Role of Paddy Rice Fields (*Sawah*) as Sediment Filter in Agroforestry Mosaics

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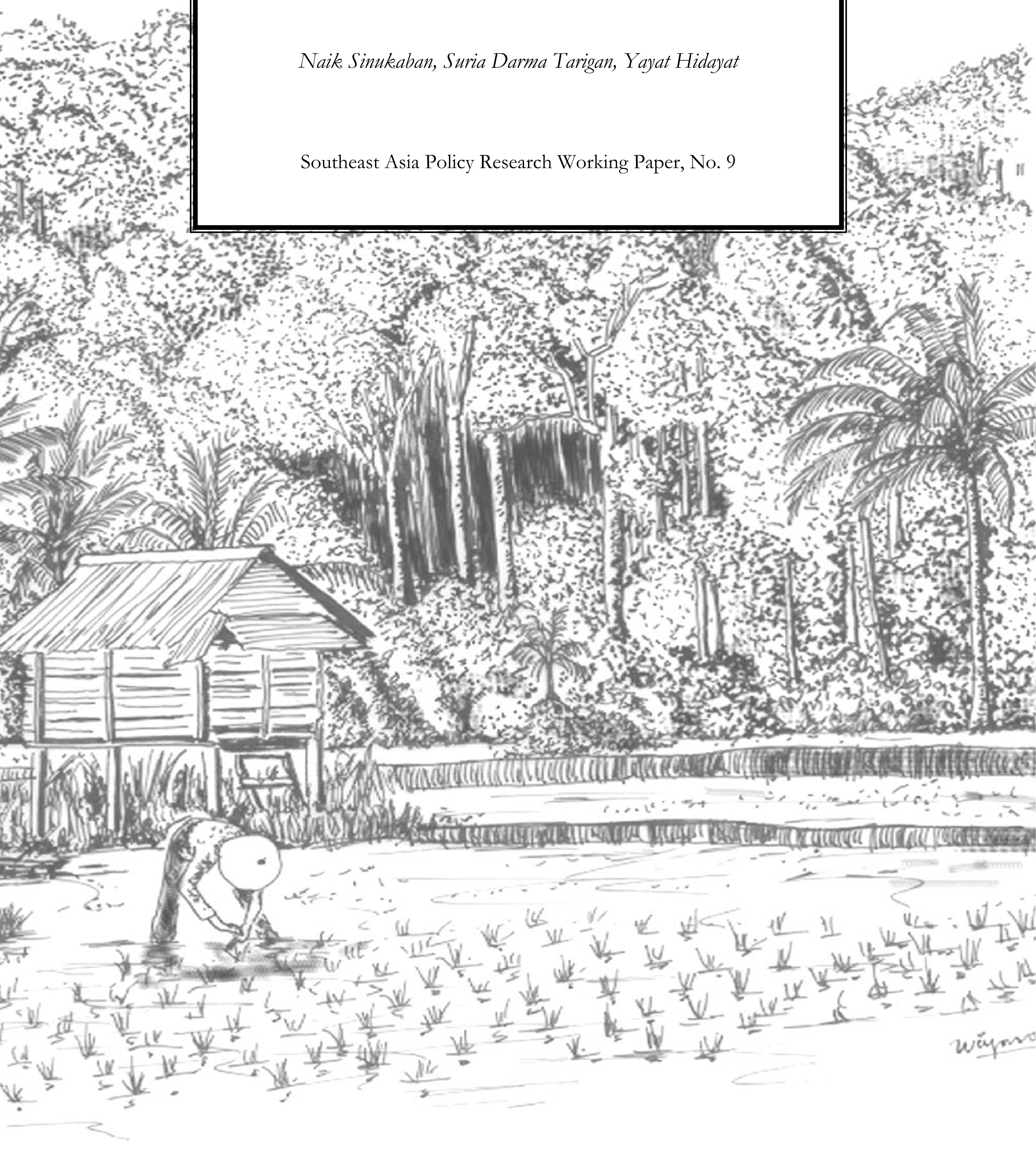

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ROLE OF PADDY RICE FIELDS (*SAWAH*) AS SEDIMENT FILTER AN AGROFORESTRY MOSAICS

FINAL REPORT

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PREFACE

In this occasion we would like to express our sincere gratitude to the International Center for Research in Agroforestry (ICRAF) South East Asia and the Asian Development Bank (RETA 5711) for the Financial support.

Our sincerely gratitude is also extended to Dr. Meine van Noordwijk and Mr. Bruno Verbist for their coorporation and support.

This report presents the 'Role of Rice Field (Sawah) as Sediment Filter in Agroforestry Mosaic'. Rice field are presumed to trap incoming sediment, therefore their role in sediment transfer in landscape scale should be considered in downstream effect prediction. Sediments coming from upper slope are often deposited in sawah terraces. Sawah terraces can therefore function as a sediment trap. But, not all incoming sediment will permanently deposited in sawah terraces, a portion of it will again leave sawah field especially during land cultivation and weeding activities.

This report prepared by Prof Naik Sinukaban, Dr. S.D. Tarigan, and Ir. Yayat Hidayat.

Hopefully, this report is useful for all parties involving in the search of better understanding concerning role of sediment filter predicting downstream effect of erosion in agroforestry mosaic.

Bogor, October 2000

IPB Team

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I. INTRODUCTION

For predictions of downstream effect of soil erosion we need to consider various factors affecting sediment transfer. Rice fields are presumed to trap incoming sediment, therefore their role in sediment transfer should be considered in prediction of downstream effects. Sediments coming from upper slope are often deposited in sawah (= paddy rice) terraces. Sawah terraces can therefore function as a sediment trap. But, not all incoming sediment will be permanently deposited in sawah terraces; a portion of it will leave the sawah field especially during land cultivation and weeding activities. Both activities will physically disperse the deposited sediment and in turn a portion of the sediment will leave the sawah along with run-off. Knowledge of how much net sediments are permanently deposited in sawah terraces is very important for adjustment of off-site prediction of erosion from upper-slope.

The objective of this research is thus to measure the sediment balance of a sawah field on annual basis. Due to funding limitations, however, this research covers only one planting season. We hope to be in a position to continue this research to complete a full one-year analysis.

II. LOCATION

The study site is located around UNILA Research Station in Sumberjaya, Way Besai Upper Catchment, Lampung (Sumatra, Indonesia), as described in earlier reports (Sinukaban et al. 2000).

Figure 1. Research Site in Sumberjaya, Lampung

III. Methodology

III.1. Sediment Balance of Rice Field

Studying the role of sawah in sediment transfer in landscape scale involves following steps:

a). Measuring sediment balance of rice field plot.

The sediment balance should be evaluated on annual basis in order to be able to capture all farming activities influencing sediment balance such as land cultivation and weeding. Both of these activities will physically disperse the deposited sediment and in turn a portion of the dispersed materials will leave the sawah with run-off. The effectiveness of sawah as sediment filter is determined from the difference between sediment inflow and outflow. Sediment inflow can be determined using sediment and run-off collectors. Meanwhile, sediment outflow is sediment concentration multiplied by run-off volume out of sawah. Sediment concentration is determined by sampling water flowing through the outlet of the sawah during land preparation and weeding. Water samples are analyzed in the Laboratory using the dry weight method. Run-off volume will be determined by installation of portable Parshall flume at the outlet of the sawah. Since sawah in the area are planted twice a year, the measurement will be made accordingly.

Figure 2. Measurement of Sediment Concentration Using Parshall Flume

Figure 3. Sediment Collector to Measure Sediment Inflow

b). Differentiating sawah having cut-off drain and those that don't

The existence cut-off drain between neighboring slope and sawah will reduce the role of sawah as sediment filter. Therefore, it is necessary to separate sawahs having a cut-off drain between neighboring slope and those that don't. In a landscape scale this segregation can be easily done through field observation. Segregation at catchment scale requires rules that can be applied in a GIS context.

c). Identifying spatial extend of sawah in a landscape scale

The existence of sawah in the landscape around Sumberjaya area shows a consistent pattern. Wherever a slope transition occurs from steep to flat in low-lying area, there is a high probability that this area has been turned into a sawah. This pattern make it possible to delineate a spatial extend of sawah from topographic map. In a catchment scale GIS procedures can be used to identify and delineate the spatial extent of sawah. This spatial extend can be adapted to the existing models.

Figure 4. Weeding activity

III.2. Modeling Sediment Dynamic of Rice Field using Process-Based Model

The ultimate goal of this research is to be able to model the role of sawah as sediment filter for adjustment of off-site effect of erosion prediction in a catchment scale. To integrate role of sawah as sediment filter in a broader spatial analysis, like distributed model or GIS/PC Raster, the sediment dynamic should be expressed in a transfer function. This can be done by using process-based model.

During land cultivation a large amount of sediment in sawah terraces are available to be transported. The terraces are usually very flat. Therefore, the amount of sediment leaving the terraces is limited by runoff transport capacity. Limited runoff transport capacity prevails on geometric setting such rice field. In this report the use of process-based model have been made. The equation of process-based model limited by runoff transport capacity is shown below (Misra and Rose, 1989).

$$c = k * Q^{0.4}$$

$$k = ((F*SD*S*(L^{0.4}))/(((SD/WD)-1*Phi))*(((S^{0.5})/n)^{0.6})$$

Where c = Sediment concentration
F = Fraction of stream power of overland flow
SD = Sediment density (kg/m^3)
WD = Water density (kg/m^3)
S = Slope (decimal)
L = Slope length
n = Manning's coefficient
Q = Effective runoff (runoff per unit area)

Sediment prediction for land preparation and weeding activities is differentiated. During weeding activity a portion of soil surface has been covered by rice crop. The effect of the coverage is introduced to the equation by weighting sediment concentration (c) with $e^{(-ks*Cs)}$. Parameter ks has a value ranging from 5 to 10. Parameter Cs is fraction of surface contact cover.

