Challenges and difficulties in sediment modeling applied to sedimentation study of the Lobo reservoir in Brazil

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Introduction

- Siltation in Hydropower Dams:

- RESOLUÇÃO CONJUNTA Nº3 de 10/08/2010 ANA/ANEEL

- Almost 30 years of research.

Lobo Reservoir Watershed

- Located between the districts of Itirapina and Brotas, in SP (22° 15' S and 47° 49' W).

- Built in 1936 for hydroelectric energy generation .

- 2,21 MW hydro power dam (SHP).

- Main tributaries (Itaqueri River, Geraldo river, Lobo stream, Feijão stream).

- 280 km² wide watershed.
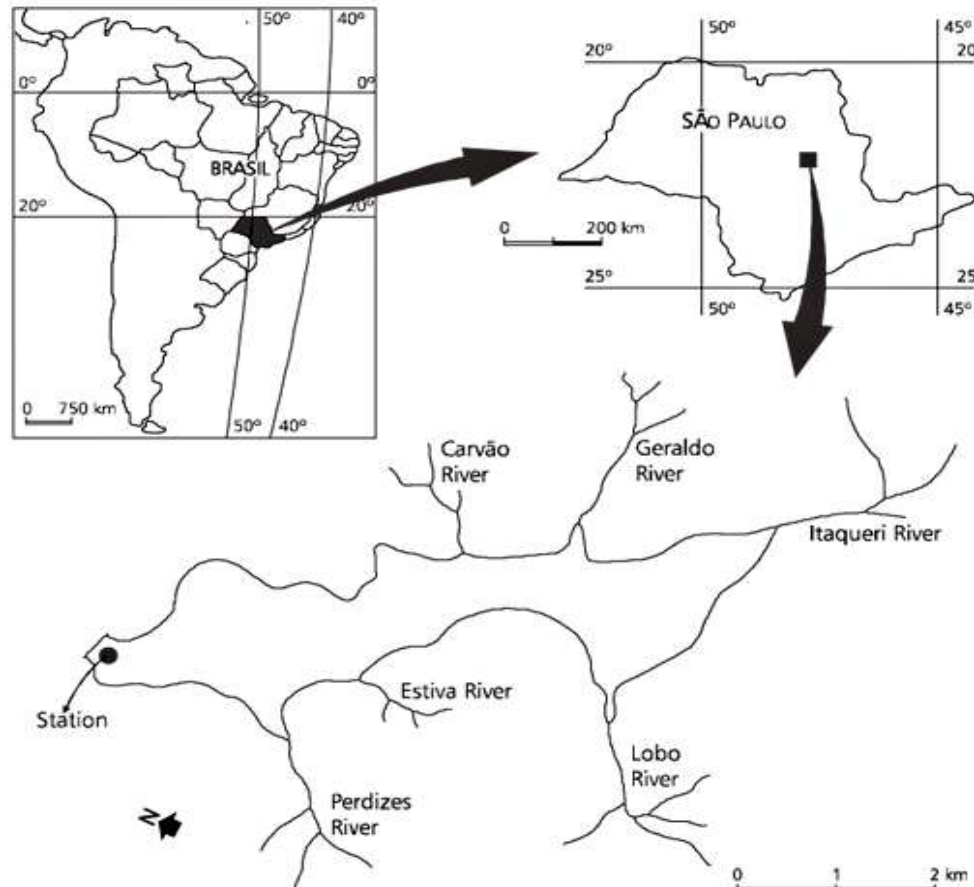
Tundisi, J. G. et al.2004. The response of Carlos Botelho (Lobo, Broa) reservoir to the passage of cold fronts as reflected by physical, chemical, and biological variables. *Braz. J. Biol*.64(1) 177-186.

Perimet	
Volume	$22{,}0 \times 10^{6} \text{m}^{3}$

International Lake Environment Committee. 2010. Photos of the Lobo/Broa reservoir. World Lakes Database. Shiga, Japan.: available at: www.illec.or.jp. Accessed 10/05/2010.

Tundisi, J.G. et al. 1986. The Lobo (Broa) ecosystem. *Ciência Interamericana*.25(114):.18-31.

