Photo I.5.3 Recently Constructed Dry Masonry Micro-SABO Dam (1993) at the Area of Concepción Dam.

Photo I.5.4 Dry Masonry Micro-SABO Dam Already Filled (H=2m, L=12m) Constructed by SANAA at Concepción Dam Area.

5.3.2 GABION

The gabion dams should be installed in wider riverbeds, where the retained sediment volume be optimum. Gabion structures have the shortcoming that need inspections and repairs from time to time, due to the possible oxidation of the wire netting in the external facing caused by the flow of sediments producing the wearing of galvanized wire. Such wearing can be avoided by using protective stone or wood beds which avoid the direct contact between wire and flow.

6. PLAN OF EROSION/SEDIMENT CONTROL

6.1 METHODOLOGY

The estimation of the number of micro SABO dams were made based on the gradient, length, and Horton`s order number of the streams selected for the pilot project. The drainage system is shown in *Figure I.6.1*. The typical sections of the proposed dams for sediment retention are shown in *Figure I.6.2*.

The lenght of filling by sediments is calculated according to Hattinger[11] as:

$L=H/(tg\alpha-tg\beta)$

where: L = lenght of filling by sediments

H = depth of land near the internal facing of dam

tg α= original gradient of the river bed (%)

tg β= compensation gradient proposed for the riverbed after the filling up.

Besides, the volumen of sediment can be estimated by the equation of a pyramid as:

$V=(1/3)AxL$

where: V = volume of filling

A= section at the rear of dam

L= lenght of filling

Or using an approximated way as follows:

$V=(1/2)bxHxL$

where: b = average breadth of filling

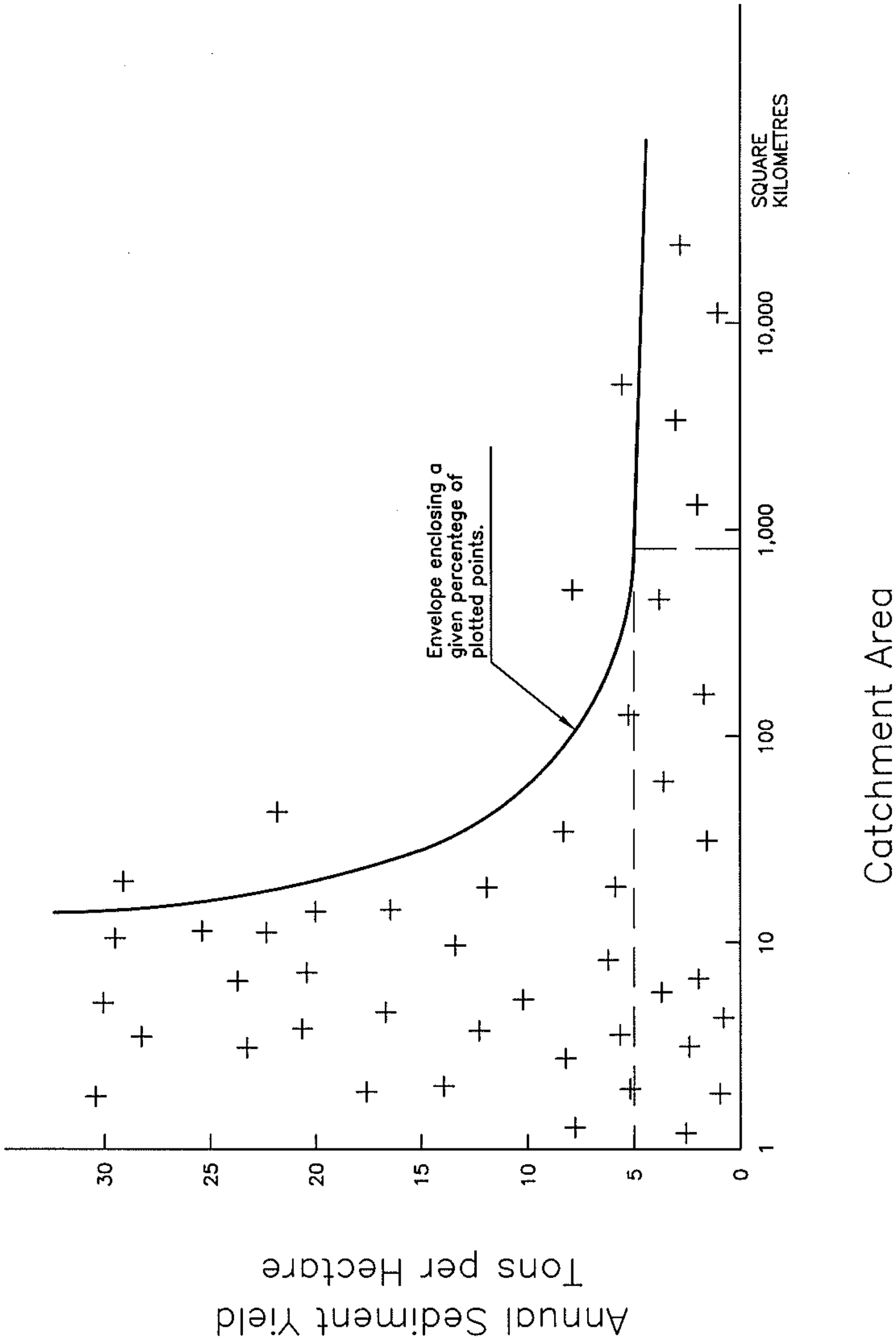
For the calculation it has been considered a continuous chain of dams of same height for the levelling of gradients. However, optionally higher dams (primary) construction may be constructed proper for the specific conditions of sediment discharge of the riverbeds, with larger compensation gradients. As the watershed management works continue, including afforestation, soil conservation and riverbed corrections, the grain size and volume of materials will be less, producing a decrease of the compensation gradient, and consequently requires smaller dams with gentler gradients (*Figure I.6.3*)[12].

