Aerial photographs and 'Photo-Maps' for community forestry

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SUMMARY

The main purpose of the work reported is the field-evaluation of large-scale aerial photographs (1:1,250 and 1:2,500 scale) as non-literate aids for supporting participatory work by Forest User Groups (FUGs) and for participatory mapping of community forests in Nepal. Aerial photographs used in conjunction with a Geographical Information System (GIS) were also tested as a possible alternative to current chain-and-compass practices for surveying community forests. Survey maps are required for the preparation of community forest Operational Plans, which constitute legal agreements between Forest User Groups and His Majesty's Government of Nepal.

Fieldwork was conducted with Department of Forest staff supported by the Nepal-UK Community Forest Project in Parbat District in the Dhauligiri Region of the Middle Hills in Nepal. The single most important finding was that aerial photographs made information, issues surrounding forest management, and participatory processes more accessible to non-literate people, thereby empowering them to take greater control over decision-making. Overall, the use of aerial photographs and participatory 'photo-mapping' (the practice of mapping on to a transparency placed over an aerial photograph) were found to be beneficial in the following ways:

• *Authenticity:* all people and particularly non-literate participants were confident that aerial photographs were accurate records of the distribution and condition of their resources;

• *Consistency of information:* unlike conventional participatory maps (drawn on paper or on the ground), information on aerial photographs and participatory photo-maps was transferable and consistently interpreted between groups;

• *Non-literate media*: information on aerial photographs was self-evident to many people (interpretation being relatively independent of education or social status);

• *Empowerment and ownership:* users were more fully engaged in discussions and therefore had greater opportunity to represent their views;

• *Facilitation:* any instrument that supports participatory processes is an aid to the facilitator. More specifically, information presented on aerial photographs naturally directed discussions towards specific community and resource issues;

• *User-friendliness and adaptability*: aerial photographs are robust participatory tools that can be used to complement existing field-practices and enhance their effectiveness without the need for extensive training or prescriptive guidelines;

• *Strengthening of the Forest User Group institution through commonality of purpose:* aerial photographs were welcomed by users RDFN paper 23e - Summer 1 and created an atmosphere in which the objectives of users and District Forest Office staff were seen to be complementary;

• *Potential of aerial photographs and Chain-and- compass surveys as a base for survey maps:* early indications suggest that surveys based on aerial photograph images may be more accurate and precise than the traditional chain-and-compass surveys and can be carried out more quickly and more cost-effectively, as well as being more participatory in nature.

AERIAL PHOTOGRAPHS FOR PARTICI-PATORY WORK AND FOR RESOURCE ASSESSMENT

In Nepal, following the recently updated Forest Act (1993) and Byelaws (1995) and changes in community forestry policy (HMG Nepal Department of Forests, 1997; MFSC Forestry Development Project, 1995), District Forest Offices (DFOs) are under growing pressure to form and support greater numbers of Forest User Groups. As greater demands are placed on DFO resources, it becomes evermore essential that non-literate people (who make up 85 percent of Nepal's rural population) and other less-advantaged groups are adequately informed and engaged in community forestry processes.

The main reason for investigating aerial photographs as non-literate (visual) means for communication was the assumption that users who are reliably informed of their rights and know the resources in question are empowered to take a more active role in decision-making. Women and the landless poor are among the non-literate groups who have been identified as being most vulnerable In Nepal the limitations of smaller-scale enlargements and difficulties in obtaining large-scale images are well documented by workers such as Jackson and Ingles (1995) and Jackson and co-workers (1994). Early work by Carson (1987), however, concludes that 1:5,000 enlargements "...provide an ideal base for the rapid appraisal of village resources in the Middle Mountains of Nepal". The author comments that the use of aerial

photographs encourages planners to take a more integrated view of social and economic factors and their operation in a natural landscape. The utility of 1:5,000 aerial photographs has also been endorsed by other workers (Poole, 1995b).

