International Journal of Ecology and Environmental Sciences
www.ecologyjournal.in
Online ISSN: 2664-7133
Received: 03-05-2026, Accepted: 03-06-2026, Published: 18-06-2026
Volume 8, Issue 2, 2026, Page No. 95-100

# Local drivers of deforestation and forest degradation in the Pool Department, Republic of the Congo: Integrating community perceptions and environmental field observations

**Makaya Helischa Audrey, IFO Suspense Averti***
Laboratory of Remote Sensing and Forest Ecology, Marien Ngouabi University, Brazzaville, Republic of the Congo
**Corresponding Author:** IFO Suspense Averti
**DOI:** https://doi.org/10.66856/ijees.2026.8.2.8051

**Abstract**
Local drivers of deforestation and forest degradation cannot be fully understood without linking environmental field observations with community perceptions. This study analyses local drivers of deforestation and forest degradation in the Pool Department, Republic of the Congo, through a territorial cross-analysis of two complementary datasets: an environmental and social field database documenting rural activities, environmental risks and hydrological proximity, and a community survey database documenting perceived causes of forest decline, perceived timing of its onset and forest types still present. The datasets were combined at the locality level and not through row-by-row merging. The results show that perceived causes of forest decline are dominated by the association of agriculture, charcoal production and fuelwood use, whilst field observations reveal agricultural dominance, a pastoral specificity in Koubola and high hydrological sensitivity in Linzolo, Yalavounga and Yangui. Responses on current forest conditions indicate the dominance of secondary forests, suggesting that qualitative forest degradation is a central process in the Pool Department. The study identifies differentiated local profiles: multiple pressure in Missafou, an agricultural-hydrological profile in Linzolo, a pastoral-energy profile in Koubola, an agricultural-riparian profile in Yalavounga and an older perceived memory of forest decline in Yangui. The findings show that deforestation and forest degradation in the Pool Department are part of a socio-ecological system combining agricultural conversion, wood energy, riparian degradation and the gradual transformation of primary forests into secondary forests.

**Keywords:** Local drivers, community perceptions, deforestation, forest degradation, wood energy, agriculture, Pool Department, Republic of the Congo

## Introduction

Recent literature on the Congo Basin shows that deforestation and forest degradation are frequently associated with the rural complex, namely the interaction between small-scale agriculture, villages, roads, fallows, wood energy and domestic uses of natural resources (Molinario et al., 2017; Tyukavina et al., 2018; Shapiro et al., 2023) [4, 6, 7]. In southern Republic of the Congo, the Pool Department is an area where these factors take a specific form because rural localities are embedded within savanna-forest mosaics, gallery forests, secondary formations and landscapes connected to urban markets.

The scientific problem addressed in this paper differs from a simple environmental-risk diagnosis. The aim is to understand how observed field pressures are articulated with community perceptions of the causes, timing and current condition of forests. This approach shifts the analysis from a descriptive inventory of risks to an interpretation of local drivers of deforestation and forest degradation. It is also consistent with recent calls to examine degradation processes beyond industrial logging, including small-scale agriculture, fuelwood extraction and diffuse rural pressures (Besisa et al., 2025) [1].

The central research question is: how can the integration of environmental observations and community perceptions help identify local drivers of deforestation and forest degradation in rural localities of the Pool Department? The working hypothesis is that localities with strong agricultural activity and high hydrological proximity present pressure profiles compatible with riparian degradation, whereas community perceptions make it possible to identify the underlying socio-economic drivers, especially agriculture, charcoal production and fuelwood use.

The general objective is to analyse local drivers of deforestation and forest degradation in the Pool Department by combining environmental observations and community perceptions. The specific objectives are to: (i) identify perceived causes of forest decline; (ii) describe the perceived timing of the onset of this decline; (iii) analyse forest types still reported by respondents; (iv) cross these variables with activity and environmental-risk profiles; and (v) propose an integrated typology of localities.

## Materials and methods

### 1. Study area

The study focuses on the localities common to the two datasets in the Pool Department: Missafou, Linzolo, Koubola, Yalavounga and Yangui. These localities are situated in a rural landscape characterised by agriculture-savanna-secondary forest mosaics, riparian zones and vegetation formations weakened by human use. The Pool Department is affected by pressures related to agriculture, wood energy, livestock keeping and changing land occupation. The study area is shown in Figure 1.