IV. RESULTS AND DISCUSSION

In this preliminary research efforts are focused on studying topic a), that is measuring sediment balance of rice plot. Topic b) will be dealt mainly based on field evidence collected during field observation in the research site. Both activities were carried out only in a landscape basis. In a catchment basis these activities will be carried out in the second phase of the research.

Activity related to topic c) that is, digitizing of topographic map of WAY BESAI catchment, has been done by ICRAF researchers. This digital map can be used to delineate spatial extent of sawah using GIS procedures. But, there is still problem encountered due to the poor quality of topographic map. Recently, SPOT and Ikonos image from Sumberjaya has been procured by ICRAF. Both of these images have quite good resolution, which are 20 m for SPOT image and 4 m for IKONOS image. Such resolution is viewed as good enough to identify spatial extend of sawah. However, the analysis of those images still require some times and will not be included in this report. This part of analysis will be carried out in the second phase of the research.

IV.1. Sediment Balance of Rice Field

a. Sediment Outflow

a.1. Pattern of sediment concentration during activity of rice cultivation

Run-off in rice field generally has low transport capacity. This is due the flatness of sawah terraces. Moreover, the water depth during those activities is normally kept in low level to make the cultivation such as land preparation easier. Farmers do not carry out those activities simultaneously for all sawah fields in a block. They usually carry out those activities gradually one block after the other. The low transport capacity of the run-off is reflected in the pattern of sediment concentration during those activities.

The concentration of sediment at the outlet decreases significantly with the increase of travel time/distance of run-off. Longer travel time/distance provide more time for suspended load to settle during transportation . According to the data in Appendix 2 (Land Preparation in S13) and Appendix 3 (Land Preparation in S11), the sediment concentration was increased during land preparation and back to normal after around 200 minutes. In smaller block, for instance block S4 (having an area of 57 m^2), compared to S13 (having an area of 305 m^2) the time needed to get to the normal concentration was even shorter; that was 100 min (see Figure 6).

During land preparation in S11, sediment going out of S11-outlet was 15.19 kg (see Appendix 3, Land Preparation in S11). Meanwhile, during land preparation in S11, sediment going out of S13-outlet (two blocks downward) is 7.69 kg (see Appendix 4, Land Preparation in S11). This means that some 7.5 kg was deposited some where on its way from block S11 to block13.

During land preparation three blocks away of the outlet that is in S10 sediment going out of S10-outlet was 13.93 kg (see Appendix 4, Land Preparation in S10). Meanwhile, during land preparation in S10, sediment going out of S13-outlet (three blocks downward) was 9.60 kg (see Appendix 4, Land Preparation in S10). This means that some 7.38 kg deposited some where on its way from block S10 to block13.

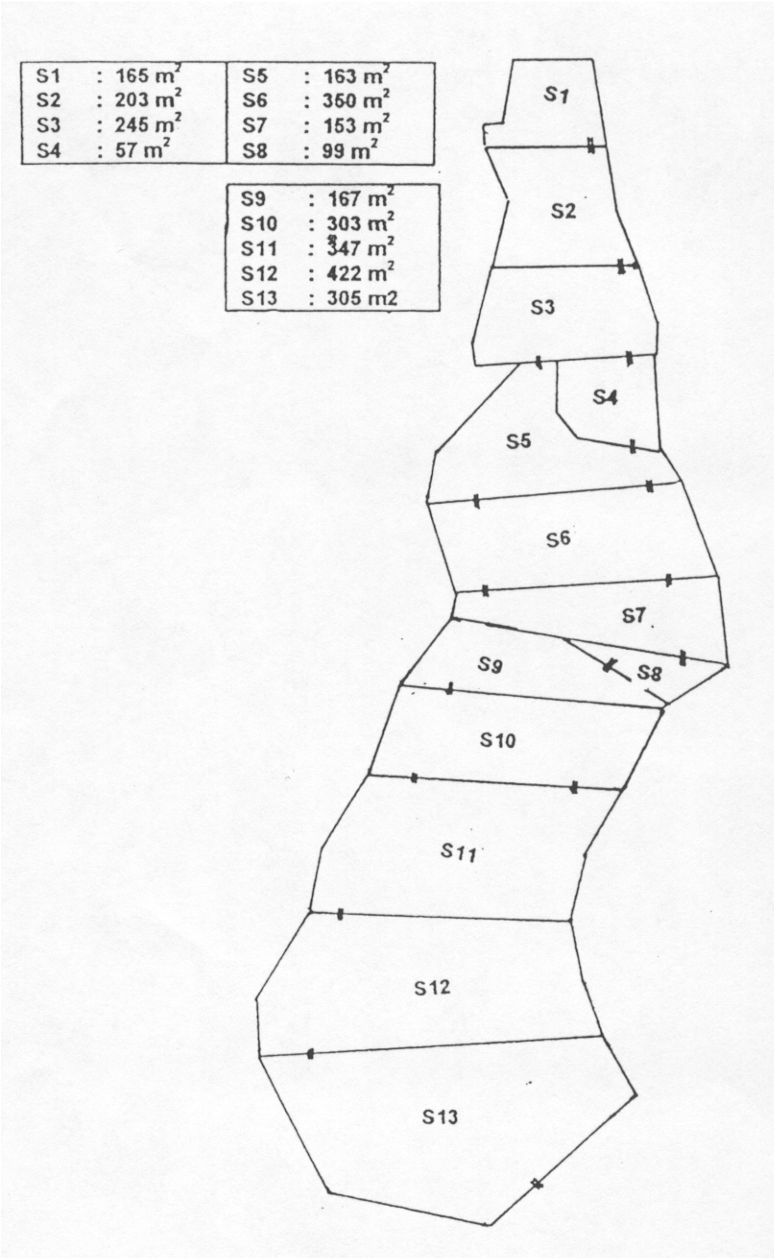

Figure 5. Layout of Rice Field (not to scale)

Time Minutes	Sed. Concentrat. kg/l
0	0,0012
10	0,0010
20	0,0057
30	0,0057
40	0,0050
55	0,0058
70	0,0066
80	0,0080
87	0,0080
100	0,0013

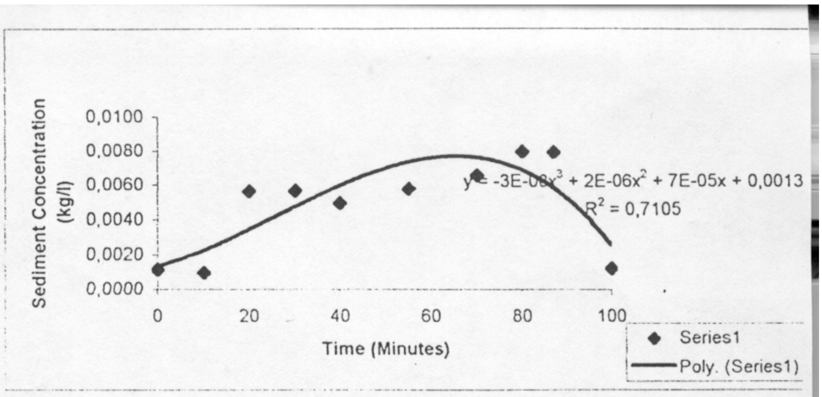

Figure 6. Pattern During Land Preparation in Block S4

a.2. Total outgoing sediment

Total sediment outflow from rice field has been calculated for 4 different activities (see Appendices 1 – 12). Those activities are:

1. Land Preparation
2. Preparation for Transplantation
3. Transplantation
4. Weeding activities

Data in Table 1 shows the amount of outgoing sediment from sawah outlet (outlet of S13 block) during different activities in respective blocks. Total sediment leaving sawah will not be the sum up of outgoing sediment from each block of rice field (see Figure 5 for block layout).

Table 1. Outgoing Sediment from Sawah outlet (outlet of S13 block) in kg

Activity	Code of Block Where Activities Going on													
	S 1	S 2	S 3	S 4	S 5	S 6	S 7	S 8	S 9	S 10	S 11	S 12	S13	Total (kg)
Land Preparation							10.3		9.1	9.6	7.7	72.4	21.2	130.3
Preparation for transplanting							4.5		2.9	4.8		37.9		65.1
Transplanting							3.7		4.4		4.9	2.0	7.9	22.9
Weeding Activity I								26.7						26.7
Weeding Activity II														26.7
Total outgoing sediment														271.7

Based on those data and observation in the field, the following conclusion can be drawn.

1. Outgoing sediment during land preparation was twice as much as land preparation for transplanting.
2. Outgoing sediment during land preparation was six times as much as both for transplantation as well as for weeding.
3. Weeding activity is done twice for one season cultivation.
4. Due to its longer travel distance, activity in block S1-S6 does not contribute to the outgoing sediment in outlet S13. (This statement is drawn based on the observation in the field).

b. Sediment Inflow

Source of sediment in sawah can be sub-divided in to three parts:

1. Erosion coming from surrounding agricultural slope

2. During land preparation farmer used to chop terrace wall producing a large amount of soil.
3. Sediment from feeding stream

In this research, the first type of sediment source has been estimated using sediment collectors. However, during the research period only 7 rainfall events have occurred, which do not represent the whole spectrum of one-year rainfall events. The result of measurement is presented in Appendix 18. As a comparison, result of other erosion study from coffee field carried out on UNILA research station located nearby location is shown in Table 2.

Table 2. Erosion Rate During Dry Season (from April to July, 1997) in Coffee Field Around Research Site .

