Figure B.24 - Example of banjir bandang hazard map on kali Jompo catchment area after updated by using field survey data

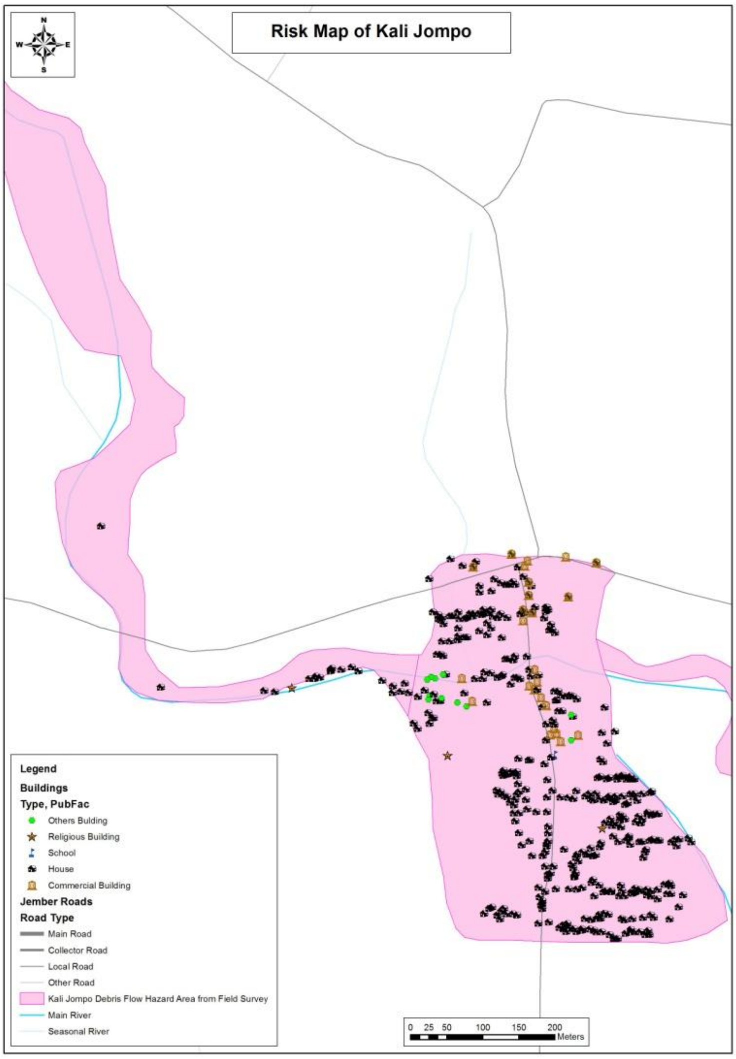

Figure B.25 - Example of risk map of banjir bandang

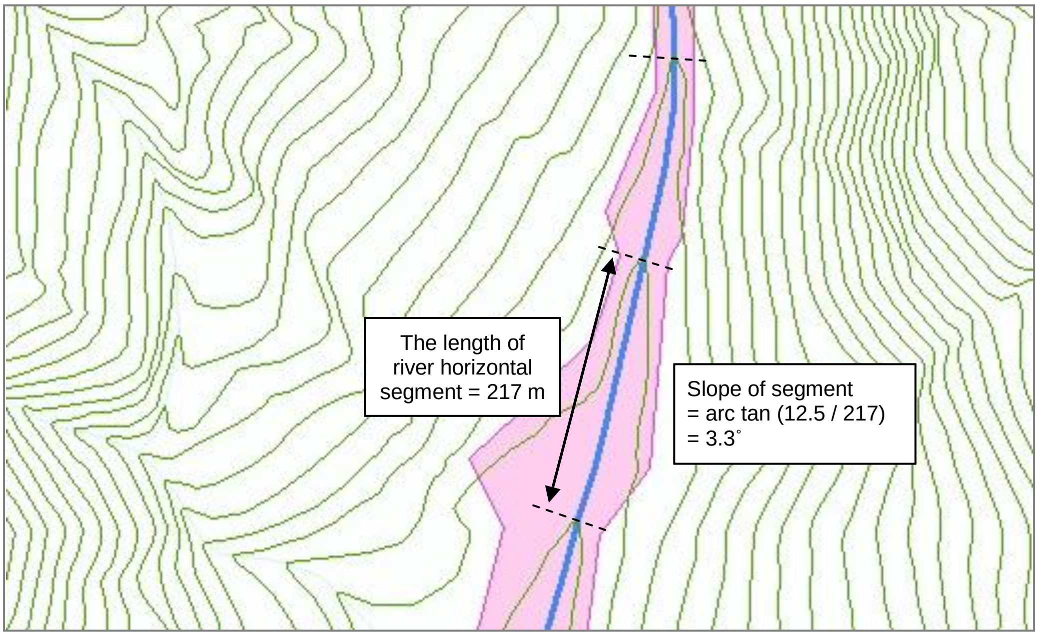

Figure B.26 – Method of defining topographic slope of river segment

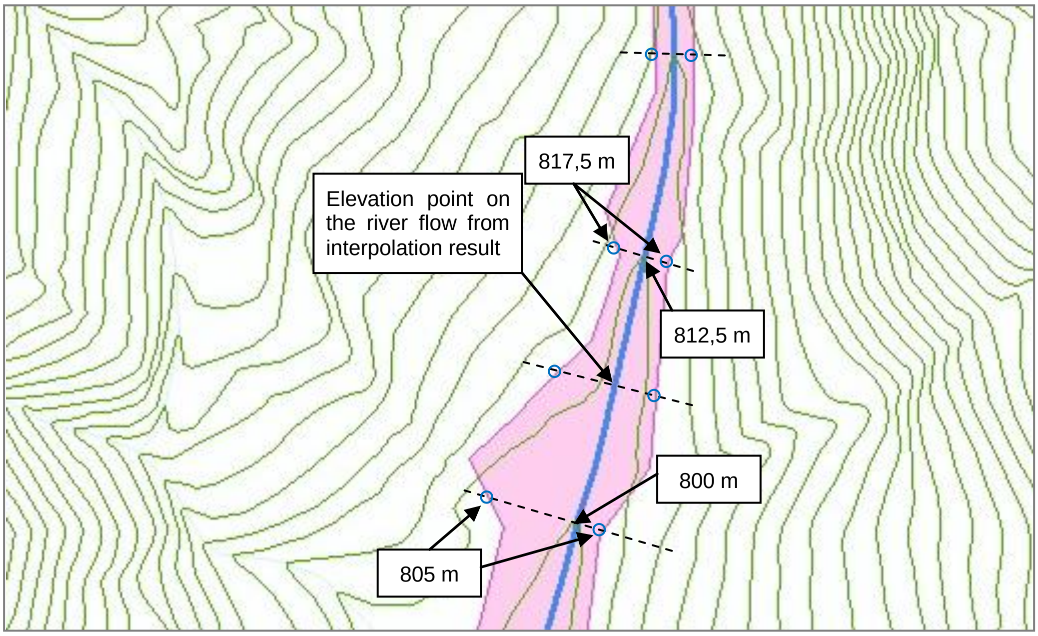

Figure B.27 – Method to making banjir bandang prone areas manually

Figure B.28 – Handheld GPS

Figure B.29 – Clinometer

Figure B.30 – Compasses

Figure B.31 – Disto/ digital measurement tool

Appendix C
(informative)
Table

Table C.1 – The types of imagery data and its feature

Imagery	Feature	Price estimation
ALOS (Advanced Land Observation Satellite)	• ALOS PRISM - Black n White - Spatial resolution = 2,5 m - Coverage area 70 km x 35 km (1 scene) • ALOS AVNIR-2 - Color - Spatial resolution = 10 m - Coverage area 70 km x 60 km (1 scene)	For archive data: • Full scene (70 km x 35 km), resolution 2.5m B/W = Rp 4.500.000 • Full scene (70 km x 60 km), resolution 10m color = Rp 5.000.000 • Full scene (70 km x 60 km), resolution 2.5m color = Rp 12.500.000
SPOT	• SPOT 5 - Color and Black n White - Spatial resolution = 2,5 m, 5 m, 10 m - Coverage area 60 km x 60 km (1 scene) • SPOT 4 - Color and Black n White - Spatial resolution = 10 m, 20 m - Coverage area 60 km x 60 km (1 scene) • SPOT 1, 2, 3 - Color and Black n White - Spatial resolution = 10 m, 20 m - Coverage area 60 km x 60 km (1 scene)	For SPOT 5. • 1/8 scene (441 km^2), resolution 2.5m color = Rp 33.300.000 • 1/8 scene (441 km^2), resolution 5m color = Rp 23.670.000 • 1/8 scene (441 km^2), resolution 10m color = Rp 13.050.000