The technique described here of mapping on transparency over an aerial photograph has previously been described for Nepal (Personal Communication, Suraj P. Shrestha, School of Forestry, Auburn University, USA) and in Indonesia (Fox, 1986). The recent availability of high quality 1:50,000 aerial photographs for Parbat District in Nepal, coupled with improvements in image-processing and information technologies, provided a valuable opportunity for the Nepal-UK Community Forestry Project and Parbat DFO to determine whether these are effective visual instruments for community forestry.

FIELD EVALUATION OF AERIAL PHOTOGRAPHS AND PARTICIPATORY 'PHOTO-MAPS'

Field studies were undertaken in Parbat District of the Dhauligiri Region in the Middle Hills of Nepal. Within an overall aim of to exclusion from consultations. Maps and mapping processes are widely regarded as a means for empowering local communities (for examples see Foster Brown *et al.*, 1995; Jarvis and MacLean Stearman, 1995). Amongst the many information tools of Participatory Rural Appraisal (PRA) used for community forestry, participatory mapping is used to great effect (Carter, 1996; Carter *et al.*, 1995; Jackson *et al.*, 1994; Lamb, 1993; Poole, 1995a). It is not regarded, however, as a reliable means for establishing the scale of areas or for determining boundary information (Ingles *et al.*, 1996). There are also limitations to the practice of participatory mapping with respect to the equitability with which stakeholder interests are represented. This partly arises from the fact that an individual's ability or willingness to participate may be strongly influenced by education and social environment. In the study reported here it seemed that these influences were not so apparent when groups worked with aerial photographs.

The successful use of aerial photographs for participatory land-use planning is reported for Ethiopia (Ridgway, 1997) and for northern Thailand (Tan Kim Yong U, 1992). Robert Ridgway (1997) describes the value of aerial photographs as follows: "Without any barrier of written words to limit their observations, they (farmers) are able to comment knowledgeably on the potentials and constraints of the natural resources as seen on the photos, so large scale air photos have been the principal tool of participatory planning at the village level in a remote area of Ethiopia". evaluating aerial photographs as a non-literate tool for participatory work, specific objectives were to determine their usefulness for:

- stimulating discussion amongst villagers;

- recognising and interpreting immediate surroundings;

• encouraging greater participation and more equitable representation of the views of non-literate individuals, women and marginalised groups;

• providing a base over which participatory maps could be drawn;

• transferring information from one group to another; and

• complementing conventional approaches to participatory mapping. Photographic enlargements were made from high quality 1:50,000 monochrome contact prints and a diapositive (positive transparency).

Those most extensively used were a 1:12,500 image for the north of Parbat district, and 1:2,500 and 1:1,250 enlargements showing community forests with houses and fields of the surrounding village wards clearly visible. Enlargements were laminated and were sufficiently large (approximately 90cm by 90cm) for up to twelve people to view comfortably.

The principal field evaluations involved 12 participatory sessions during May and June 1997 at two forest sites (Thulosalgari and Akhori Pakho forests under the jurisdiction of Gyadi Range Post) where users had applied for FUG status. Further study of low-cost enlargements produced by digital means was undertaken at Tribeni Range Post in November 1997 and March 1998. Ongoing work includes the survey-use of aerial photography with GIS technology and the development of operational systems for low cost production of 'photo-maps' (digitally scanned and geographically corrected aerial photographs).

In May and June of 1997 each session was observed by a Community Forestry Officer (CFO), a Forest Ranger, a Forest Guard, a volunteer worker and a research worker. Although stricter control of the participatory environment (including the user-sector represented and the circumstances of discussions) might have been desirable from an 'experimental' perspective, it was not considered appropriate for an initial evaluation of user-responses to aerial photo-graphs. It would also have been unnecessarily prescriptive and extractive in terms of user-involvement. For purposes of consistency, however, the field-team tried to replicate certain aspects of location and stages of participatory sessions. A typical discussion comprised the following sequence of events:

• the Forest Ranger and Forest Guard would arrange a meeting, usually at one of the stone resting platforms known as *chautaara*. All present would introduce themselves and their interest in the discussions;

• if an earlier group had drawn a paper participatory map, this was presented for comment;

• the group was shown small-scale and large-scale aerial photographs. This helped to 'calibrate' and encourage consensus in perceptions of surroundings;

• a ‘conventional’ participatory map was produced by coloured marker-pen on brown paper;

• using a transparent plastic overlay, would sometimes be reluctant to enter a public discussion became less self-conscious, possibly as a result of their interest and understanding of the photographic medium.