[11] Hubert Hattinger, 1979. Page 29

[12] F.López Cadenas de Llano/FAO, 1988. Page 28

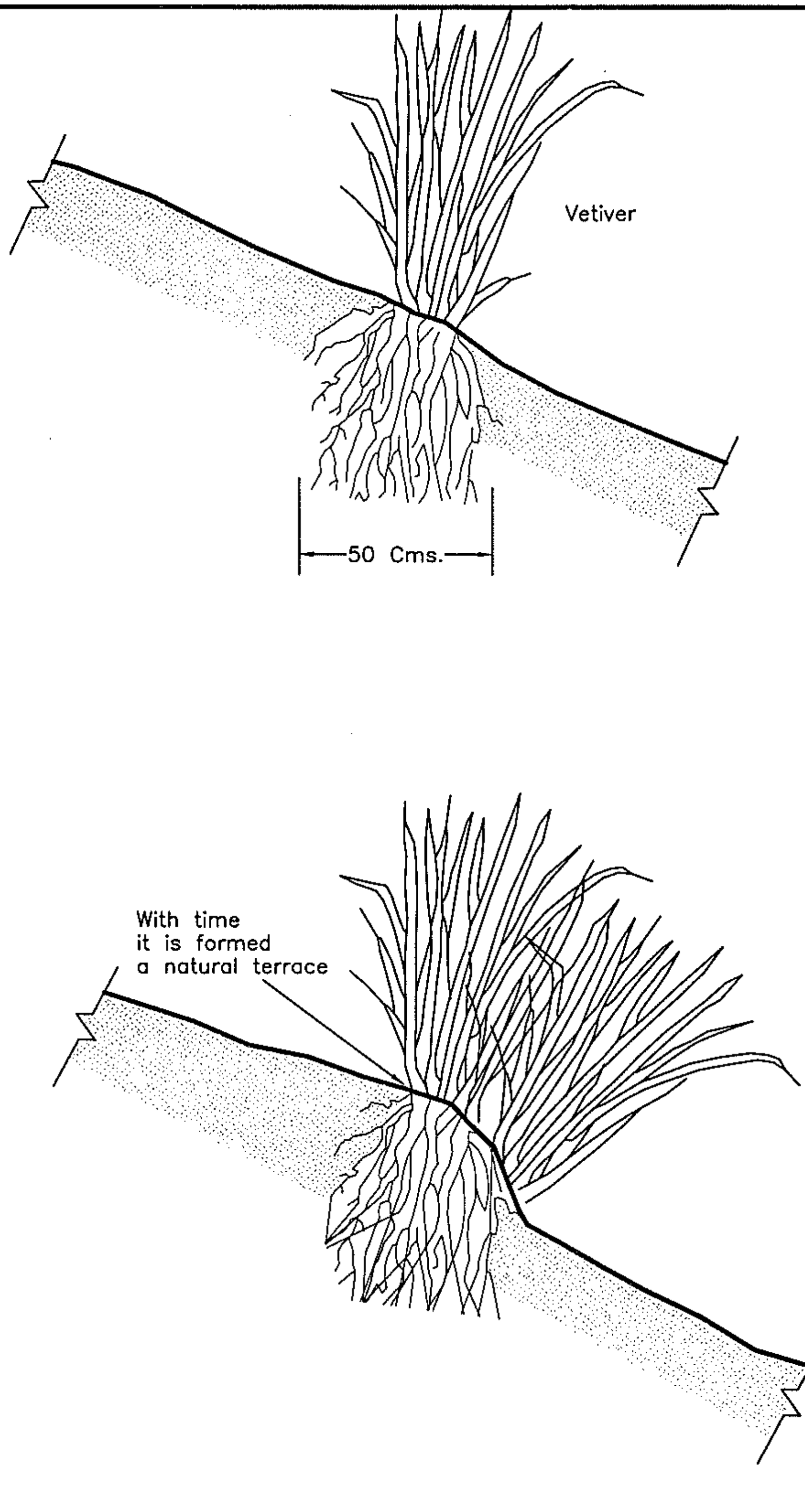
Table I.3.9 Classification of Land Use in the Study Area

