Land use and carbon stock in slash & burn ecosystems
– a case study in Laos –



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> Important food production system in tropical mountain of Southeast Asia

> Laos /Thailand /Vietnam /China /Myanmar /Bangladesh /India

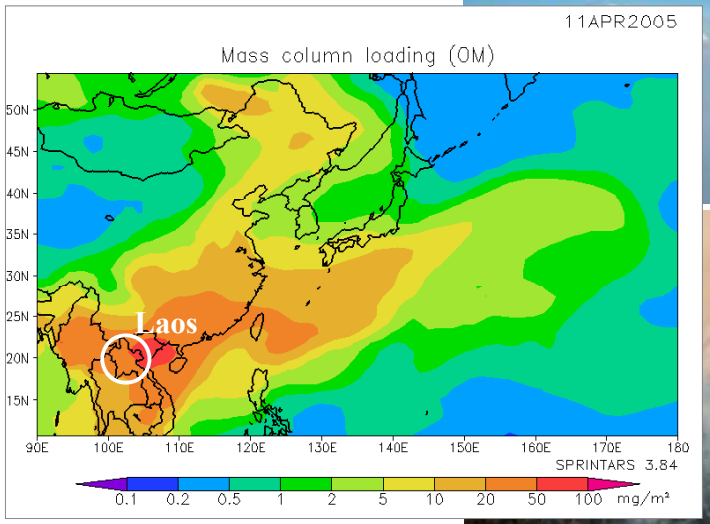
> 1/3 of national population was involved in S/B Ag. in mid-90's (Paravongviengham, 1998)

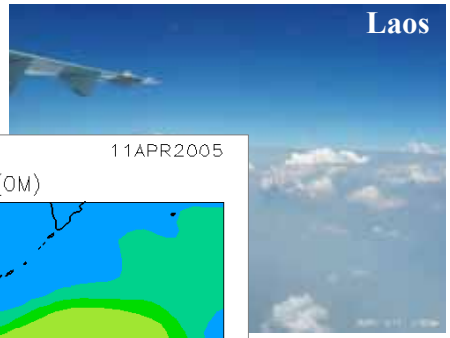

Population growth & Land-use regulation

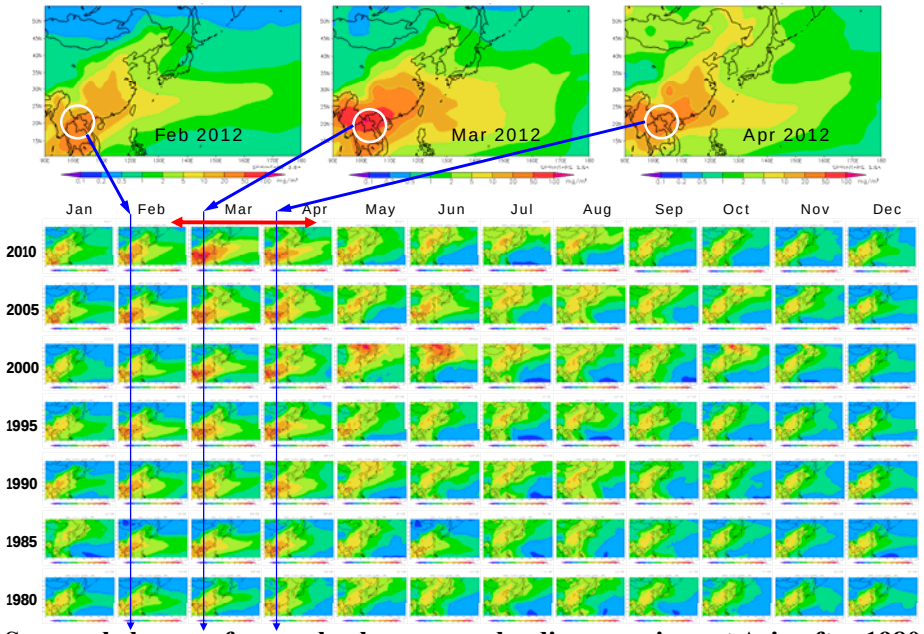
Expansion of S&B-area / Shortened fallow period are causing some unfavorable changes.

