Meteorological and Landuse Influences on the 2014 Flood in Malaysia

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Outline

1. Introduction on Dec 2014 Flood
2. Factors contributing to Flood
    - Rainfall
    - Land use
3. Forest versus plantation catchment
4. Cumulative Watershed Effects

Source: Zulkifli Yusop (UTM)

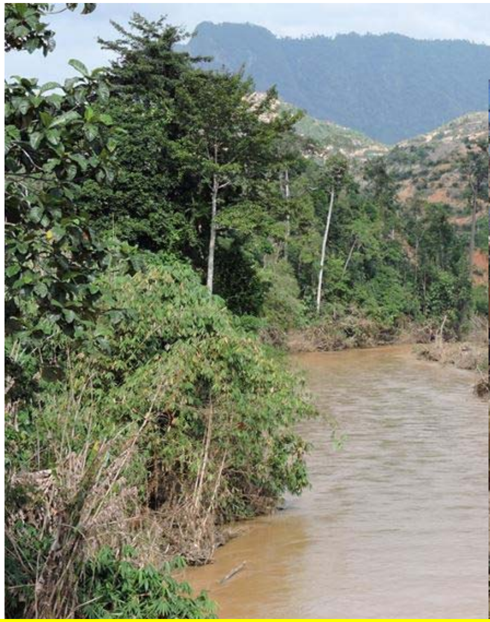
Major Floods in Malaysia

Year	State Affected	Damage (RM Mil.)	No of Death	Victim evacuated
1926	Kelantan, Kuala Lumpur & Perak			
1967	Kelantan	199.3	38	320,000
1971	Large area in Peninsular Malaysia, Sabah & Sarawak. State of emergency was declared		57	
1988	Kelantan	33.3		
Dec 2004	Kelantan, Terengganu, Pahang			
2005	Kedah, Perlis, Kelantan, Terengganu	240.		
Dec 2006 / Jan 07	Pahang, Kelantan, Johor, Kedah	316.		
Nov 2010	Kedah, Johor and Perlis			
Dec 2014	Kelantan, Pahang, Perak	>300		

- More than 300 k people evacuated
- More RM 3 billion loss
- ~20 death

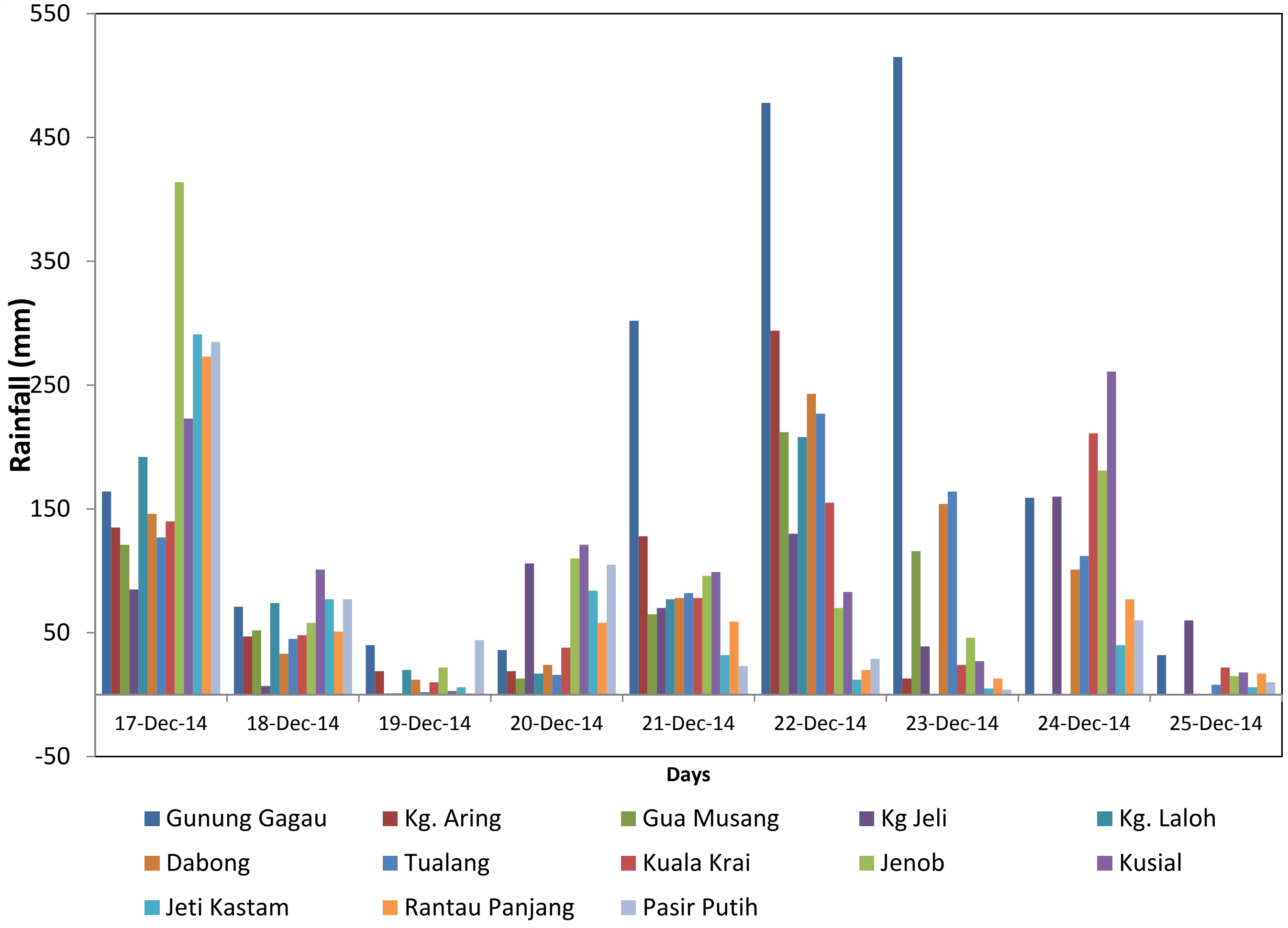
Zulkifli Yusop (UTM)

Channel Erosion



- The flow was so powerful
- Possible cause; creation and burst of Debris Dams that release huge amount of water/energy

Rainfall during Kelantan 2014 Flood



- Max Rainfall at Gunung Gagau 1765 mm (17 to 24 Dec)
- Other stations; Jenob 997 mm, Kusial 918 mm, Kuala Kerai 704 mm, Dabong, 791 mm, Tualang 783 mm, Kg Aring 655 mm
- Water level peak at Kuala Krai on 25 Dec
- Annual Rainfall 2300mm

