាមការ (បន្ត)



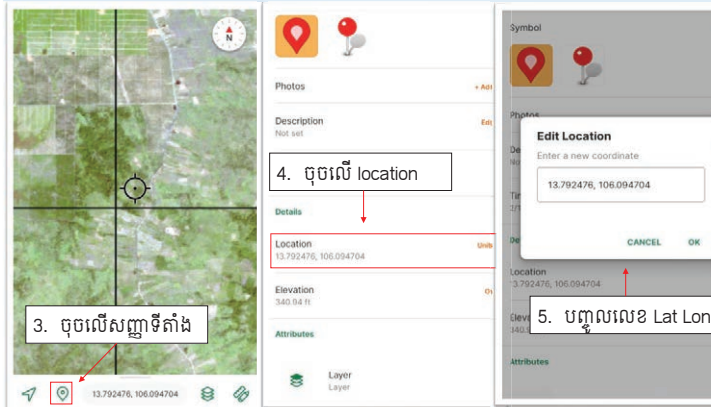
ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបម្លែងនិយាមការ (បន្ត)



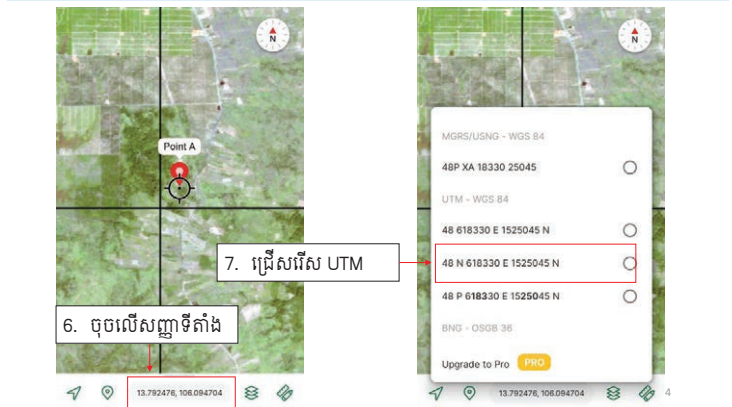
ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបម្លែងនិយាមការ (បន្ត)



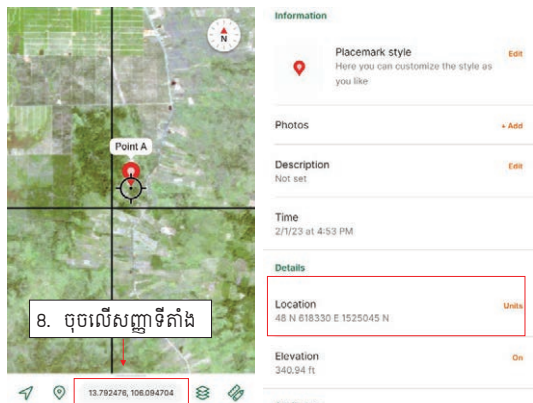
ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

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



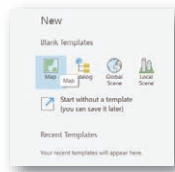
86

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបញ្ចូលទិន្នន័យទៅក្នុងកម្មវិធី GIS (បន្ត)



3. ដំណើរការកម្មវិធី ArcGIS Pro

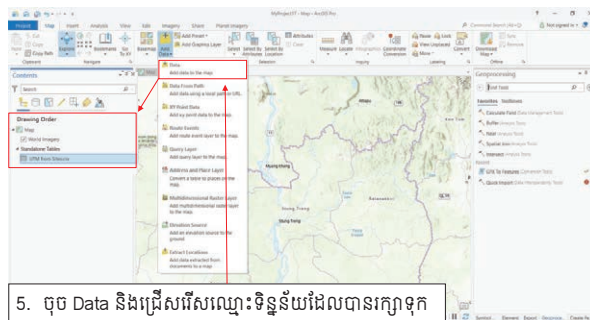


4. ជ្រើសរើស Map និងសរសេរឈ្មោះផែនទី

87

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបញ្ចូលទិន្នន័យទៅក្នុងកម្មវិធី GIS (បន្ត)