1. Degradation of soil and forest resources; crop productivity / labor productivity
2. Negative impacts on atmospheric CO_2 & biodiversity


Aerosol column mass loading (OM) in east Asia on the same day: 11/04/2005 by SPRINTERS (Takemura et al., 2005)







Seasonal change of aerosol column mass loading (OM) in east Asia after 1980 by SPRINTERS (Takemura et al., 2005)

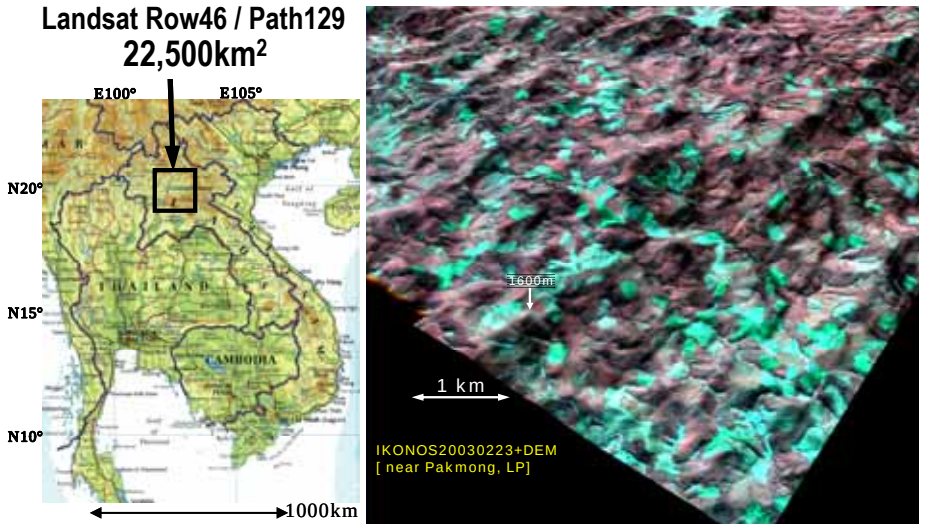
→ More sustainable ecosystem management..
for higher food security and less environmental impacts

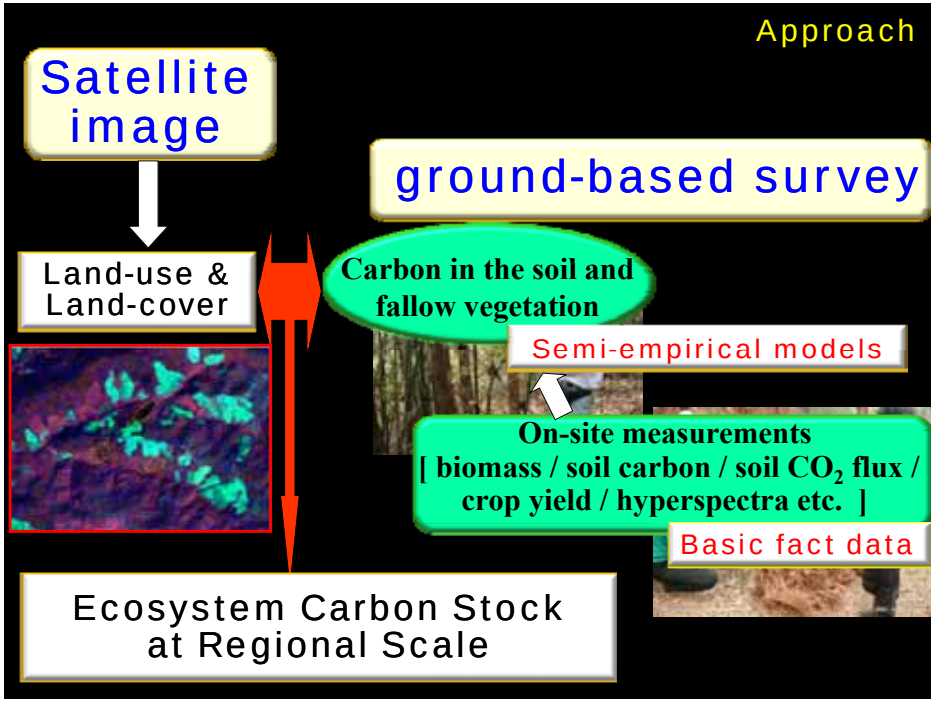
→ Scientific information is limited.
; Ground-based / Quantitative / Spatial

Objectives

1. Quantify land-use and carbon stock in S&B-ecosystems based on RS and ground-based observations.
2. Propose alternative ecosystem management scenarios for higher carbon stock capacity and food security.