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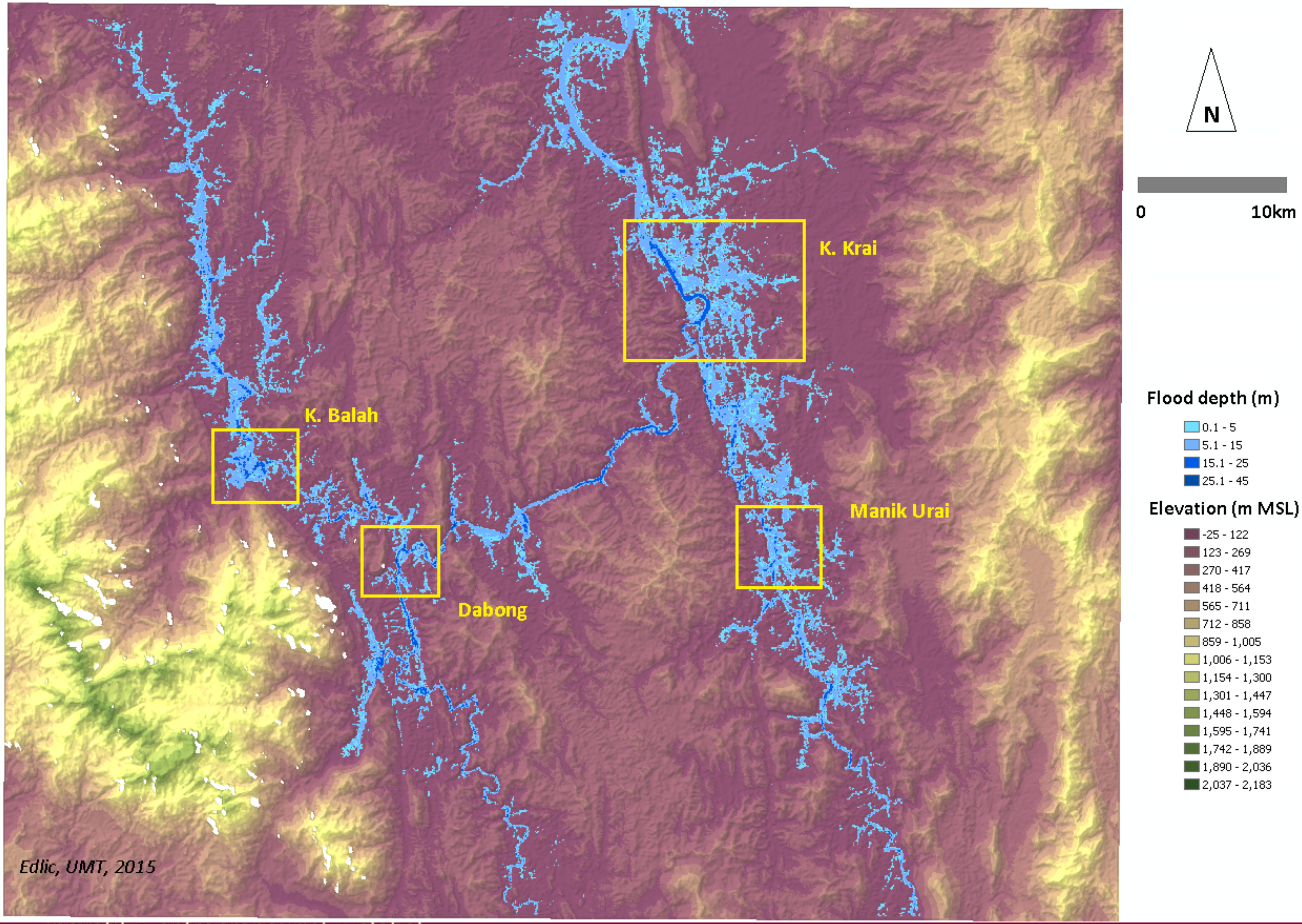
Cumulative Rainfall and the Return Period

Station	1 days (mm)	ARI (yr)	3 days (mm)	ARI (yr)	5 days (mm)	ARI (yr)	7 days (mm)	ARI (yr)
Dabong	243	14	498	27	600	28	690	31
Gua Musang	212	89	393	136	407	59	580	181
Gunung Gagau	515	60	1295	>500	1490	>500	1601	>500
Kuala Krai	211	4	390	5	506	6	564	6
Kg Aring	294	43	441	22	507	17	655	30
Kg Lalok	208	8	302	5	396	6	588	14
Rantau Panjang	273	9	325	3	442	4	475	4

Sumber: Nor Eliza Alias (UTM)



Flooded Area is 7.4%

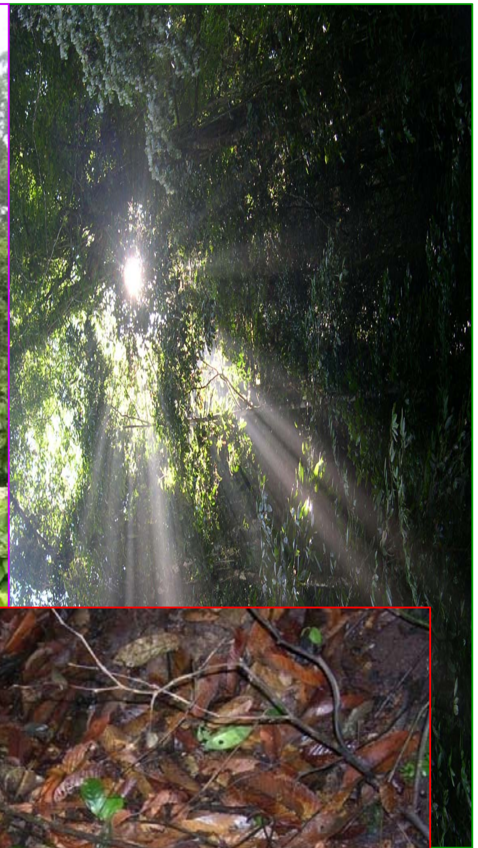
Sumber: Edlic Sathiamurthy (UMT)

