Participatory biodiversity monitoring in the buffer zone of Royal Bardia National Park

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Royal Bardia National Parks and the Department of National Parks and Wildlife Conservation have produced Participatory Biodiversity Monitoring (PBM) guidelines in consultation with the buffer zone user's in 2002. Based on the guidelines, the PBM sites were established in four Buffer Zone Community Forests. The members of *Ranjhabichtole Rammapur, Baghkhor* and *Satkhaluwa* forest user committee's with support of RBNP are jointly conducting PBM since December 2002 in buffer zone community forest jointly. Sample plots with 16,312 m transects have been already laid out to assess changes in forest condition and for monitoring of fauna on a fixed day and time in each month. Besides that focus group discussions are being held every three months and photo point monitoring on yearly basis. Twelve carnivores including three endangered species and thirty-three herbivores were recorded during these monitoring assessments. The plant species in community forest and farmlands of four users committees have also been recorded. Sixty-one bird species in *Baghkhor,* seventy-three in *Rammapur*, seventy-two in *Ranjhabichtol* and sixty-seven in *Satkhaluwa* community forest has been recorded (of which sixteen bird species recorded at *Satkhaluwa* lake alone). An economic loss equivalent to NRs 287,359.00 (U$ 3936) in four Users Committes has been recorded due to crops and livestock depredation. The affected farmers lack scaring devices to chase the wild raiders and necessary arrangement should be made to compensate them. Buffer Zone Management Council and the park need to arrange additional fund for the continuation of Participatory Biodiversity Monitoring.

Key words : Biodiversity, monitoring, protected area, buffer zone, community forest

Out of total areas (14.72 million ha) of the country, forest covers about 4.27 million ha (29%) and shrub covers 1.56 million ha (10.6%) (FRISP 1999). Since 1973, sixteen Protected Areas (PAs) in Nepal have been created which covers 19.21% of the total land areas of the country (DNPWC 2004). The largest PAs in Terai the Royal Bardia National Park (RBNP) is located in the Mid-Western Development Region of Nepal. It covers 47 percent (968 km²) of the total area of Bardia district (2025 km²). It was gazetted as a wildlife reserve in 1976 and then as a national park in 1988. Shorea robusta is dominant vegetation type in the park. The other vegetation types include mixed Sal-Pine forest, Khair-Sissoo forest, Riverine forest and grassland communities, representing both tropical and sub-tropical species. Some endangered fauna in the park and its buffer zone are; Mammals: Tiger (*Panthers tigris*), Wild Asian elephant (*Elephas maximus*), One-horned rhino (*Rhinoceros unicornis*), Four horned antelope (*Tetraceros quadricornis*); Reptiles: Ghariyal (*Gavialis gangeticus*), Rock python (*Python molrus)*; Birds: Great hornbill (*Buceros bicornis)*, Bengal florican (*Houbaropsis begalensis*), Sarus crane (*Grus antigone*). The faunal diversity of RBNP is presented in Table 1.

Table 1: Faunal diversity of RBNP

S.N	Group of organism	Number of species
1	Mammals	53
2	Reptiles	25
3	Birds	400
4	Fishes	121

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The creation of PAs have not only resulted in the population increase of wildlife species but also has increased the incidents of human casualty, property damage, livestocks depredation and crop damage consequently parks and people conflicts. From the mid-eighties, it has been realized that striking a balance between wildlife and human needs can ensure the future of biodiversity conservation. To accommodate the need of time, His Majesty's Government of Nepal has introduced the Buffer Zone concept in the fourth amendment of National Parks and Wildlife Conservation Act 1973 and promulgated Buffer Zone Management Regulation

1994. In this regard the main objective of the buffer zone is to conserve the biodiversity through community participation together with their development

The buffer zone of the Royal Bardia National Park was declared in 1994. The area of the buffer zone is 327 km^2 and includes 147 clusters of 94 Wards and 17 Village Development Committees. The major conservation partners involved in the park are CARE-Nepal (Buffer Zone Development Project phase out in June 2004), WWF Nepal (Terai Arc Landscape), UNDP (Participatory Conservation Program) and KMTNC (Bardia Conservation Program).

Objectives of PBM

The main objective of the participatory biodiversity monitoring is to train the buffer zone communities in the bio-diversity monitoring and build up their capacity by creating sense of ownership among them on the natural resources management of buffer zone. The following are the specific objectives of PBM.

