The Hand of God: Delineating Sacred Groves and their Conservation Status in India's Far East

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Sacred groves

Sacred groves (SGs) are small groves that vary in size from a few hectares to a few kilometers protected by local communities as being the sacred residences of local deities and sites for religio-cultural rituals, have served as valuable storehouses of biodiversity. SGs are forests that have been protected since the ages by traditional societies. In the past SGs were present in numerous parts of the world, nearly every continent, and were entities held sacred by communities with different religions and different forms of economic and social organization. Most of the world's SGs have disappeared and few remain today. However some SGs have been passed down the generations and the hills of the north eastern region of India (NER) are one instance where pristine groves relatively undisturbed by man, are found even today. SGs have well developed forest ecosystems and high degrees of species richness and a rich biodiversity in general, depending on the extent of preservation of the grove.

The present study is confined to the area covered by two satellite data scenes, corresponding to a Survey of India topographical sheet of 1:50,000 scale. This is approximately 1500 sq. kilometers. Within this area in Meghalaya's East Khasi Hills district, the total area of which is 5196 square km, the focus being on the Mawphlang-Sohra area which possesses the best preserved sacred grooves in the region, easily among the better preserved grooves in India. Herein lies the rationale of choosing this area. This area also accounts for about half of the 30 odd SGs of East Khasi Hills.The other area is that of Assam's Karbi Anglong district, in which the Western part of the district,i.e. the Hmaren sub-division, where numerous un-reported SGs exist.

Delineating SGs

More than 30 sacred groves exist in the East Khasi Hills district of Meghalaya.Nearly two thirds of these are in excess of 100 hectares in size. In the neighbouring Karbi Anglong in Assam, in the eastern part of the district more than 100 SGs proliferate. These two districts, both inhabited by indigenous tribal populations

portray different contexts of conservation of SGs. In East Khasi Hills SGs are fairly well documented and strictly governed ; this is less so in eastern Karbi Anglong. However in the former context, where modernization has spread to a greater extent, the status of SGs seem to be on the wane, at least in the eyes of the educated. Although most SGs are well preserved it is difficult to foresee how they will far in coming decades. In the Karbi context, though almost undocumented, lack of modernization has perhaps aided the conservation status of SGs. Both contexts, however, indicate that SGs are storehouses of biodiversity and most that were delineated in this study were associated with healthy and well developed forest ecosystems, high degrees of species richness and are perhaps, among the more well preserved SGs in India. These SGs are an instance of how community control, belief in age old traditional values coupled with the slow spread of globalization can and do have positive outcomes for conservation of common resources. Community control is aided by traditional self governing institutions that have been legalized in these two contexts.

The study was felt necessary since SGs in the Eastern Himalayas are poorly inventoried, and though village communities look after their own SGs there is a lack of knowledge of the existence, status and extent of SGs beyond village or immediate boundaries. As such delineating the spatial extent of SGs fills an information gap and can assist future conservation strategies. Satellite data was used to delineate SGs. Supervised classification of the satellite imagery was performed following field checks aided by a handheld global positioning system (GPS).

However it needs to be pointed out that field verification is an absolute necessity in delineating SGs, particularly smaller ones. Only the largest SG, Longchap Sarpo, was easily identifiable on satellite imageries. The smaller SGs, which often are as small as a copule of hectares, cannot be delineated using 23 meter resolution data sans ground truthing. As such, accuracy assessment assumes much significance. Several sacred grooves are not contiguous with forest areas, but are distinct patches the margins of which are open pastures or fields that have been hitherto prone to extractive activities. In other cases SGs are contiguous with forest areas and in these tracking a path using a GPS was necessary to have boundaries of SGs delineated.