Forest vs plantation

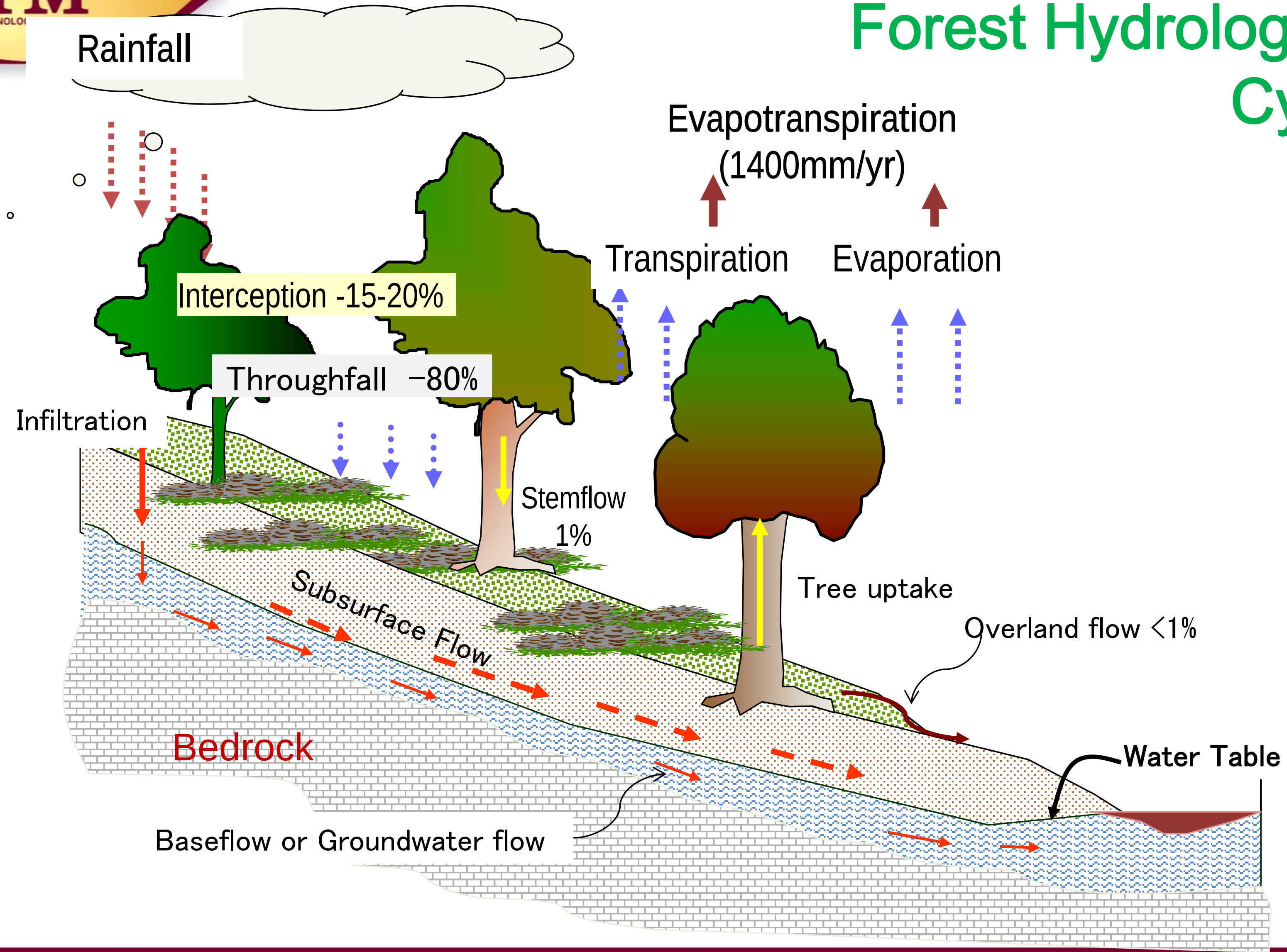
Source: Zulkifli Yusop (UTM)

Forest - an Ultimate Protection

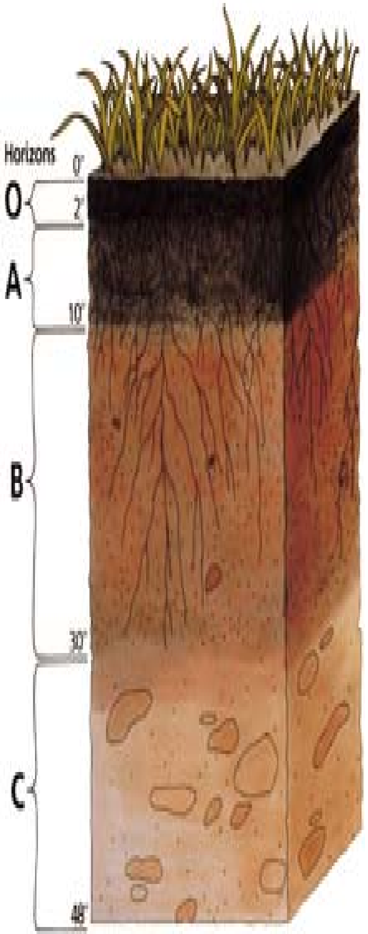
- Forest: multi-layered canopy, undergrowth, litter layer, thick hair root → high infiltration
- Low erosion < 1 ton/ha/yr

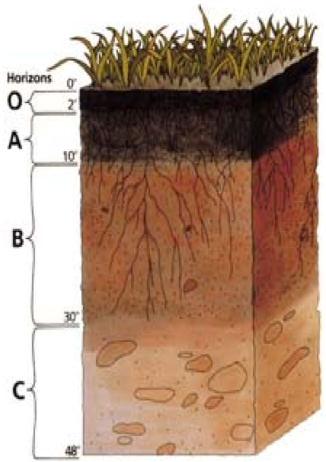



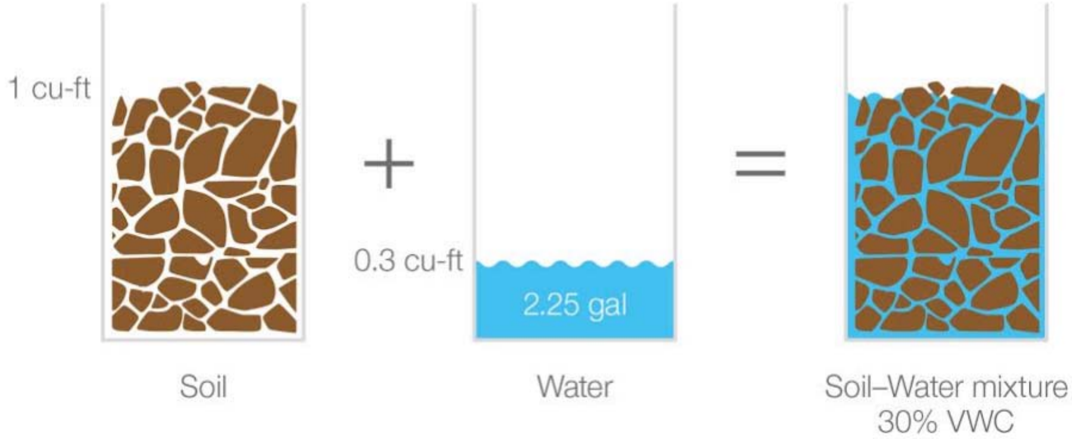

Forest Hydrological Cycle



- Deeper soil has bigger capacity to store water
- Higher initial loss







Source: Zulkifli Yusop (UTM)