- *Floral diversity:* List down the floral diversity and its values in buffer zone community forest and farmland.
- *Movement of wildlife:* Identify the movements of wild animals and their activities along transects in buffer zone community forest.
- *People and Wildlife conflicts:* List down the human casualties/injuries, livestock and crop depredation in the three-user committee's area with valuation.
- *Problem wild animals:* Identify the crops and livestock raiders, and their seasonal movements in and around the crop and settlements including their means of mitigation.
- *Establishment of Sample plots*: Establish the permanent sample plots to record the forest condition in terms of canopy cover, density, and natural regeneration and species richness in BZCF.
- *Controlling measures*: Investigate the controlling measures adopted by local farmers to protect their life, crop and livestock depredation by wild carnivores and herbivores.
- *Database*: Establish baseline data of PBM in four BZCF in the buffer zone of RBNP

Participatory biodiversity monitoring (PBM) guidelines 2002

Participatory biodiversity monitoring (PBM) is a new concept, which deals with the monitoring of the biological diversity in the PAs (BZCF) together with, trained local community and PAs staff. PBM Guidelines were prepared with a series of consultations at field and center levels. The workshops with the participation of concerned stakeholders were organized to share the methods and experience of participatory biodiversity monitoring while initiating the preparation of guideline. The following, objectives, methods, and data collections formats were developed for the guidelines. Thus, the park and BZDP prepared a

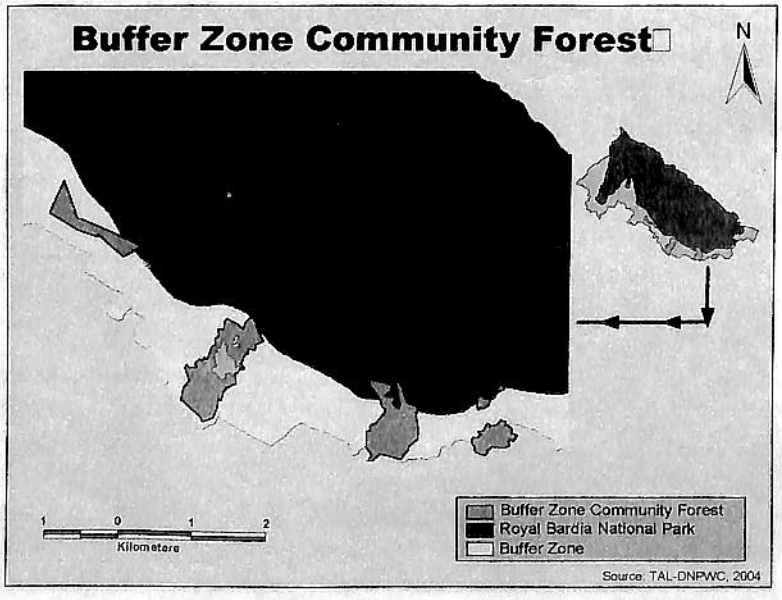
Participatory Biodiversity Monitoring Sites

Ranjhabichtole (a & b)

Baghkhor

Satkhaluwa and Satkhaluwa Tal

Rammapur



"Participatory Biodiversity Monitoring Guidelines" in Nepali in 2002 (RBNP 2002)

Monitoring sites

Monitoring sites were selected in the Eastern Sector, Buffer Zone of RBNP. Four Buffer Zone Community Forests (BZCF) namely *Rammapur, Satkhaluwa, Baghkhor and Ranjhabichtol* from *Karelia, Bhadda, and Baghkhor* User Committees were selected for PBM. *Rammapur* is located on south of East West Highway, and other three are in the north of Highway (Map 1). Besides that, *Khaireni* BZCF was also selected given the high bio-diversity value because of *Satkhaluwa* Lake. Details of this BZCFs are presented in the Table 2.

Material and methods

Designation of Line Transects and Sample plots

One to two permanent transects have been constructed in each of BZCF depending upon the size. Altogether 16,312 meters long transect has been laid out to observe the wildlife movements and their activities (Table 3). Permanent Sample Plots for vegetation analysis have been established at an equal interval of 100 m along the transect line for inventory of trees, shrub and natural regeneration. For convenience square plot methods have been used to collect the data (Yadav 1988).

Three different sample plot sizes were designated, 100 m^2 for trees, 25 m^2 for shrub/pole sizes and 1 m^2 for natural regeneration respectively in the community forest for trees, pole size and natural regeneration measurements. Sample plots were marked with enamel paints. GPS of all transects and sample plots and four BZCF have been taken to sketch the map.

Observation

The monitoring team has to walk along the transect once in a month for PBM. Presence of wild animals, records of footprints, tracks, droppings, scats of wild animals are to be recorded during monitoring. Initially the team will observe the wildlife movements once in a month in the morning. As one time observation would not give sufficient data of wildlife movements, observations should be repeated several times to bring consistency in the data recorded.

A one day meeting on the PBM conducted in October 2003, decided to increase the observation frequency on transects monitoring up to three times a month on different time (down, dusk and afternoon), which have been followed since then.