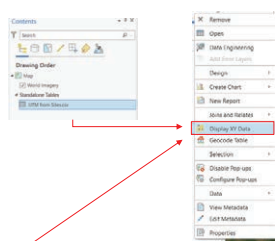


5. ចុច Data និងជ្រើសរើសឈ្មោះទិន្នន័យដែលបានរក្សាទុក

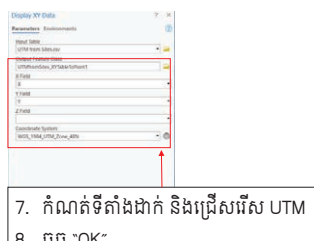
88

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបញ្ចូលទិន្នន័យទៅក្នុងកម្មវិធី GIS (បន្ត)



6. មើលទិន្នន័យ រួចជ្រើសរើស Display XY Data

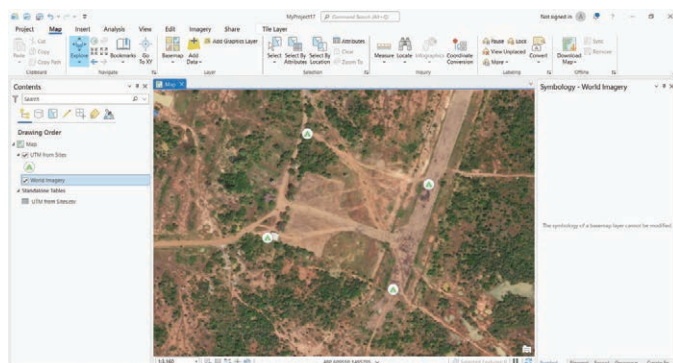


7. កំណត់ទីតាំងដាក់ និងជ្រើសរើស UTM
8. ចុច "OK"

89

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

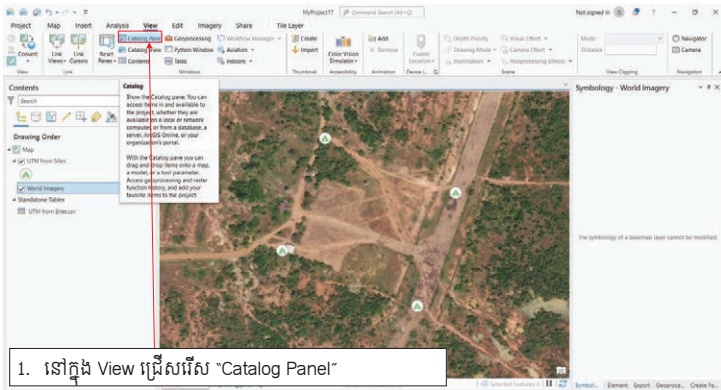
ការបញ្ចូលទិន្នន័យទៅក្នុងកម្មវិធី GIS (បន្ត)



90

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

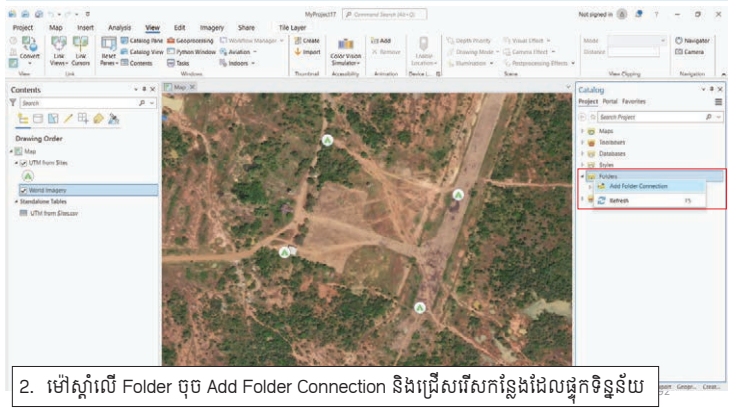
ការបង្ហាញពីទំហំនៃទីតាំងដែលបានចតរូប



1. នៅក្នុង View ជ្រើសរើស "Catalog Panel"