Interpretation

This normally began with recognition of linear features such as rivers, a road and trails. Forests were identified and – on the larger scale enlargements – houses, schools, fields and the location of the *chautaara* were quickly recognised. Children were particularly good at interpreting images, although in one discussion an elderly gentleman, after briefly examining an aerial photograph, named all the rivers and then located a group of five pines he had planted 15 years previously. Possibly as a result of long experience of oblique landscape views from hillside perspectives, people were very adept at photo-interpretation. It was noted, however, that the process of interpretation was accelerated when familiar landmarks were present and forest-users were particularly anxious to see their houses. The only limitation recorded was that a few individuals with poor sight had difficulty with interpretation.

Participation

As mentioned above, the photographs effectively engaged women and socially-disadvantaged individuals in discussions. Following initial excitement aroused by the photographs, the people most familiar with the forest naturally became more involved in discussions as the meeting progressed. In comparison to conventional participatory mapping, which can rely heavily on the facilitator to direct discussions, consultations were spontaneously initiated by issues which were visually evident on aerial photographs. participants would draw the participatory ‘photo-map’ (PPM) by repeating the participatory map process and transferring boundary information to a transparent plastic sheet over a 1:1,250 or 1:2,500 enlargement.

Two independent exercises were conducted during 1997 and 1998. In the first, PPMs produced by different groups were superimposed to determine how closely the forest, ward and within-forest division boundaries drawn by one group agreed with those produced by others. Secondly, approaches combining aerial photographs and GIS were compared to chain-and-compass methods of survey. The latter are used by the DFO to produce maps of community forests which are required for the legal agreement between a DFO and FUGs that is known as the Operational Plan.

Aerial photographs as a non-literate tool for participatory work

Clear themes emerged which were consistent in all participatory sessions and repeatedly recorded by the field-observers.

Stimulating discussion

The aerial photographs were highly effective 'ice-breakers', engaging the immediate attention of all present. The interest generated by the aerial photographs meant that groups were often larger than ideal for participatory work. The introduction of enlargements was invariably followed by a few minutes of relatively quiet inspection of images. Discussions were naturally directed by the information presented on (and issues implied by) aerial photographs. Some of the field-team observed that women and poorer people who In one group, women were quick to recognise the openness of tree canopy in a part of the forest and attributed this to unrestricted grazing over which they had no control. Other groups identified illegal farming of supposedly shared forest resources and conflicts over boundaries and land use. In all sessions groups were able to describe the division and use of forests.

Aerial photographs as a base for participatory mapping

Without common reference points, spatial perceptions of a landscape vary from person to person. This is particularly evident when comparing conventional participatory maps produced by different groups for the same forest area. Aerial photographs provide an accurate standard by which forest-users may calibrate their spatial perceptions of the landscape. On many occasions, individuals said that they appreciated the enlargements because they were 'real'. Due to the authenticity, reliability and spatial accuracy of information portrayed, people were more trusting of participatory processes. Boundaries and areas were represented with greater accuracy when drawn over aerial photographs. As landscape attributes were self-evident there was less inclination to use symbols, for example drawing trees to indicate forested areas.

Transferring information between groups

It was apparent that paper participatory maps had little meaning for those not present when they were drawn. Difficulties with interpretation resulted from confusion over the meaning of linear features (boundaries, trails or rivers) and the size, shape and representation of areas. One women's group was openly concerned that a map drawn by the neighbouring ward represented an attempt to exclude them from the planned forest user group. No such limitations were experienced with either enlargements or participatory photo-maps as photographic information was interpreted consistently by all groups.