IKONOS	- Color - Spatial resolution = 1 m. - The area of minimum purchase = 100 km^2	Minimum purchase 100km^2. • Archive data, 12 – 30 USD / km^2. • New acquisition, 20 – 35 USD / km^2.
Quickbird	- Color - Spatial resolution = 0,65 m	Minimum purchase of archive = 25km^2, Minimum purchase of new acquisition = 90km^2. • Archive data, 14 USD / km^2. • New acquisition, 17 USD / km^2.
World View	• WorldView-2 & WorldView-1 - Color - Spatial resolution = 0,5 m - The area of minimum purchase = 25 km^2	Minimum purchase of archive = 25km^2, Minimum purchase of new acquisition = 90km^2. • Archive data, 14 USD / km^2. • New acquisition, 17 USD / km^2.
Aerial Photographs	- Color - Cloud-free - Spatial resolution ≈ 0,3 m	

Table C.2 - Information table about the intersection between sub-area and landslide area

Sub-area ID	Landslide occurrence per sub-area	Landslide potential based on past landslide events
…	…	…
95	0	0
96	0	0
97	0	0
98	2	1
99	1	1
100	0	0
101	3	1
102	0	0
103	0	0
104	0	0
105	0	0

106	0	0
107	0	0
108	0	0
…	…	…

Table C.3 - Information table about the intersection between sub-areas and geological or micro-topographic elements

Past landslide per sub-area		Geological and micro-topographic elements					
Sub-area ID	Landslide occurrence	Sub-area ID	Landslide occurrence	Sub-area ID	Landslide occurrence	Sub-area ID	Landslide occurrence
…	…	…	…	…	…	…	…
400	1	0	0	0	0	0	0
401	0	0	0	0	0	0	0
402	0	0	0	0	0	0	0
403	0	0	0	0	1	1	0
404	0	0	0	0	0	0	0
405	0	0	0	0	0	0	0
406	1	0	0	0	0	0	0
407	1	0	0	0	0	0	0
408	0	0	0	0	0	0	0
409	0	0	0	0	0	0	0
410	1	0	0	0	0	0	0
411	0	0	0	0	0	0	0
412	0	0	0	0	0	0	0
413	0	0	0	0	0	0	0
414	0	0	0	0	0	0	0
415	0	0	0	0	0	0	0
416	0	0	0	0	0	0	0
417	0	0	0	0	0	0	0
418	0	0	0	0	1	1	0
…	…	…	…	…	…	…	…

Table C.4 – Information table of finding the best combination of geological/micro-topographic elements