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

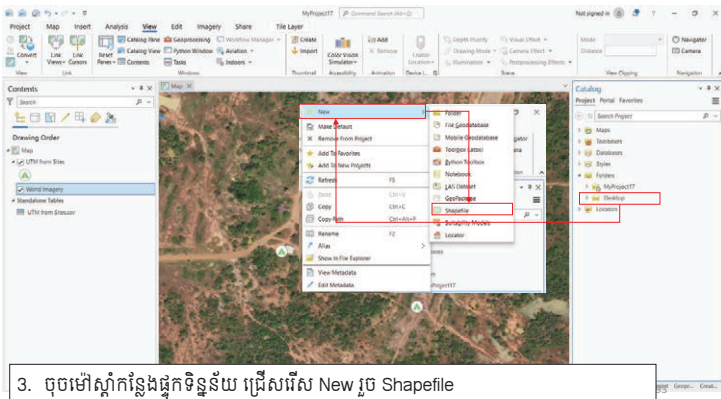
ការបង្ហាញពីទំហំនៃទីតាំងដែលបានចតរូប (បន្ត)



2. មើលស្តារបើ Folder ចុច Add Folder Connection និងជ្រើសរើសកន្លែងដែលផ្ទុកទិន្នន័យ

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការបង្ហាញពីទំហំនៃទីតាំងដែលបានចតរូប (បន្ត)



3. ចុចមើលស្តារបើផ្ទុកទិន្នន័យ ជ្រើសរើស New រួច Shapefile

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

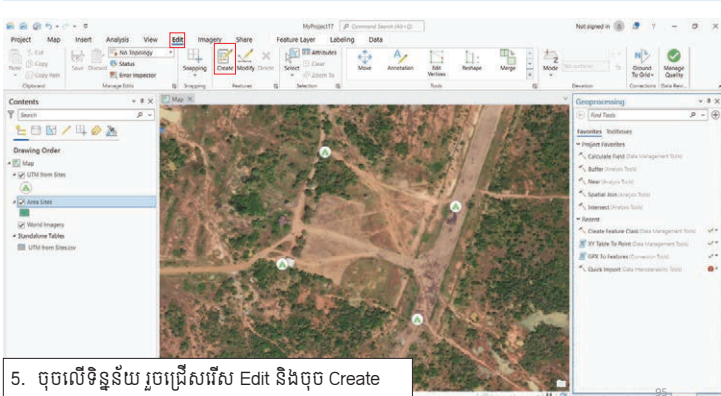
ការបង្ហាញពីទំហំនៃទីតាំងដែលបានចតរូប (បន្ត)



4. ដាក់ឈ្មោះទិន្នន័យ និងជ្រើសរើស UTM រួចចុច RUN

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

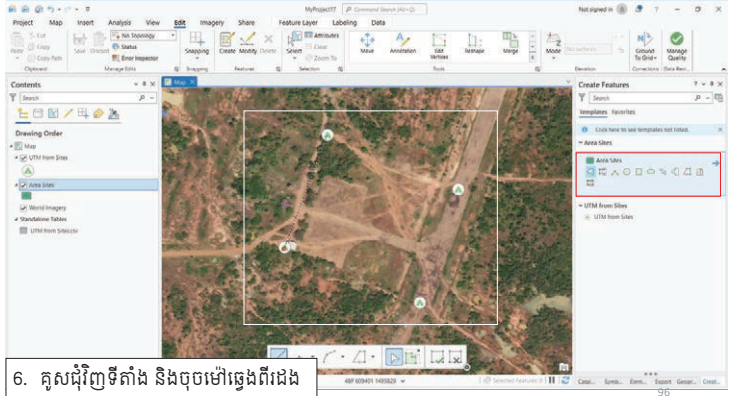
ការបង្ហាញពីទំហំនៃទីតាំងដែលបានចតរូប (បន្ត)