Treatment	Erosion Rate (kg/ha)
Tillage	222
Non-Tillage	133
Non-Alley	208
Alley	131

Source: Approach for Sustainable Crop Production System in Red Acid Soil Region in Indonesia (Iijima, Izumi, Yuliadi, and Sunyoto, 1999)

As it is clear from Table 2, the rate of erosion in coffee field is also quite small in the dry season. Due to this reason and the fact that sediment source of type nr. 2 play an important role, the results of sediment collectors measurement are not yet used to estimate sediment inflow. Therefore, sediment balance in sawah in this research should be considered only for dry season balance and not as annual balance.

According to the field observation during the land preparation, sediment source of type nr.2 contribute to a greater amount of sediment source. See for example block nr. S4 and S8, these blocks do not receive sediment directly from surrounding slope, nevertheless this fact do not reduce sediment concentration during rice cultivation. It can therefore be concluded that no matter how small the erosion from surrounding slope, there will be no shortage of sediment source because of sediment source of type nr.2. More reliable conclusion can be obtained, if measurement of sediment outflow carried out in rice field completely surrounded by cut of drains. This measurement will be scheduled for future activity at the second phase of the research.

IV.2. Modeling Sediment Dynamic of Rice Field using Process-Based Model

As it was mentioned already, that the ultimate goal of this research is to be able to model role of sawah in sediment transfer for adjustment of off-site effect of erosion prediction in a catchment scale. In the following, the process-based model will be discussed to model the dynamic of sediment in rice field, which later can be used in spatial analysis of role of sawah as sediment filter in catchment scale. Limited runoff transport capacity is considered on sediment dynamic in rice field. In this report the use of process-based model have been made (Misra and Rose, 1989). The equation of process-based is shown below.

$$\mathbf{c = k * Q^{0.4}}$$

$$\mathbf{k = ((F*SD*S*(L^{0.4}))/(((SD/WD)-1*Phi))*(((S^{0.5})/n)^{0.6})}$$

Where: c = Sediment concentration
F = Fraction of stream power of overland flow
SD = Sediment density (kg/m^3)
WD = Water density (kg/m^3)
S = Slope (decimal)
L = Slope length
n = Manning's coefficient
Q = Effective runoff (runoff per unit area)

a). Modeling Sediment Dynamic in a Single Block

The use of process-based model in modelling sediment dynamic in a single block will be demonstrated in the following. Block nr. 13 is chosen as an example for modelling. As an example, the transport capacity and amount of outgoing sediment will be determined during land preparation and weeding activity. Both activities different in term of surface roughness and contact cover.

Modeling During Land preparation

Table 3. Parameters Used in the Equation for Land Preparation Activity

No.	Parameter	Symbol	Unit	Value	Remark
1	Runoff	Q	m^3		
2	Effective runoff /Runnof per unit area	Qeff	m^3/m^2		
3	Fraction of stream power of overland flow	F	-	0.1	
4	Sediment density	SD	kg/m^3	2600	
5	Water density	WD	kg/m^3	1000	
6	Slope	S	decimal	0.01	
7	Slope length	L	m	10	
8	Manning's coefficient	n	-	0.5	
k	$k = ((F*SD*S*(L^{0.4}))/(((SD/WD)-1*Phi))*(((S^{0.5})/n)^{.0.6})$ $k = ((0.1*2600*0.01*(10^{0.4}))/(((2600/1000)-1)*0.6))*(((0.01^{0.5})/0.5)^{0.6})$ $k = ((2.6*(2.5))/((0.96)*(0.1/0.5)^{0.6})$ $k = 6.5/0.36$ $k = 18.1$				
c	c = sediment concentration (kg/m^3) $c = k* Q\ eff^{0.4}$ $c = 18.1 * Qeff^{0.4}$ $c = 18.1 * 0.02^{0.4}$ $c = 3.7\ kg/m^3$				
M	M = Outgoing sediment M = 3,7 * Q M = 3,7 (kg/) * 5,7 m^3 M = 21.1 kg				

Outgoing sediment from block S13 based on field measurement amounts to 21 (see Appendix 2), meanwhile prediction of outgoing sediment using process-based model amount to 21.1 kg.

Modeling During Weeding activity

The difference between land preparation and weeding activity would be reflected in the value of surface cover parameter Cs (fraction of surface contact cover) and ks. This parameter is introduced to the model to accomodate the resistance of rice crop to the water flow.

Table 4. Parameters Used in the Equation for Weeding Activity

No.	Parameter	Symbol	Unit	Value	Remark
1	Runoff	Q	m^3		
2	Effective runoff	Qeff	m^3/s		
3	Fraction of stream power of overland flow	F	-	0.1	
4	Sediment density	SD	kg/m^3	2600	
5	Water density	WD	kg/m^3	1000	
6	Slope	S	decimal	0.01	
7	Slope length	L	m	10	
8	Manning's coefficient	n	-	0.5	
9	Non-dimensional crop factor	ks		5	
10	Fraction of surface contact cover	Cs		0.3	
k	$k = ((F*SD*S*(L^{0.4}))/(((SD/WD)-1*Phi))*(((S^{0.5})/n)^{.0.6})$ $k = ((0.1*2600*0.01*(10^{0.4}))/(((2600/1000)-1)*0.6))*(((0.01^{0.5})/0.5)^{0.6})$ $k = ((2.6*(2.5))/((0.96)*(0.1/0.5)^{0.6})$ $k = 6.5/0.36$ $k = 18.1$				
c	c = sediment concentration (kg/m^3) $c = k * Qeff^{0.4} * \exp(-ks*Cs)$ $c = 18.1 * Qeff^{0.4} * \exp(-5*0.3)$ $c = 18.1 * 0.02^{0.4} * \exp(-1.5)$ $c = 0.72\ kg/m^3$				
M	M = Outgoing sediment $M = c * Q$ $M = 0.72\ (kg/m^3) * 3.6\ m^3$ $M = 2.6\ kg$				

Outgoing sediment from block S6 based on field measurement amounts to 2.8 kg (see Appendix 14, Weeding activity in S6) meanwhile prediction of outgoing sediment using process-based model amount to 2.6 kg.

b). Modeling Sediment Dynamic of Interrelated Blocks

Interrelated block means that the sediment concentration is measured in outlet sawah (outlet-S13), meanwhile activities is carried out in different blocks above it. The difference of the model sediment concentration with those of single block lies in the parameter value of slope length (L) and effective runoff (Qeff). Below, sediment concentration prediction will be demonstrated during land preparation and weeding activity.

<u>Modeling During Land Preparation</u>

Prediction of sediment concentration is carried out in outlet-S13 during land preparation in S10.

Table 5. Parameters Used in the Equation for Land Preparation Activity

No.	Parameter	Symbol	Unit	Value	Remark
1	Runoff	Q	m^3		
2	Effective runoff	Qeff	m^3/s		
3	Fraction of stream power of overland flow	F	-	0.1	
4	Sediment density	SD	kg/m^3	2600	
5	Water density	WD	kg/m^3	1000	
6	Slope	S	decimal	0.01	
7	Slope length	L	m	40	
8	Manning's coefficient	n	-	0.5	
k	$k = ((F*SD*S*(L^{0.4}))/(((SD/WD)-1*Phi))*(((S^{0.5})/n)^{.0.6})$ $k = ((0.1*2600*0.01*(40^{0.4}))/(((2600/1000)-1)*0.6))*(((0.01^{0.5})/0.5)^{0.6})$ $k = ((2.6*(4.4))/((0.96)*(0.1/0.5)^{0.6})$ $k = 11.4/0.36$ $k = 31.2$				
c	c = sediment concentration (kg/m^3) $c = 31.2 * Qeff^{0.4}$ $c = 31.2 * 0.0017^{0.4}$ $c = 2.43\ kg/m^3$				
M	M = Outgoing sediment $M = c * Q$ $M = 2.4\ (kg/m^3) * 4.7\ m^3$ $M = 11.3\ kg$				

Outgoing sediment from outlet-S13 during land preparation in block S10, based on field measurement amounts to 9.6 kg (see Appendix 4, Land Preparation in S10), meanwhile prediction of outgoing sediment using process-based model amount to 11.3 kg.

<u>Modelling During Weeding activity</u>

Prediction of sediment concentration is carried out in outlet-S13 during weeding activity in block S12 until block S18.

Table 6. Value of Parameters Used in the Equation for Weeding Activity

No.	Parameter	Symbol	Unit	Value	Remark
1	Runoff	Q	m^3		
2	Effective runoff	Qeff	m^3/s		
3	Fraction of stream power of overland flow	F	-	0.1	
4	Sediment density	SD	kg/m^3	2600	
5	Water density	WD	kg/m^3	1000	
6	Slope	S	decimal	0.01	
7	Slope length	L	-	40	
8	Manning's coefficient	n	-	0.5	
9	Non-dimensional crop factor	ks		5	
10	Fraction of surface contact cover	Cs		0.3	
k	$k = ((F*SD*S*(L^{0.4}))/(((SD/WD)-1*Phi))*(((S^{0.5})/n)^{.0.6})$ $k = ((0.1*2600*0.01*(40^{0.4}))/(((2600/1000)-1)*0.6))*(((0.01^{0.5})/0.5)^{0.6})$ $k = ((2.6*(4.4))/((0.96)*(0.1/0.5)^{0.6})$ $k = 11.4/0.36$ $k = 31.2$				
c	c = sediment concentration (kg/m^3) $c = k * Q\ eff^{0.4} * exp(-ks*Cs)$ $c = 31.2 * Qeff^{0.4} * exp(-5*0.3)$ $c = 31.2 * 0.013^{0.4} * exp(-1.5)$ $c = 5.5 * 0.2\ kg/m^3$ $c = 1.1\ kg/m^3$				
M	M = Outgoing sediment $M = c * Q$ $M = 1,1\ (kg/m^3) * 22,6\ m^3$ $M = 24.9\ kg$				

Outgoing sediment from outlet-S13 during weeding activity from S12 through block 8, based on field measurement amounts to 26.6 kg (see Appendix 17, Weeding activity in S6). Meanwhile prediction of outgoing sediment using process-based model amount to 24.9 kg.