#	Code	Sub-basin & Micro-basin	Total	Urban		Agriculture		Forest		Bush		Eroded Land		Others	
			Area (Ha)	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%
1	Acho	Choluteca	2,489	1,052	1.3	11	0.0	369	0.5	35	0.0	954	1.2	69	0.1
		Sub-total:	2,489	1,052	1.3	11	0.0	369	0.5	35	0.0	954	1.2	69	0.1
2	Asa	Sapo	294	262	0.3	-	-	-	-	-	-	27	0.0	5	0.0
		Sub-total:	294	262	0.3	-	-	-	-	-	-	27	0.0	5	0.0
		Guacerique													
3	Ag	Guacerique Abajo	729	564	0.7	-	-	7	0.0	-	-	123	0.1	36	0.0
4	Bg	Guacerique Arriba	4,904	36	0.0	1,235	1.5	1,156	1.4	2,351	2.9	69	0.1	57	0.1
5	Cg	Qda. Grande	2,514	813	1.0	693	0.8	35	0.0	648	0.8	301	0.4	23	0.0
6	Dg	Quiebramontes	1,896	-	-	514	0.6	433	0.5	949	1.2	-	-	-	-
7	Eg	Guaralalao	4,350	-	-	770	0.9	3,580	4.4	-	-	-	-	-	-
8	Fg	Quiscamote	3,041	-	-	769	0.9	2,269	2.8	3	0.0	-	-	-	-
9	Gg	Mateo	4,215	-	-	1,711	2.1	1,796	2.2	708	0.9	-	-	-	-
10	Hg	Horcones	1,097	-	-	225	0.3	656	0.8	217	0.3	-	-	-	-
11	Ig	Dulce	1,677	172	0.2	375	0.5	276	0.3	706	0.9	144	0.2	5	0.0
		Sub-total:	24,423	1,585	1.9	6,292	7.7	10,207	12.5	5,582	6.8	637	0.8	121	0.1
12	Aqg	Qda.Grande	1,042	215	0.3	74	0.1	239	0.3	389	0.5	20	0.0	106	0.1
		Sub-total:	1,042	215	0.3	74	0.1	239	0.3	389	0.5	20	0.0	106	0.1
		Grande													
13	Agr	Grande	5,287	448	0.5	1,190	1.5	1,376	1.7	1,909	2.3	220	0.3	145	0.2
14	Bgr	San Jose	13,944	-	-	3,471	4.2	9,465	11.5	804	1.0	-	-	204	0.2
15	Cgr	Ojojona	5,029	138	0.2	1,292	1.6	3,013	3.7	586	0.7	-	-	-	-
16	Dgr	Lag.El Pescado	1,551	94	0.1	665	0.8	425	0.5	349	0.4	-	-	18	0.0
		Sub-total:	25,811	680	0.8	6,618	8.1	14,278	17.4	3,648	4.5	220	0.3	367	0.4
		San José													
17	Asj	San Jose	2,260	412	0.5	577	0.7	511	0.6	649	0.8	94	0.1	16	0.0
18	Bsj	Aguila	1,066	6	0.0	414	0.5	245	0.3	401	0.5	-	-	-	-
19	Csj	Ingles	1,471	45	0.1	218	0.3	473	0.6	734	0.9	-	-	-	-
20	Dsj	Sabacuante	4,749	563	0.7	2,317	2.8	1,366	1.7	504	0.6	-	-	-	-
21	Esj	Tatumbla	7,303	491	0.6	1,523	1.9	5,018	6.1	271	0.3	-	-	-	-
		Sub-total:	16,850	1,517	1.9	5,049	6.2	7,613	9.3	2,560	3.1	94	0.1	16	0.0
22	Aqs	Qda.Salada	2,682	978	1.2	300	0.4	1,122	1.4	106	0.1	135	0.2	42	0.1
		Sub-total:	2,682	978	1.2	300	0.4	1,122	1.4	106	0.1	135	0.2	42	0.1
		Chiquito													
23	Achi	Chiquito	4,143	713	0.9	747	0.9	1,661	2.0	685	0.8	316	0.4	22	0.0
24	Bchi	Lomas/Orejona	1,128	709	0.9	243	0.3	103	0.1	-	-	57	0.1	15	0.0
25	Cchi	Burras	376	169	0.2	98	0.1	89	0.1	8	0.0	11	0.0	1	0.0
26	Dchi	Mololoa	730	22	0.0	226	0.3	323	0.4	159	0.2	-	-	-	-
27	Echi	Trojas	1,998	-	-	557	0.7	1,435	1.8	6	0.0	-	-	-	-
		Sub-total:	8,374	1,613	2.0	1,870	2.3	3,611	4.4	857	1.0	385	0.5	38	0.0
		TOTAL	81,965	7,901	10	20,214	24.7	37,438	45.7	13,177	16.1	2,471	3.0	764	0.9



(Source: Norman Hudson, 1973. Page 291)

Figure I.4.3	Relationship between Sediment Production and Catchment Area



Formacion de una Terraza Natural a Travez de la Acumulación de Sedimentos al Lado Superior de una Barrera Viva (Banco Mundial, 1990 El Zacate Vetiver, la Barrera Contra la Erosión, Washington, D.C.).