5. ចុចលើទិន្នន័យ រួចជ្រើសរើស Edit និងចុច Create

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

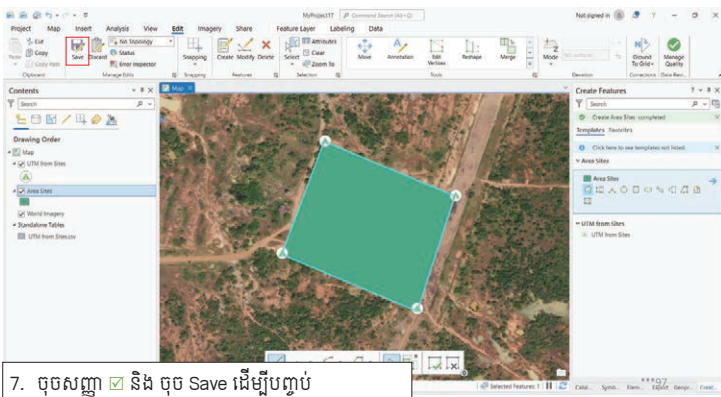
ការបង្ហាញពីទំហំនៃទីតាំងដែលបានចតរូប (បន្ត)



6. គូសជុំវិញទីតាំង និងចុចមើលឆ្វេងពីរដង

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

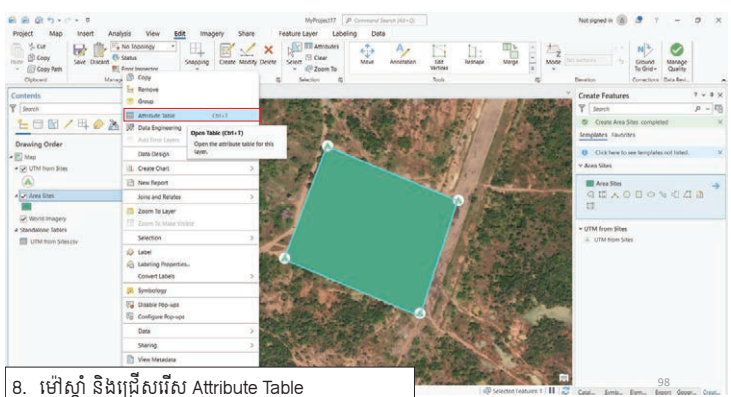
ការបង្ហាញពីទំហំនៃទីតាំងដែលបានចត្សរ (បន្ត)



7. ចុចសញ្ញា និង ចុច Save ដើម្បីបញ្ចប់

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

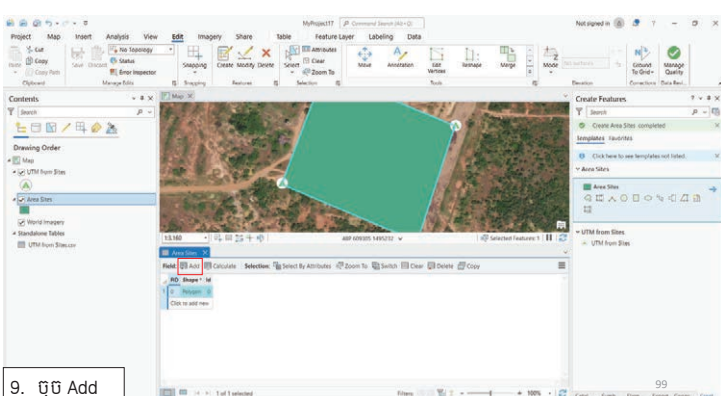
ការបង្ហាញពីទំហំនៃទីតាំងដែលបានចត្សរ (បន្ត)