Complementary use of aerial photographs and conventional participatory maps

Although not the intention of this study, some direct comparison between photographic and paper mapping was inevitable. This was brought to the attention of the field-team with great impact when one woman, frustrated at trying to interpret a paper map drawn by an earlier group, cast it aside and picked up an aerial photographic with words to the effect that "this is real, let me see it". During the course of the evaluation it became more apparent that, in spite of all facilitation measures to the contrary; participatory maps largely represented the perceptions of one or two dominant people. It is likely, however, that the two approaches are complementary. While aerial photographs bring spatial accuracy, authenticity, consensus and trust, the symbolism of conventional participatory maps provides a means for exploring perceptions of user-status in relation to resources. There was also some suggestion that by introducing aerial photographs at the beginning of sessions this improved spatial accuracy and group consensus when drawing paper maps.

Comparisons of participatory photo-maps for clarifying resource and boundary issues

In a follow-up to field work, it was found that participatory photo-maps could be very useful in clarifying the user-profiles of particular forests (Mather, 1998a). In the Akhori Pakho Forest, for example, Range Post staff thought that users had agreed on the division of forest blocks amongst wards of the Pipul Tari Village Development Committee (VDC) while the position of the boundary between Pipul Tari VDC and neighbouring Thuli Pokhari VDC was still disputed. However, when a group of women in a poorer ward of Pipul Tari VDC were presented with a 1:1,250 aerial photo of their forest during a PPM session, they stated that they and others had not been consulted concerning the division of the forest. From the composite map of four superimposed PPMs it became clear that, although there was agreement over the general locations of forest blocks, there was little consensus as to the position of boundaries between them. There was, however, far greater agreement over the supposedly disputed boundary between the VDCs. When presented with the aerial photograph and composite of PPMs on a computer display, the Forest Guard explained that the source of the dispute was that members of Pipul Tari VDC had applied to become users of forest in neighbouring Thuli Pokhari VDC where they were not welcome. There is no doubt that visual display and comparison of resources helped clarify boundary issues for both non-literate users and for DFO workers.

Comparison of aerial-photograph/GIS and chain-and-compass surveys

Early results from a pilot study indicate that participatory boundary surveys of community forests based on aerial photographs may provide an alternative to the chain-and-compass surveys conducted by DFO staff (Mather 1998b). Apart from the difficulties of accurately surveying forests on steep slopes, other

limitations of chain-and-compass surveys are: (i) that considerable time spent in survey reduces DFO time available for participatory work; (ii) the resulting boundary map usually has little reference information of use to non-literate people; and (iii) as a non-participatory survey, users have a reduced sense of 'ownership' of the Operational Plan and an opportunity for discussing forest boundary issues is missed. In a limited study in Parbat District, boundaries of four established community forests were drawn on aerial photographs, three with the participation of forest users facilitated by Range Post staff and one conducted as a desk exercise with Range Post staff (Mather, 1998b). The photographs and superimposed boundaries were scanned and the resulting digital images geometrically restored to Universal Transverse Mercator (UTM) grid coordinates on a GIS. The GIS was used to calculate forest areas and the system is capable of making printed copies of the geographically corrected image with superimposed boundary, grid and scale information. Copies may then be used in the Operational Plan and also be provided to forest-users for their reference. A comparison between chain-and-compass and aerial-photograph/ GIS surveys (summary in Table 1) indicates that, for three forests, significantly greater areas were recorded by the chain-and-compass surveys. They also took much longer to complete than GIS surveys, which required one day for participatory mapping of boundaries on aerial photographs, followed by one half day to complete GIS work. There are many possible reasons for the differences in areas recorded by the two surveys including: difficulties obtaining planimetric measurements by chain-and-compass in hilly terrain; incorrect marking of boundaries on aerial photographs; other errors associated with either form of survey. It is very unlikely that the large differences observed would have resulted from the comparatively small errors associated with restoring aerial-images to UTM coordinates. A reliable explanation for the discrepancies would require an in-depth study of potential sources of error, including the positional accuracy of survey methods and possible differences in perceptions concerning the positions of forest boundaries.

