COMPARATIVE INVESTIGATIONS OF HIMALAYA TREKKING MAPS OF THE ANNAPURNA REGION

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Abstract

17 trekking maps of the Nepalese Annapurna Region, the most frequented trekking target of the Himalaya, have been investigated regarding their relief depiction and their geometric accuracy. The relief analysis is based on 6 testsites, the geometry has been studied by means of selected profiles and error bands. Furthermore, typical information elements of trekking maps have been assessed.

1 Introduction

Every year some 30 000 trekking tourists visit the Annapurna Himal in Central Nepal. This corresponds to two thirds of all trekking tourists coming to Nepal. The mountain massif, culminating in Annapurna I with 8 091 m and 1986 in declared a national park, thus represents the most frequented region in the entire Himalayan Range. The increasing number of tourists resulted in a multitude of map products published for the trekking tourists' use. A comprehensive monograph based on an internal report [5] is going to be published in English in one of the forthcoming issues of the Sonderhefte (Special Issues) of Petermanns Geographische Mitteilungen, Gotha (Germany).

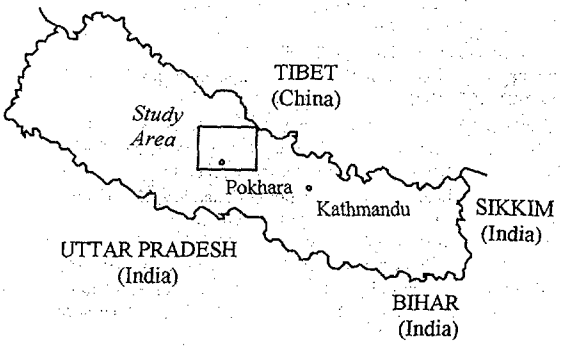

Figure 1: Location of study area

2 Maps investigated

Within the scope of this study the so-called trekking maps [4] of the Annapurna Region have been evaluated: 15 Nepalese, 1 German and 1 Austrian product. It can be assumed that (almost) the entire map material of this region available in the post-monsoon period of 1992 has been considered. Table 1 lists all the maps investigated, Table 2 comprehends various map parameters.

Map 1 **ANNAPURNA 1: 100 000 - *Finsterwalder Map***
Nepal-Kartenwerk der Arbeitsgemeinschaft für vergleichende Hochgebirgsforschung

Map 2 **ANNAPURNA CONSERVATION AREA - *ACAP Map,*** 1:125 000

Map 3 **ROUND ANNAPURNA - *Mandala Map A***
Trekking map of Pokhara Valley, Annapurna Sanctuary, Kaligandaki, Muktinath, Manang and Marsyandi Valley (1: 150 000)

Map 4 **ROUND ANNAPURNA - *Mandala Map B***
Trekking map of Pokhara Valley, Annapurna Sanctuary, Kaligandaki, Muktinath, Manang and Marsyangdi Valley (with text, 1: 225 000)

Map 5 **POKHARA TO JOMOSOM, MUKTINATH, MANANG**
Yeti Map, Pokhara Valley, Round Annapurna Himal, Dumre to Manang, Thorong La, Muktinath, Kaligandaki and Annapurna Sanctuary, 1:125 000

Map 6 **HIMALAYAN TREKKING MAP - *"Yellow" Map***
Pokhara - Jomosom - Muktinath - Manang, 1:150 000

Map 7 **AROUND ANNAPURNA, ANNAPURNA SANCTUARY & KALI GANDAKI - *Nepal Police Map,*** 1:125 000

Map 8 **AROUND ANNAPURNA & THE ANNAPURNA SANCTUARY**
and Pokhara, Annapurna Circuit 1:125 000, ***Mandala Map C***

Map 9 **POKHARA MAP TOURIST - *Mandala Map D,*** 1:550 000

Map 10 **AROUND ANNAPURNA** (1: 132 000)
"Red" and "Yellow" Contour Maps, (corresponding to 2 editions)

Map 11 **POKHARA TO JOMOSOM, MANANG - *Mandala Map E***
(Round Annapurna Himal), 1:125 000

Map 12 **HIMALAYAN TREKKING MAP - *"Blue" Map,*** 1:215 000
Trekking North of Pokhara
Pokhara - Jomosom, Dumre - Manang and Muktinath

Map 13 **ANNAPURNA - *Sattrek Map***
Satellite Image Trekking Map, 1:250 000
(experimental, first, final edition; the latter considered in this paper)