8. មើល និងជ្រើសរើស Attribute Table

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

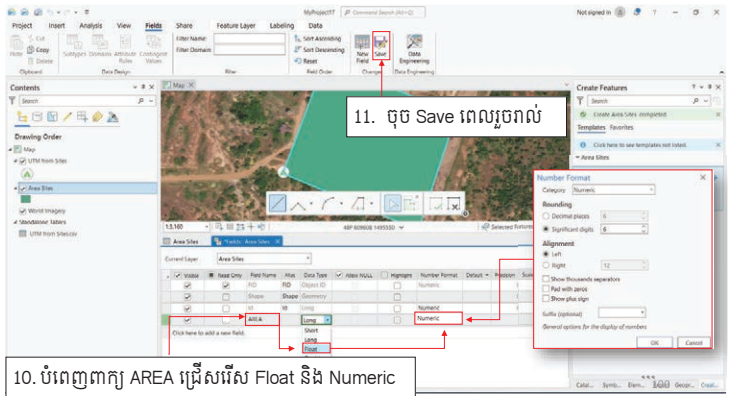
ការបង្ហាញពីទំហំនៃទីតាំងដែលបានចត្សរ (បន្ត)



9. ចុច Add

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

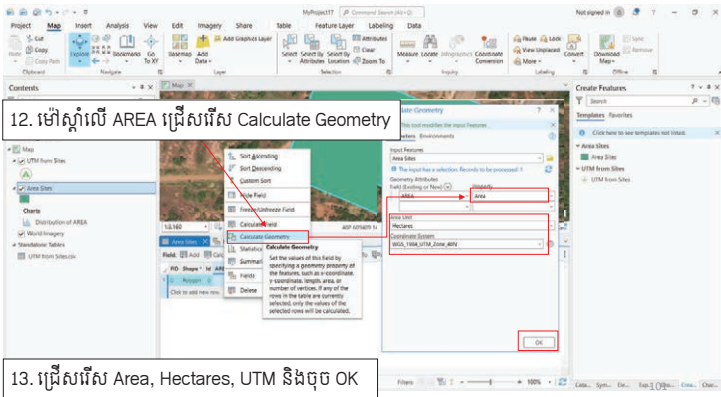
ការបង្ហាញពីទំហំនៃទីតាំងដែលបានចត្សរ (បន្ត)



10. បំពេញពាក្យ AREA ជ្រើសរើស Float និង Numeric

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

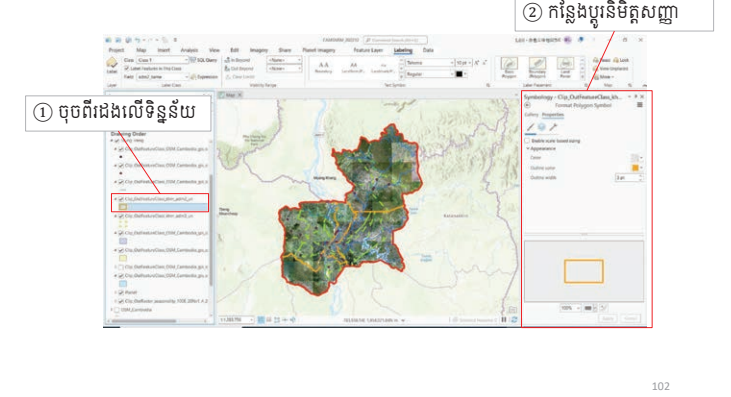
ការបង្ហាញពីទំហំនៃទីតាំងដែលបានចត្សរ (បន្ត)



13. ជ្រើសរើស Area, Hectares, UTM និងចុច OK

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

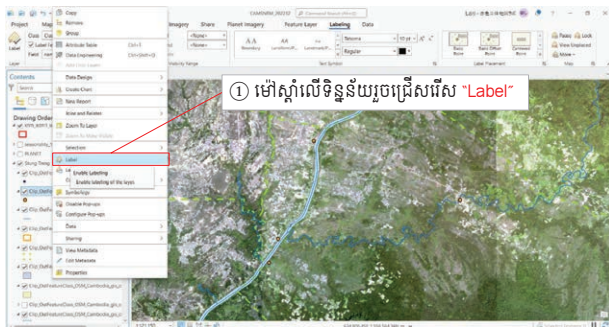
ការប្រើប្រាស់និមិត្តសញ្ញា (ពណ៌ ទំហំ និងប្រភេទខ្សែបន្ទាត់)