Logging Operation

Recovery after logging

Oil Palm Plantation

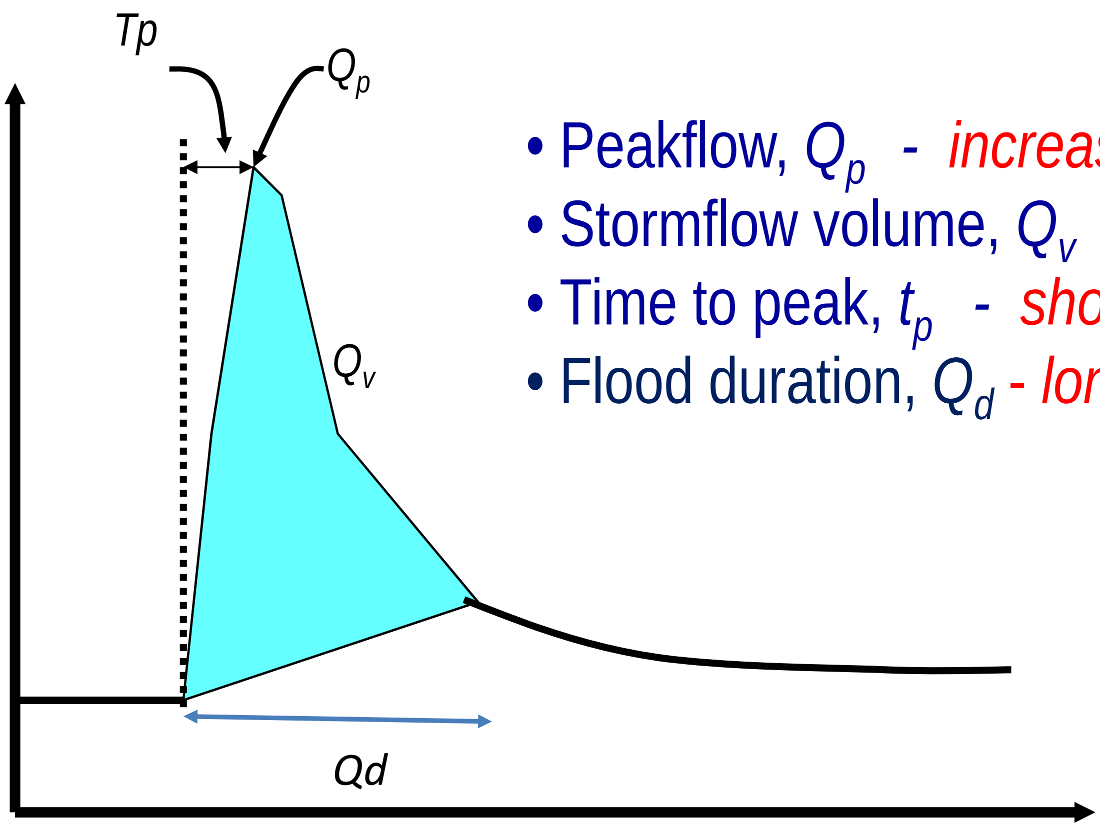
Rubber Plantation – for latex

Hydrologically more acceptable for water resource conservation

Good undergrowth, minimum compaction

Flood Response

Stormflow Response



- Peakflow, Q_p - *increase*
- Stormflow volume, Q_v - *increase*
- Time to peak, t_p - *shorter*
- Flood duration, Q_d - *longer*