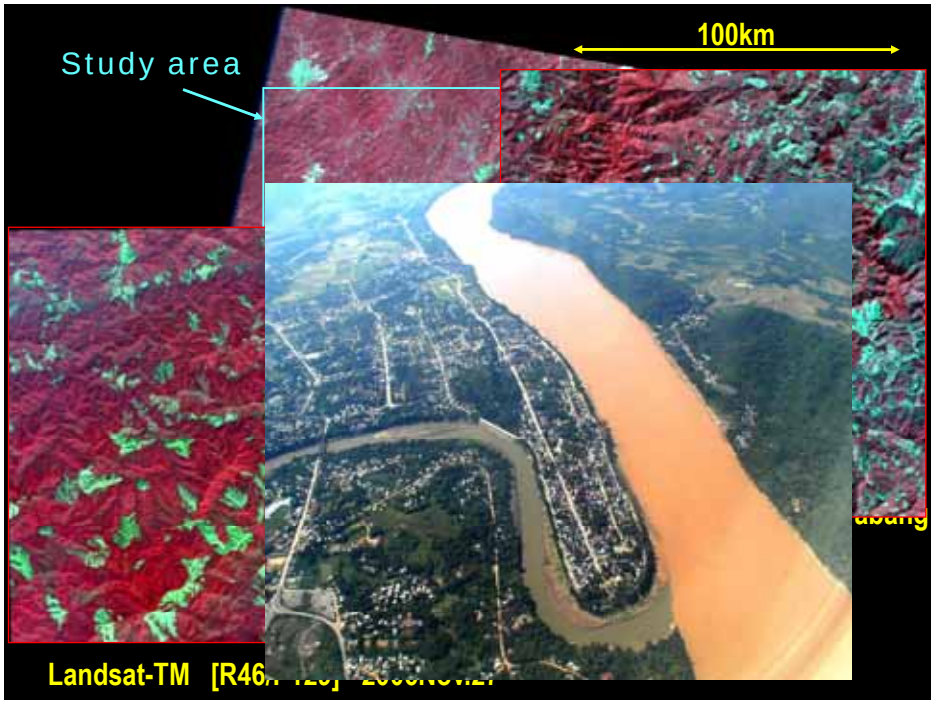
Study Area: Northern part of Laos
Typical S&B region in Mountains of SEA

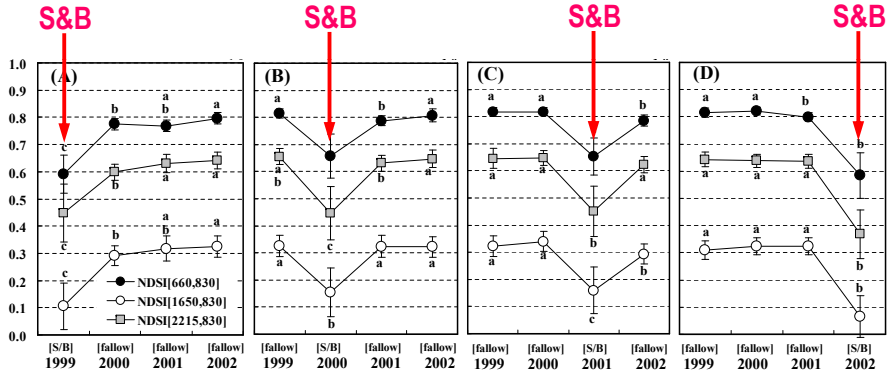




Satellite images used for this study
Data availability is low due to monsoon climate.