Table 1 Comparison of area recorded and time taken for chain-and-compass and aerial-photo-graph/ GIS surveys

Community Forest	Area recorded by compass survey (Ha)	Area recorded by GIS (Ha)	Estimated Days required for compass	Days for GIS survey including field survey	Comments on GIS survey
Chhamarke Patal	83.1	76.1	10	1.5	Desk Survey by RP staff

Pakuwa Das	6.7	4.7	2	1.5	Field Survey by RP staff and users
Bhadkore	57.5	51.9	8	1.5	Desk survey by FUG
Thaireni Sutlamare	36.8	37.9	10	1.5	Field survey with RP staff and users

In a workshop following evaluation for survey use, DFO and RP staff concluded that potential benefits of aerial-photograph/GIS surveys included: the participation of users; reduced demands on DFO field time; possible greater spatial accuracy and precision (although the source of discrepancy between this and chain-and-compass survey is not proven at the time of writing); more meaningful boundary maps; convenience of digital storage for low-cost reproduction of printed copies and for updating maps; and greater clarity and reduced likelihood for post-formation misunderstanding and boundary conflicts.

Towards providing a 'photo-mapping' service

Having demonstrated the potential of 'photo-maps' as a source of authentic and non-literate information, a service is being planned for producing these at low cost. The technical steps involved are to: (i) produce a single geometrically-correct digital image for a district by making a mosaic from several aerial photographs; (ii) for the purposes of storage, to compress the large computer data set resulting from such a high resolution image; (iii) provide a computer system for retrieving images and for printing 'photo-maps'. The system should also be capable of producing copies with superimposed grid, scale and boundary information as required.

Such 'photo-maps' (properly called 'ortho-photomaps'), which show the same detail as the original images but without geometric errors due to optical distortion, tilt or relief displacement, are planimetric and preserve consistent scale (Campbell, 1996). In addition to their use for participatory discussion, planimetric photo-maps could therefore be a base for participatory survey.

Questions surrounding the accessibility and 'appropriateness' of technologies have largely been answered by recent developments in and reductions in costs of image-scanning, data storage and ink-jet printing. Perhaps the greater

challenge is to place a service institutionally so that it is technically sustainable and genuinely accessible to support Forest User Groups in Nepal.

CONCLUSIONS

Overall there was a strong sense that large-scale enlargements made from aerial photographs and 'photo-maps', whether used during FUG formation or for forest survey, were to some degree 'self-initiating' or catalysts with respect to participation. Discussions centred on photographic enlargements were spontaneous, developed a strong momentum and naturally focused on issues important to forest users. Although still essential as 'referees' of participatory processes, facilitators also benefited from the accessibility of photographic information through not having to continually stimulate discussion, therefore having greater freedom to listen to and learn from meetings where participants more freely engaged in issues and presented their expectations.

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GLOSSARY OF SELECTED TERMS AND ABBREVIATIONS

CFO Community Forestry Officer
DFO District Forest Office
FG Forest Guard
FR Forest Ranger
FUG Forest User Group
GIS Geographical Information System
MFSC HM Government of Nepal Ministry of Forest and Soil Conservation
PPM Participatory Photo-Map – a participatory map drawn on a transparency over an aerial photograph
PRA Participatory Rural Appraisal
RP Range Post (smallest unit of the forest administration)
UTM Universal Transverse Mercator – an internationally standardised form of map projection, also used as the national standard for Nepal
VDC Village Development Committee
Chain-and-compass survey (also known as linear- or chain survey) – a simple, low-cost and robust method widely used for all types of land survey. Linear measurements made with calibrated chains or measuring tapes are used in conjunction with compass bearings and triangulation to survey boundaries and areas.

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Notes to readers

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