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Understanding Sediment Cascades along River Networks for Sustainable Catchment Management

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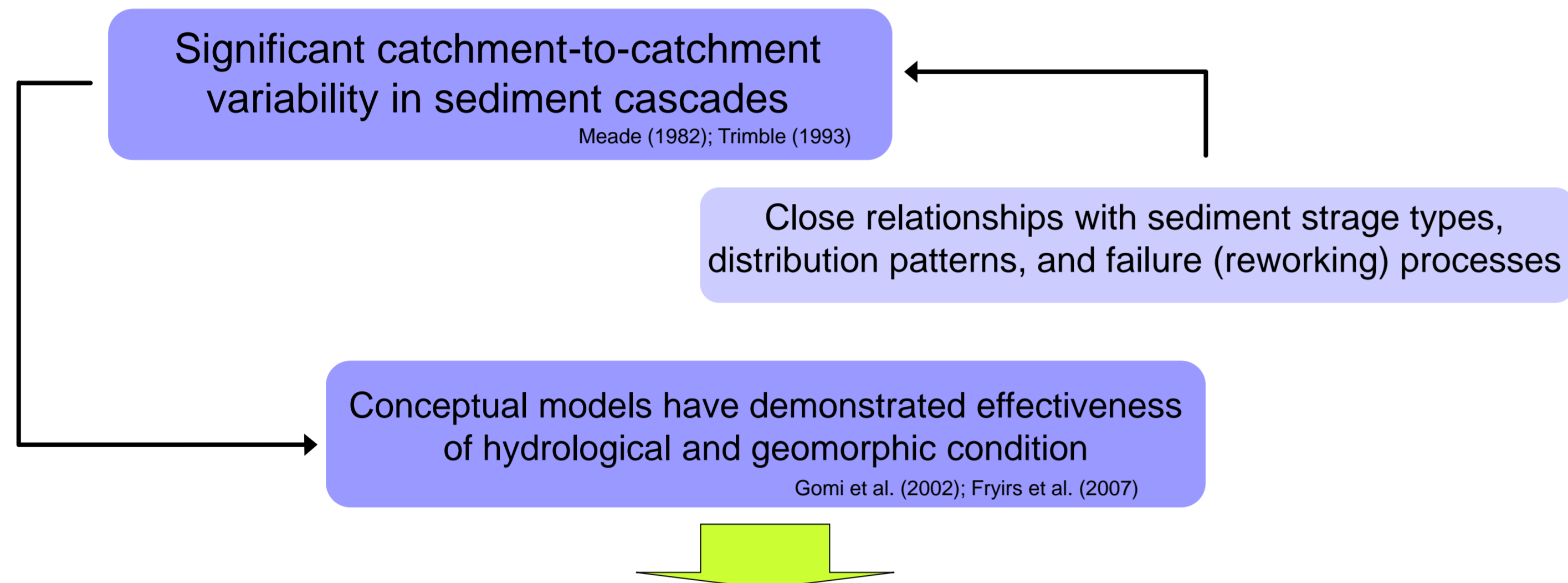
1. Management of River Network is essential for Sustainable Water Supply & Land Use

River network functions not only as "pipe line network" for water resources transport, but also as "jerky conveyor belt" for sediment transport from hillslopes to outlet of catchment (Fig.1). Because sediment transport along river network (hereafter, **sediment cascade**) is primarily modulated by intermittent supply, storage and failure (reworking) in cascade system, its activation and/or alternation has potential threats to cause flood and sediment disasters and undesirable changes in river network structure and linkages.

Therefore, knowledge of cascade system dynamics along river network is required to use water resources and surrounding landscapes sustainably, and to avoid loss of lives, housing, and infrastructure.