Sub-area ID	Landslide events	Circular arc crack (A)		Ancient deep-seated landslide (B)		A and B		A or B	
		S3	S2	S3	S2	S3	S2	S3	S2
…	…	…	…	…	…	…	…	…	…
400	1	0	0	0	0	0	0	0	0
401	0	0	0	0	0	0	0	0	0
402	0	0	0	0	0	0	0	0	0
403	0	0	0	0	0	0	0	0	0
404	0	0	0	1	0	0	0	1	0
405	0	0	0	1	0	0	0	1	0
406	1	0	0	0	0	0	0	0	0
407	1	0	0	1	1	0	0	1	1
408	0	1	0	1	0	1	0	1	0
409	0	0	0	0	0	0	0	0	0
410	1	0	0	0	0	0	0	0	0
411	0	0	0	1	0	0	0	1	0
412	0	0	0	1	0	0	0	1	0
413	0	0	0	0	0	0	0	0	0
414	0	0	0	0	0	0	0	0	0
415	0	0	0	0	0	0	0	0	0
416	0	0	0	0	0	0	0	0	0
417	0	0	0	0	0	0	0	0	0
418	0	0	0	0	0	0	0	0	0
…	…	…	…	…	…	…	…	…	…

Table C.5 - Example of extraction results data table of point attribute data to calculate the value log(pixel wide x accumulation flow value)

Points ID	Pixel wide	Slope	Accumulation value	Pixel wide x accumulation flow value	log(pixel wide x accumulation flow value)
52070	2500	14.13	0	0	0.00
52071	2500	12.31	0	0	0.00
52072	2500	13.50	13	32500	4.51
52073	2500	14.62	20	50000	4.70
52074	2500	13.84	0	0	0.00
52075	2500	15.25	2	5000	3.70
52076	2500	18.02	0	0	0.00
52077	2500	19.01	0	0	0.00
52078	2500	37.12	0	0	0.00
...	...	...	...	...	...

Table C.6 - Example of data table to calculate amount of points that match the range criteria of slope value and the value of log(pixel wide x accumulation flow value) which from all of study area

slope	3.4 - 3.7	3.7 - 3.88	3.88 - 4.1	4.1 - 4.44	4.44 - 4.72	4.72 - 5.11	5.11 - 5.4	5.4 - 5.7	5.7 <
0 - 10	6281	3516	3768	4510	2896	3297	2202	2166	7169
10 - 15	6623	3472	3459	3497	1906	1890	1191	1116	1940
15 - 20	7214	3482	3069	2956	1399	1249	712	563	948
20 - 25	6380	3117	2509	2258	1028	885	410	309	446
25 - 30	5287	2643	2211	1926	747	540	246	132	226
30 - 35	4568	2347	1858	1396	536	363	133	83	114
35 - 40	3332	1709	1366	1026	299	208	84	38	52
40 <	4096	2397	2100	1609	511	310	97	28	63
								Total points number	**144514**

Table C.7 - Example of data table to calculate amount of points that match the range criteria of slope value and the value of log(pixel wide x accumulation flow value) which intersect to landslide area

slope	3.4 - 3.7	3.7 - 3.88	3.88 - 4.1	4.1 - 4.44	4.44 - 4.72	4.72 - 5.11	5.11 - 5.4	5.4 - 5.7	5.7 <
0 - 10	2	1	0	0	0	3	1	0	9
10 - 15	1	3	2	3	6	4	3	1	4
15 - 20	9	4	11	11	10	6	3	0	5
20 - 25	10	12	11	19	5	3	0	1	3
25 - 30	12	18	14	19	5	3	0	0	3
30 - 35	31	13	10	13	3	3	2	0	0
35 - 40	19	16	9	6	3	2	0	0	0
40 <	77	51	38	43	25	4	1	0	1
								Total points number	**610**

Table C.8 - Example of landslide ratio table

slope	3.4 - 3.7	3.7 - 3.88	3.88 - 4.1	4.1 - 4.44	4.44 - 4.72	4.72 - 5.11	5.11 - 5.4	5.4 - 5.7	5.7 <
0 - 10	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.001
10 - 15	0.000	0.001	0.001	0.001	0.003	0.002	0.003	0.001	0.002
15 - 20	0.001	0.001	0.004	0.004	0.007	0.005	0.004	0.000	0.005
20 - 25	0.002	0.004	0.004	0.008	0.005	0.003	0.000	0.003	0.007
25 - 30	0.002	0.007	0.006	0.010	0.007	0.006	0.000	0.000	0.013
30 - 35	0.007	0.006	0.005	0.009	0.006	0.008	0.015	0.000	0.000
35 - 40	0.006	0.009	0.007	0.006	0.010	0.010	0.000	0.000	0.000
40 <	0.019	0.021	0.018	0.027	0.049	0.013	0.010	0.000	0.016
								Average ratio	**0.004**

Table C.9 - Selecting cell that has the same or more than twice value than the average ratio value

slope	3.4 - 3.7	3.7 - 3.88	3.88 - 4.1	4.1 - 4.44	4.44 - 4.72	4.72 - 5.11	5.11 - 5.4	5.4 - 5.7	5.7 <
0 - 10	0.075	0.067	0.000	0.000	0.000	0.216	0.108	0.000	0.297
10 - 15	0.036	0.205	0.137	0.203	0.746	0.501	0.597	0.212	0.488
15 - 20	0.296	0.272	0.849	0.882	1.693	1.138	0.998	0.000	1.250
20 - 25	0.371	0.912	1.039	1.993	1.152	0.803	0.000	0.767	1.594
25 - 30	0.538	1.613	1.500	2.337	1.586	1.316	0.000	0.000	3.145
30 - 35	1.608	1.312	1.275	2.206	1.326	1.958	3.563	0.000	0.000
35 - 40	1.351	2.218	1.561	1.385	2.377	2.278	0.000	0.000	0.000
40 <	4.454	5.041	4.287	6.331	11.590	3.057	2.442	0.000	3.760