Map 14 **ROUND ANNAPURNA - *Mandala Map F***
Trekking map of Pokhara Valley, Annapurna Sanctuary, Kaligandaki, Muktinath, Manang and Marsyangdi Valley (with text, 1: 225 000)

Map 15 **ROUND ANNAPURNA - *Mandala Map G,*** 1:200 000
Trekking map of Pokhara Valley, Annapurna Sanctuary, Kaligandaki, Muktinath, Manang and Marsyangdi Valley (with text)

Map 16 **POKHARA TO DHORPATAN, TANSEN - *Mandala Map H,*** 1:250 000
Round Annapurna and Dhaulagiri Himal, Kali Gandaki, Muktinath, Marsyandi Valley, Lumbini, Siddartha Highway and Chitwan National Park

Map 17 **ANNAPURNA & DHAULAGIRI HIMAL, 1:250 000 - *Gurung Map***

Table 1: Trekking maps investigated. Internal („colloquial") denomination of maps within this study in italics

3 Relief Presentation and Geometric Accuracy

In most cases the relief is represented by elevation contours. Their intervals, however, vary strongly and reach from 100 m to 5 000 ft (1 524 m). In 6 testareas representing the different terrain types of the region the relief depiction has been studied in detail.

	Map 1 *Finsterwalder Map*	Map 2 *ACAP Map*
Map Title	ANNAPURNA	ANNAPURNA CONS. AREA
Scale as indic. on map	1:100 000	1:125 000
Publisner / Copyright	Arbeisgemeinschaft für vergl. Hochgebirgsforschung, Munich	ACAP, WWF, King Mahendra Trust for nature conservation
Map authors	Finsterwalder, R. et al.	?
Year of publication	1993	1988
Map format (cm x cm)	85 x 79	71 x 59
Map type	Peak-and-ridge topogr. map	Peak-and-ridge topogr. map
Contour intervals	100 m	100 m
Map projection	Lamb. conf. conic proj. (Ev.ell.)	none (?)
Coordinate grid	geographical, 15', ticmarked	geographical, 15'
Colours	8	8
Location map	none	none
Scale bar	yes (miles and km)	yes (only km)
Glacier depiction	yes	yes
Forest depiction	yes	yes
Relief shading	yes	yes
Town Plan of Pokhara	no	none
Naming of geogr. loc.	complete / satisfactory	incomplete

	Map 5 *Yeti Map*	Map 13 *Sattrek Map*
Map Title	Pokhara to Jomosom, Muktinath..	ANNAPURNA
Scale as indic. on map	1:125 000	1:250 000
Publisner / Copyright	Yeti Productions, Kathmandu	CARTOCONSULT, Austria, R. Kostka, Graz
Map authors	Josephson, Tiwari; Kathmandu	R. Kostka, Graz et al.
Year of publication	1988	1991
Map format (cm x cm)	73,5 x 69	51 x 38
Map type	Peak-and-ridge topogr. map	Satellite Image Trekking Map
Contour intervals	1000 ft	contour lines missing
Map projection	none (?)	none
Coordinate grid	missing	geographical, 30'
Colours	1	7
Location map	none	yes
Scale bar	yes (miles and km)	yes (only km)
Glacier depiction	yes	yes
Forest depiction	not indicated	yes
Relief shading	not indicated	yes
Town Plan of Pokhara	yes	yes
Naming of geogr. loc.	very rudimentary	satisfactory

Table 2: Parameters of selected maps

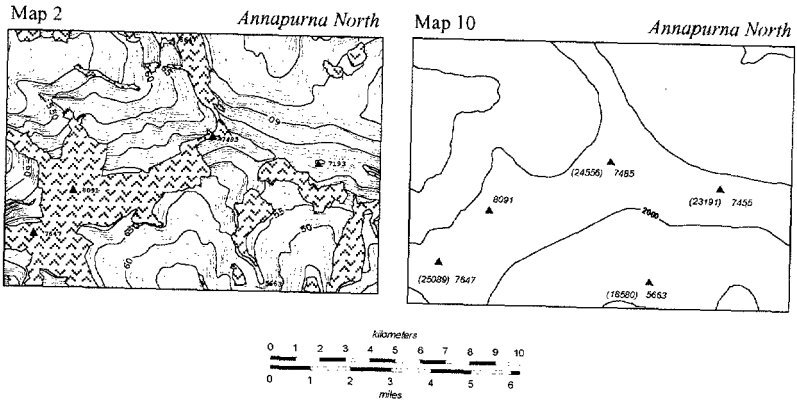

Figure 2: Relief presentation in the testsite "Annapurna North" of Maps 1 and 10; NB: Subject to scale reduction, elevation figures in the reproduction of the "ACAP Map" (Map 2, left), which are easily legible at the original scale, cannot be identified.