Combination of remote-sensing and field observation successfully reconstructed dynamics of sediment cascades for about 50 years. Here, based on the results, **aim of this study is addressed to quantitatively evaluate hydrogeomorphic threshold(s) which significantly effect on sediment cascade dynamics and their variation.**

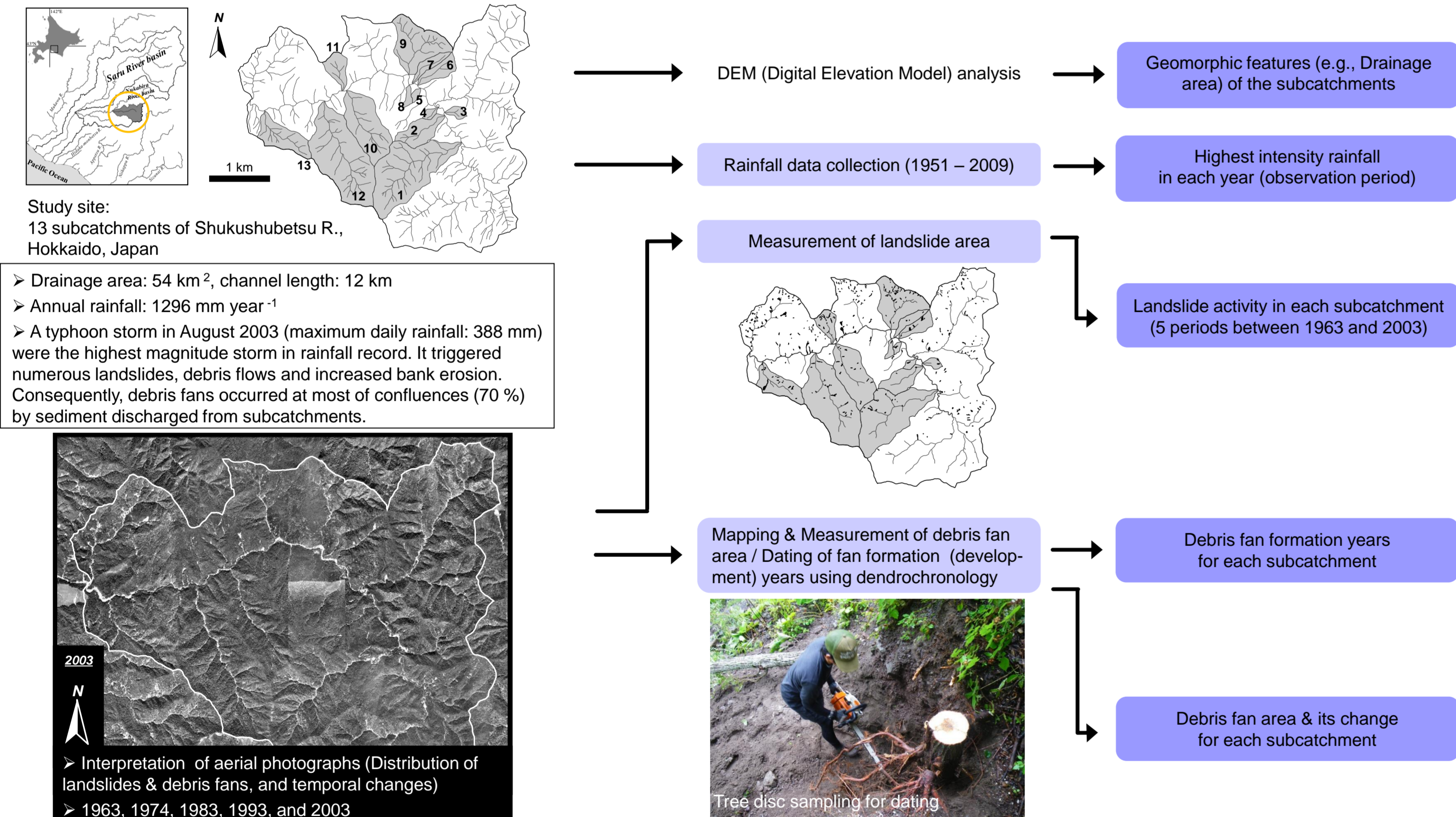
2. Understanding Sediment Cascades is a Key for Management of River Network



However, hydrogeomorphic thresholds which significantly effect on sediment cascade dynamics have not quantitatively evaluated!