Table C.10 - Example of determining the range of slope value and the value of log(pixel wide x accumulation flow value)

slope	3.4 - 3.7	3.7 - 3.88	3.88 - 4.1	4.1 - 4.44	4.44 - 4.72	4.72 - 5.11	5.11 - 5.4	5.4 - 5.7	5.7 <
0 - 10	0.075	0.067	0.000	0.000	0.000	0.216	0.108	0.000	0.297
10 - 15	0.036	0.205	0.137	0.203	0.746	0.501	0.597	0.212	0.488
15 - 20	0.296	0.272	0.849	0.882	1.693	1.138	0.998	0.000	1.250
20 - 25	0.371	0.912	1.039	1.993	1.152	0.803	0.000	0.767	1.594
25 - 30	0.538	1.613	1.500	2.337	1.586	1.316	0.000	0.000	3.145
30 - 35	1.608	1.312	1.275	2.206	1.326	1.958	3.563	0.000	0.000
35 - 40	1.351	2.218	1.561	1.385	2.377	2.278	0.000	0.000	0.000
40 <	4.454	5.041	4.287	6.331	11.590	3.057	2.442	0.000	3.760

Table C.11 - Example of calculation to find minimum amount of points per sub-area that most correlated with landslide occurrence

Sub-area ID	Landslide occurrence	Amount of landslide potential points	Range amount of landslide potential points				
			0 ≤	50 ≤	100 ≤	150 ≤	200 ≤
1	0	0	1	0	0	0	0
2	0	0	1	0	0	0	0
3	0	0	1	0	0	0	0
4	0	0	1	0	0	0	0
5	0	0	1	0	0	0	0
6	0	0	1	0	0	0	0
7	0	0	1	0	0	0	0
8	0	0	1	0	0	0	0
9	0	0	1	0	0	0	0
10	0	0	1	0	0	0	0
…	…	…	…	…	…	…	…
595	0	0	1	0	0	0	0
596	0	0	1	0	0	0	0
597	0	0	1	0	0	0	0
598	0	50	1	1	0	0	0
599	0	2	1	0	0	0	0
600	0	28	1	0	0	0	0
S1	**109**	**22435**					

	0	*50*	*100*	*150*	*200*
S2	109	69	39	18	5
S3	600	164	89	39	10
Cover ratio (S2/S1)	100.00%	63.30%	35.78%	16.51%	4.59%
Hitting ratio (S2/S3)	18.17%	42.07%	43.82%	46.15%	50.00%

Appendix D
(informative)
Description and interpretation technique of deep-seated landslide

For ease in interpreting the deep-seated landslide area by using imagery data, first we must know the type, shape, and character of deep-seated landslide.

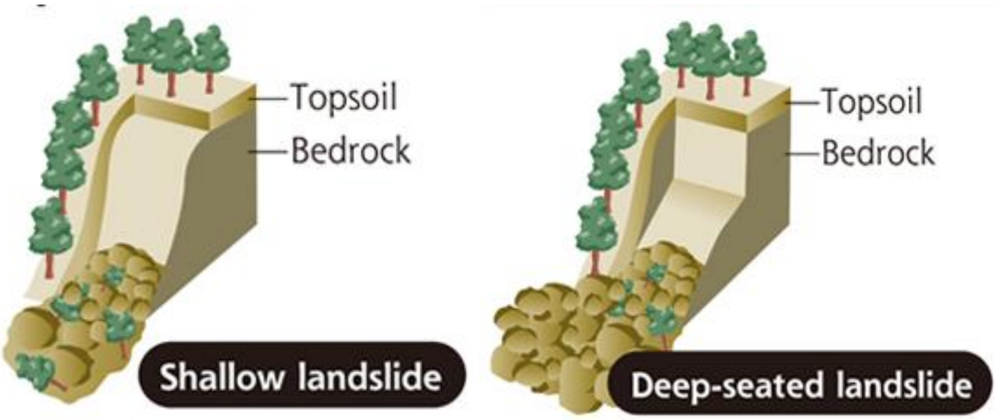

Figure D.1 – The difference between shallow landslide and deep-seated landslide

As shown on Figure D.1, deep-seated landslide occurred at a depth greater than the surface landslide, so the material that is moving on deep-seated landslide is much larger than a normal surface landslide.

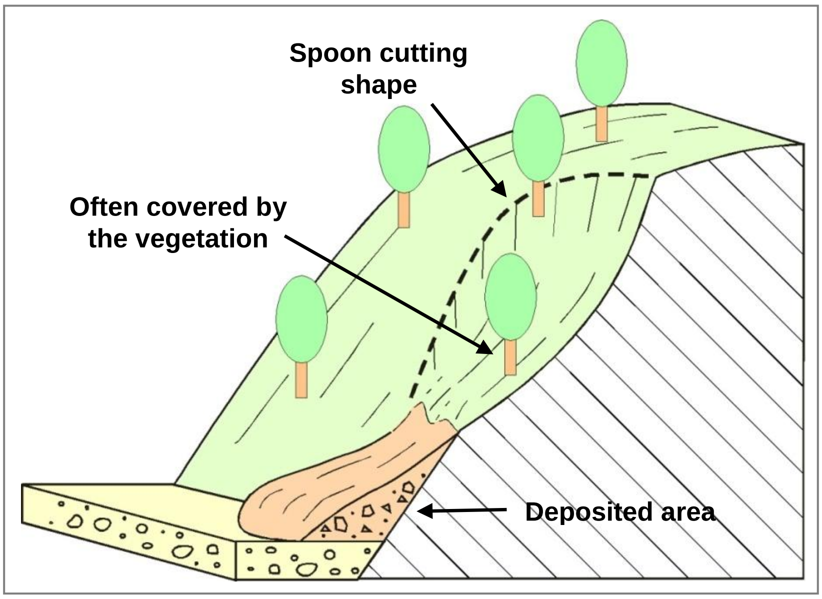

Figure D.2 – The shape of deep-seated landslide

The sliding surface on slip deep-seated landslide shaped like a spoon, so that when seen from above at the interpretation of image data, it looks like a curve or arc.