IV.3. Differentiating sawah having cut-off drain between neighbouring slope and those that doesn't

According to the observation in the rice field around Sumberjaya area in Lampung, there is a certain pattern whether a rice field is bordered to its surrounding agricultural slope with cut-off drain or not. If the feeding stream of rice field has a discharge rate bigger than sawah’s water requirement, there is a high probability that cut-off drain is present at least in one side of the sawah. The lower the position of sawah in a sub-catchment, the bigger the possibilities of sawah having cut-of drain to drain excess water, because discharge rate of feeding stream getting bigger. The correlation between size of sub-catchment and discharge rate of its tributary is positive. Therefore, sawah situated in a lower sub-catchment usually have cut-off drain. By delineating size of sub-catchment and position of sawah in topo map, one can make first judgement, whether the existing sawah has cut-off drain or not.

As for example, discharge rate of feeding stream on the field where measurement was done is 4 l/sec. The rice field has an area of 0.3 ha. Normal water requirement for rice cultivation amounts to 1 l/sec/ha. Therefore, the total water requirement of 0.3 ha amount to 0.3 ha * 1 l/sec/ha = 0.3 l/sec. Meanwhile feeding stream has discharge rate of 4 l/sec. Therefore, a water drain (cut-off drain) should exist around field to drain of 3.7 l/sec/ha excess incoming water.

Figure 7. Cut-off Drain with an Excess of 3.7 l/sec

V. CONCLUSION

Source of sediment in sawah can be sub-divided in to three parts:

1. Erosion coming from surrounding dry land slope
2. During land preparation farmer used to chop terrace wall producing a large amount of soil.
3. Sediment brought by feeding stream

According to the field observation during the land preparation, sediment source of type nr.2 contribute to a greater amount of sediment source.

Total sediment outflow from rice field have been calculated for 4 different activities during rice cultivation. Those activities are:

1. Land Preparation
2. Preparation for Transplantation
3. Transplantation
4. Weeding activities

Following sediment characteristics have been identified:

- Outgoing sediment during land preparation is twice as much as land preparation for transplanting.
- Outgoing sediment during land preparation is six times as much as both for transplantation and for weeding.
- Outgoing sediment is greater than inflow sediment during dry season

Any activities carried out at a distance of 40 – 50 m above the outlet do not contribute a significant amount of sediment to the stream. Some 270 kg sediment every season form a unit of normal size of sawah can be expected to leave sawah and enter the stream networks.

Uniform geometric factors of rice fields such as slope steepness, surface coverage, and steady-uniform flow make the application of process-based model quite accurate. The model can be integrated to spatial model to adjust prediction of off-site effect of erosion.

Future Research Needs

Some important issue related to this topic still need to be studied:

1. Sediment balance in sawah especially sediment inflow during wet season to have a complete data on annual basis.
2. Correlation of sawah position in sub-catchment with its cut-off drain.
3. Relation between geometric factors of sawah (such as size, position in landscape, etc) with pattern of outgoing sediment.
4. Integrating rice field plot analysis to catchment scale for adjustment of off-site effect of erosion prediction.

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APPENDICES

Appendix 1: Land Preparation in S4, S7, and S6

Sampling			Sediment	Runoff	Total
Code	Interval	Date	Concentr	Vol.	Sediment
	(Sec.)		(gr/l)	(lt)	(kg)
	Land Preparation in S4				
S4T0	0	7/21/2000	1.175	0.00	0.00
S4T10	600	7/21/2000	0.991	141.24	0.14
S4T20	600	7/21/2000	5.663	135.96	0.77
S4T300	600	7/21/2000	5.678	125.98	0.72
S4T40	600	7/21/2000	4.966	108.17	0.54
S4T55	900	7/21/2000	5.793	144.73	0.84
S4T70	900	7/21/2000	6.610	126.66	0.84
S4T80	600	7/21/2000	8.002	79.75	0.64
S4T87	420	7/21/2000	7.965	81.72	0.65
S4T100	780	7/21/2000	1.255	279.19	0.35
Total	6000			1223.40	5.48
	Land Preparation in S7				
ST0	600	7/21/2000	1.290	0.00	0.00
ST10	600	7/21/2000	1.039	410.44	0.43
ST20	600	7/21/2000	1.506	395.10	0.59
ST30	600	7/21/2000	2.483	380.33	0.94
ST40	600	7/21/2000	1.685	380.33	0.64
ST50	600	7/21/2000	2.057	352.42	0.72
ST60	600	7/21/2000	2.409	339.25	0.82
ST75	900	7/21/2000	1.476	489.85	0.72
Total	5100			2747.726649	4.87
	Land Preparation in S6				
S6T0	0.00	7/24/2000	0.41	0.00	0.00
S6T10	600.00	7/24/2000	0.68	673.54	0.46
S6T20	600.00	7/24/2000	0.70	699.69	0.49
S6T30	600.00	7/24/2000	2.31	726.87	1.68
S6T40	600.00	7/24/2000	0.49	846.53	0.42
S6T55	900.00	7/24/2000	0.33	1269.79	0.42
S6T70	900.00	7/24/2000	0.39	1222.32	0.48
S6T85	900.00	7/24/2000	0.19	936.18	0.17
S6T100	900.00	7/24/2000	2.75	803.84	2.21
S6T115	900.00	7/24/2000	0.73	803.84	0.58
S6T130	900.00	7/24/2000	0.30	664.41	0.20
Total	7800.00			8647.01	7.13

Appendix 2: Land Preparation in S13 and S12

Sampling			Sediment	Runoff	Total
Code	Interval	Date	Concentr	Vol.	Sediment
	(Sec.)		(gr/l)	(lt)	(kg)
	Land Preparation in S13				
S13T10	600	8/6/2000	1.864	280.40	0.52
S13T20	600	8/6/2000	4.863	280.40	1.36
S13T30	600	8/6/2000	2.024	280.40	0.57
S13T40	600	8/6/2000	2.025	280.40	0.57
S13T50	600	8/6/2000	3.925	280.40	1.10
S13T60	600	8/8/2000	1.784	280.40	0.50
S13T70	600	8/6/2000	1.700	280.40	0.48
S13T80	600	8/6/2000	4.982	280.40	1.40
S13T90	600	8/6/2000	4.466	280.40	1.25
S13T100	600	8/6/2000	5.388	280.40	1.51
S13T110	600	8/6/2000	1.458	280.40	0.41
S13T120	600	8/6/2000	2.691	280.40	0.75
S13T130	600	8/6/2000	2.513	269.92	0.68
S13T150	1200	8/6/2000	7.398	539.84	3.99
S13T160	600	8/6/2000	4.203	269.92	1.13
S13T170	600	8/6/2000	7.149	269.92	1.93
S13T180	600	8/6/2000	5.045	269.92	1.36
S13T190	600	8/6/2000	2.447	269.92	0.66
S13T200	600	8/6/2000	1.428	269.92	0.39
S13T210	600	8/6/2000	1.675	269.92	0.45
Total	12600			5794.096381	21.02
	Land Preparation in S12				
S12T0	0	8/8/2000	1.436	0.00	0.00
S12T20	1200	8/8/2000	2.516	2478.16	6.24
S12T30	600	8/8/2000	2.081	1239.08	2.58
S12T40	600	8/8/2000	5.781	1239.08	7.16
S12T50	600	8/8/2000	5.614	1239.08	4.48
S12T60	600	8/8/2000	5.815	1239.08	7.21
S12T70	600	8/8/2000	5.548	1239.08	6.87
S12T80	600	8/8/2000	5.338	1239.08	6.61
		Rest			
S12T90	600	8/8/2000	7.235	1239.08	8.96
S12T100	600	8/8/2000	6.728	1287.20	8.66
S12T110	600	8/8/2000	6.690	1287.20	8.61
S12T120	600	8/8/2000	6.619	1287.20	8.52
S12T130	600	8/8/2000	5.424	1287.20	6.98
S12T140	600	8/8/2000	5.847	1287.20	7.53
S12T160	600	8/8/2000	3.632	1287.20	4.67
S12T170	600	8/8/2000	1.417	1239.08	1.76
S12T180	600	8/8/2000	1.059	1239.08	1.31
S12T190	600	8/8/2000	1.286	1239.08	1.59
Total	10800			22592.13814	99.75