4. Variation in Patterns of Sediment Cascades

4-1. Procedures for field measurements & data analyses



5. Hydrogeomorphic Thresholds for Changes in Sediment Cascades & Debris Fan Formation

5-1. Relationships with rainfall intensity

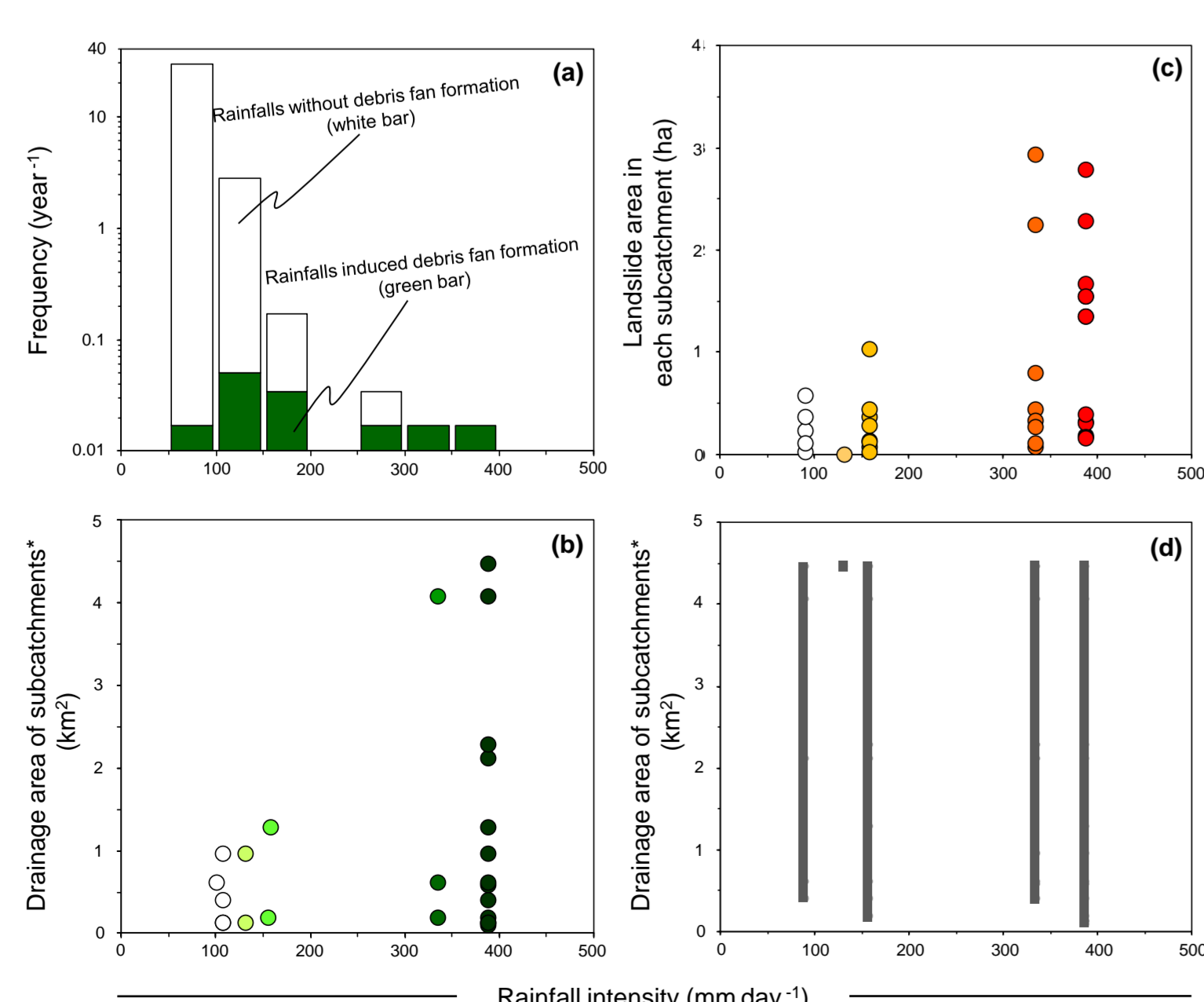


Fig.4. Relationships of debris fan formation and landslide occurrence with rainfall intensity