13. ជ្រើសរើស Area, Hectares, UTM និងចុច OK

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

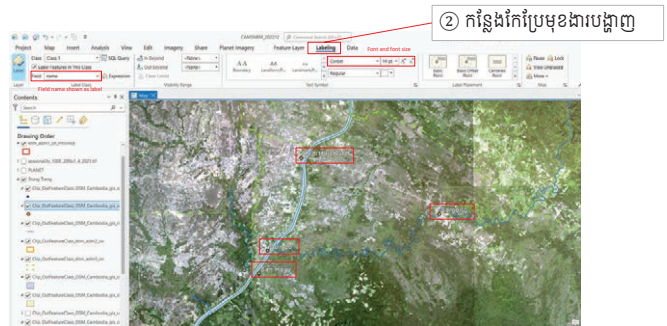
ការប្រើប្រាស់មុខងារបង្ហាញឈ្មោះ:



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ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

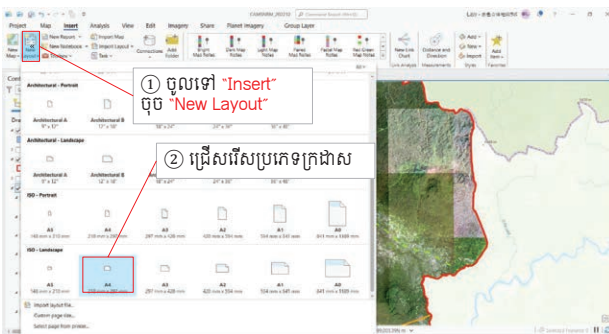
ការប្រើប្រាស់មុខងារបង្ហាញឈ្មោះ: (បន្ត)



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ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

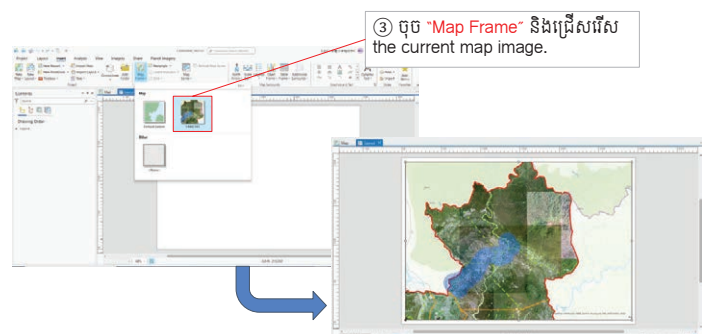
ការប្រើប្រាស់មុខងារកំណត់ផែនទីលើក្រដាស



105

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

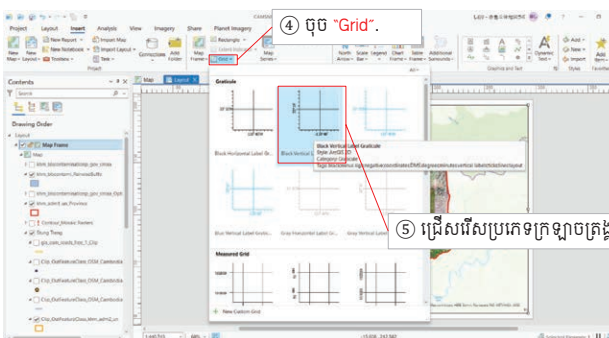
ការប្រើប្រាស់មុខងារកំណត់ផែនទីលើក្រដាស (បន្ត)



106

ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

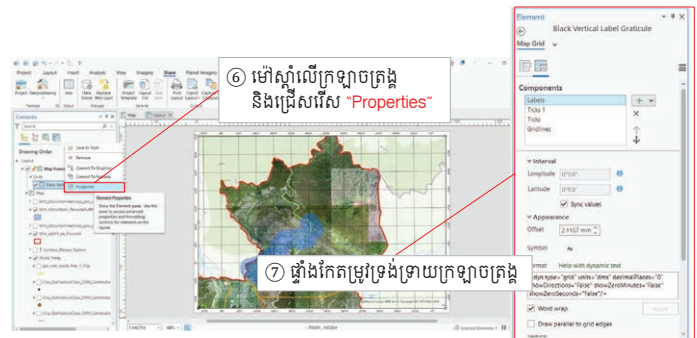
ការប្រើប្រាស់មុខងារកំណត់ផែនទីលើក្រដាស (បន្ត)