Appendix 3: Land Preparation in S12 and S11

Sampling			Sediment	Runoff	Total
Code	Interval	Date	Concentr	Vol.	Sediment
	(Sec.)		(gr/l)	(lt)	(kg)
	Land Preparation in S12				
S13T0	0	8/8/2000	0.444	0.00	0.00
S13T20	1200	8/8/2000	2.818	2574.40	7.26
S13T40	1200	8/8/2000	3.116	2574.40	8.02
S13T80	2400	8/8/2000	2.384	5148.79	12.27
S13T100	1200	8/8/2000	3.339	2574.40	8.60
S13T120	1200	8/8/2000	3.413	2574.40	8.79
S13T140	1200	8/8/2000	2.360	2574.40	6.08
S13T160	1200	8/8/2000	3.349	2574.40	8.62
S13T180	1200	8/8/2000	3.144	2574.40	8.09
S13T200	1200	8/8/2000	1.655	2574.40	4.26
S13T220	1200	8/8/2000	0.172	2574.40	0.44
Total	13200			28318.37	72.43
	Land Preparation in S11				
S11T0	0	8/12/2000	1.199	0.00	0.00
S11T10	600	8/12/2000	1.251	152.42	0.19
S11T20	600	8/12/2000	6.465	152.42	0.99
S11T30	600	8/12/2000	7.153	152.42	1.09
S11T40	600	8/12/2000	7.840	152.42	1.19
S11T50	600	8/12/2000	7.889	152.45	1.20
S11T60	600	8/12/2000	6.520	152.42	0.99
S11T70	600	8/12/2000	7.800	152.42	1.19
S11T90	1200	8/12/2000	6.086	316.67	1.93
		rest			
S11T100	600	8/12/2000	6.226	158.30	0.99
S11T110	600	8/12/2000	5.488	158.34	0.87
S11T120	600	8/12/2000	5.029	158.34	0.80
S11T130	600	8/12/2000	5.673	158.34	0.90
S11T140	600	8/12/2000	3.966	158.34	0.63
S11T150	600	8/12/2000	3.362	158.34	0.53
S11T160	600	8/12/2000	2.016	164.49	0.33
S11T170	600	8/12/2000	1.794	164.49	0.30
S11T190	1200	8/12/2000	1.927	328.97	0.63
S11T200	600	8/12/2000	1.310	164.49	0.22
S11T210	600	8/12/2000	1.380	164.49	0.23
Total	12600			3320.52	15.19

Appendix 4: Land Preparation in S11,S10 and S10

Sampling			Sediment	Runoff	Total
Code	Interval	Date	Concentr	Vol.	Sediment
	(Sec.)		(gr/l)	(lt)	(kg)
	Land Preparation in S11				
S13T0	0	8/12/2000	1.368	0.00	0.00
S13T20	1200	8/12/2000	1.401	304.84	0.43
S13T40	1200	8/12/2000	2.713	304.84	0.83
S13T60	1200	8/12/2000	2.988	304.84	0.91
S13T80	1200	8/12/2000	2.015	304.84	0.61
S13T100	1200	8/12/2000	2.469	328.97	0.81
S13T120	1200	8/12/2000	2.780	328.97	0.91
S13T140	1200	8/12/2000	2.356	328.97	0.78
S13T160	1200	8/12/2000	2.318	328.97	0.76
S13T180	1200	8/12/2000	2.439	328.97	0.80
S13T200	1200	8/12/2000	1.557	328.97	0.51
S13T220	1200	8/12/2000	1.011	328.97	0.33
Total	13200			3522.14	7.69
	Land Preparation in S10				
S10T0	0	8/13/2000	1.335	0.00	0.00
S10T10	600	8/13/2000	1.625	170.87	0.28
S10T20	600	8/13/2000	7.056	170.87	1.21
S10T30	600	8/13/2000	5.923	170.87	1.01
S10T40	600	8/13/2000	4.554	170.87	0.78
S10T50	600	8/13/2000	4.771	177.51	0.85
S10T60	600	8/13/2000	4.800	177.51	0.85
S10T60	600	8/13/2000	3.167	177.51	0.56
S10T70	600	8/13/2000	3.946	177.51	0.70
S10T80	600	8/13/2000	4.779	177.51	0.85
S10T90	600	8/13/2000	7.789	177.51	1.38
S10T100	600	8/13/2000	7.457	177.51	1.32
S10T110	600	8/13/2000	6.160	177.51	1.09
S10T120	600	8/13/2000	4.744	177.51	0.84
S10T130	600	8/13/2000	6.004	177.51	1.07
S10T140	600	8/13/2000	1.189	184.40	0.22
S10T150	600	8/13/2000	2.063	184.40	0.38
S10T160	600	8/13/2000	1.387	184.40	0.26
S10T170	600	8/13/2000	1.541	184.40	0.28
Total	10800			3196.199913	13.93
	Land Preparation in S10				
S13T0	0	8/13/2000	2.096	0.00	0.00
S13T30	1800	8/13/2000	1.259	574.69	0.72
S13T60	1800	8/13/2000	1.646	574.69	0.95
S13T90	1800	8/13/2000	2.052	597.01	1.23
S13T120	1800	8/13/2000	0.739	597.01	0.44
S13T150	1800	8/13/2000	2.772	597.01	1.65
S13T180	1800	8/13/2000	3.933	597.01	2.35
S13T210	1800	8/13/2000	1.407	597.01	0.84
S13T240	1800	8/13/2000	2.375	597.01	1.42
Total	14400			4731.45	9.60

Appendix 5: Land Preparation in S9, S9, S8 and S7

Sampling			Sediment	Runoff	Total
Code	Interval	Date	Concentr	Vol.	Sediment
	(Sec.)		(gr/l)	(lt)	(kg)
	Land Preparation in S9				
S13T0	0	8/14/2000	3.475	0.00	0.00
S13T30	1800	8/14/2000	3.082	574.69	1.77
S13T60	1800	8/14/2000	2.511	574.69	1.44
S13T90	1800	8/14/2000	2.921	597.01	1.74
S13T120	1800	8/14/2000	2.184	597.01	1.30
S13T150	1800	8/14/2000	2.379	597.01	1.42
S13T180	1800	8/14/2000	2.341	597.01	1.40
Total	10800			3537.43048	9.08
	Land Preparation in S9				
S9T0	0	8/14/2000	1.714	0.00	0.00
S9T10	600	8/14/2000	3.107	170.87	0.53
S9T30	1200	8/14/2000	5.605	341.75	1.92
S9T40	600	8/13/2000	7.133	177.51	1.27
S9T60	1200	8/14/2000	8.462	355.02	3.00
S9T70	600	8/14/2000	8.398	177.51	1.49
S9T80	600	8/14/2000	8.794	177.51	1.56
S9T90	600	8/14/2000	6.323	177.51	1.12
S9T100	600	8/14/2000	6.888	177.51	1.22
S9T120	1200	8/14/2000	4.160	355.02	1.48
S9T130	600	8/14/2000	3.009	177.51	0.53
S9T150	1200	8/14/2000	0.935	355.02	0.33
Total	9000			2642.733234	14.46
	Land Preparation in S8 and S7				
S13T0	0	8/15/2000	2.300	0.00	0.00
S13T30	1800	8/15/2000	1.357	574.69	0.78
S13T60	1800	8/15/2000	2.084	574.69	1.20
S13T90	1800	8/15/2000	1.788	574.69	1.03
S13T120	1800	8/15/2000	2.615	574.69	1.50
S13T150	1800	8/15/2000	3.384	574.69	1.94
S13T210	3600	8/15/2000	3.405	1149.39	3.91
S13T240	1800	8/15/2000	0.780	574.69	0.45
S13T270	1800	8/15/2000	0.922	574.69	0.53
Total	16200			5172.236143	11.34
	Land Preparation in S7				
S7T0	0	8/15/2000	1.385	0.00	0.00
S7T20	1200	8/15/2000	5.327	304.84	1.62
S7T30	600	8/15/2000	5.153	152.42	0.79
S7T40	600	8/15/2000	5.461	152.42	0.83
S7T50	600	8/15/2000	2.593	152.42	0.40
S7T60	600	8/15/2000	5.157	152.42	0.79
S7T70	600	8/15/2000	3.120	152.42	0.48
S7T90	1200	8/15/2000	2.723	304.84	0.83
S7T100	600	8/15/2000	7.537	152.42	1.15
S7T110	600	8/15/2000	7.342	152.42	1.12
S7T120	600	8/15/2000	2.426	152.42	0.37
S7T130	600	8/15/2000	3.040	152.42	0.46
Total	7800			1981.427628	8.83

Appendix 6: Land Preparation in S6

Sampling			Sediment	Runoff	Total
Code	Interval	Date	Concentr	Vol.	Sediment
	(Sec.)		(gr/l)	(lt)	(kg)
	Land Preparation in S8				
S8T20	1200	8/15/2000	10.460	304.84	3.19
S8T30	600	8/15/2000	3.971	152.42	0.61
S8T50	1200	8/15/2000	5.412	316.67	1.71
S8T60	600	8/15/2000	5.296	158.34	0.84
S8T70	600	8/15/2000	5.744	158.34	0.91
S8T80	600	8/15/2000	3.819	158.34	0.60
Total	4800			1248.935834	7.86

Appendix 7: Transplantation in S5, S6, and S7

Sampling			Sediment	Runoff	Total
Code	Interval	Date	Concentr	Vol.	Sediment
	(Sec.)		(gr/l)	(lt)	(kg)
	Transplantation in S5				
S5T0	0	8/1/2000	1.224	0.00	0.00
S5T20	1200	8/1/2000	4.847	271.91	1.32
S5T30	600	8/1/2000	4.707	135.95	0.64
S5T40	600	8/1/2000	4.662	130.87	0.61
S5T50	600	8/1/2000	1.946	130.87	0.25
Total	3000			669.60982	2.82
	Transplantation in S5				
S7T0	0	8/1/2000	1.235	0.00	0.00
S7T20	1200	8/1/2000	2.041	368.81	0.75
S7T40	1200	8/1/2000	2.282	355.02	0.81
S7T60	1200	8/1/2000	0.985	355.02	0.35
Total	3600			1078.84356	1.91
	Transplantation in S6				
S6T0	0	8/3/2000	0.958	0.00	0.00
S6T10	600	8/3/2000	1.171	184.40	0.22
S6T20	600	8/3/2000	0.499	184.40	0.09
S6T30	600	8/3/2000	0.951	184.40	0.18
S6T40	600	8/3/2000	0.757	184.40	0.14
S6T50	600	8/3/2000	0.936	177.51	0.17
S6T60	600	8/3/2000	1.826	177.51	0.32
S6T70	600	8/3/2000	2.800	177.51	0.50
S6T80	600	8/3/2000	0.818	177.51	0.15
Total	4800			1447.64954	1.76
ST = S7	Transplantation in S7				
ST0	0	8/3/2000	0.048	0.00	0.00
ST10	600	8/3/2000	0.822	223.10	0.18
ST20	600	8/3/2000	0.494	223.10	0.11
ST30	600	8/3/2000	2.477	223.10	0.55
ST40	600	8/3/2000	1.450	223.10	0.32
ST50	600	8/3/2000	1.582	223.10	0.35
ST60	600	8/3/2000	1.951	214.76	0.42
ST70	600	8/3/2000	0.312	214.76	0.07
ST80	600	8/3/2000	1.843	214.76	0.40
Total	4800			1759.78538	2.40