Figure I.5.2	**Formation of a Natural Terrace with a Living Barrier**

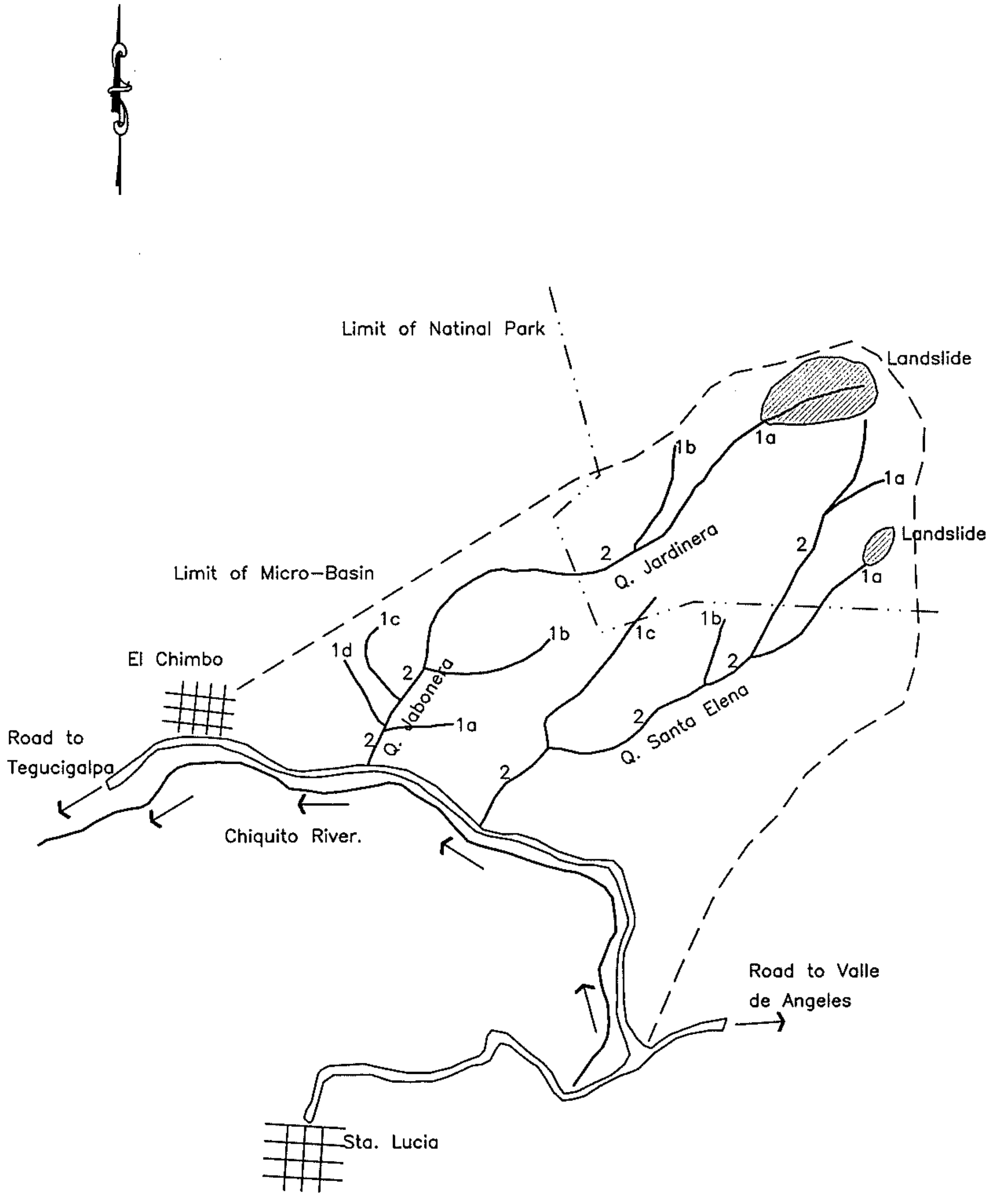