27/5/2010 9:57
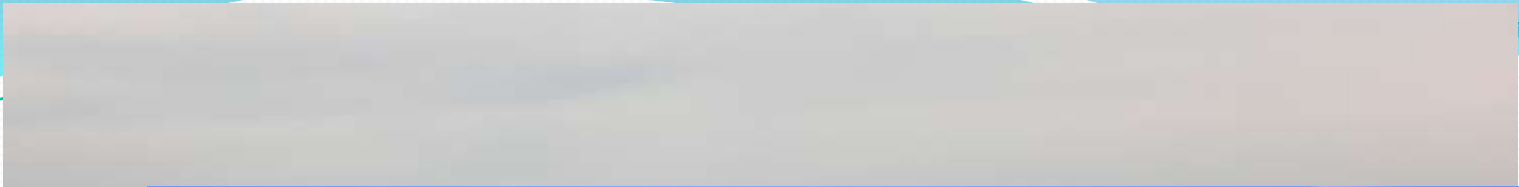
Tropical Agriculture

- The techniques used in Brazil are roughly adapted for tropical conditions.
- Tillage:
    - Substrate exposure sun heat
    - Lost of moisture
    - extinguishes the microbiological fauna, which helps the decomposition and nutrient utilization

Tropical Agriculture

- Traditional Practices:
- Subsidence farming (traditional techniques and family natured ventures).
- Demanding more water and inputs .
- Lower productivity and efficiency.
- Less technology.

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Tropical Crops

- Species present a distinct behavior in the tropics:

    - Daylight exposition (Winter and Summer)
    - Photosynthesis and breathing activity

- Different weathr introduction
- Genetic improvement

Tropical Crops

- Maize

Characteristics	Temperate	Tropical
Growth Conditions		
Annual weather variation	Relatively stable	Variable, Not predictable
Annual rainfall variation	Relatively uniform	Variable, Not predictable
Photoperiod	Long days	Short days
Night temperature	Fresh	Warm
Soil Conditions	Usually favorable	Frequently adverse
Seeding period	Restricted (few days)	Broad (several months)
Seeding season	Restricted (few days)	Broad (several months)
Growing Season	Well-defined	Variable, broad
Difficulties for germination	Cold soil and fungus	Soil insects
Maize types		
Vegetative Cycle	Uniform, adapted to the growing season.	Variable, to adapt to weather conditions.
Plant size	Low to medium	Usually tall

- Paterniani, E.1990. Maize breeding in the tropics. *Critical Reviews in Plant Sciences*. 9: 125-154.

Runoff

- Different climate conditions
- Intense rainfall events
- amount of total rain that fall is much greater than in the temperate zone

Runoff

Ames, Iowa, USA			Piracicaba, SP, Brazil		
Period	Average (mm)	Standard Derivation (mm)	Period	Average (mm)	Standard Derivation (mm)
July	92,6	35,51	December	218,9	75,88
August	97,6	40,74	January	216,1	94,10
Ames, Iowa, US, 42°N,93°			Piracicaba, SP, Brazil, 22°, 47°W		

Paterniani, E.1990. Maize breeding in the tropics. *Critical Reviews in Plant Sciences*. 9: 125-154.

Data:02/01/2011						Data:03/01/2011					
0	10	20	30	40	50	0	10	20	30	40	50
116.2	116.3	116.5	116.6	116.9	117.1	16.6	16.6	16.6	16.6	16.6	16.6
117.4	118.8	120.4	123.8	127.0	130.0	16.6	16.6	16.6	16.6	16.7	17.6
131.4	132.0	132.6	136.9	134.0	134.0	18.0	18.2	18.3	18.4	18.2	18.6
140.1	145.6	147.0	147.2	147.2	147.3	18.6	18.6	18.8	18.9	19.0	19.2
147.4	147.4	147.6	148.0	148.4	147.8	19.3	19.5	19.6	19.8	20.2	20.4
150.1	150.2	150.3	151.0	152.2	152.9						
153.9	155.0	156.8	158.8	159.0	159.4						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	1.5	2.0	2.3
0.0	0.0	0.0	0.0	0.0	0.0	10.0	10.1	10.6	10.9	11.0	11.0
0.0	0.0	0.0	0.0	0.0	0.0	11.0	11.1	11.1	11.1	11.1	11.1
0.0	0.0	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2
0.0	0.0	0.0	0.0	0.0	0.0	11.2	11.2	11.3	11.4	11.4	11.4
0.0	0.0	0.0	0.0	0.0	0.0	11.4	11.4	11.4	11.4	11.4	11.5
0.0	0.0	0.0	0.0	0.0	0.0	11.6	11.8	11.9	12.1	12.3	12.4
0.0	0.0	0.0	0.0	0.0	0.0	12.4	12.4	12.4	12.4	12.4	12.6
0.0	0.0	0.0	0.0	0.0	0.0	12.6	12.6	12.6	12.6	12.6	12.6
0.0	0.0	0.0	10.0	20.0	35.6	12.6	12.6	12.6	12.6	12.6	12.6
43.6	54.0	62.2	70.0	90.0	97.6	12.6	12.6	12.6	12.6	12.6	12.6
104.8	104.8	107.1	107.3	107.4	107.9	12.6	12.6	12.6	12.6	12.6	12.6
108.1	108.2	108.7	110.0	110.6	111.1	12.6	12.6	12.6	12.6	12.6	12.6
111.6	112.1	112.6	113.0	113.2	113.3	12.6	12.6	12.6	12.6	12.6	12.6
113.6	113.8	114.1	114.4	114.9	114.8	2.612	13.0	14.0	14.6	15.4	15.4
114.9	115.0	115.2	115.4	115.6	115.6	15.5	15.9	16.3	16.4	16.5	16.5
115.8	115.8	115.8	115.8	115.9	116.0	16.5	16.5	16.5	16.5	16.6	16.6