Accuracy Assessment

The computing saying 'garbage in, garbage out' recognizes that if you put poor quality into your program, you will output poor quality results. The saying applies to GIS since the results of analysis are only as good as the data put into the GIS in the first place (Heywood, Cornelius and Carver 2003). Thus the data used is this study needs to be assessed in terms of accuracy. A frequently used method is that of the error matrix which is widely used as a method for assessing classification accuracy of remotely sensed images (Story and Congalton, 1986; Congalton, 1991; Congalton and Green, 1993, Lo and Yeung, 2005). An error matrix, also known as classification error matrix or confusion matrix is a square array of values, denoted as C, which cross-tabulates the number of sample spatial data units assigned to a particular category relative to the actual category as verified by the reference data (Lo and Yeung,2005) that can be applied to both raster as well as vector data. In addition to the interpretation of errors of commission and omission, the error matrix may also be used to compute a series of descriptive indices to quantify the attribute accuracy of the data. These include the overall accuracy, producer's accuracy, and user's accuracy (ibid.p.114-115)

Following classification, sample points were verified on the ground to obtain an accuracy assessment using measures such as object accuracy, producer accuracy, mean accuracy and Kappa accuracy.

The following assessments were derived:

Producer's	Accuracy	User's accuracy		Overall accuracy
class 1	81.01%	class1	92.09%	87.4%
class 2	88.76%	class2	84.04%	
class 3	90.29%	class3	83.04%	
class 4	98.77%	class4	86.02%	
class 5	82.93%	class5	94.44%	
class 6	50.00%	class6	100.00%	
class 7	100.00%	class7	100.00%	

Overall accuracy /total accuracy	: 87.4%
user/object accuracy	: 87.44%
producer/classification accuracy	: 87.44%
mean accuracy	: 87.44%
areal difference	: 0
Overall Kappa Accuracy	:83.85%

A word of caution is necessary here: different measurements can produce different results, and as in the case of other statistical measurements, accuracy estimations do not always indicate the same thing, and we thus have to be careful when drawing conclusions based on them. Nonetheless, using several accuracy measurements, a better picture of the accuracy can be established.

The different measurements give different results, because they measure different things. It would be possible to get the same results only if the same accuracy was being measured: since this is not the case, we get different accuracy results from the same error matrix. An analogy here can be drawn to illustrate: only in a rare case would the values of mean and mode in a distribution be the same, in most cases the results would be quite different.

Thus, while overall accuracy indicates the probability of a randomly selected point on the map being correctly classified, the user accuracy measures the probability of a randomly selected point on the map being classified in the same class in the field; the two measures reflect quite different dimensions of accuracy assessment.

Again, for instance,the mean accuracy for a class always falls in between the two values of user and producer accuracy, though similar results are produced, the 3 measures (mean accuracy, user accuracy and producer accuracy) essentially measure different attributes of accuracy.

As to which accuracy assessment one should choose, it can be safely asserted that in order to present a balanced and complete picture of accuracy assessment, all the measures should be used and indicated.

Conservation Status

The National Forest Policy,1988, points out that natural forests serve as a gene pool resource and help to maintain ecological balance. SGs are the last remnants of natural

forests and are extremely valuable storehouses of biodiversity. SGs have well developed forest ecosystems and remarkable biodiversity. Studies in North East India have pointed out that SGs have a high degree of species richness (Jamir and Pandey 2002, Upadhaya et. al. 2003). Sacred groves are not mere physical entities. They reflect the value system of communities. The dynamics of the sacred groves can be related to the changes taking place in the socio-cultural realms of the society. Ethno-botanists and anthropologists are debating the role of sacred groves as in-situ conservation mechanism of the communities. As the MS Swaminathan Research Foundation observes:

> "SGs are a biological heritage and a system that has helped to preserve the representative genetic resources existing in the surrounding regions for generations. By conserving the flora and fauna these communities have conserved valuable genetic resources, which can be used in further afforestation, programmes and also certain endemic and rare plants are being conserved in the sacred groves. A study to identify such existing groves and the threats faced by these groves has to be undertaken on a priority basis." (MSSRF,n.d.)