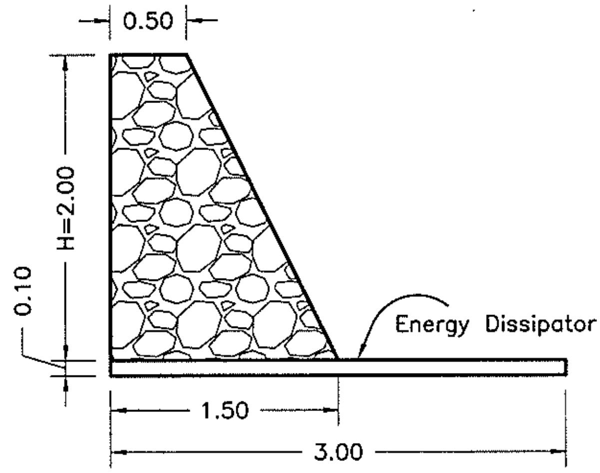
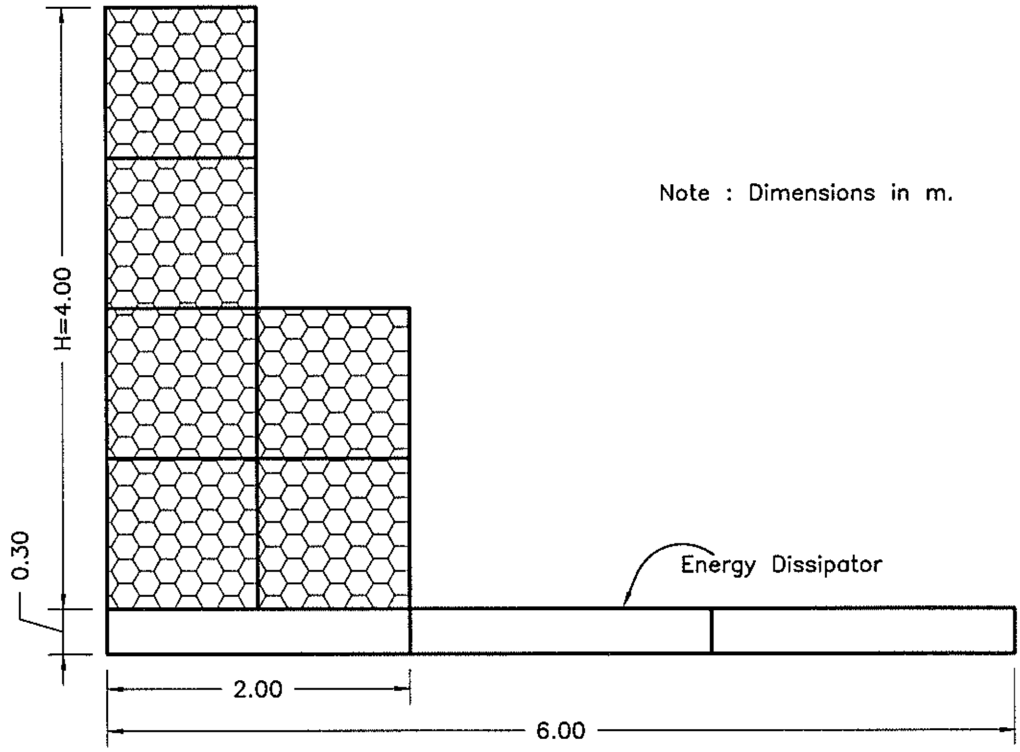