5-2. Rainfall and geomorphic thresholds

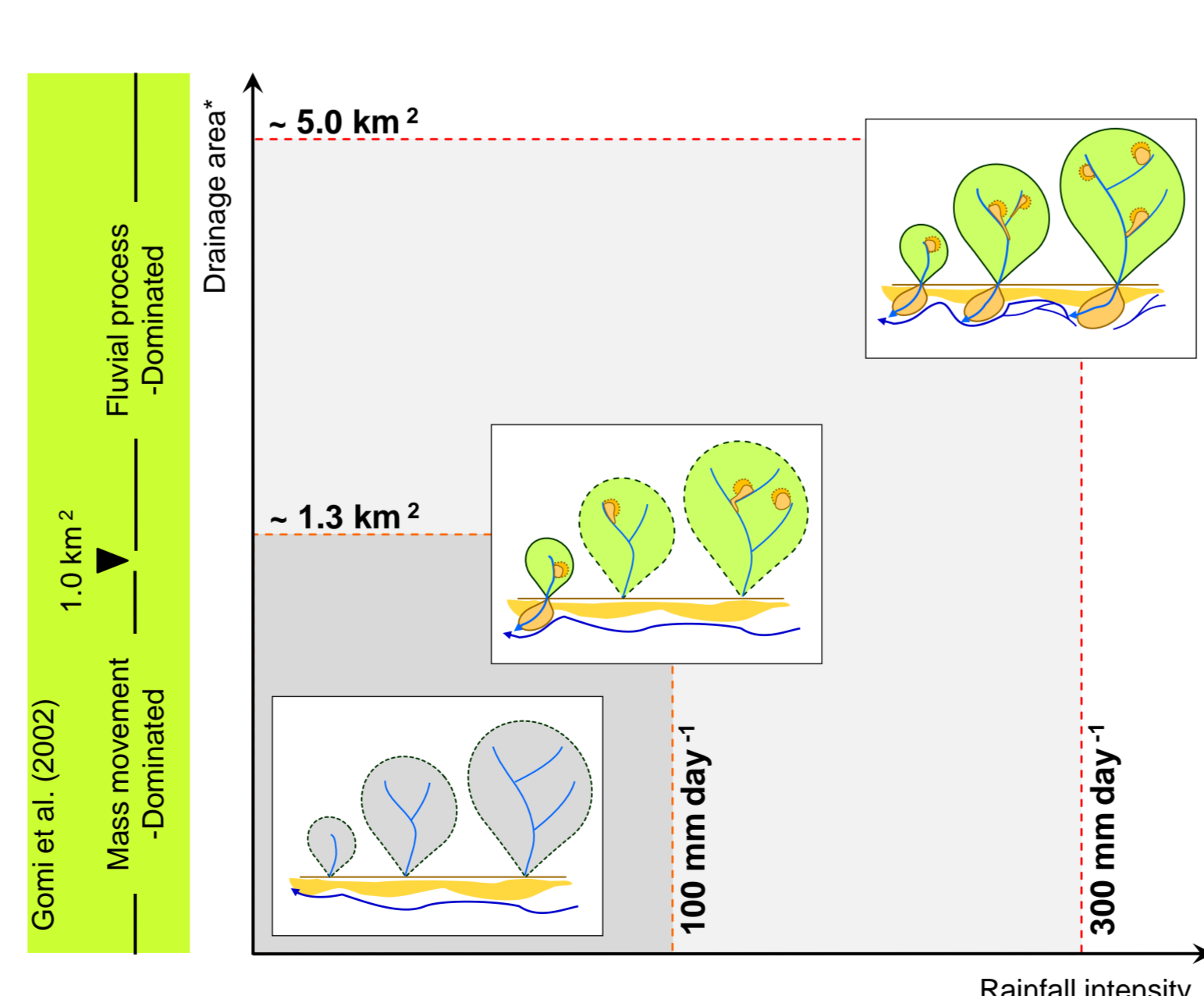


Fig.5. Schematic diagram of hydrogeomorphic thresholds for changes in sediment cascades

- As rainfall intensity of storm events increased,
 - Proportion of storm events which induced debris fan formation increased.
 - Both upper limits of landslide area in subcatchments and of drainage area of subcatchments which form debris fan increased.
- Detected thresholds which modulate variation in sediment cascades dynamics are
 - 1.3 km² of drainage area, and
 - 100 mm day⁻¹ and 300 mm day⁻¹

6. Summary

- Significant hydrogeomorphic thresholds which modulate variation in sediment cascades of subcatchments were successfully detected by comparing reconstructed sediment cascade dynamics with rainfall records.
- Quantification of hydrogeomorphic thresholds enables to plan and practice sustainable catchment management.