Here is an explanation of the interpretation and digitization techniques of deep-seated landslide area. Figure D.3 illustrates the deep-seated landslide in transverse view as well as topographic projection on a plane, or in other words that if seen from above using imagery data.

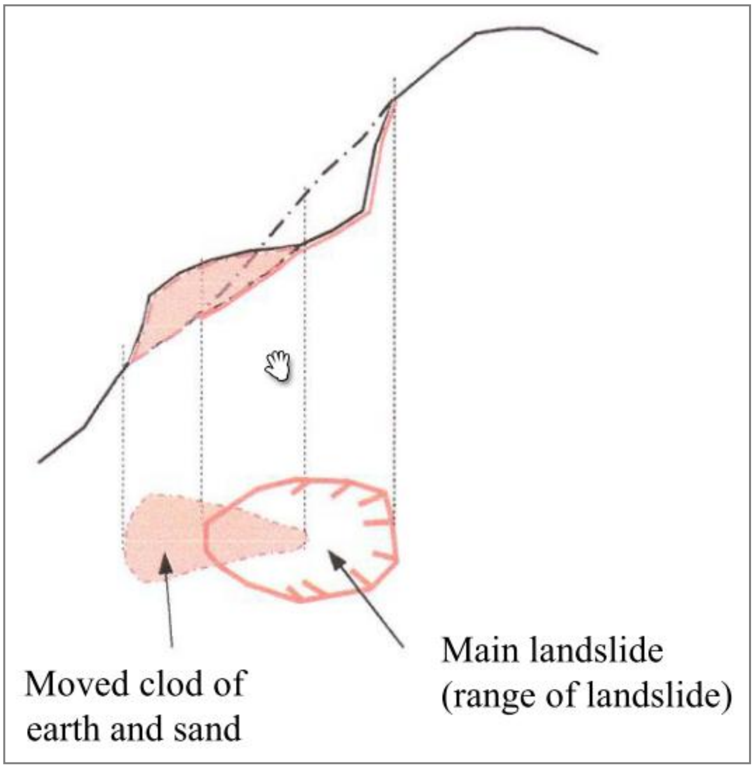

Figure D.3 – Interpretation technique of deep-seated landslide

Figure D.3 shows that there will be two types of area interpretation which are main landslide and landslide material. The area that we should to interpret is the main landslide because this part is the actual landslide location on the topography.

Appendix E
(informative)
Description of micro-topographic elements

For ease in interpreting the micro-topographic elements using imagery data, first we must know the type, shape, and character of each micro-topographic elements.

There are five micro-topographic elements. As illustrated on Figure E.1, the elements are:
1) Ancient deep-seated landslide
2) Circular arc crack
3) Gentle ridge top
4) Linear depression
5) Mass rock creep slope

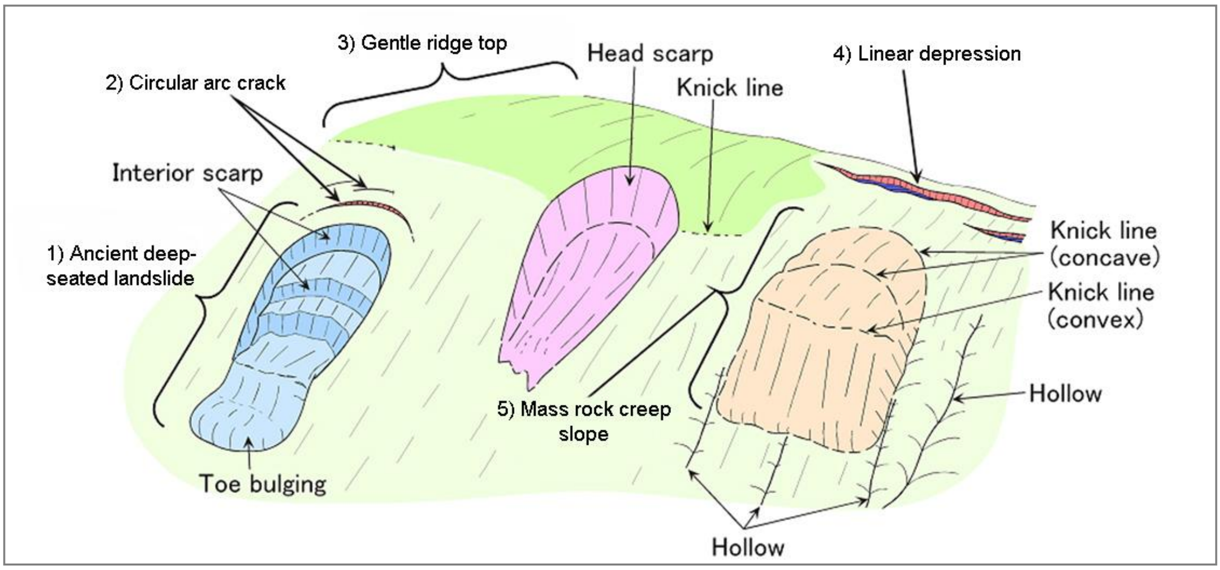

Figure E.1 – The types of micro-topographic elements

A term "scarp" as written on Figure E.1 is a line of cliffs produced by faulting or erosion; a relatively straight, clifflike face or slope of considerable linear extent, breaking the general continuity of the land by separating surfaces lying at different levels.

Figure E.2 shows the types of micro-topographic elements that are interpreted using imagery data.