Figure I.6.1	Drainage System at the Pilot Project Area

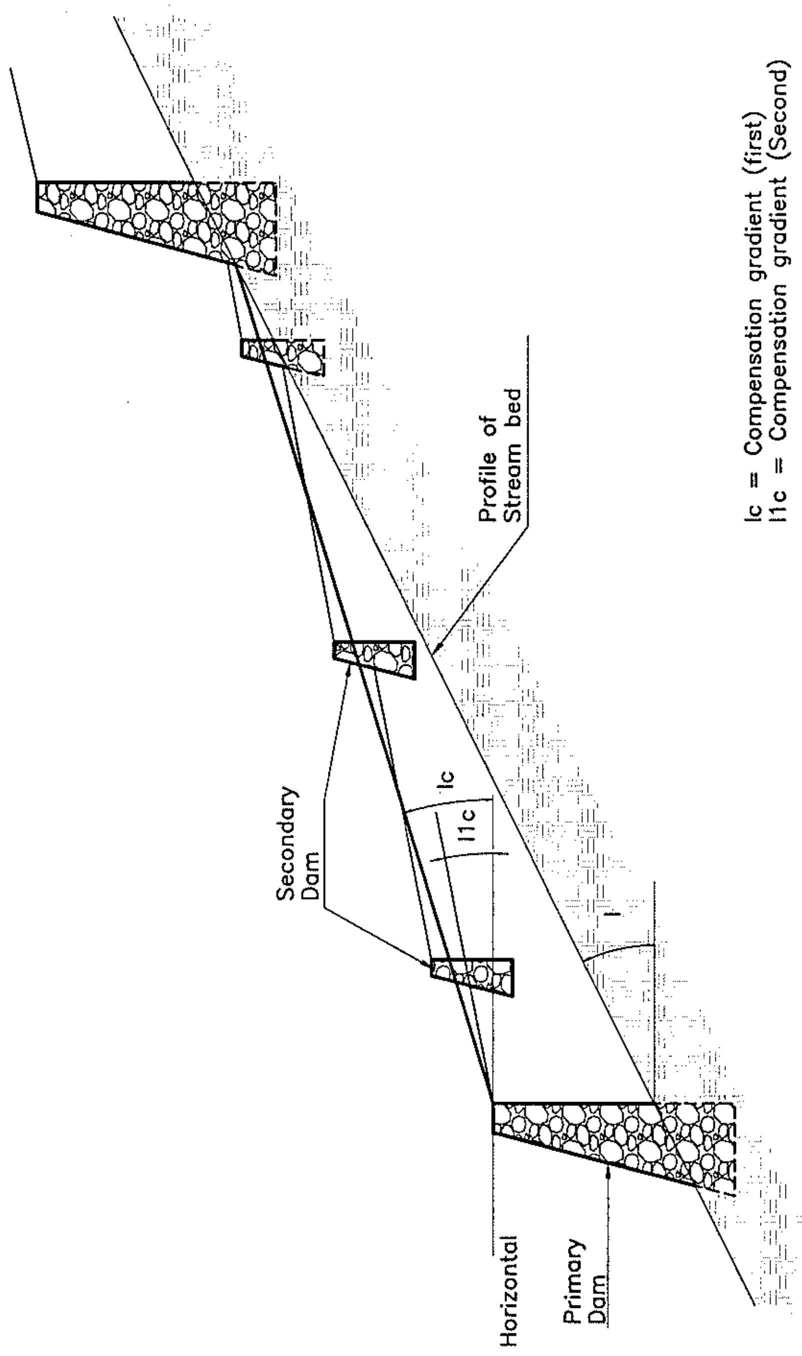


Dry Masonry Dams



Gabion Dam

Figure I.6.2	Typical Micro-Sabo Dams for Sediment Relation



(Source : F. Lopez Cadenas de Llano/FAO, 1988, Corrección de Torrentes y Estabilización de Cauces).