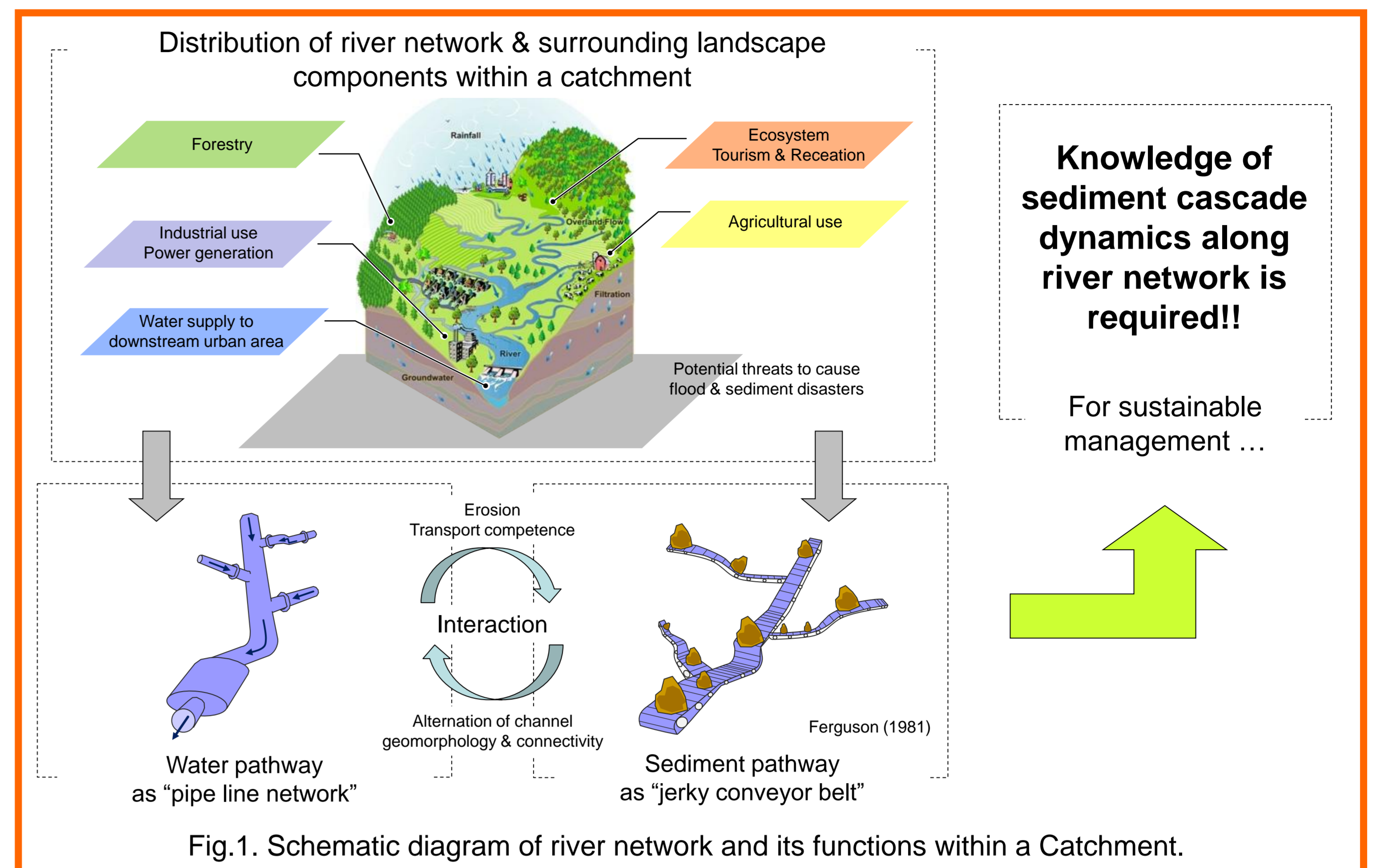


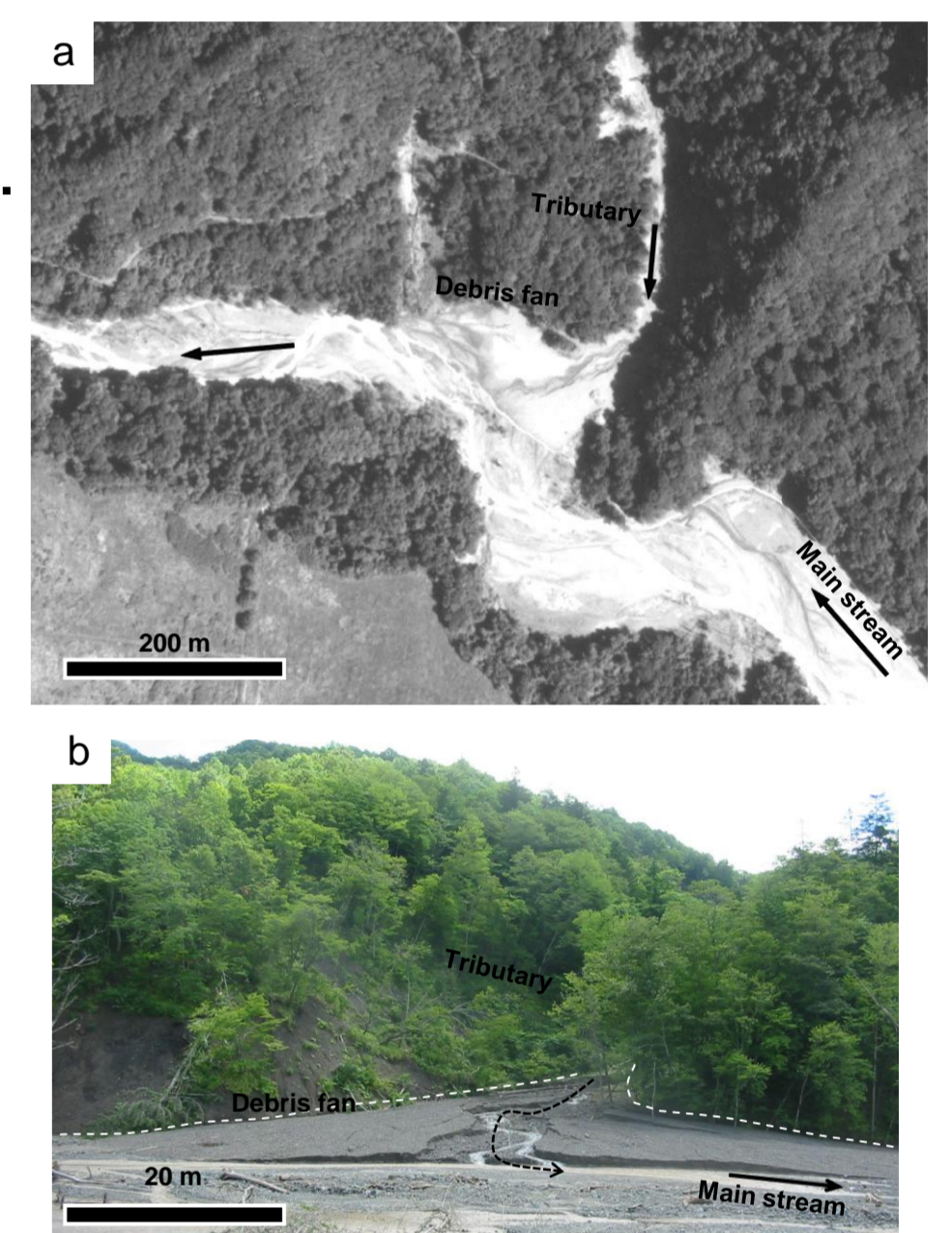
Fig.1. Schematic diagram of river network and its functions within a Catchment.