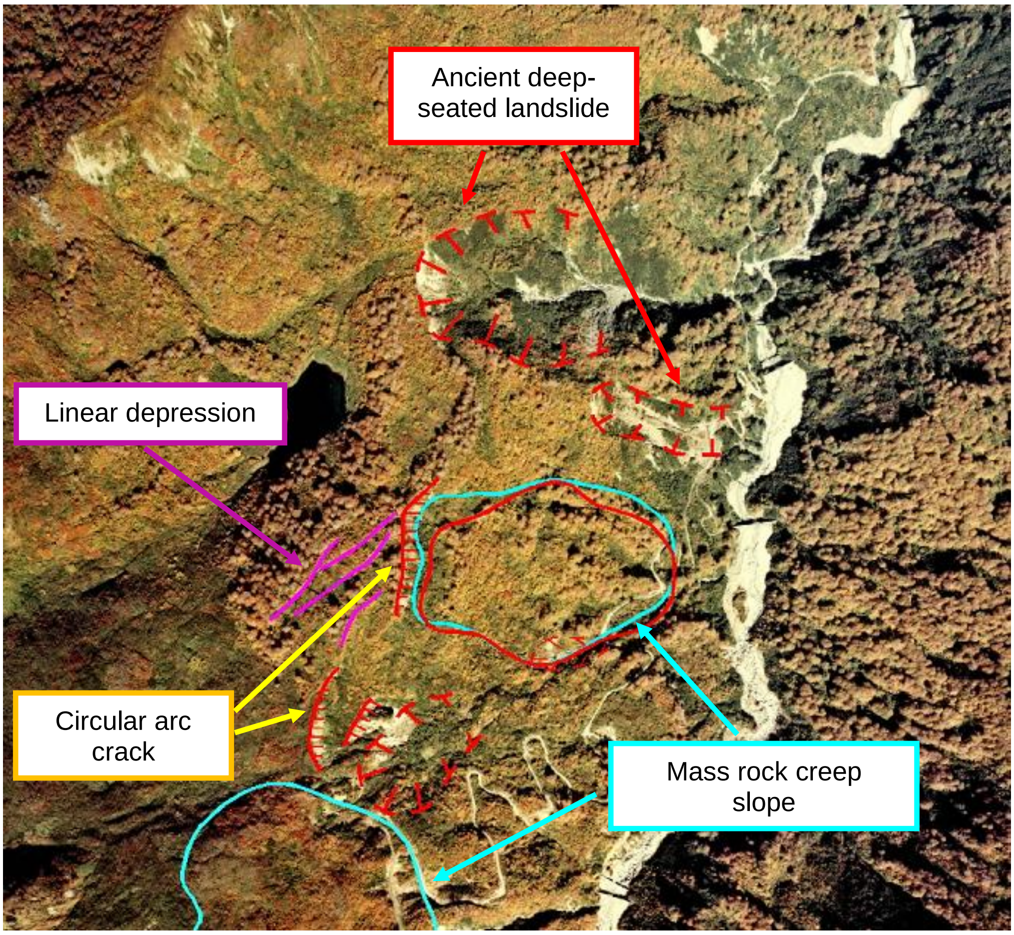

Figure E.2 – The types of micro-topographic elements that interpreted on imagery data

Appendix F
(informative)
Theory of Hitting Ratio and Cover Ratio

Hitting ratio and cover ratio is a statistical method to see the level of accuracy of the analysis results.

1) Hitting ratio

Hitting ratio can be defined as the ratio of precision, which is a way to measure the accuracy of predictive value of the presence of landslide events based on the presence of other factors in a sub-area. Hitting ratio has formula = S2/S3, where S2 is the number of sub-area that contains the element factor and has a landslide data, and S3 is the number of all sub-area that contains the element factor.

2) Cover ratio

Cover ratio is a way to measure the value of the coverage prediction of landslide occurrence based on the presence of other factors. Coverage ratio has formula = S2/S1, where S2 is the number of sub-area that contains the element factor and has a landslide data, and S1 is the number of sub-area that has landslide data.

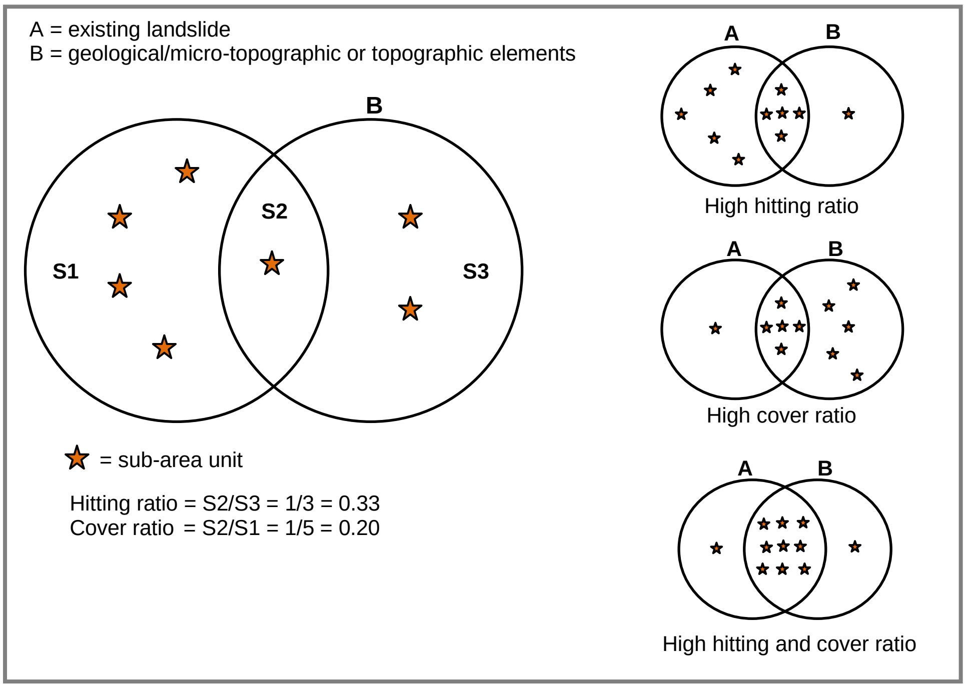

Figure F.1 - The concept of hitting ratio and cover ratio theory

Appendix G
(informative)
The work steps

How to find the number of landslides potential points per sub-area that are most correlated with the landslide events are as follows:

The contents of Table D.1 below comes from the example case in Sinjai region. The first column contains sub-area ID, the second column indicates whether a sub-area has landslide events, while the third column contains the number of landslide potential points per sub-area. The value of the third column is obtained through literal data of spatial data were extracted using GIS software and made into a table using spreadsheet tool software. Sub-areas with landslide events are marked in orange.