Figure I.6.3	**Ideal Representation of Sediment Accumulation in Chain of Dams**

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SUPPORTING REPORT I

APPENDIX I

APPENDIX I.1: SOIL TESTS RESULTS AND CALCULATION OF SOIL ERODIBILITY, FACTOR K

Sampling Date	09/05/2001	09/05/2001	09/05/2001	09/05/2001	09/05/2001	10/05/2001	10/05/2001	10/05/2001	10/05/2001	10/05/2001	10/05/2001	11/05/2001	11/05/2001	11/05/2001	11/05/2001	11/05/2001
Sample No.	1-A	1-B	2-A	2-B	4	6	7	9	10	11	12	13	15	16	19	20
Prof (m)	0.0--0.40	0.0--0.40	0.0--0.40	0.0--0.40	0.0--0.30	0.0--0.20	0.0--0.20	0.0--0.20	0.0--0.20	0.0--0.20	0.0--0.20	0.0--0.20	0.0--0.20	0.0--0.20	0.0--0.20	0.0--0.40
Lab. No.	171	208	161	209	162	169	167	172	165	168	163	176	177	182	175	187
Unified Classif.	ML	ML	SC	CL	SM	SM	GP-GC	MH	MH	MH	SM	SP-SC	MH	GM	SM	SC
AASHTO Classif.	A-7-6(8)	A-4(5)	A-6(2)	A-7-6(10)	A-2-6(1)	A-2-(0)	A-2-7(0)	A-7-5(20)	A-7-5(15)	A-7-5(12)	A-7-5(4)	A-2-6(0)	A-7-5(17)	A-2-7(0)	A-7-5(5)	A-2-6(0)
Place	Col. Ruben Antunez	Col. Ruben Antunez	Res.Siconey ChimboKm6	Res.Siboney ChimboKm6	El Tablón	La Brea	El Empedrado	Ojojona Este	Cruce Ojojona	Altos Santa Rosa	Presa Conc Abajo	Balneario Sn Matias	Falla Carr Norte	Cerro Grande	Tatumbla 2 Kms Sur	Villanueva
Sieve (Inch/No.)	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing
3"																
2"3/8																
2"							100							100		
1"1/2							93							92	100	
1"							86							88	94	
3/4"							81					100	100	80	92	
3/8"					100	100	66			100	100	99	98	58	86	
No.4			100		96	89	32			91	97	86	96	41	68	100
No.10	100	100	97	100	85	50	20	100	100	85	91	48	91	37	63	52
No.40	99	96	63	82	65	25	11	95	97	73	64	21	80	27	56	26
No.200	69	59	42	74	34	13	8	87	57	57	38	12	68	15	42	13
Liquid Limit (LL) (%)	41	36	36	41	38	50	46	70	63	54	52	34	63	44	56	23
Plasticity Index (IP) (%)	14	10	12	16	12	15	20	34	28	23	20	11	29	15	20	11
% Natural Moisture	9.30	4.6	3.50	15.8	9.40	12.9	6.3	6.9	10.60	4	14.80	7.2	8.9	2	6.1	10.2
Specific Gravity (Gs)	2.15	2.57	2.60	2.66	2.28	2.07	2.19	2.26	2.40	2.29	2.27	2.3	2.18	2.27	2.29	2.13
%Gravel	0.00	0.00	3.00	0.00	15.00	59.00	78.00	0.00	0.00	15.00	9.00	38.00	11.00	63.00	37.00	48.00
%Sand	11	15	44	22	32	30	11	8	15	20	35	31	14	14	13	32
%Fine sand+silt	84	80	51	58	53	10	10	46	81	45	56	29	50	23	44	19
%Clay	5	5	2	20	0	1	1	46	4	20	0	2	25	0	6	1
k(cm/sec) (estimated)	5.90E-07	5.30E-07	3.00E-07	5.60E-05	7.50E-06	7.50E-06	3.20E-02	1.60E-07	1.60E-07	1.60E-07	7.50E-06	3.60E-04	1.60E-07	3.00E-07	7.50E-06	3.00E-07
SOIL ERODIBILITY FACTOR K																
1.-Particle Size Parameter (M)																
M = (100-%clay) (%silt + fine sand)	7,980	7,600	4,998	4,640	5,300	990	990	2,484	7,776	3,600	5,600	2,842	3,750	2,300	4,136	1,881
2.-Organic matter, a (assumed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.-Soil structure code, b	1	1	2	1	2	2	3	2	1	1	2	3	2	3	3	3
4.-Profile Permeability Class, c	6	6	6	5	5	5	2	6	6	6	5	3	6	6	5	6
5.- Soil Erodibility Factor K	0.75	0.71	0.49	0.40	0.49	0.12	0.07	0.26	0.73	0.33	0.52	0.25	0.37	0.28	0.42	0.24
Factor K in metric unitsX1.292	0.97	0.92	0.63	0.52	0.64	0.15	0.09	0.34	0.94	0.42	0.67	0.32	0.48	0.36	0.54	0.31