3. Significance of Debris Fan Formation

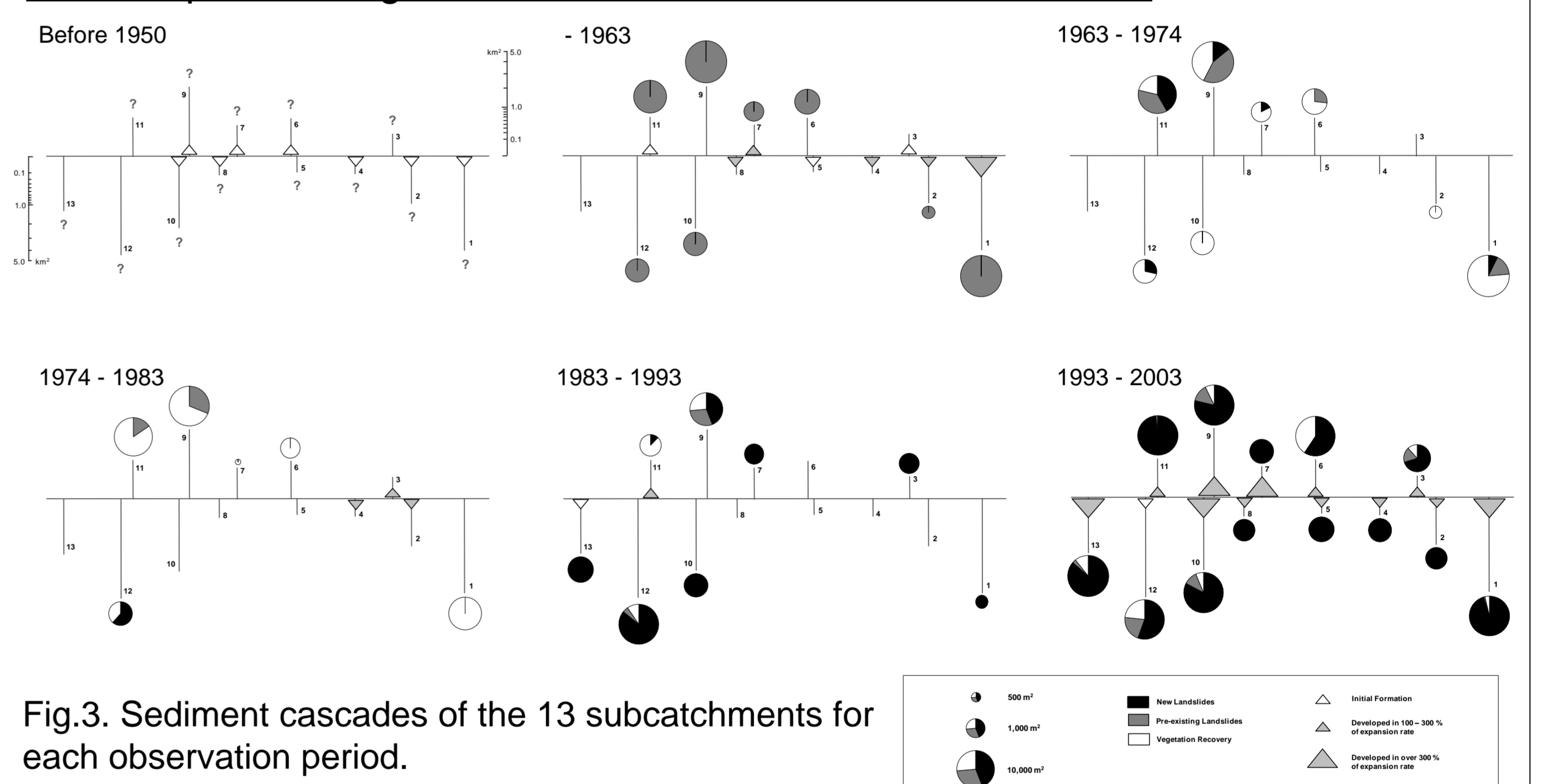
- Debris fan formation mostly results from occurrence of debris flow that attained subcatchment outlet (Ashida, 1985).
 - ∴ Variation in sediment cascades may lead to difference in timing of debris fan formation
- Debris fan works as "buffer" in sediment cascade system between subcatchment and main stream (Harvey, 2010).
 - ∴ Debris fan may alter structure of sediment cascade.

To understand sediment cascade dynamics, exploring processes of debris fan formation (development) is effective!

Fig.2. Views of debris fan at river confluence. (a) from aerial photograph; (b) from river bank opposite side of the debris fan.



4-2. Temporal changes in sediment cascades & their variation



- Debris fan formation years did not necessarily coincident with landslide occurrence in subcatchments.
- In subcatchments which abruptly develop their fans by the 2003 storm, landslide occurrence before 2003 did not result in fan formation.

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