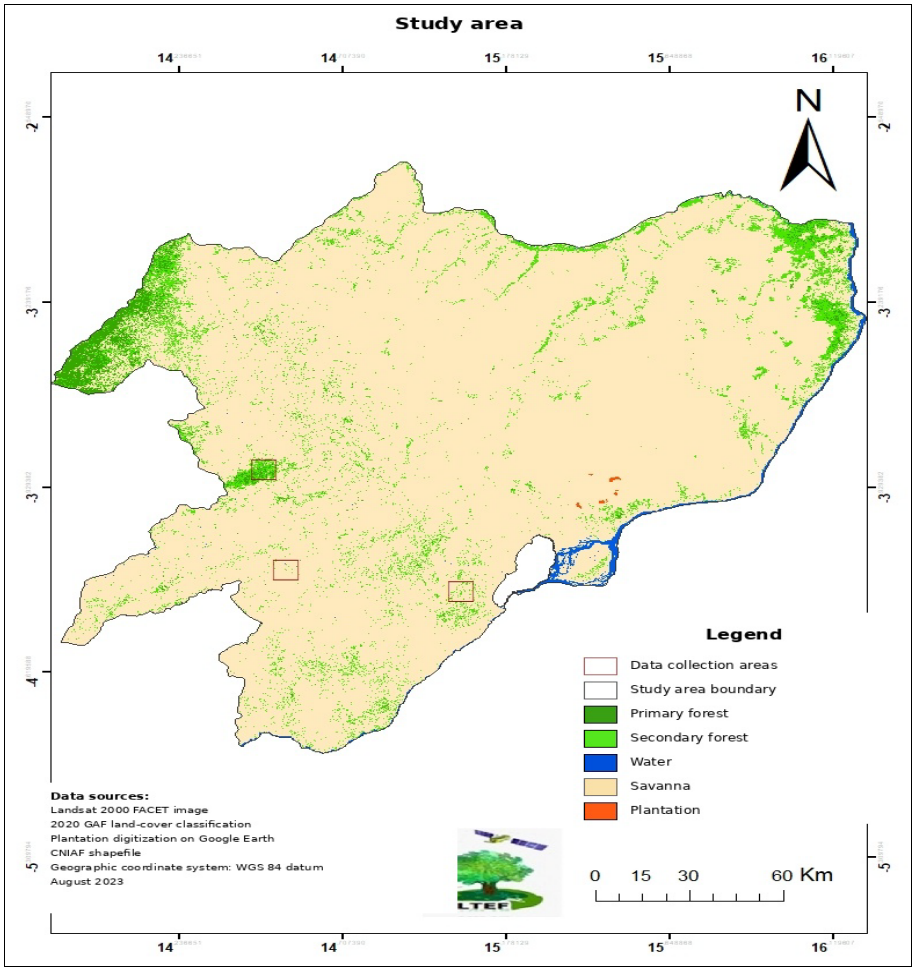


**Fig 1:** General location of the study area in the Pool Department.

## 2. Data sources and combination

Two complementary datasets were used. The first is an environmental and social field database documenting activities, localities, proximity to water points and reported environmental risks. The second is a community survey database documenting perceived causes of forest decline, the perceived period during which this decline began, and the forest types still present according to respondents.

Because the two datasets do not have the same unit of observation, their combination was carried out at the level of common localities. The procedure is therefore not an individual row-by-row merge, but a territorial cross-analysis of indicators. This approach allows observed pressures to be compared with community perceptions for each common locality. Variables relating to sub-projects and direct beneficiaries were not used as analytical indicators.

## 3. Variables and analyses

The environmental variables retained were agricultural occurrences, livestock occurrences, risks to fragile environments, risks to rivers or lakes, and hydrological proximity. The community survey variables were perceived causes of forest decline, the median declared year of onset of this decline, and forest types still present. Analyses were descriptive and interpretative. They aimed to identify local driver profiles rather than to establish individual-level statistical causality.