Stormflow Response to Rainfall

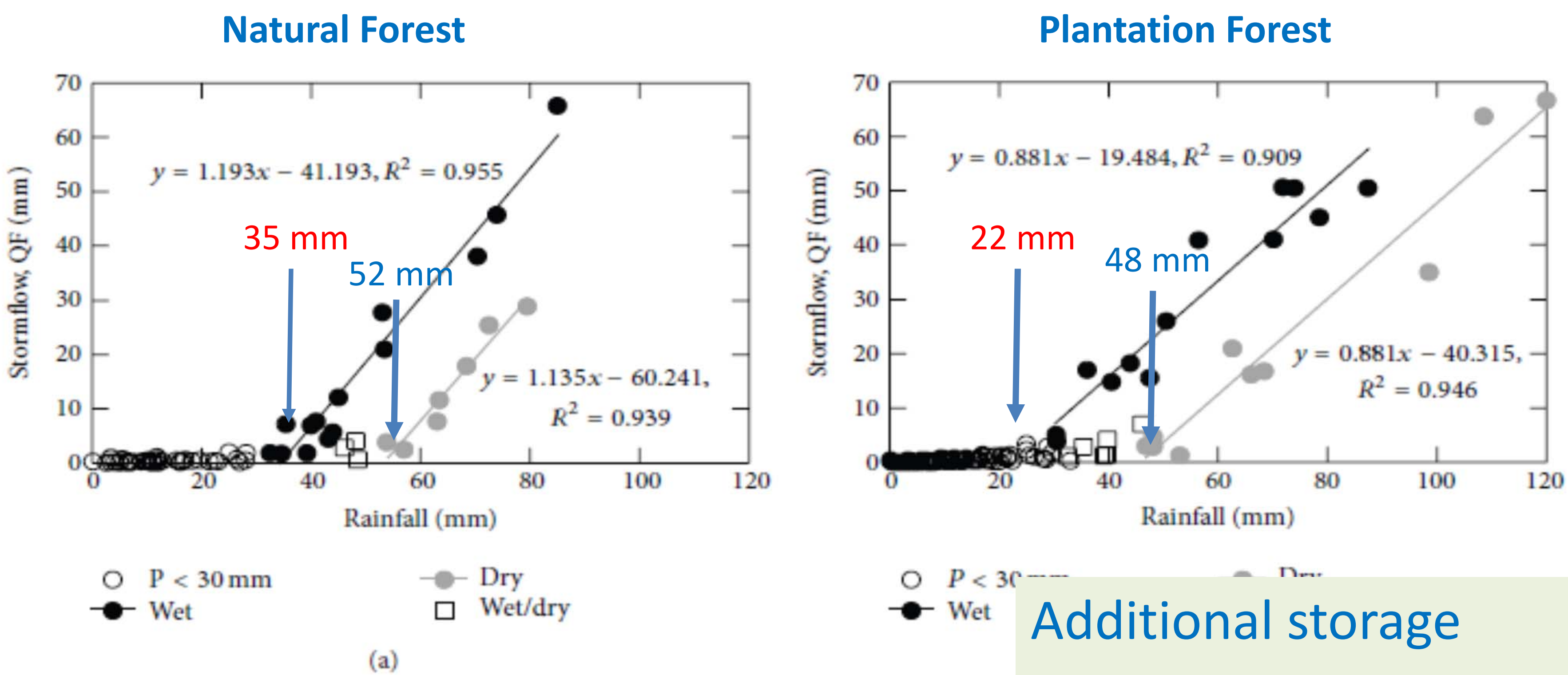


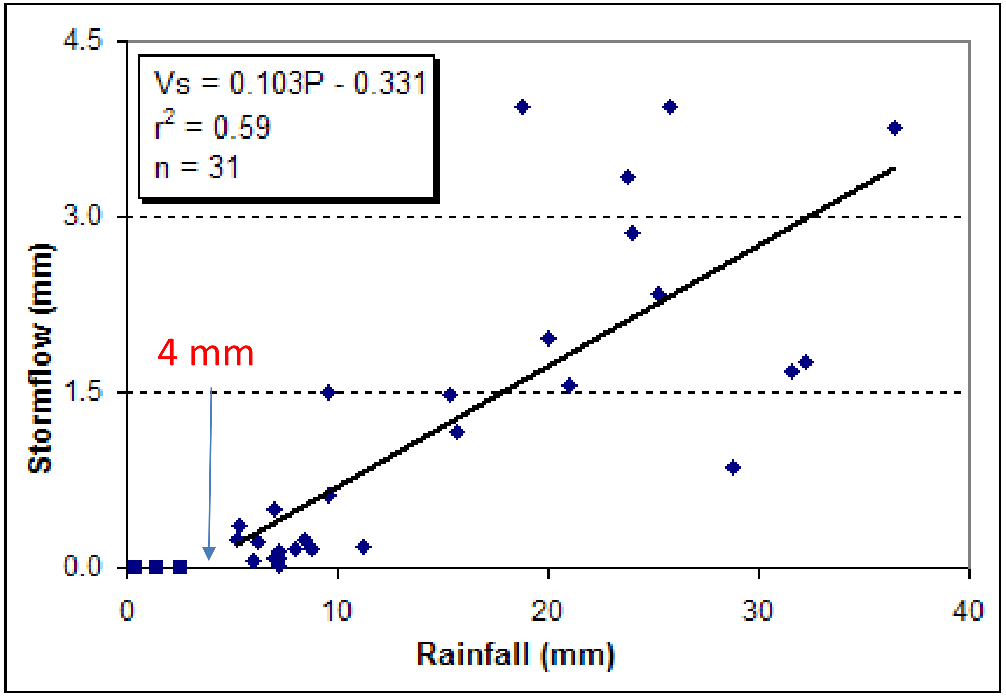
FIGURE 3: Relationships between stormflow (QF) and rainfall events during wet and dry co
catchment C3 (b) for observation from January 2006 to June 2007.