No.	Date (yyyy.mm.dd)	Sensor	No.	Date (yyyy.mm.dd)	Sensor
1	1973.01.24	Landsat-MSS	22	2001.02.06	Landsat-ETM
2	1975.12.31	Landsat-MSS	23	2001.11.21	Landsat-ETM
3	1986.03.17	Landsat-MSS	24	2002.02.09	Landsat-ETM
4	1988.01.26	Landsat-TM	25	2002.02.28	IKONOS
5	1989.03.25	Landsat-TM	26	2002.11.08	Landsat-ETM
6	1989.12.14	Landsat-TM	27	2003.02.23	IKONOS
7	1990.01.31	Landsat-TM	28	2003.02.23	IKONOS
8	1990.11.15	Landsat-TM	29	2003.04.03	QuickBird
9	1991.04.08	Landsat-TM	30	2003.10.18	QuickBird
10	1992.02.06	Landsat-TM	31	2003.12.05	Landsat-TM
11	1993.02.08	Landsat-TM	32	2004.04.11	Landsat-TM
12	1994.01.10	Landsat-TM	33	2004.12.07	Landsat-TM
13	1995.02.14	Landsat-TM	34	2005.02.28	QuickBird
14	1996.02.17	Landsat-TM	35	2005.11.24	Landsat-TM
15	1997.02.03	Landsat-TM	36	2005.12.16	QuickBird
16	1997.11.02	Landsat-TM	37	2005.12.21	QuickBird
17	1999.01.24	Landsat-TM	38	2006.02.28	Landsat-TM
18	1998.11.05	Landsat-TM	39	2006.11.27	Landsat-TM
19	1999.11.16	Landsat-ETM	40	2006.11.10	Landsat-TM
20	2000.03.07	Landsat-ETM	41	2008.03.05	Landsat-TM
21	2000.11.02	Landsat-ETM			

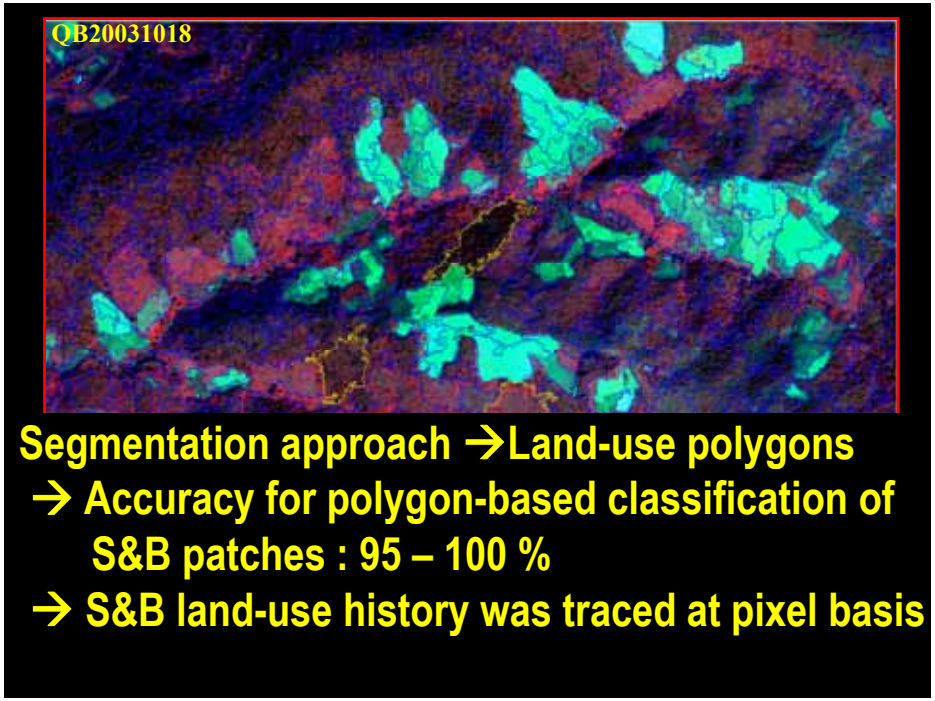




→ **Direct assessment is not feasible**

→ **S&B patches could be identified clearly**

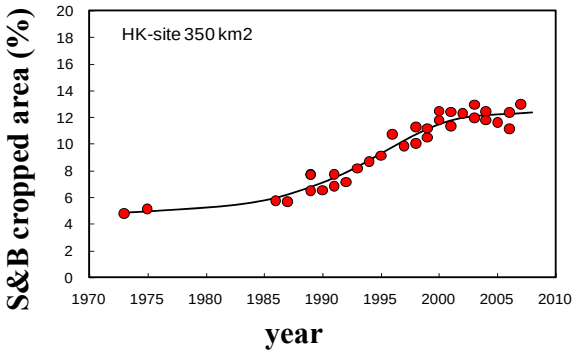
(Inoue et al. 2007)