## Results

### 1. Common localities and integrated observation profiles

**Table 1:** Common localities and integrated profiles.

| Locality | Env. obs. | Survey resp. | Water (%) | Agric. | Livestock | Fragile | Rivers/lakes | Integrated profile |
|---|---|---|---|---|---|---|---|---|
| Missafou (Mindouli) | 74 | 100 | 66.2 | 35 | 13 | 17 | 21 | Multiple agriculture-wood-energy pressure |
| Linzolo (Goma tse-tse) | 43 | 39 | 90.9 | 24 | 6 | 10 | 6 | Agricultural-hydrological |
| Koubola (Goma tse-tse) | 21 | 22 | 64.7 | 7 | 9 | 5 | 1 | Pastoral-energy |
| Yalavounga (Kinkala) | 17 | 18 | 100.0 | 12 | 2 | 11 | 7 | Agricultural-riparian |
| Yangui (Kinkala) | 15 | 18 | 93.3 | 10 | 5 | 3 | 6 | Agricultural with older memory |

The common localities display contrasting profiles. Missafou combines a high diversity of activities, high hydrological risks and a strong perception of the agriculture-wood-energy association. Linzolo and Yalavounga combine agricultural dominance with strong hydrological proximity. Koubola is distinguished by a pastoral profile, whereas Yangui combines agriculture, hydrological proximity and an older perceived memory of forest decline.

## 2. Perceived causes of forest decline

**Table 2:** Perceived causes of forest decline.

| Locality | Agriculture only | Agriculture + charcoal/fuelwood | Charcoal/fuelwood only | War/tree felling |
|---|---|---|---|---|
| Missafou (Mindouli) | 3 | 66 | 22 | 9 |
| Linzolo (Goma tse-tse) | 5 | 31 | 3 | 0 |
| Koubola (Goma tse-tse) | 0 | 22 | 0 | 0 |
| Yalavounga (Kinkala) | 0 | 18 | 0 | 0 |
| Yangui (Kinkala) | 0 | 15 | 0 | 3 |

Community perceptions show a very strong dominance of the combined agriculture-charcoal-fuelwood category. This association is reported in all common localities and is particularly high in Missafou, Linzolo, Koubola and Yalavounga. Causes limited to agriculture alone or to charcoal/fuelwood alone are less frequent, indicating that respondents perceive forest decline as a composite process rather than as the effect of a single activity.

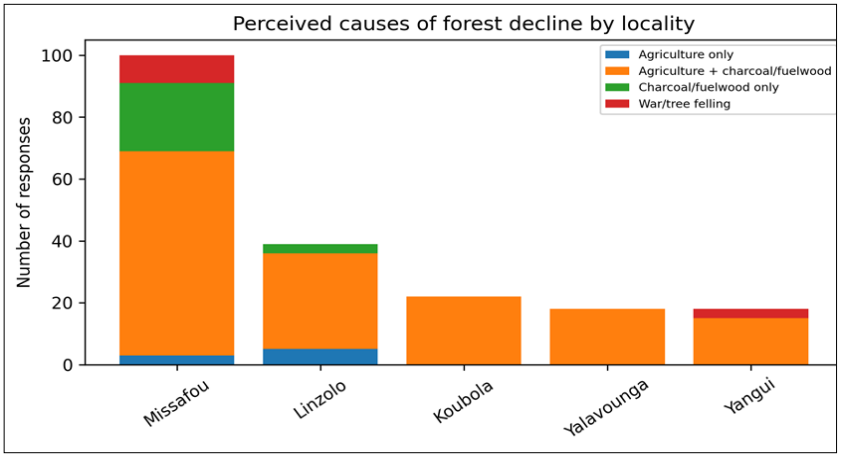


**Fig 2:** Perceived causes of forest decline by locality.

## 3. Perceived timing of the onset of forest decline

**Table 3:** Perceived timing of the onset of forest decline.

| Locality | Responses | Median | Minimum | Maximum |
|---|---|---|---|---|
| Missafou (Mindouli) | 100 | 1997 | 1970 | 2003 |
| Linzolo (Goma tse-tse) | 39 | 2000 | 2000 | 2000 |
| Koubola (Goma tse-tse) | 22 | 2000 | 1995 | 2000 |
| Yalavounga (Kinkala) | 18 | 2000 | 1978 | 2000 |
| Yangui (Kinkala) | 18 | 1985 | 1975 | 2000 |

The perceived timing of forest decline varies among localities. Yangui is distinguished by an older median year, whereas Linzolo, Koubola and Yalavounga mainly locate the beginning of forest decline around 2000. Missafou displays a wider dispersion of responses, suggesting a more heterogeneous environmental memory. These results indicate that forest decline is perceived as a process with locally specific trajectories.

