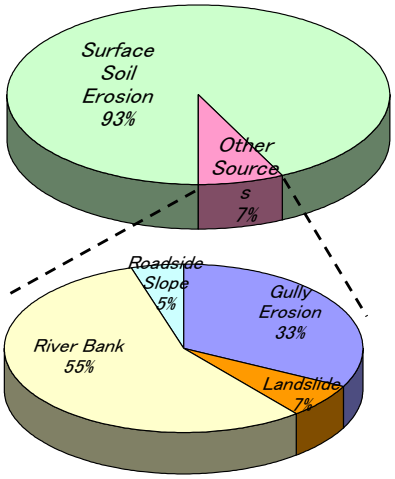
As seen on the right, dominant erosion source is soil erosion from the land surface. Its volume is 93% of the total, while total sediment yield from other sources is only 7%. Excluding soil erosion from the land surface, riverbank erosion is predominant at 55% of total sediment yield which exclude soil erosion Gully erosion follows with 33% and roadside slope erosion is only 5%.



Source : JICA Study Team

Figure 4.6.1 Percentage of Annual Wonogiri Sediment Yield by Source

4.6.2 Sediment Delivery Ratio

Much of the eroded sediment from a distant source will typically encounter more opportunities for re-deposition before the watershed outlet. The ratio between the erosion rate and sediment yield is the "sediment delivery ratio (SDR)". Dr. Gregory L. Morris and Dr. Jiahua Fan (1997)[3] have described the sediment delivery ration as follows:

> *"The sediment delivery ratio cannot be measured directly because gross erosion is never measured in a watershed; erosion rate is extrapolated from smaller plots or computed from modeling. Thus, the delivery ratio is actually the ratio of measured yield to the estimated erosion rate based on USLE or some other erosion prediction methodology. Delivery ratios much greater than unity have been reported by some researchers, and reflect the inability of erosion prediction models to account for all the erosion processes upstream of the point of yield measurement."*

Dr. Boyce (1975)[4] stated that the relationship of sediment yield to drainage area usually differs from the sediment delivery to drainage area relationship by only a constant, and summarized several relationships for the sediment delivery ratio as quoted below:

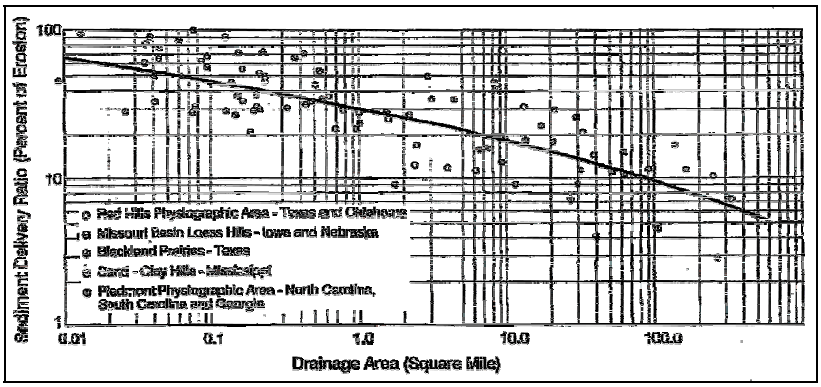


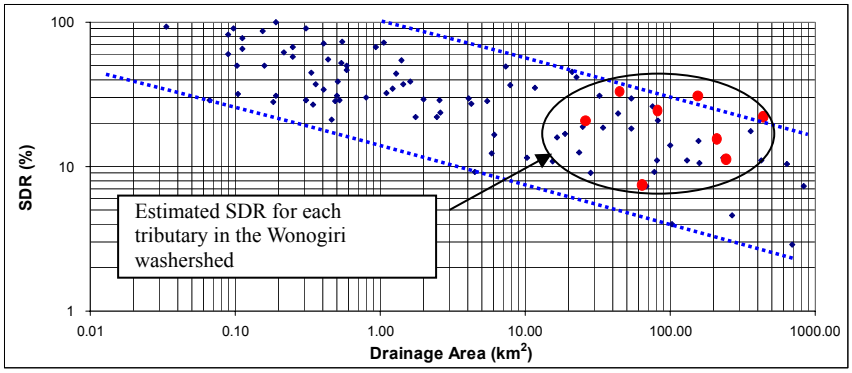
Figure 4.6.2 Sediment Delivery Ratios from Selected Areas in the United States (Boyce, 1975), from Reservoir Sedimentation Handbook

Under the Study, the SDR for soil erosion from land surface was extrapolated by using the measured sedimentation volume in the Wonogiri reservoir which was directly

[3] Gregory L. Morris, and Jiahua Fan, 1997, "Reservoir Sedimentation handbook", pp. 6.29-6.33

[4] Boyce,R.C.,1975."Sediment Routing with Sediment-Delivery Ratios,"pp.61-65. In Present and Prospective Technology for Predicting Sediment Yields and Sources. ARS-S-40. USDA Sedimentation Lab., Oxford, Miss.

surveyed in the Study. SDRs for each tributary are summarized in the figure and table below:



Source: JICA Study Team

Figure 4.6.3 Sediment Delivery Ratios in the Wonogiri Dam Watershed

Table 4.6.2 Annual Sediment Yield and Sediment Delivery Ratio in Wonogiri Dam Watershed

River System	Area	Annual Sediment Yield	from Land Surface			Other Sources			Gross Annual Sediment Yield from Watershed
			Annual Soil Erosion	Annual Sediment Yield	Sediment Delivery Ratio	Annual Erosion	Annual Sediment Yield	Sediment Delivery Ratio	
	km^2	mm/year	$1,000m^3$ /year	$1,000m^3$ /year	(%)	$1,000m^3$ /year	$1,000m^3$ /year	(%)	MCM/year
Keduang	420.95	2.69	4,805	1,134	23.6%	84	84	100%	1.219
Tirtomoyo	230.64	2.04	4,498	470	10.4%	34	34	100%	0.504
Temon	62.59	0.97	915	61	6.7%	12	12	100%	0.073
Upper Solo	205.52	2.88	3,579	591	16.5%	14	14	100%	0.605
Alang	169.38	1.93	993	327	32.9%	75	75	100%	0.401
Ngunggahan	82.39	2.35	730	194	26.6%	7	7	100%	0.201
Wuryantoro	44.11	2.36	338	104	30.7%	4	4	100%	0.108
Remnant	27.67	2.35	380	65	17.1%	2	2	100%	0.068
Total	**1,243.25**	**2.37**	**16,239**	**2,947**	**18.1%**	**230**	**230**	**100%**	**3.18**

Source: JICA Study Team