Additional storage

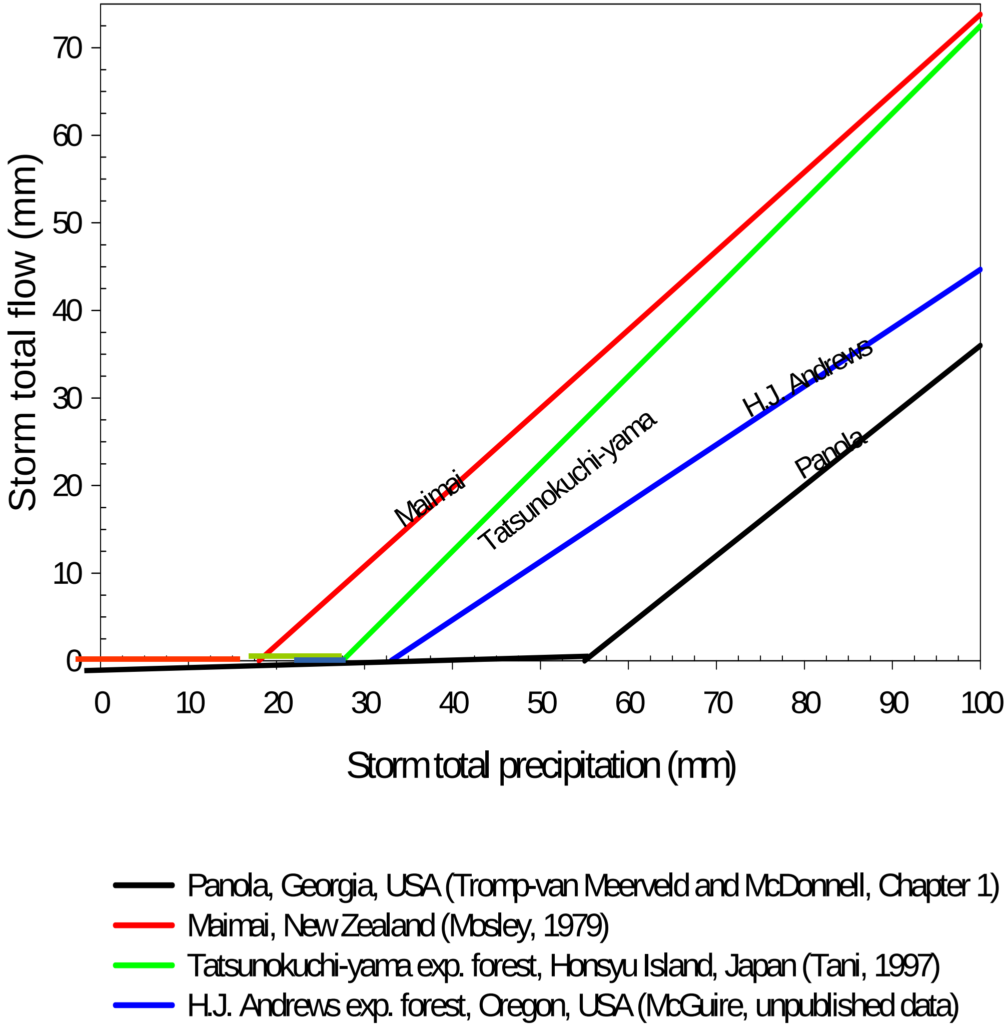
Dry period 13 mm

Wet period 4 mm

Stormflow vs Rainfall in oil palm catchment

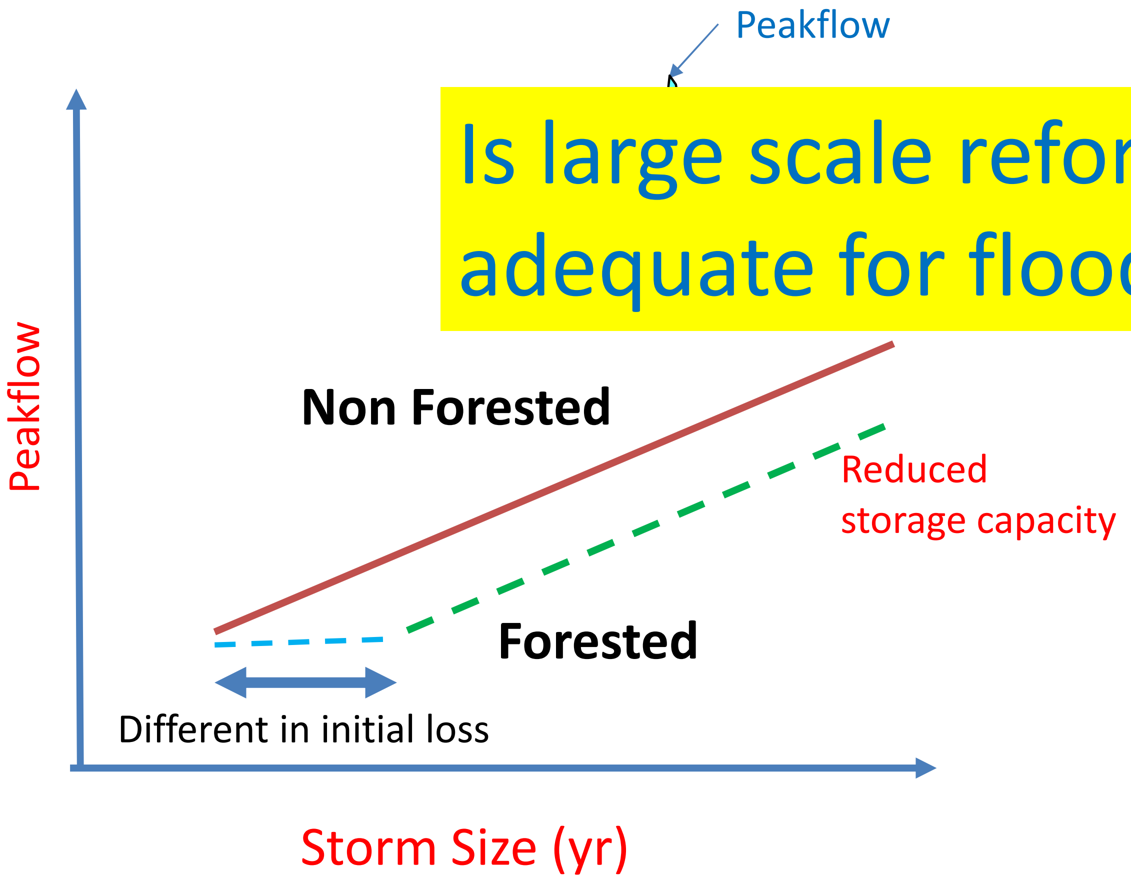


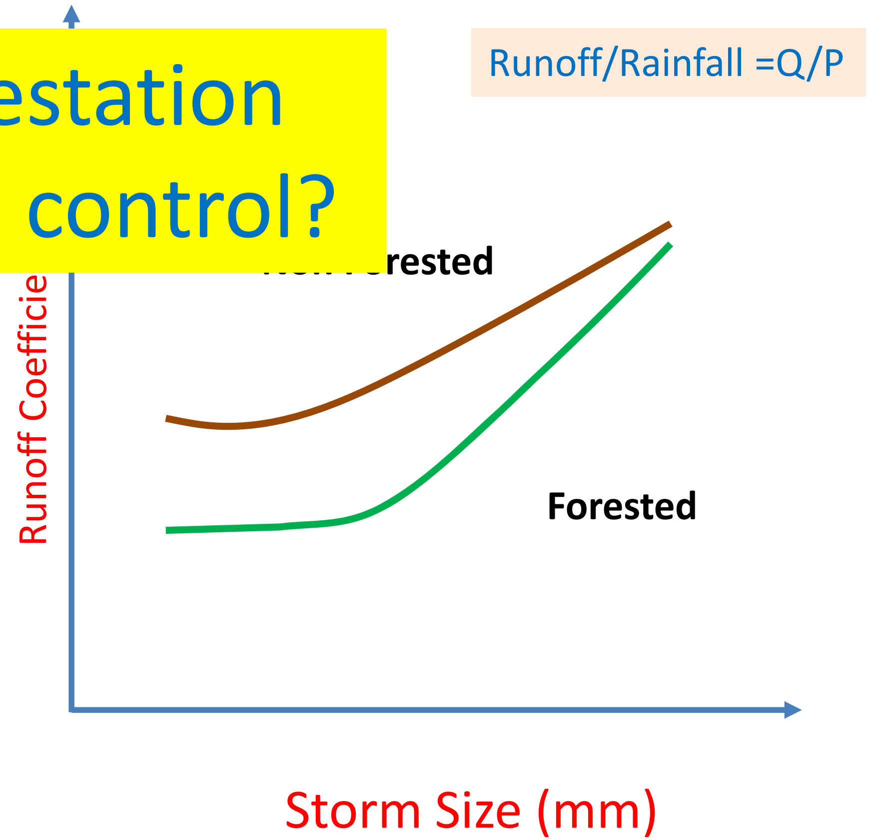
Elsewhere – Forested Catchment



Peakflow Response to Storm Size

Is large scale reforestation adequate for flood control?