The above illustrations nicely show the wide variety in relief representation and the exact and detailed information displayed in Map 2.
Figure 3 comprehends some strongly diverging examples of the landforms as mirrored by the elevation contours. It shows the contour line pattern at the famous Pisang Peak (6 091 m) above 5 500 m (18 000 ft).

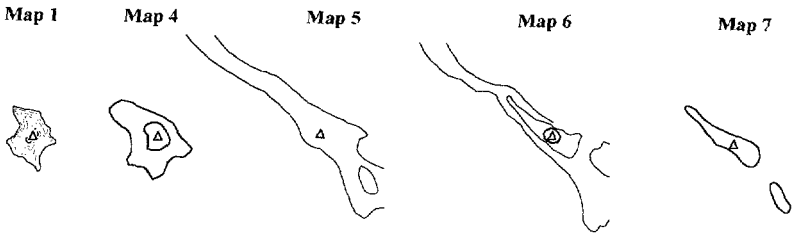

Figure 3: Contour lines presentation >= 5 500 m (18 000 ft) on the "Pisang Peak" (∆, 6 091 m)

In order to visualise the geometric accuracy of the maps, two representative profiles have been constructed based on the relief information available. Figure 4 shows one of them with 3 individual transects superimposed.
A quantitative assessment of the geometric accuracy was rather difficult, since for most Nepalese products a sound geometric base seems to be missing. In this respect, the generation of error bands [6] proved to be a feasible method for the graphic depiction. Figure 5 shows some results.

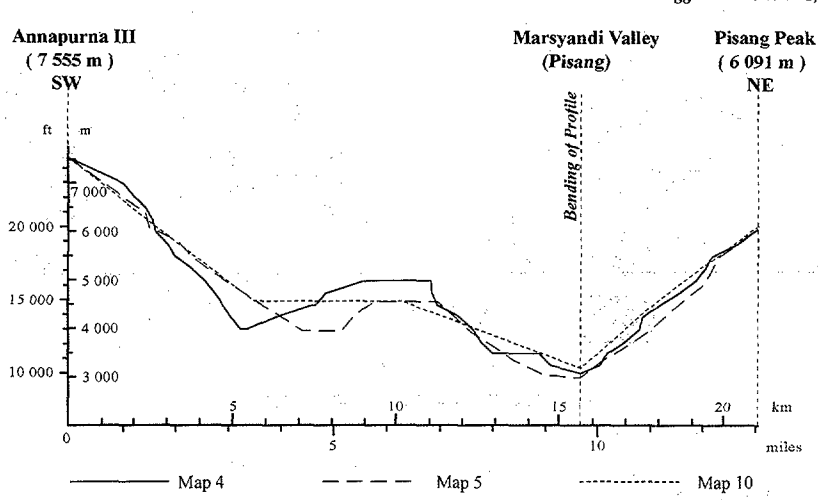

Figure 4 : Test profiles of Maps 4, 5 and 10

The error band width corresponds to the planimetric displacement. The resulting height displacement in relation to error band width and slope gradient can be seen in Table 3.

Current activities aim at the visualisation of differential digital elevation models (DEMs), taking the „Finsterwalder Map" (Map 1) as geometric reference. This will then allow illustrative statements on the areal accuracy distribution.

4 Scales

Table 4 shows the partly strong discrepancies between indicated (figures, bars) and calculated scales.

5 Map Information Contents

Trekking maps contain special information elements clearly distinct from European hiking maps [4]. The studied maps showed, e.g., a variety of transportation line types (6 categories of permanently and 4 of only temporarily usable roads). The classification of the trekking routes (major and side routes etc.) is similarily diverse. Several maps contain signatures for particular objects like health posts, police stations, teahouses, petroleum depots and others.