Appendix 8: Transplantation in S6, S13, and S12

Sampling			Sediment	Runoff	Total
Code	Interval	Date	Concentr	Vol.	Sediment
	(Sec.)		(gr/l)	(lt)	(kg)
	Transplantation in S6				
S7T0	0	8/3/2000	0.557	0.00	0.00
S7T20	600	8/3/2000	0.460	269.92	0.12
S7T40	1800	8/3/2000	0.287	779.49	0.22
S7T60	1200	8/3/2000	0.176	519.66	0.09
S7T100	2400	8/3/2000	0.399	1039.32	0.41
Total	6000			2608.37999	0.85
	Transplantation in S13				
S13T10	600	8/10/2000	0.726	152.42	0.11
S13T20	600	8/10/2000	1.537	152.42	0.23
S13T30	600	8/10/2000	0.826	152.42	0.13
S13T40	600	8/10/2000	4.163	152.42	0.63
S13T60	1200	8/10/2000	5.897	316.67	1.87
S13T70	600	8/10/2000	1.825	158.34	0.29
S13T80	600	8/10/2000	4.930	158.34	0.78
S13T90	600	8/10/2000	3.794	158.34	0.60
S13T100	600	8/10/2000	1.516	158.34	0.24
S13T110	600	8/10/2000	2.672	158.34	0.42
S13T120	600	8/10/2000	1.655	158.34	0.26
S13T130	600	8/10/2000	1.898	158.34	0.30
S13T140	600	8/10/2000	2.475	158.34	0.39
S13T180	2400	8/10/2000	2.547	633.35	1.61
Total	10800			2826.38329	7.87
	Transplantation in S12				
S12T0	0	8/11/2000	0.091	0.00	0.00
S12T10	600	8/11/2000	0.467	104.13	0.05
S12T20	600	8/11/2000	0.115	104.13	0.01
S12T30	600	8/11/2000	2.075	104.13	0.22
S12T40	600	8/11/2000	2.812	104.13	0.29
S12T50	600	8/11/2000	0.881	104.13	0.09
S12T60	600	8/11/2000	0.606	104.13	0.06
S12T70	600	8/11/2000	1.333	108.17	0.14
		rest			
S12T80	600	8/11/2000	1.667	108.17	0.18
S12T90	600	8/11/2000	0.810	108.17	0.09
S12T100	600	8/11/2000	1.077	108.17	0.12
S12T110	600	8/11/2000	1.523	108.17	0.16
S12T120	600	8/11/2000	1.404	108.17	0.15
S12T130	600	8/11/2000	2.924	108.17	0.32
S12T140	600	8/11/2000	1.407	112.37	0.16
S12T150	600	8/11/2000	2.133	112.37	0.24
S12T160	600	8/11/2000	0.424	112.37	0.05
S12T170	600	8/11/2000	1.620	112.37	0.18
Total	10200			1831.47	2.51

Appendix 9: Transplantation in S12 and S11

Sampling			Sediment	Runoff	Total
Code	Interval	Date	Concentr	Vol.	Sediment
	(Sec.)		(gr/l)	(lt)	(kg)
	Transplantation in S12				
S13T0	0	8/11/2000	0.194	0.00	0.00
S13T20	1200	8/11/2000	0.196	224.75	0.04
S13T40	1200	8/11/2000	0.089	224.75	0.02
S13T60	1200	8/11/2000	1.408	224.75	0.32
S13T80	1200	8/11/2000	1.616	224.75	0.36
S13T100	1200	8/11/2000	1.269	224.75	0.29
S13T120	1200	8/11/2000	1.690	224.75	0.38
S13T140	1200	8/11/2000	0.993	224.75	0.22
S13T160	1200	8/11/2000	0.932	224.75	0.21
S13T180	1200	8/11/2000	0.813	224.75	0.18
Total	10800			2022.71367	2.02
	Transplantation in S11				
S11T0	0	8/13/2000	0.938	0.00	0.00
S11T0	0	8/13/2000	0.938	0.00	0.00
S11T10	600	8/13/2000	2.832	152.42	0.43
S11T20	600	8/13/2000	4.538	152.42	0.69
S11T30	600	8/13/2000	1.095	152.42	0.17
S11T40	600	8/13/2000	3.337	152.42	0.51
S11T50	600	8/13/2000	3.055	152.42	0.47
S11T60	600	8/13/2000	4.547	152.42	0.69
S11T70	600	8/13/2000	2.338	152.42	0.36
		rest			
S11T80	600	8/13/2000	2.919	152.42	0.44
S11T90	600	8/13/2000	6.148	158.34	0.97
S11T110	1200	8/13/2000	3.821	316.67	1.21
S11T120	600	8/13/2000	2.624	158.34	0.42
S11T130	600	8/13/2000	5.796	158.34	0.92
S11T140	600	8/13/2000	1.375	158.34	0.22
S11T150	600	8/13/2000	7.468	158.34	1.18
S11T160	600	8/13/2000	5.220	158.34	0.83
S11T170	600	8/13/2000	8.203	158.34	1.30
Total	10200			2644.37003	10.80
	Transplantation in S11				
S13T0	0	8/13/2000	0.249	0.00	0.00
S13T30	1800	8/13/2000	1.153	457.25	0.53
S13T60	1800	8/13/2000	1.286	493.46	0.63
S13T90	1800	8/13/2000	2.022	493.46	1.00
S13T120	1800	8/13/2000	0.330	493.46	0.16
S13T150	1800	8/13/2000	2.812	493.46	1.39
S13T180	1800	8/13/2000	2.076	493.46	1.02
S13T210	1800	8/13/2000	0.235	493.46	0.12
Total	12600			3417.99482	4.85

Appendix 10: Transplantation in S10,S9, S8 and S7

Sampling			Sediment	Runoff	Total
Code	Interval	Date	Concentr	Vol.	Sediment
	(Sec.)		(gr/l)	(lt)	(kg)
	Transplantation in S10				
S10T0	0	8/15/2000	6.091	0.00	0.00
S10T10	600	8/15/2000	5.769	125.98	0.73
S10T20	600	8/15/2000	1.068	125.98	0.13
S10T30	600	8/15/2000	1.004	125.98	0.13
S10T50	1200	8/15/2000	1.157	251.96	0.29
S10T60	600	8/15/2000	1.063	125.98	0.13
S10T70	600	8/15/2000	1.459	125.98	0.18
S10T80	600	8/15/2000	1.135	125.98	0.14
S10T90	600	8/15/2000	1.586	125.98	0.20
S10T100	600	8/15/2000	1.732	125.98	0.22
Total	6000			1259.80046	2.16
	Transplantation in S9				
S9T0	0	8/15/2000	1.390	0.00	0.00
S9T10	600	8/15/2000	1.094	125.98	0.14
S9T20	600	8/15/2000	1.221	125.98	0.15
S9T30	600	8/15/2000	1.423	125.98	0.18
S9T40	600	8/15/2000	1.511	125.98	0.19
S9T50	600	8/15/2000	1.399	125.98	0.18
S9T60	600	8/15/2000	1.286	125.98	0.16
S9T70	600	8/15/2000	1.881	125.98	0.24
S9T80	600	8/15/2000	2.255	125.98	0.28
S9T90	600	8/15/2000	1.692	125.98	0.21
Total	3600			755.880277	1.26
	Transplantation in S9 and S10				
S13T0	0	8/15/2000	0.091	0.00	0.00
S13T30	1800	8/15/2000	1.193	553.21	0.66
S13T60	1800	8/15/2000	1.269	553.21	0.70
S13T90	1800	8/15/2000	0.398	553.21	0.22
S13T120	1800	8/15/2000	1.714	553.21	0.95
S13T150	1800	8/15/2000	1.023	553.21	0.57
S13T180	1800	8/15/2000	1.625	553.21	0.90
S13T210	1800	8/15/2000	0.707	553.21	0.39
Total	12600			3872.46281	4.39
	Transplantation in S8 and S7				
S13T0	0	8/16/2000	0.817	0.00	0.00
S13T30	1800	8/16/2000	1.059	553.21	0.59
S13T60	1800	8/16/2000	1.528	553.21	0.85
S13T90	1800	8/16/2000	1.356	553.21	0.75
S13T120	1800	8/16/2000	1.346	574.69	0.77
S13T150	1800	8/16/2000	0.633	574.69	0.36
S13T180	1800	8/16/2000	0.672	574.69	0.39
Total	10800			3383.70563	3.70