SGs are important storehouses of biodiversity, having remained largely undisturbed by human interference. In three SGs of Jaintia Hills in Meghalaya, a total of 395 plant species was found distributed in 108 families in an area of approximately 28 hectares (Jamir and Pandey,2002). Haridasan and Rao (1985) reported that at least 50 rare and endangered species were thriving in SGs of Meghalaya. Similarly a high tree density and a high degree of species richness (using indices as the Shannon's diversity index and Pielou's evenness index) were calculated by Upadhyay et.al.(2003). Going by the rich biodiversity recorded in neighbouring areas, it is certain that SGs of Karbi Anglong also possess rich plant, bird and animal species; the present study, however, does not focus on this aspect of SGs.

Due to the sacred nature of SGs, wherein cutting of trees or even removal of wood and leaf litter are customarily prohibited, the SG is in a position to play an important role. An SG can preserve and maintain the microclimate within the SG area, recharge aquifers, and enhance nutrient cycling. Many of the SGs are the primary source for

perennial streams, and are the last resorts to many animals for their water requirements in dry seasons (Pushpagandan et al. 1998; Malhotra et al. 1999).

Several studies have emphasized that certain ancient SGs represent climax forests. Pushpagandan et al. (1998) showed that the floral biodiversity in small SGs represent the normal range of floral species richness of tropical rainforests. For example, 960 angiosperm species found in the 90 km^2 area of Silent Valley, of which 722 species were recorded from only 1.4 km^2 of SGs in Kerala.

The concept of the 'sacred' species provides a basis not only for natural resource management, but also for rehabilitation of degraded ecosystems with community participation. (Ramakrishnan,2001). Thus, a system of incentives needs to be worked into the system so as to reward communities that conserving SGs; given that SGs perform useful environmental tasks not merely for the immediate vicinity but for a much larger audience. Given the importance of SGs a look at their conservation status is necessary.

Of late a decline in traditional beliefs has led to a decline in practices and rituals associated with SGs. In the SGs around Cherrapunji, Meghalaya wherein in the past every village had at least one SG, Khiewtam and Ramakrishnan (1989) observe that the last ceremony was done in 1926 and apart from a few groves at other places rituals and ceremonies have become a thing of the past. They state that at Mawmluh,Mawsmai and Wahlong villages, all in the vicinity of Cherra, the rituals have been either stopped or discontinued, in one case due to lack of cooperation from the village elders (Khiewtam and Ramakrishnan 1989). Similarly, population pressure,economic developemnt and changing value systems and beliefs have undermined the status of SGs across our country (Khurana, 1998), from Kerala (Chandrashekara and Sankar,1998) to the Garhwal Himalayas (Sinha and Maikuri,1998). Fortunately the SGs in Karbi Anglong have not been a victim of such trends and in general continue to be quite well preserved. Yet, there is a need to learn from elsewhere and the excellent preserved status of the Mawphlang SG in neighbouring Meghalaya is a case in point. The latter is so well preserved that it attracts tourists and researchers from various places. The groove is rich in

orchids,rhododendrons and other species and is the pride of the people of Mawphlang (Anon.,2004)

Preliminary tabulation of the data suggests that the status of SGs as an institution are still quite strong in both study locales in Meghalaya and Assam, although for a section of the respondents based in urban areas the essence of the SG seemed to be lost.

Only in one case was a SG virtually decimated in Karbi Anglong, but this instance, that of the Longchap Sarpo SG, was an aberration rather than the norm and reflected how loss of community control and the settling of migrants from elsewhere with differing value systems and beliefs can adversely affect common resources that are no longer perceived as sacred (see Figures 1-3).

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Fig.1 Priest performing a ritualistic offering atop the SG

Fig.2 One of the SGs in Karbi Anglong

Fig.3. Dense vegetation in a SG unscathed by the human touch.

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