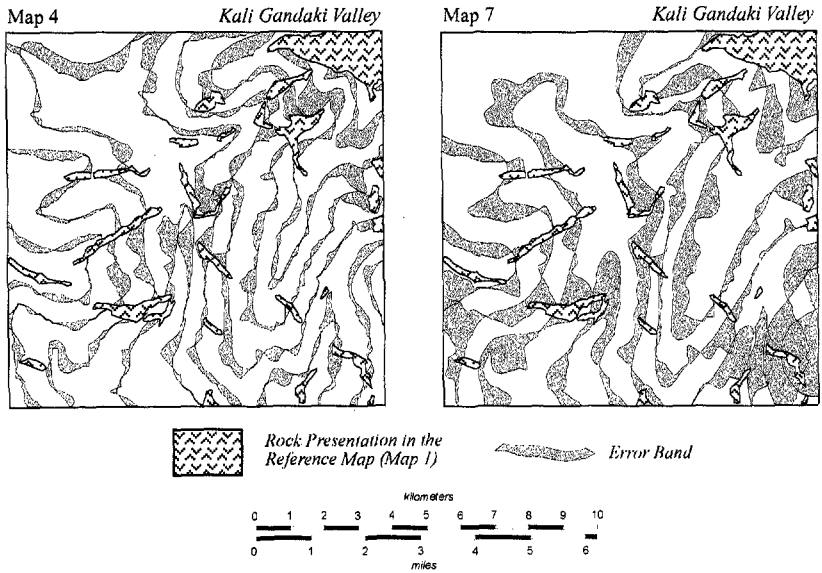

Figure 5: Error bands of Maps 4 (left) and 7

Error Band Width				Slope Gradient in Degrees						
in Meters	5	10	15	20	25	30	35	40	45	50
50	4,4	8,8	13,4	18,2	23,3	28,9	35	42	50	60
100	8,7	17,6	26,8	36,4	46,6	57,7	70	84	100	119
200	17,5	35,3	53,6	72,8	93,3	116	140	168	200	238
300	26,2	52,9	80,4	109	140	173	210	252	300	358
400	35	70,5	107,2	146	187	231	280	336	400	477
500	43,7	88,2	134	182	233	289	350	420	500	596
600	52,5	107,8	160,8	218	280	346	420	503	600	715
700	61,2	123,4	187,6	255	326	404	490	587	700	834
800	70	141,1	214,4	291	373	462	560	671	800	953
900	78,7	158,7	241,2	328	420	520	630	755	900	1073
1000	87,5	176,3	268	364	466	577	700	839	1000	1192
1100	96,2	194	295	400	513	635	770	923	1100	1311
1200	105	211,6	322	437	560	693	840	1007	1200	1430
1300	113,7	229,2	348	473	606	751	910	1091	1300	1549
1400	122,5	246,9	375	510	653	808	980	1175	1400	1668
1500	131,2	264,5	402	546	699	866	1050	1259	1500	1788

Table 3: Height errors in relation to slope gradients and error band widths (in meters)

	Scale Figure	Scale Bar	Calculated / Actual Scale
Map 1	1:100 000	1:100 000	1:100 000
Map 2	1:125 000	—	1:125 000
Map 3	1:150 000	1:140 000	1:140 000
Map 4	1:225 000	1:200 000	1:225 000
Map 5	1:125 000	1:115 000	1:145 000
Map 6	—	1:270 000 (km) 1:145 000 (mil)	1:145 000
Map 7	—	1:100 000	1:125 000
Map 8	1:125 000	—	1:210 000
Map 9	—	1:550 000	1:550 000
Map 10	1:132 000	—	1:150 000
Map 11	1:125 000	1:100 000	1:125 000
Map 12	—	1:400 000 (km) 1:215 000 (mil)	1:215 000
Map 13	1:250 000	1:250 000	1:250 000
Map 14	1:225 000	1:200 000	1:225 000
Map 15	1:200 000	1:160 000	1:175 000
Map 16	1:250 000	1:250 000	1:250 000
Map 17	1:250 000	1:250 000	1:250 000

Table 4: Scale figure, scale bar and calculated scales of the maps investigated
NB: The calculation of the actual scale is based on a comparison of distances in the reference map (Map 1) and the respective respective map products

6 Results and Conclusions

In conclusion it can be stated that the investigated trekking maps are of very different usefulness. The European type Map 1, the „Finsterwalder Map", is by far the best-suited for trekking tourists. The best Nepalese product is Map 2, the „ACAP Map". In both these maps the relief as the most important element is depicted most accurately. Considering all evaluated map elements listet in Chapter 5 and the overall impression of the map graphics, only 7 out of the 17 maps investigated more or less fulfill the requirements of a high-mountain hiking map as a means of orientation.

References

[1] Brandstätter, L., 1983. Gebirgskartographie. Enzyklopädie der Kartographie und ihrer Randgebiete, Bd. II, Vienna, Deuticke Publ., 319 p.

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