Appendix 11 : Preparation for transplantation in S12

Sampling			Sediment	Runoff	Total
Code	Interval	Date	Concentr	Vol.	Sediment
	(Sec.)		(gr/l)	(lt)	(kg)
	Preparation for transplantation in S12				
S13T0	0	8/10/2000	3.269	0.00	0.00
S13T20	1200	8/10/2000	5.625	463.53	2.61
S13T40	1200	8/10/2000	7.190	463.53	3.33
S13T60	1200	8/10/2000	8.040	463.53	3.73
S13T80	1200	8/10/2000	15.052	463.53	6.98
S13T100	1200	8/10/2000	13.944	481.53	6.71
S13T120	1200	8/10/2000	14.858	481.53	7.15
S13T140	1200	8/10/2000	6.452	481.53	3.11
S13T200	3600	8/10/2000	2.929	1444.59	4.23
Total	12000			4743.305554	37.85
	Preparation for transplantation in S11				
S11T0	0	8/12/2000	1.311	0.00	0.00
S11T10	600	8/12/2000	1.139	184.40	0.21
S11T20	600	8/12/2000	1.497	184.40	0.28
S11T30	600	8/12/2000	1.135	184.40	0.21
S11T40	600	8/12/2000	1.166	184.40	0.22
S11T50	600	8/12/2000	3.607	184.40	0.67
S11T60	600	8/12/2000	2.150	184.40	0.40
		rest			
S11T70	600	8/12/2000	3.011	184.40	0.56
S11T80	600	8/12/2000	1.326	184.40	0.24
S11T90	600	8/12/2000	1.779	191.56	0.34
S11T100	600	8/12/2000	2.142	191.56	0.41
S11T110	600	8/12/2000	2.480	191.56	0.48
S11T120	600	8/12/2000	1.863	191.56	0.36
S11T130	600	8/12/2000	1.940	191.56	0.37
S11T140	600	8/12/2000	2.560	191.56	0.49
S11T150	600	8/12/2000	1.824	191.56	0.35
S11T160	600	8/12/2000	1.738	191.56	0.33
S11T170	600	8/12/2000	1.679	191.56	0.32
S11T180	600	8/12/2000	1.118	191.56	0.21
Total	10800			3390.866944	6.43
	Preparation for transplantation in S10				
S13T0	0	8/13/2000	0.563	0.00	0.00
S13T30	1800	8/13/2000	1.738	512.62	0.89
S13T60	1800	8/13/2000	1.393	532.53	0.74
S13T90	1800	8/13/2000	1.450	532.53	0.77
S13T120	1800	8/13/2000	2.020	532.53	1.08
S13T150	1800	8/13/2000	0.984	532.53	0.52
S13T180	1800	8/13/2000	1.454	532.53	0.77
Total	10800			3175.261416	4.78

Appendix 12 : Preparation for transplantation in S9, S8, and S7

Sampling			Sediment	Runoff	Total
Code	Interval	Date	Concentr	Vol.	Sediment
	(Sec.)		(gr/l)	(lt)	(kg)
	Preparation for transplantation in S9				
S13T0	0	8/14/2000	0.125	0.00	0.00
S13T30	1800	8/14/2000	0.376	597.01	0.22
S13T60	1800	8/14/2000	0.998	597.01	0.60
S13T90	1800	8/14/2000	1.449	597.01	0.87
S13T120	1800	8/14/2000	0.961	597.01	0.57
S13T150	1800	8/14/2000	0.170	597.01	0.10
S13T180	1800	8/14/2000	0.954	597.01	0.57
Total	10800			3582.067006	2.93
	Preparation for transplantation in S9				
S9T0	0	8/14/2000	0.100	0.00	0.00
S9T10	600	8/14/2000	1.965	177.51	0.35
S9T20	600	8/14/2000	7.863	177.51	1.40
S9T30	600	8/14/2000	3.417	177.51	0.61
S9T50	600	8/14/2000	1.000	177.51	0.18
S9T60	600	8/14/2000	1.101	184.40	0.20
S9T70	600	8/14/2000	8.598	184.40	1.59
S9T80	600	8/14/2000	1.993	184.40	0.37
S9T95	600	8/14/2000	2.359	184.40	0.44
S9T100	600	8/14/2000	2.730	184.40	0.50
S9T110	600	8/14/2000	3.438	184.40	0.63
S9T110	600	8/14/2000	2.520	184.40	0.46
S9T120	600	8/14/2000	1.974	184.40	0.36
S9T130	600	8/14/2000	1.949	184.40	0.36
S9T140	600	8/14/2000	2.101	184.40	0.39
Total	8400			2554.067485	7.83
	Preparation for transplantation in S7 and S8				
S13T0	0	8/16/2000	0.106	0.00	0.00
S13T30	1800	8/16/2000	0.976	553.21	0.54
S13T60	1800	8/16/2000	1.800	553.21	1.00
S13T90	1800	8/16/2000	1.440	553.21	0.80
S13T120	1800	8/16/2000	1.986	553.21	1.10
S13T150	1800	8/16/2000	0.738	553.21	0.41
S13T180	1800	8/16/2000	0.354	553.21	0.20
S13T210	1800	8/16/2000	0.805	553.21	0.45
Total	12600			3872.46281	4.48

Appendix 13 : Preparation for transplantation in S7 and S8

Sampling			Sediment	Runoff	Total
Code	Interval	Date	Concentr	Vol.	Sediment
	(Sec.)		(gr/l)	(lt)	(kg)
	Preparation for transplantation in S7				
S7T0	0	8/16/2000	4.584	0.00	0.00
S7T10	600	8/16/2000	1.991	125.98	0.25
S7T20	600	8/16/2000	4.216	121.27	0.51
S7T30	600	8/16/2000	7.055	121.27	0.86
S7T50	1200	8/16/2000	1.202	242.54	0.29
S7T60	600	8/16/2000	4.218	121.27	0.51
S7T70	600	8/16/2000	3.609	121.27	0.44
S7T80	600	8/16/2000	5.417	121.27	0.66
S7T90	600	8/16/2000	2.280	121.27	0.28
S7T100	600	8/16/2000	2.007	121.27	0.24
Total	6000			1217.414484	4.04
	Preparation for transplantation in S8				
S8T10	0	8/16/2000	2.461	0.00	0.00
S8T20	1200	8/16/2000	2.682	251.96	0.68
S8T30	600	8/16/2000	1.480	125.98	0.19
S8T40	600	8/16/2000	2.455	125.98	0.31
S8T50	600	8/18/2000	4.989	125.98	0.63
Total	3000			629.900231	1.80

Appendix 14 : Weeding activity in S6, S7, and S4

Sampling			Sediment	Runoff	Total
Code	Interval	Date	Concentr	Vol.	Sediment
	(Sec.)		(gr/l)	(lt)	(kg)
	Weeding activity in S6				
S6T0	0	9/11/2000	0.688	0.00	0.00
S6T10	600	9/11/2000	0.882	314.36	0.28
S6T20	600	9/11/2000	0.980	314.36	0.31
S6T40	1200	9/11/2000	0.155	628.71	0.10
S6T50	600	9/11/2000	1.124	314.36	0.35
S6T60	600	9/11/2000	0.582	302.60	0.18
S6T80	1200	9/11/2000	0.900	605.21	0.54
S6T90	600	9/11/2000	0.917	302.60	0.28
S6T100	600	9/11/2000	1.410	302.60	0.43
S6T110	600	9/11/2000	0.689	302.60	0.21
S6T120	600	9/11/2000	0.410	302.60	0.12
Total	7200			3690.00	2.79
	Weeding activity in S7				
S7T0	0	9/11/2000	0.689	0.00	0.00
S7T10	600	9/11/2000	0.991	314.36	0.31
S7T20	600	9/11/2000	4.220	314.36	1.33
S7T30	600	9/11/2000	1.046	314.36	0.33
S7T40	600	9/11/2000	1.900	314.36	0.60
S7T50	600	9/11/2000	0.224	314.36	0.07
S7T60	600	9/11/2000	1.086	326.56	0.35
S7T70	600	9/11/2000	1.045	326.56	0.34
S7T80	600	9/11/2000	0.930	326.56	0.30
Total	4800			2551.47	3.63
	Weeding activity in S6				
S7T20	1200	9/11/2000	0.908	653.13	0.59
S7T40	1200	9/11/2000	1.056	653.13	0.69
ST60	1200	9/11/2000	2.059	653.13	0.61
S7T100	2400	9/11/2000	1.909	1306.25	1.43
S7T120	1200	9/11/2000	2.480	653.13	0.62
S7T160	2400	9/11/2000	1.050	1306.25	1.18
Total	9600			5225.01	5.12
	Weeding activity in S4				
S4T0	0	9/12/2000	1.333	0.00	0.00
S4T10	600	9/12/2000	1.900	291.29	0.55
S4T20	600	9/12/2000	1.740	291.29	0.51
S4T30	600	9/12/2000	1.917	291.29	0.56
S4T40	600	9/12/2000	1.833	302.60	0.55
S4T50	600	9/12/2000	1.422	302.60	0.43
Total	3000			1479.08	2.60