107

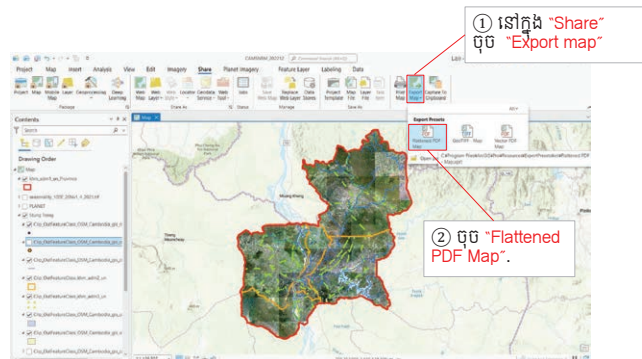
ការប្រមូលព័ត៌មានទីតាំងភូមិសាស្ត្រ និងការប្រើប្រាស់ក្នុងផែនទី (បន្ត)

ការប្រើប្រាស់មុខងារកំណត់ផែនទីលើក្រដាស (បន្ត)



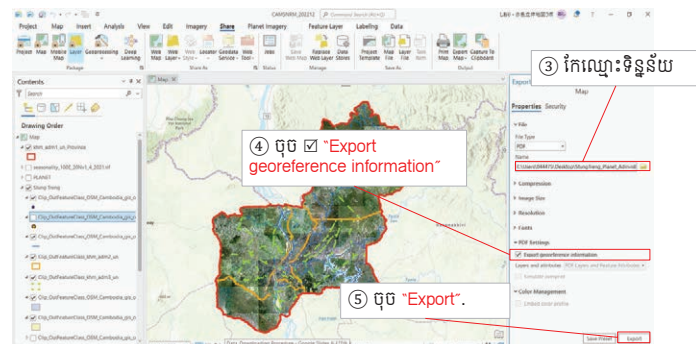
108

ការបញ្ចេញទិន្នផលផែនទីជាទម្រង់ Geo-PDF



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ការបញ្ចេញទិន្នផលផែនទីជាទម្រង់ Geo-PDF (បន្ត)



110

ការដំណើរការរូបភាព និងការរៀបចំផែនទីរូបភាពពីជ្រុង

- ប្រើប្រាស់កម្មវិធី Pix4D និងអនុវត្តតាមការណែនាំ



111

ការដំណើរការរូបភាព និងការរៀបចំផែនទីរូបភាពពីជ្រុង (បន្ត)

- គំរូផែនទីដែលនឹងជំនួសដោយរូបភាពជ្រុង



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បទពិសោធន៍ និងការយល់ដឹងបន្ថែមអំពីការអនុវត្ត ការពិនិត្យស្ថានភាពទីតាំងហោះហើរ

- ពិនិត្យមើលឧបសគ្គដែលនៅជុំវិញ មុនពេលហោះហើរ
- ការហោះដោយដៃគឺវិធីសាស្ត្រដែលអាចប្រើប្រាស់ក្នុងការពិនិត្យមើលឧបសគ្គដែលនៅខ្ពស់ជាងផែនការហោះហើរ
- ត្រូវតាមដានជ្រុងពេលកំពុងហោះហើរ
- បើមានឧបសគ្គផ្សេងចុច RTH



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បទពិសោធន៍ និងការយល់ដឹងបន្ថែមអំពីការហោះហើរ(ត) ការបង្កើតផែនការហោះហើរសម្រាប់ការផលិតផែនទី

- ការបង្កើតផែនការហោះហើរ: KML បានដំណើរការនៅក្នុង DJI Pilot បានល្អប្រសើរ ត្រាតែ KML នោះបានរូបរាងមិនបត់បែនច្រើន