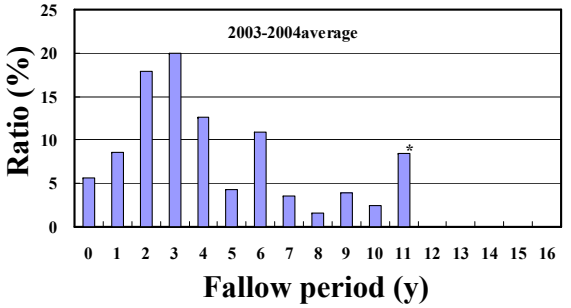
Segmentation approach →Land-use polygons

→ Accuracy for polygon-based classification of S&B patches : 95 – 100 %

→ S&B land-use history was traced at pixel basis



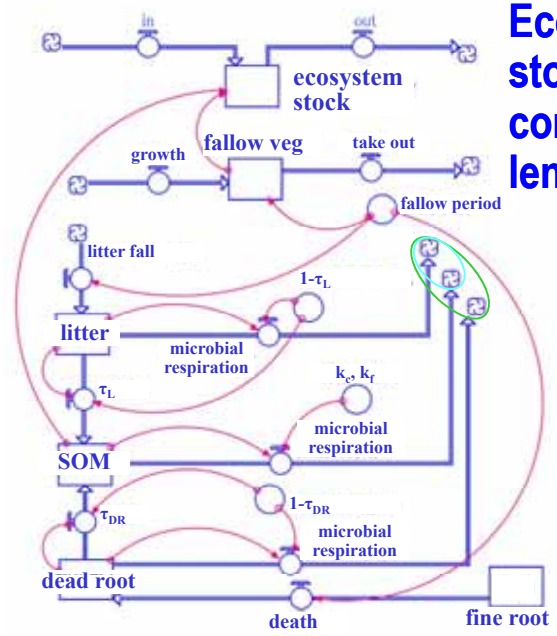
Chrono-sequential change of S&B area



Frequency distribution of fallow period

* sum for age >11y

(Inoue et al. 2010)

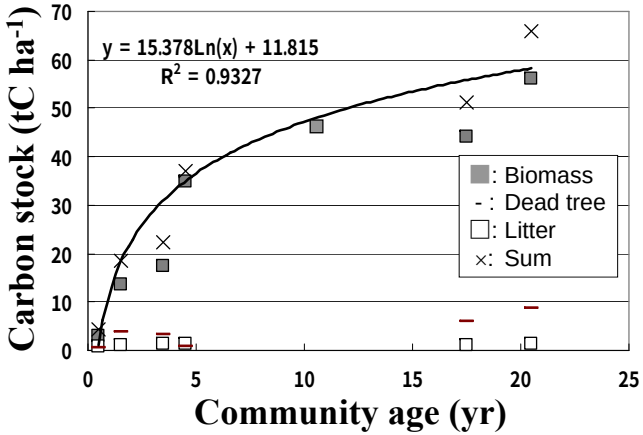


Ecosystem carbon stock as a function of community age (fallow length)

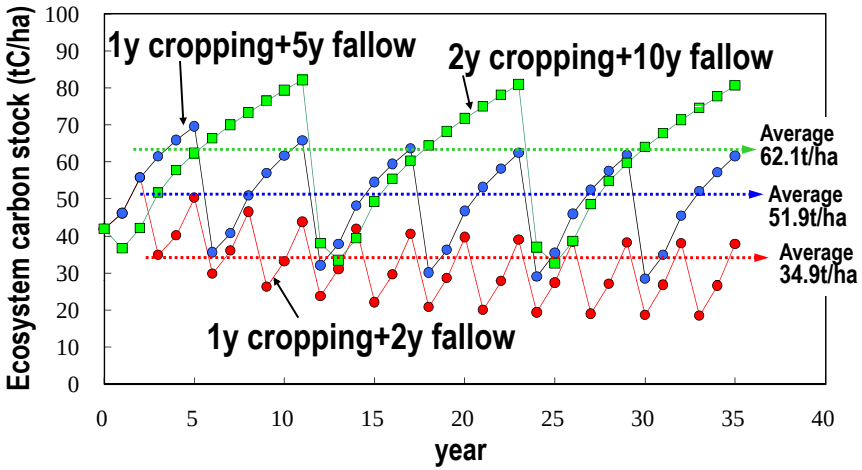
Carbon stock in fallow vegetation

C [biomass + Litter + Dead wood] = 15.378Ln(y)+11.815

y: community age (yr) = fallow period (0.5-20 yr)