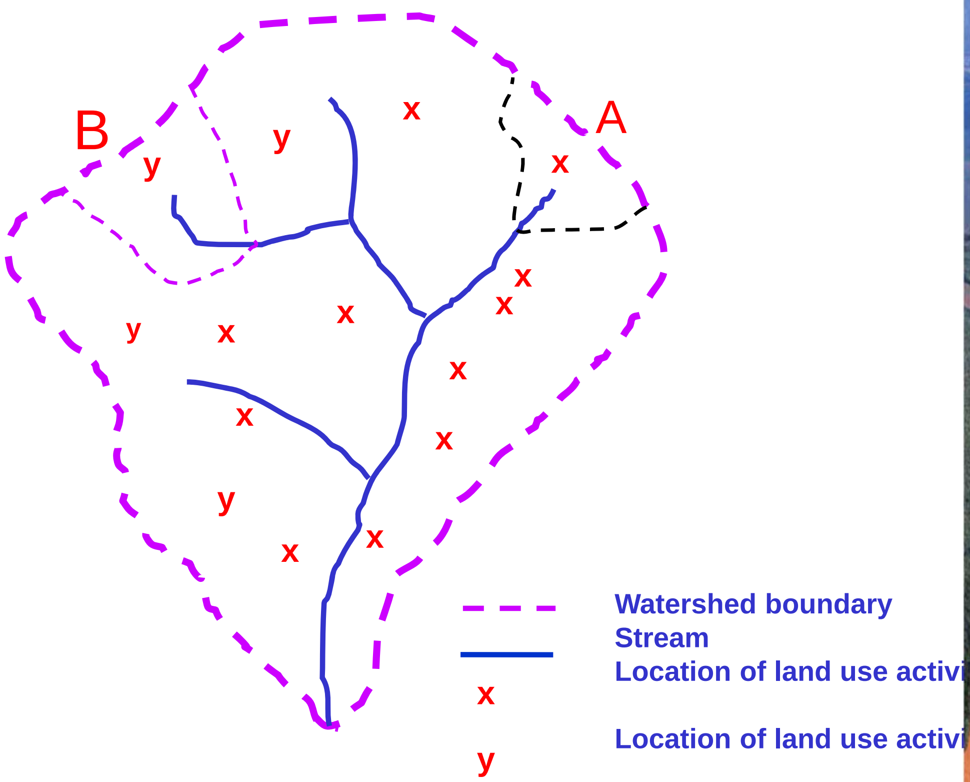


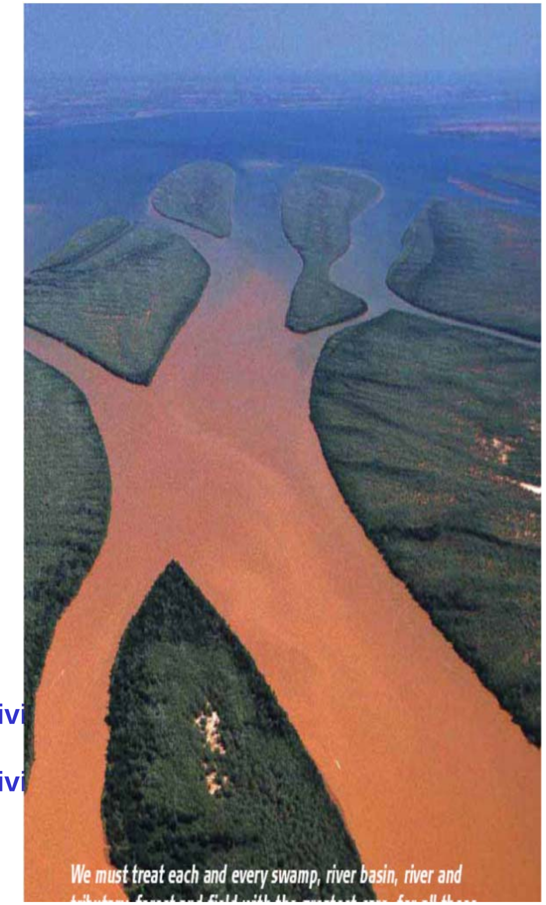


Zulkifli Yusop (UTM)

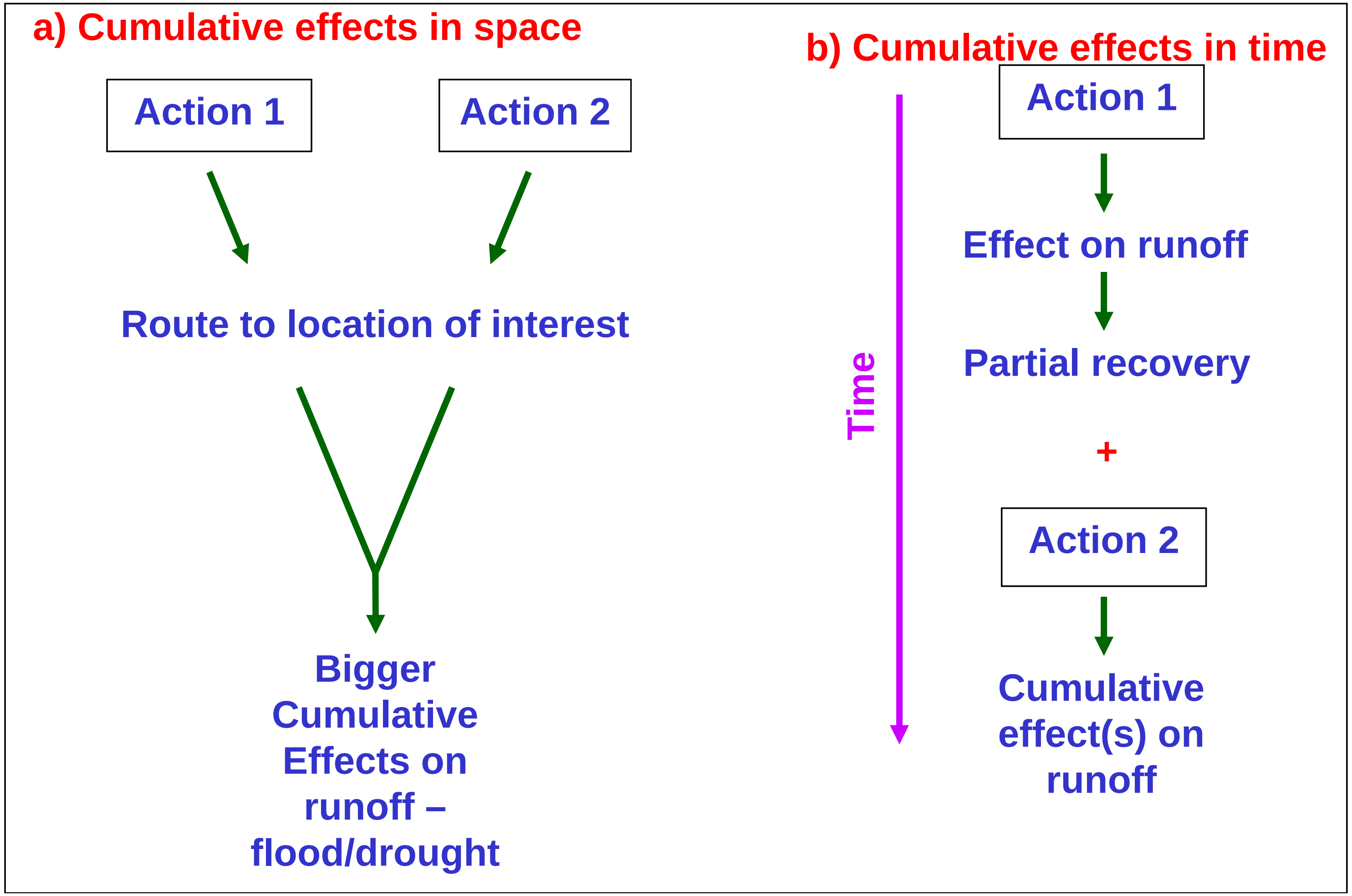
1. Peakflow is smaller in forested catchment but increase at a higher rate with storm size (return period)
2. Runoff coefficient (C) increase with storm size and for large storms the C values in forested and non-forested catchments become closer
3. Large flood normally occur during the second wave of heavy and continuous storms when the catchment storage is already filled up

Watershed Cumulative Effects (WCEs)