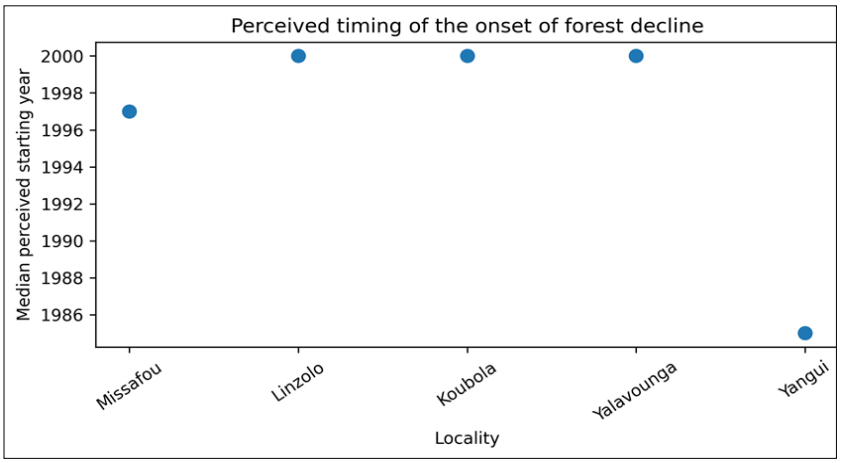


**Fig 3:** Perceived timing of the onset of forest decline.

## 4. Forest types still present according to respondents

**Table 4:** Forest types still reported by respondents.

| Locality | Primary forest | Primary + secondary | Secondary forest | No forest |
|---|---|---|---|---|
| Missafou (Mindouli) | 7 | 2 | 80 | 11 |
| Linzolo (Goma tse-tse) | 0 | 4 | 30 | 5 |
| Koubola (Goma tse-tse) | 0 | 0 | 22 | 0 |
| Yalavounga (Kinkala) | 0 | 0 | 18 | 0 |
| Yangui (Kinkala) | 1 | 0 | 17 | 0 |

Responses indicate a clear dominance of secondary forests in all common localities. Primary forest is rarely reported and appears mainly in Missafou and marginally in Yangui. The absence of forest is reported in some responses, particularly. Missafou and Linzolo. This result highlights the centrality of forest degradation: the problem is not only the disappearance of forest cover, but also the qualitative transformation of primary or mature forests into secondary formations.

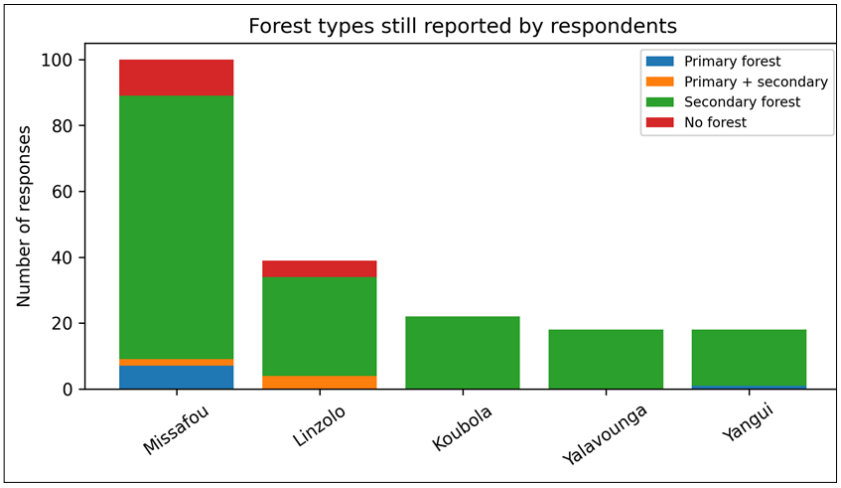


**Fig 4:** Forest types still present according to respondents.

## 5. Cross-reading of agricultural pressure and hydrological sensitivity

The cross-reading of agricultural occurrences and hydrological proximity distinguishes several configurations. Linzolo and Yalavounga combine agricultural presence with high hydrological sensitivity. Missafou has strong agricultural activity but a lower proportional hydrological sensitivity, whilst concentrating more reported risks. Koubola is less agricultural but more pastoral. This confirms that local drivers should be interpreted at the locality scale rather than through a single aggregated indicator.