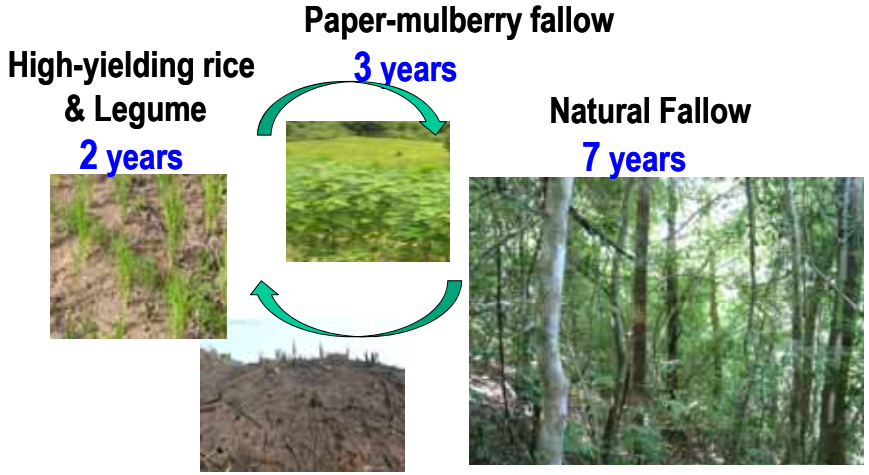
(Kiyono et al. 2007)

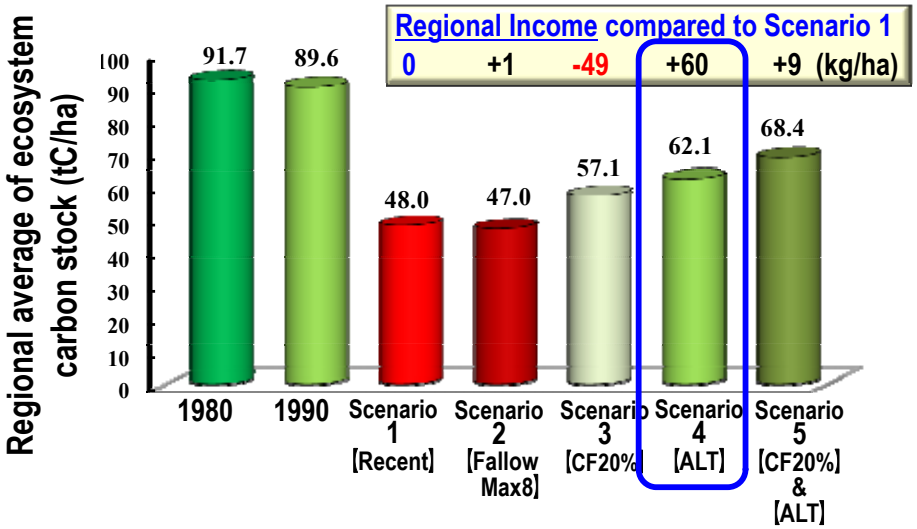


Ecosystem carbon stock in various cropping-fallow cycle patterns as simulated by the simple model (Inoue et al. 2010)

[ALT] Alternative Management Option

2 year Cropping + 10 year Fallow





Regional average of ecosystem carbon stock under some major scenarios

CF20%: Save 20% for conservation forest and never used for S&B.

ALT-system: 2y cropping + 10y fallow using new cultivars & cash crops.

Summary of the case study (1/2)

1. Classification based on segmentation of time-series satellite imagery was quite useful to trace the land-use history and to derive the community age at a pixel basis.
2. Coupling community-age distribution with an ecosystem carbon model was useful for assessment of regional carbon stock, especially in regions with low accessibility and low data availability.

Summary of the case study (2/2)

3. Could quantify the degradation of ecosystem carbon stock and land resources, as well as the negative impact to atmosphere. Results are useful for relative assessment of land-use scenarios.

4. Suggested some alternative ecosystem management scenarios for higher carbon sequestration capacity, regional income & sustainability of ecosystem resources.

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