The next column is the range of landslides potential point, that is made next in the spreadsheet software tool. The columns are intended to mark the sub-areas with number of landslide potential points according to a certain amount by multiples of fifty.

Table G.1 – The calculation table of the number of landslide potential point that correlates with landslide events per sub-area

Sub-area ID	Landslide events	Number of landslide potential points	The range of number of landslide potential points				
			0 ≤	50 ≤	100 ≤	150 ≤	200 ≤
1	0	156	1	1	1	1	0
2	0	112	1	1	1	0	0
3	0	62	1	1	0	0	0
4	0	135	1	1	1	0	0
5	0	78	1	1	0	0	0
6	0	107	1	1	1	0	0
7	1	53	1	1	0	0	0
8	0	115	1	1	1	0	0
9	0	49	1	0	0	0	0
10	0	12	1	0	0	0	0
11	1	128	1	1	1	0	0
12	0	64	1	1	0	0	0
13	0	92	1	1	0	0	0
14	1	149	1	1	1	0	0
15	0	4	1	0	0	0	0
16	0	109	1	1	1	0	0
17	0	100	1	1	1	0	0
18	0	48	1	0	0	0	0
19	0	74	1	1	0	0	0
20	0	151	1	1	1	1	0
21	0	70	1	1	0	0	0
22	0	65	1	1	0	0	0
23	0	82	1	1	0	0	0
24	0	15	1	0	0	0	0
25	0	95	1	1	0	0	0
26	0	44	1	0	0	0	0
27	0	77	1	1	0	0	0
28	0	108	1	1	1	0	0
29	1	211	1	1	1	1	1
30	0	62	1	1	0	0	0
31	0	126	1	1	1	0	0
32	0	3	1	0	0	0	0
33	0	38	1	0	0	0	0
34	0	115	1	1	1	0	0
35	0	217	1	1	1	1	1
36	0	52	1	1	0	0	0
37	0	94	1	1	0	0	0
38	0	20	1	0	0	0	0

39	0	70	1	1	0	0	0
40	1	195	1	1	1	1	0
41	0	94	1	1	0	0	0
42	0	158	1	1	1	1	0
43	0	122	1	1	1	0	0
44	0	95	1	1	0	0	0
45	1	91	1	1	0	0	0
46	0	37	1	0	0	0	0
47	0	13	1	0	0	0	0
48	1	144	1	1	1	0	0
49	0	124	1	1	1	0	0
50	0	110	1	1	1	0	0
51	1	73	1	1	0	0	0
52	0	53	1	1	0	0	0
53	0	85	1	1	0	0	0
54	1	129	1	1	1	0	0
55	1	136	1	1	1	0	0
56	1	87	1	1	0	0	0
57	1	105	1	1	1	0	0
58	1	113	1	1	1	0	0
59	1	174	1	1	1	1	0
60	0	80	1	1	0	0	0
61	0	116	1	1	1	0	0
62	1	88	1	1	0	0	0
63	0	38	1	0	0	0	0
64	0	53	1	1	0	0	0
65	1	134	1	1	1	0	0
66	0	20	1	0	0	0	0
67	1	120	1	1	1	0	0
68	1	153	1	1	1	1	0
69	0	61	1	1	0	0	0
70	1	82	1	1	0	0	0
71	0	26	1	0	0	0	0
72	0	85	1	1	0	0	0
73	0	165	1	1	1	1	0
74	0	97	1	1	0	0	0
75	0	42	1	0	0	0	0
76	0	195	1	1	1	1	0
77	0	194	1	1	1	1	0
78	0	118	1	1	1	0	0
79	0	152	1	1	1	1	0
80	0	83	1	1	0	0	0
81	0	134	1	1	1	0	0
82	0	110	1	1	1	0	0
83	0	89	1	1	0	0	0
84	0	25	1	0	0	0	0
85	0	57	1	1	0	0	0
86	0	15	1	0	0	0	0
87	0	181	1	1	1	1	0
88	0	217	1	1	1	1	1
89	0	100	1	1	1	0	0
90	0	142	1	1	1	0	0
91	0	86	1	1	0	0	0
92	1	169	1	1	1	1	0
93	0	231	1	1	1	1	1
S1	**20**	9158					

Max Value: 231

	0	50	100	150	200
S2	**20**	**20**	**14**	**5**	**1**
S3	**93**	**76**	**43**	**16**	**4**
Cover ratio (S2/S1)	100.00%	100.00%	70.00%	25.00%	5.00%
Hitting ratio (S2/S3)	21.51%	26.32%	32.56%	31.25%	25.00%
	21.51%	26.32%	22.79%	7.81%	1.25%

To find a correlation of number of landslide potential points with landslide events, hitting ratio and cover ratio method is used. The number of values in the second column is the value for the parameter of S1 which is the number of sub-areas contained landslide events. In the above column, the value of S1 is 20. The number of values in the fourth, fifth, sixth, seventh and eighth column are the parameters of S3 for each number parameter of multiple 50.

Parameter S2 is the number of sub-areas with landslide events as well as parameter of specific number of factors. For example, in the fourth column for the number parameter 0, the value of S2 is 20; in the fifth column for the number parameter 50, the value of S2 is 20; in the third column for the number parameter 100, the value of S2 is 14; so on.