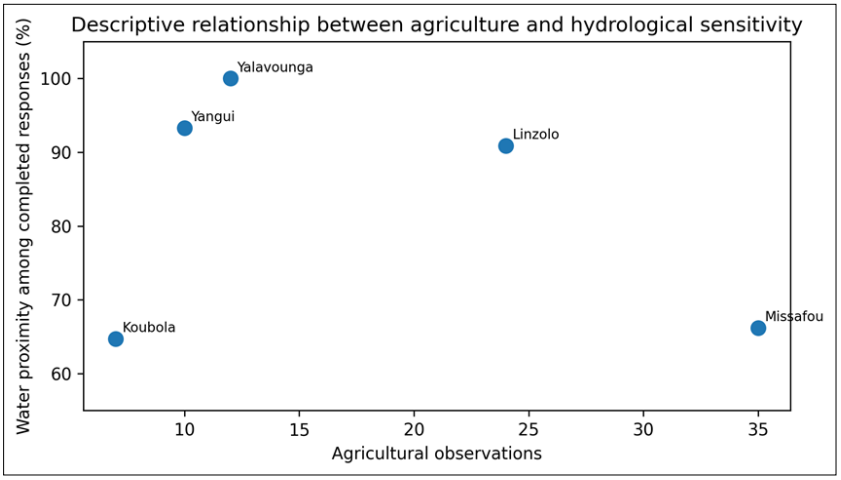


**Fig 5:** Descriptive relationship between agricultural observations and hydrological proximity.

## Discussion

### 1. A socio-ecological interpretation of local drivers

The results show that deforestation and forest degradation in the Pool Department cannot be reduced to a single factor. Community perceptions place the combined agriculture-charcoal-fuelwood driver at the centre of the process, whilst environmental observations show that rural activities are embedded in differentiated hydrological and ecological

contexts. This convergence supports the interpretation of a composite driver in which agricultural conversion, wood-energy extraction and riparian degradation interact.

This interpretation is consistent with recent studies in the Congo Basin that highlight the role of the rural complex in forest loss and degradation (Molinario et al., 2017; Tyukavina et al., 2018; Shapiro et al., 2023) [4, 6, 7]. In the Pool Department, this complex takes a local form that combines fields, wood-energy use, livestock keeping, water points, secondary formations and fragile environments. The contribution of this study is to show how these components combine differently from one locality to another.

## 2. Agriculture and wood energy as a combined rather than separate driver

The fact that respondents strongly associate agriculture, charcoal production and fuelwood use is a major result. It indicates that forest decline is not perceived as the simple effect of opening fields, nor as an isolated consequence of charcoal production. It is understood locally as the result of successive or simultaneous uses: clearing, recovery of wood, charcoal or fuelwood production, cultivation, fallow and gradual landscape transformation.

This result has important policy implications. Policies focused only on banning charcoal or only on improving agriculture are likely to be insufficient. Responses should combine agroecological intensification, agroforestry, energy alternatives, village plantations, fallow restoration and control of new clearing. Because the driver is combined, the response should also be combined. This conclusion is consistent with Masolele et al. (2024) [3], who show that post-deforestation land uses in Africa are diverse, and with Besisa et al. (2025) [1], who call for forest-degradation research to broaden its focus beyond formal logging.

## 3. Secondary forests and qualitative degradation of forest cover

The dominance of secondary forests reported by respondent's shows that forest degradation is a central process. A secondary forest may retain tree cover, but it does not necessarily have the same floristic composition, structure, and biomass or carbon-storage capacity as a primary or mature forest. Local perceptions therefore point to a qualitative transformation of forest cover, even where forest has not completely disappeared.

This distinction is critical for scientific interpretation. Deforestation refers to the loss or conversion of forest cover, whereas degradation refers to a reduction in the ecological or functional quality of the forest. The survey data are particularly useful for documenting this second dimension, because they indicate the perceived condition of forest formations and the gradual disappearance of primary forests. This complements satellite-based approaches, which are powerful for detecting forest-cover loss but may under-represent subtle degradation processes (Vancutsem et al., 2021) [8].

## 4. Riparian environments and local amplification of pressures

The strong hydrological proximity observed in Linzolo, Yalavounga and Yangui suggests that watercourses, lowlands and gallery forests are priority spaces of potential degradation. Agriculture in riparian zones may lead to riverbank clearing, erosion, organic pollution and fragmentation of gallery forests. Livestock can reinforce these effects through trampling and pressure on watering points.

Riparian environments are sensitive ecological interfaces. Their degradation may precede measurable forest loss and reduce landscape resilience. Restoration of vegetated buffer strips and protection of watercourses should therefore be considered central preventive measures in the Pool Department. The spatial organisation of activities around water points and access routes should also be examined in future work, as accessibility has been shown to influence forest disturbance in the Congo Basin (Kleinschroth et al., 2019) [2].