Runoff

- SCS curve number procedure:
  - rainfall intensity and duration are not considered
  - Daily Rain
- Green & Ampt infiltration method.
  - time-based model
  - simulates impacts of rainfall intensity
  - Duration
  - infiltration processes

Runoff (SCS- Curve Number)

- For Brazilian soils is difficult to frame a soil unit into these classes of hydrologic soils,

- Most of users of the method in Brazil consider only the top soil layers in order to fit in the original classification.

- Three classifications for the hydrologic soil of São Paulo (Setzer & Porto, 1979; Lombardi Neto et al., 1989; Kutner et al., 2001).

- The Lombardi Neto et al. (1989) classification is more similar to the orignal and easier to apply.

Runoff

- This classification accounts depth, texture, texture gradient within the soil superficial and subsuperfical horizons, porosity of the soil and expansive clay activity.

- But the proposal take controversial considerations some clay soils where put in the groups A and B (low runoff) and some sandy soils where classified in the groups C and D (High runoff).

- It is observed a general trend to underestimate the observed values..

Group	Erosion resistance group	Main Characteristics				
		Depth	Permeability	Texture	Texture gradient [1]	Great grouping of soils [4]
A	High	Very deep (>2m) or deep(1 to 2m)	Fast/Fast Moderated/Fast	Loamy/Loamy Clay/Clay Clay loam/Clay Loam	< 1,2	LR,LE, LV, LVr, LVt, LH LEa and LVa
B	Moderated	Deep (1 to 2m)	Fast/Fast Moderated/Fast Moderated/Moderated	Sandy/Sandy Sandy/Loamy Sandy/Clay Loam Loamy/Clay Loam Clay Loam/Clay	1,2 – 1,5	LJ, LVP, PV, PVL, Pln, TE, PVls, R, RPV, RLV, LEa[3] and LVa[3]
C	Low	Deep (1 to 2m) or moderately deep (0,5 to 0,1m)	Slow/Fast Slow/Moderated Fast/Moderated	Sandy/Loamy[2] Loamy/Clay Loam[2] Sandy/Clay Loam Sandy/Clay	>1,5	Pml, PVp, PVls, Pc and M
D	Very Low	Moderately deep (0,5 to 0,1m) or shallow (0,25 to 0,50m)	Fast, moderated or slow over slow	Highly variable	Highly variable	Li-b, Li-ag, gr, Li-fi, Li-ac and PVp (shallow)

- [1]: Average of the clay content in horizon B (excluding B3) divided by the average all clay content in horizon A.
- [2]: Only with an abrupt shift between the texture in horizons A to the B.
- [3]: Only with a sandy horizon A.
- [4]: Brazilian nomenclature.

Runoff (Green-Ampt)

- There is a loss of data due to regression equations that are needed to parameterize the model

- Requires hourly rainfall data

- When modeling hydrologic systems of large areas, as drainage area increases, stream flow peaks tend to smooth out and the use of Green-Ampt becomes ineffective.

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Conclusion

- In Brazil few SWAT applications can be found
- Most of these studies are concentrated in the southeast and south regions of Brazil.
- The greatest limitation is the difficulty to find regional parameters that could be inputted in the SWAT database.
- Little or no experimental data or literature available for the Brazilian crops and weather to support any changes.
- Unpaved roads that are used to dispose the agriculture production.

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Conclusions

- More studies must be made for full application of the SWAT,

- Experimental data researches in tropical condition in order to build a database of the land/use and crops behavior,

- The effect of different agriculture practices and different soil properties

- More comparisons between the runoff methods for tropical conditions.

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Thank You for your attention !! Muito Obrigado !!

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