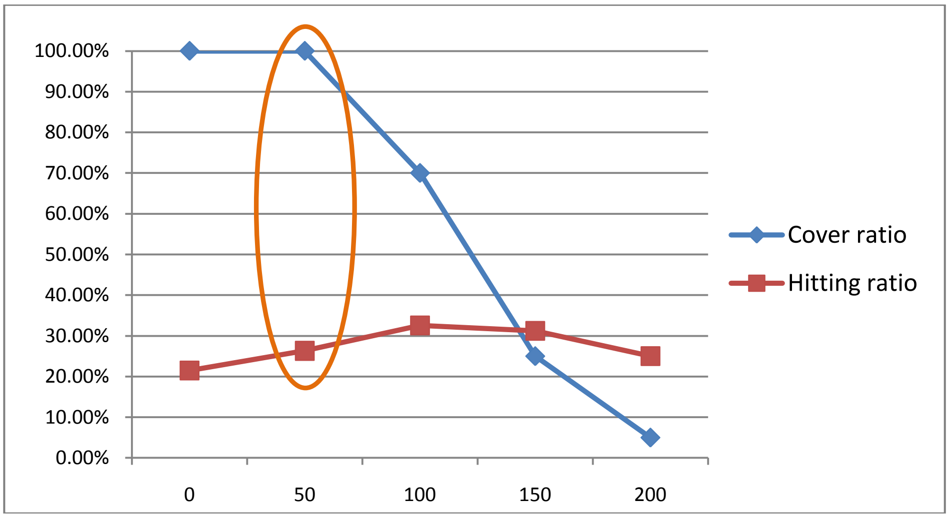

Figure G.1 – The calculation result of hitting ratio and cover ratio

After obtaining all the values for the parameters S1, S2, and S3, next is to calculate the value of hitting ratio and cover ratio. These values are calculated on a small column at the bottom. From the calculation is known that the fifth column is the column that shows the number of landslide potential points per sub-area or at least 50 which is the most correlated with the landslides occurrence.

Bibliography

AGRICA (http://agrica.wordpress.com/).

Alva Kurniawan, et. all., *General Dictionary of Geology*. Environmental Geographic Student Association, Indonesia, 2009.

ArcGIS Desktop Help.

Badan Penelitian Pekerjaan Umum, *Manual for Extraction of Mountain Streams that Could Cause Deep Seated Landslide*, Jepang, 2008.

Badan Pengkajian dan Penerapan Teknologi (http://www.bppt.go.id/)

Departemen Pekerjaan Umum (PU) / JICA, *Guideline for Overall Planning of Integrated Sediment-related Disaster Management (Tentative Draft)*, 2006.

Departemen Pekerjaan Umum (PU) / JICA, *Manual to Investigate Sediment Related Disaster (Primary Draft),* 2006.

Departemen Pekerjaan Umum (PU) / JICA, *The Manual for the Investigation Methods of Slope Disaster (Draft)*, 2006.

Departemen Pekerjaan Umum (PU) / JICA, *The Survey and Zoning Manual for Streams Susceptible to Debris Flows (Draft)*, 2006.

Departemen Pekerjaan Umum (PU) / JICA. *Making Hazard Map of Sediment Related Disaster (Draft)*.

Departemen Pekerjaan Umum (PU) Direktorat Jenderal Sumber Daya Air Sabo Technical Center/ JICA, *Guideline on Warning and Evacuation System/Making of Hazard Map of Sediment Related Disaster (Draft)*, 2006.

Departemen Pekerjaan Umum (PU), *Kamus Istilah Bidang Pekerjaan Umum*, Indonesia, 2008.

Departemen Permukiman dan Prasanara Wilayah, Direktorat Jenderal Sumber Daya Air, *Introduction to Sabo Technical*, Yogyakarta, Indonesia, 2003.

Dr. K. (Klaus) Tempfli, *DTM and differential modeling*. Oxford, England / ed. by P.R.T. Newby, 1991.

English-Word Information (http://wordinfo.info/).

GIS Indonesia (http://gis-indonesia.blogspot.com/).

GIS Konsorsium Aceh Nias, Staf Pemerintah Kota Banda Aceh, *Modul Pelatihan ArcGIS Tingkat Dasar*, Indonesia, 2007.

Haryono Kusumosubroto, *Seminar Diseminasi Teknologi Sabo*, Semarang, Indonesia, 2006.

Haryono Putro, *Paper Model Simulasi Hidrologi pada Kawasan Pengembangan Pemukiman sebagai Upaya Konservasi Air*, Universitas Gunadarma, Jakarta.

Lembaga Ilmu Pengetahuan Indonesia (http://www.geotek.lipi.go.id/)

Peraturan Pemerintah Nomor 37 Tahun 2010 Tentang Bendungan.

Peta Geologi Bersistem Indonesia, Pusat Penelitian dan Pengembangan Geologi, *Lembar Besuki Jawa, Lembar Jember Jawa, Lembar Lumajang Jawa, Lembar Probolinggo Jawa*.

Peta Rupabumi BIG digital, nomor lembar peta: *1607-541, 1607-542, 1607-543, 1607-544, 1607-631, 1607-632, 1607-633, 1607-634, 1607-641, 1607-643, 1608-221, 1608-222, 1608-311, 1608-312, 1608-321*.

PROMISE Indonesia (Program for Hydro-Meteorological Risk Disaster Mitigation in Secondary Cities in Asia). 2009. *Banjir dan Upaya Penanggulangannya*.

PT. Petacitra (http://petacitra.com/).

Sabo Division, Sabo Department, River Bureau, Ministry of Construction, *Guideline for Survey of Debris-Flow-Prone Streams and Survey of Debris Flow Hazard Areas (Proposal)*, 1999.

Undang-Undang Republik Indonesia Nomor 4 Tahun 2011 Tentang Informasi Geospasial. Sekretariat Negara Republik Indonesia.

Undang-Undang Republik Indonesia Nomor 7 Tahun 2004 Tentang Sumber Daya Air. Sekretariat Negara Republik Indonesia.

Wikipedia Indonesia (http://id.wikipedia.org/).