## 5. Territorial differentiation of drivers

The typology resulting from the cross-analysis of the two datasets shows that local drivers are not homogeneous. Missafou presents a multiple-pressure profile in which activities and perceptions converge towards a strong agriculture-wood-energy-hydrological risk interaction. Linzolo has an agricultural-hydrological profile, whereas Yalavounga represents a sensitive agricultural-riparian case. Koubola is characterised by the relative importance of livestock, but perceptions also link forest decline to wood energy. Yangui is distinguished by an older perceived timing of forest decline.

This differentiation requires adapted responses: agroforestry and energy alternatives in Missafou, riparian protection in Linzolo and Yalavounga, grazing-route management in Koubola, and ecological restoration combined with historical monitoring in Yangui. A uniform policy would be less effective than spatially explicit and locally differentiated planning.

## 6. Limitations and perspectives

The study relies on a locality-level cross-analysis and therefore cannot establish individual-level causality. Reported causes and years are based on perceptions and environmental memory. They should be compared with satellite data to measure effective forest-cover loss. The next step should use GPS coordinates to create buffer zones around localities and analyse tree-cover loss using Landsat, Sentinel-2 or Global Forest Change. This would make it possible to test the consistency between community perceptions and measured land-cover changes.

## Conclusion

This paper has shown that local drivers of deforestation and forest degradation in the Pool Department form a socio-ecological system combining agriculture, charcoal production, fuelwood use, localised livestock keeping, hydrological proximity and the transformation of primary forests into secondary forests. The integration of community perceptions and environmental observations moves the analysis beyond a simple risk inventory and helps identify local logics of forest decline.

The main contribution of the study is to show that respondents perceive forest decline as the result of a combined agriculture-wood-energy driver, while environmental observations reveal local contexts of vulnerability, especially around water points and fragile environments. The surveyed localities display distinct profiles and therefore require differentiated responses.

Future research should integrate GPS points with satellite data to quantify forest-cover loss and assess the consistency between local perceptions and measured landscape change.

Author contributions

MAKAYA Helischa Audrey contributed to community survey data collection, organisation of field observations, structuring of community information and interpretation of results. IFO Suspense Averti contributed to the scientific design, methodological supervision, and cross-analysis of the databases, writing, critical revision and validation of the final version. Both authors read and approved the submitted manuscript.

**Conflict of interest statement**

The authors declare that they have no conflict of interest in relation to this study.

**Data Availability**

The data used in this study are available from the corresponding author upon reasonable request, subject to the conditions governing the use of survey data and applicable institutional requirements.

**References**


1. Besisa L, et al. Assessing Forest Degradation in the Congo Basin: The Need to Broaden the Focus from Logging to Small-Scale Agriculture. Forests,2025:16:953.
2. Kleinschroth F, Laporte N, Laurance WF, Goetz SJ, Ghazoul J. Road expansion and persistence in forests of the Congo Basin. Nature Sustainability,2019:2:628:634.
3. Masolele RN, et al. Mapping the diversity of land uses following deforestation across Africa. Scientific Reports,2024:14:1681.
4. Molinario G, Hansen MC, Potapov PV, Tyukavina A, Stehman SV, Barker B, et al. Quantification of land cover and land use within the rural complex of the Democratic Republic of Congo. Environmental Research Letters,2017:12:104001.
5. Molinario G, Hansen MC, Potapov PV, Tyukavina A, Stehman SV. Contextualizing landscape-scale forest cover loss in the Democratic Republic of Congo between 2000 and 2015. Land,2020:9(1):23.
6. Shapiro A, et al. Small-scale agriculture continues to drive deforestation and degradation in fragmented forests in the Congo Basin (2015-2020). Land Use Policy,2023:134:106922.
7. Tyukavina A, Hansen MC, Potapov PV, et al. Congo Basin forest loss dominated by increasing smallholder clearing. Science Advances,2018:4(11):2993.
8. Vancutsem C, Achard F, Pekel JF, et al. Long-term monitoring of forest cover changes in the humid tropics. Science Advances,2021:7:1603.
9. Vennetier P. Géographie du Congo-Brazzaville. ORSTOM, 1966.
10. Monographie du département du Pool. République du Congo, 2011.