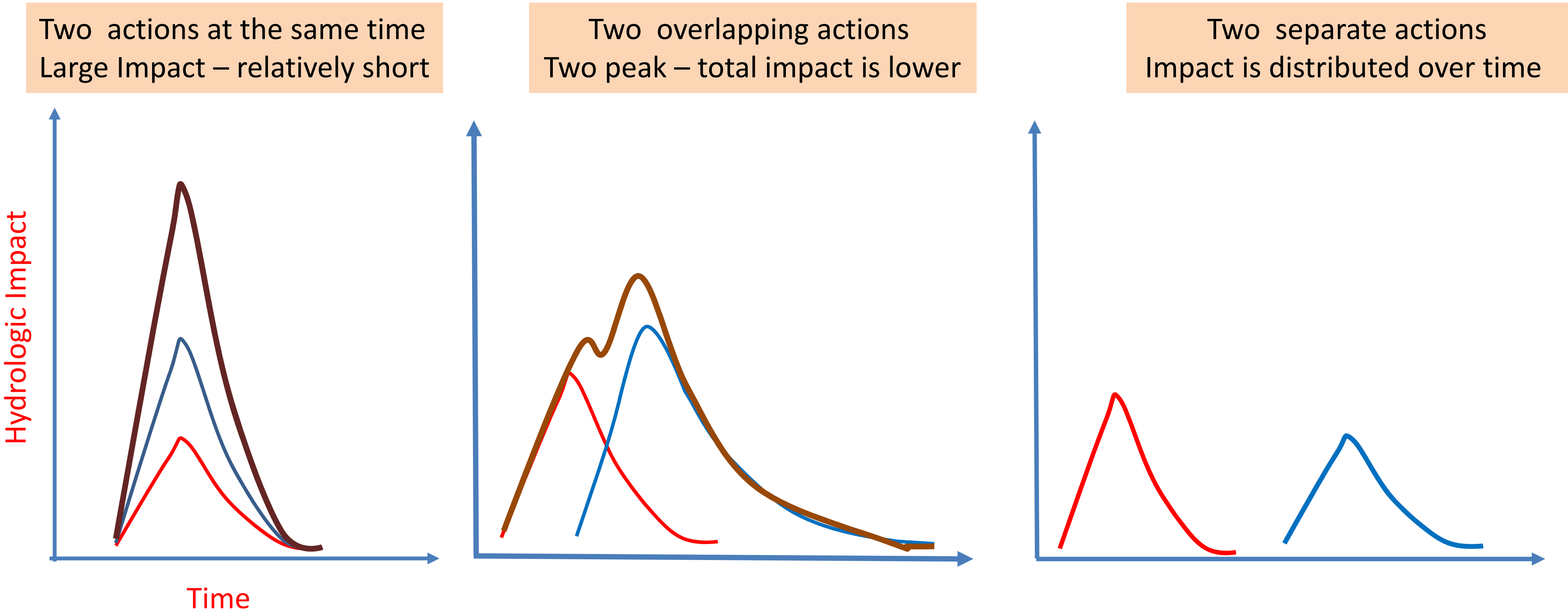




Watershed Cumulative Effects (WCEs) – Spatial and Temporal

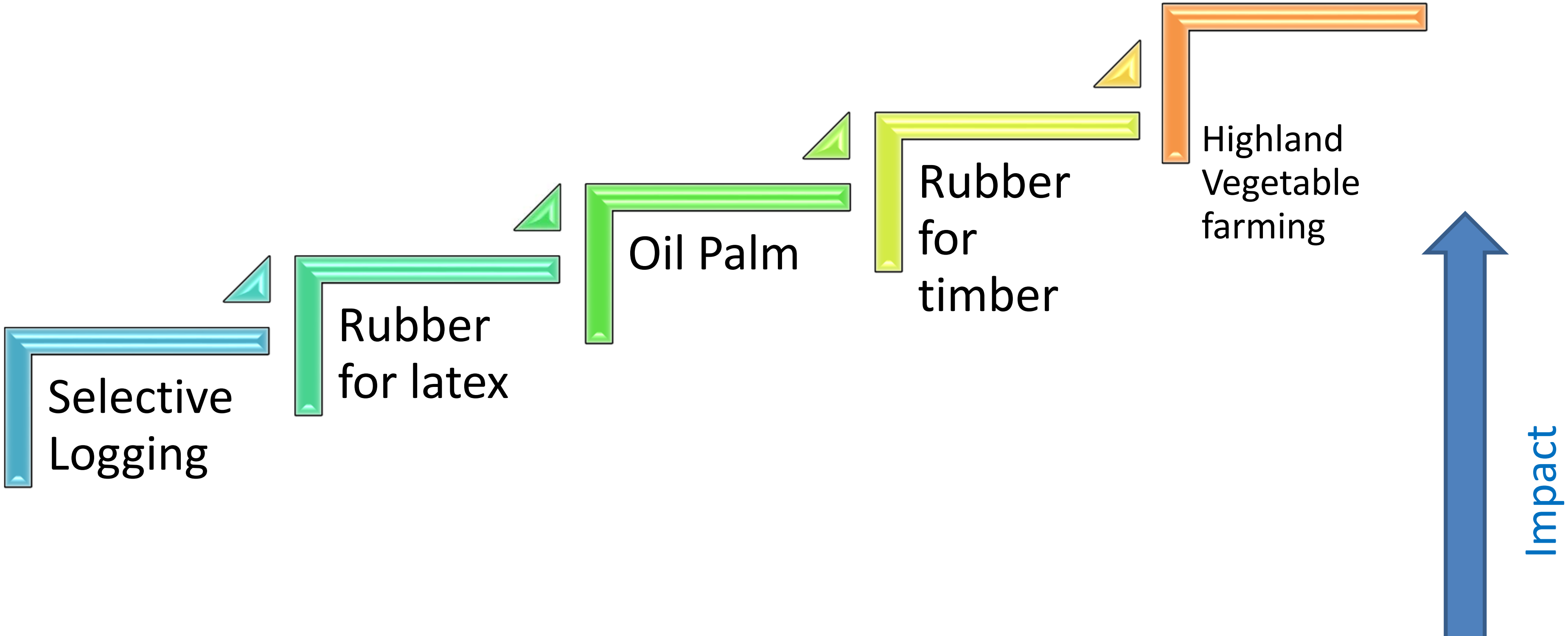


Cumulative Watershed Effects



Source: Zulkifli Yusop (UTM)

Long Term Hydrological Impact per Unit Area



Rotation	- 30-55 yrs - Hilly to Steep topo	-30 yrs -Undulating to Hilly	-25 yrs -Undulating to hilly	-12 yrs -Hilly to steep	-3 to 6 months Steepland

Conclusion

1. Forest can minimise flood damage but not adequate to mitigate major flood
2. Large floods are mostly associated with extreme climatic factor (rainfall) rather than land-use
3. Degree of hydrological impact: LTC>Oil Palm> Rubber > Selective logging.

Source: Zulkifli Yusop (UTM)

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