Appendix 15 : Weeding activity in S5, S4, and S2

Sampling			Sediment	Runoff	Total
Code	Interval	Date	Concentr	Vol.	Sediment
	(Sec.)		(gr/l)	(lt)	(kg)
	Weeding activity in S5				
S5T0	0	9/12/2000	0.794	0.00	0.00
S5T10	600	9/12/2000	1.142	291.29	0.33
S5T20	600	9/12/2000	0.110	291.29	0.03
S5T30	600	9/12/2000	1.000	291.29	0.29
S5T40	600	9/12/2000	1.539	291.29	0.45
S5T60	1200	9/12/2000	0.875	605.21	0.53
S5T70	600	9/12/2000	1.241	302.60	0.38
S5T90	1200	9/12/2000	1.595	605.21	0.97
S5T100	600	9/12/2000	2.023	302.60	0.61
S5T110	600	9/12/2000	0.973	302.60	0.29
S5T120	600	9/12/2000	1.679	302.60	0.51
Total	7200			3585.99	4.39
	Weeding activity in S5 and S4				
S7T60	3600	9/12/2000	0.658	1959.38	1.29
S7T90	1800	9/12/2000	0.964	1017.74	0.98
S7T120	1800	9/12/2000	0.975	1017.74	0.99
S7T150	1800	9/12/2000	0.735	1017.74	0.75
Total	9000			5012.59	4.01
	Weeding activity in S2				
S2T0	0	9/13/2000	0.230	0.00	0.00
S2T10	600	9/13/2000	0.861	269.92	0.23
S2T20	600	9/13/2000	0.928	269.92	0.25
S2T30	600	9/13/2000	6.607	269.92	1.78
S2T40	600	9/13/2000	0.848	280.40	0.24
S2T50	600	9/13/2000	0.881	280.40	0.25
S2T60	600	9/13/2000	0.848	280.40	0.24
S2T70	600	9/13/2000	0.810	291.29	0.24
S2T80	600	9/13/2000	1.111	291.29	0.32
S2T90	600	9/13/2000	1.000	291.29	0.29
S2T110	1200	9/13/2000	1.300	582.58	0.76
S2T120	600	9/13/2000	1.584	291.29	0.46
S2T135	900	9/13/2000	0.386	436.94	0.17
S2T150	900	9/13/2000	0.484	436.94	0.21
Total	9000			4272.58	5.44

Appendix 16 : Weeding activity in S3, S2, and S1

Sampling			Sediment	Runoff	Total
Code	Interval	Date	Concentr	Vol.	Sediment
	(Sec.)		(gr/l)	(lt)	(kg)
	Weeding activity in S3				
S3T0	0	9/13/2000	0.352	0.00	0.00
S3T10	600	9/13/2000	0.876	280.40	0.25
S3T20	600	9/13/2000	0.911	280.40	0.26
S3T30	600	9/13/2000	1.000	280.40	0.28
S3T40	600	9/13/2000	0.784	280.40	0.22
S3T50	600	9/13/2000	0.784	291.29	0.23
S3T60	600	9/13/2000	1.482	291.29	0.43
S3T70	600	9/13/2000	0.598	291.29	0.17
S3T80	600	9/13/2000	4.733	291.29	1.38
S3T90	600	9/13/2000	2.848	291.29	0.83
S3T100	600	9/13/2000	0.397	291.29	0.12
S3T120	1200	9/13/2000	0.628	582.58	0.37
S3T130	600	9/13/2000	1.445	291.29	0.42
S3T150	1200	9/13/2000	0.189	582.58	0.11
Total	9000			4325.81	5.06
	Weeding activity in S2 and S3				
S7T0	0	9/13/2000	0.288	0.00	0.00
S7T10	600	9/13/2000	0.562	314.36	0.18
S7T20	600	9/13/2000	1.218	314.36	0.38
S7T30	600	9/13/2000	1.324	314.36	0.42
S7T60	1800	9/13/2000	0.421	943.07	0.40
S7T90	1800	9/13/2000	0.384	979.69	0.38
S7T120	1800	9/13/2000	0.441	979.69	0.43
S7T150	1800	9/13/2000	2.532	979.69	2.48
S7T180	1800	9/13/2000	1.239	979.69	1.21
S7T210	1800	9/13/2000	1.235	979.69	1.21
S7T240	1800	9/13/2000	0.735	979.69	0.72
S7T270	1800	9/13/2000	0.456	979.69	0.45
Total	16200			8743.96	8.25
	Weeding activity in S1				
S1T0	0	9/14/2000	1.768	0.00	0.00
S1T10	600	9/14/2000	2.430	314.36	0.76
S1T20	600	9/14/2000	2.357	314.36	0.74
S1T30	600	9/14/2000	3.029	326.56	0.99
S1T50	1200	9/14/2000	3.030	653.13	1.98
S1T50	600	9/14/2000	1.799	326.56	0.59
S1T60	600	9/14/2000	2.429	326.56	0.79
S1T80	600	9/14/2000	0.573	326.56	0.19
S1T90	600	9/14/2000	1.800	339.25	0.61
S1T100	600	9/14/2000	2.648	339.25	0.90
S1T110	600	9/14/2000	1.571	339.25	0.53
S1T120	600	9/14/2000	2.477	339.25	0.84
S1T135	900	9/14/2000	1.410	508.87	0.72
S1T150	900	9/14/2000	0.556	508.87	0.28
Total	9000			4962.81	9.92

Appendix 17 : Weeding activity in S1, S11, S12, and S8

Sampling			Sediment	Runoff	Total
Code	Interval	Date	Concentr	Vol.	Sediment
	(Sec.)		(gr/l)	(lt)	(kg)
	Weeding activity in S1				
S7T0	0	9/14/2000	0.979	0.00	0.00
S7T30	1800	9/14/2000	1.093	979.69	1.07
S7T60	1800	9/14/2000	0.954	979.69	0.93
S7T90	1800	9/14/2000	1.132	1017.74	1.15
S7T120	1800	9/14/2000	0.070	1017.74	0.07
S7T150	1800	9/14/2000	1.146	1017.74	1.17
S7T180	1800	9/14/2000	0.693	1017.74	0.71
Total	10800			6030.32	5.10
	Weeding activity in S11				
S11T0	0	9/26/2000	0.530	0.00	0.00
S11T10	600	9/26/2000	4.056	326.56	1.32
S11T20	600	9/26/2000	2.260	410.44	0.93
S11T30	600	9/26/2000	2.032	478.01	0.97
S11T40	600	9/26/2000	2.115	578.32	1.22
S11T50	600	9/26/2000	1.500	624.11	0.94
S11T70	1200	9/26/2000	1.013	1399.36	1.42
S11T80	600	9/26/2000	0.916	478.01	0.44
Total	4800			4294.80	7.24
	Weeding activity in S12				
S12T0	0	9/26/2000	0.453	0.00	0.00
S12T5	300	9/26/2000	2.923	289.16	0.85
S12T20	900	9/26/2000	2.153	803.83	1.73
S12T40	1200	9/26/2000	1.541	852.75	1.31
S12T60	1200	9/26/2000	1.209	852.75	1.03
S12T80	1200	9/26/2000	1.335	993.14	1.33
Total	4800			3791.64	6.25
	Weeding activity in S12 through S8				
S13T5	300	9/26/2000	1.044	407.43	0.43
S13T20	900	9/26/2000	0.309	1319.08	0.41
S13T35	900	9/26/2000	3.645	1319.08	4.81
S13T50	900	9/26/2000	0.845	1269.77	1.07
S13T70	1200	9/26/2000	1.450	1693.02	2.45
S13T90	1200	9/26/2000	1.385	1629.73	2.26
S13T110	1200	9/26/2000	1.819	1568.81	2.85
S13T130	1200	9/26/2000	1.591	1510.16	2.40
S13T150	1200	9/26/2000	0.950	1568.81	1.49
S13T180	1800	9/26/2000	1.315	2353.21	3.09
S13T210	1800	9/26/2000	0.515	2539.53	1.31
S13T240	1800	9/26/2000	0.745	2740.61	2.04
S13T270	1800	9/26/2000	0.714	2740.61	1.96
Total	16200			22659.85	26.58

Appendix 18: Sediment Concentratrion in Sediment Collectors

Sampling Code	Date	Sediment Concentr (gr/l)	Runoff Vol. (lt)	Total Sediment (kg)
A1	9/8/2000	1.2	13.50	0.016
A2	9/8/2000	0.9	84.15	0.047
Sub-Total				**0.063**
B1	9/8/2000	1.2	13.50	0.016
B2	9/8/2000	0.8	17.55	0.014
Sub-Total				**0.030**
C1	9/8/2000	2.1	13.50	0.028
C2	9/8/2000	0.5	21.06	0.010
Sub-Total				**0.038**
D1	9/8/2000	7.9	31.40	0.248
D2	9/8/2000	1.1	282.60	0.304
D3	9/8/2000	1.7	13.50	0.023
Sub-Total				**0.575**
E1	9/8/2000	14.9	31.40	0.468
E2	9/8/2000	6.3	282.60	1.782
E3	9/8/2000	0.5	19.80	0.010
Sub-Total				**2.260**
A1	10/8/2000	1.4	2.00	0.003
B1	10/8/2000	1.1	2.10	0.002
C1	10/8/2000	1.2	3.00	0.004
D1	10/8/2000	0.7	31.40	0.022
D2	10/8/2000	0.9	13.15	0.012
Sub-Total				**0.043**
E1	10/8/2000	1.3	31.40	0.042
E2	10/8/2000	2.1	16.47	0.034
Sub-Total				**0.076**
A1	27/08/2000	0.7	8.00	0.005
B1	27/08/2000	0.9	5.50	0.005
E1	27/08/2000	0.6	15.34	0.010
Sub-Total				**0.020**
D1	3/9/2000	3.1	10.23	0.032
B1	3/9/2000	0.6	10.59	0.007
A1	8/9/2000	0.7	1.50	0.001
C1	8/9/2000	0.7	2.00	0.001
E1	8/9/2000	1.2	4.38	0.005
Sub-Total				**0.046**
A1	9/9/2000	0.8	2.00	0.002
B1	9/9/2000	2.9	1.00	0.003
D1	9/9/2000	8.5	4.38	0.037
Sub-Total				**0.042**
A1	23/09/2000	5.4	4.20	0.022
B1	23/09/2000	1.2	3.90	0.005
C1	23/09/2000	9.5	12.20	0.115
D1	23/09/2000	6.4	14.25	0.091
E1	23/09/2000	12.1	14.61	0.177
Sub-Total				**0.410**
Total				**3.603**

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