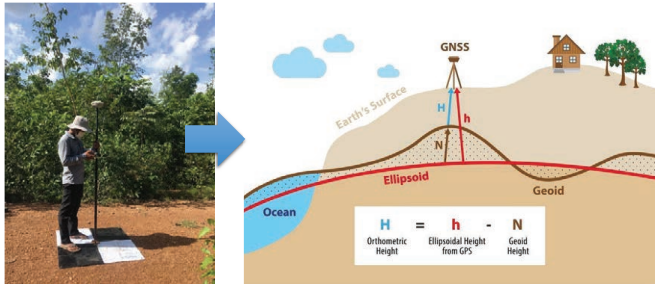


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បទពិសោធន៍ និងការយល់ដឹងបន្ថែមអំពីការហោះហើរ (ត)

ការវាស់វែងចំណុច GCPs

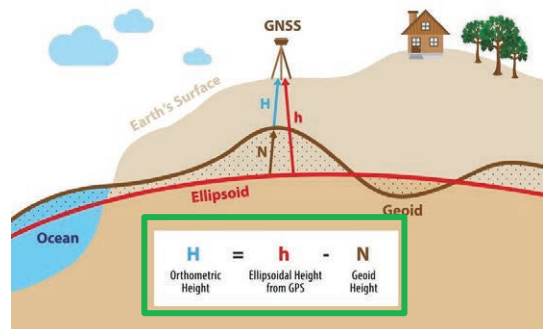
- ស្វែងយល់អំពីទំនាក់ទំនងកំពស់ Z ដែលនឹងទទួលបានបន្ទាប់ពីការវាស់វែង



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បទពិសោធន៍ និងការយល់ដឹងបន្ថែមអំពីការហោះហើរ (ត)

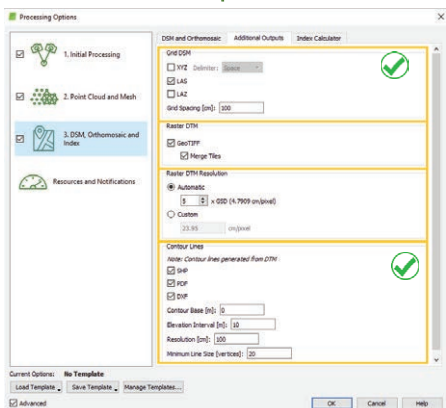
ការវាស់វែងចំណុច GCPs (បន្ត)



116

បទពិសោធន៍ និងការយល់ដឹងបន្ថែមអំពីការហោះហើរ (ត)

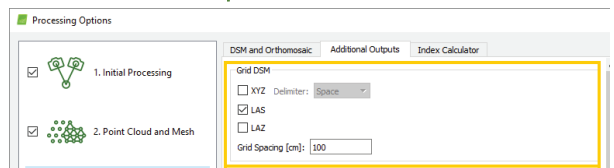
ការកំណត់មុខងារមួយចំនួននៅក្នុងកម្មវិធី Pix4D



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បទពិសោធន៍ និងការយល់ដឹងបន្ថែមអំពីការហោះហើរ (ត)

ការកំណត់មុខងារមួយចំនួននៅក្នុងកម្មវិធី Pix4D

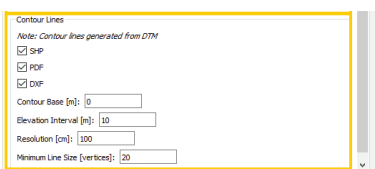


- Grid Spacing ប្រើដើម្បីកំណត់ចម្ងាយរវាង 3D Point Clouds ពីរ
- ប្រសិនបើ Grid Spacing ត្រូវបានកំណត់នៅចំនួន 100cm។ មានន័យថា វាត្រូវបានជ្រើសរើស 3D Point Clouds រៀងរាល់ 100cm

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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 ត្រូវបានលប់ចោល។

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ស្វ័យអវិជ្ជា