Wetland monitoring

Satkhaluwa Tal at *Bhada* UC, is a big lake in the buffer zone. The teams have carried out the observation for the avifauna, reptiles, and mammals. Direct observations of wildlife were carried out around water holes. At the same time, probable reasons for death of wildlife species were also recorded with the help of local people. Especially birds watching were carried out in and around the *Tal.*

Photo-Point monitoring

Photo point monitoring is the observation of change in the vegetation cover in different interval of time at certain patches of forest. This monitoring has been

Table 2: Four Buffer Zone Community Forests selected for PBM

Community Forest	HH	Population	CF area (ha)	Male	Female	Cultivated land (ha)
Rammapur	512	3431	503.94	1762	1669	235
Ranjhabichtol	79	476	320.78	253	223	28.2
Baghkhor (Amohiya)	463	2998	731.88	1529	1469	62.00
Satkhaluwa (Khaireni)	511	4005	609.27	2065	1985	180.00
Total	1565	10,910	2,165.87	5,609	5,346	505.20

Source: Office records of RBNP (BZDP) 2003

Table 3: Details of the transects and plots monitoring in four BZCF

BZCF	Location	Transects (meters)	No of plots
Satkhaluwa	*Khaireni*	2957	29
Rammapur	*Rammapur*	5365	54
Baghkhor	*Amohiya*	2340	23
Ranjahbichtole	*Ranjahbichtole*	2150	21
"	"	3500	35
Total		16,312	162

Source: Fieldwork

carried out every six month. Photos of selected forest patches (viz, Rammapur, *Satkhaluwa, Baghkhor* and *Ranjahbichtol* BZCF) were taken two times in a year from designated points and direction. Photographs were taken front and back face of the patch on the same day.

Focus group discussion

Interaction with communities (elderly persons, hunters and gatherers and UCs members) was conducted to gauze the perception about the crops and livestock depredation by wild animals. Much of the discussions focused on frequency of crop damage, livestock depredation, and human casualty/injuries. The focus group discussions were organized every three-month (Table 4). Each PBM team have their own focus groups. They interacted with the same groups of people four times (every third month) in a year.

Table 4: Details of the focus group discussion in four UCs CF

BZCF	Discussion schedule	Group size	Places
Satkhaluwa	Every 3 months	8-10	*Khaireni*
Rammapur	Every 3 months	15	*Rammapur*
Baghkhor	Every 3 months	10-12	*Amohiya*
Ranjhabichtole	Every 3 months	10-12	*Ranjha*

Materials used in PBM

Silva compass have been used for laying out the Transects and to identify direction. D-tapes (diameter tape) and M-tapes (measuring tapes) are provided for dbh and height measurements of trees and poles including lying out of transects. Books on birds and mammals were also provided to the team for bird identification and other wild animals. Binoculars were provided for watching the birds and animals.

Major findings

Observation of fauna in BZCF

The PBM teams identified the following different types of herbivores and carnivores in four BZCF:

- The endangered species such as tiger, hyena and four horned antelope were recorded.
- A total of thirty-three herbivores and ten carnivores were identified in the PBM (Please refer Figure 1 .
- The monitoring team also recorded a group of 15- 20 elephants raiding the crops in *Rammapur, Kaireni, and Ranjhabichtol* but there is not such incident in *Amohiya* a group of Rhinos raiding the crops in *Rammapur.*

Fig 1 : Number of carnivores and hervivores recorded in the PBM

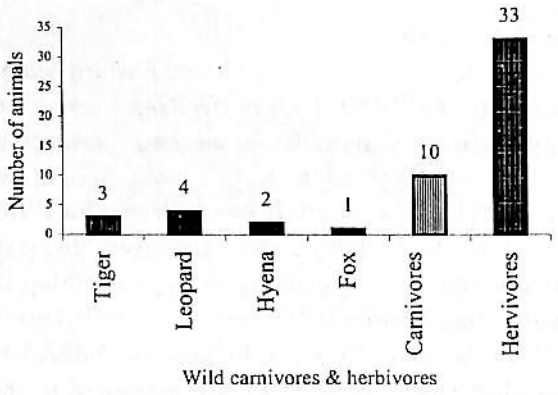


Photo point monitoring

A total of sixteen photographs have been taken in four Users Committees from August 19, 2002 to March 28, 2003. Photographs were taken at the interval of six months from the designated points. Photos show can give the seasonal changes in the condition of the forest.

Establishment of permanent sample plot

The sample plots, established during the PBM can be taken as baselines for the further study of floral diversity and management of BZCF. On the basis of sample plots, the number of trees, poles, saplings and natural regeneration in the BZCF can be estimated. A total of 181 permanent sample plots have been established in four BZCFs. Out of which 29, 53, 23 and 56 plots were established in *Khaireni, Rammapur, Amohiya* and *Ranjhabichtole* respectively.

The Table 5 shows that the number of trees per hectare in Baghkhor (*Amohiya)* is lower (73) compared to other BZCF. *Ranjhabichtole* consists of higher density of bushes with pole size. There are two transects in *Ranjhabichtole,* 13 tree species and 42 types of *Butyan* (bushes plus saplings and poles) were recorded in the plots of 3500 meter transect. Sixteen trees species and 35 types of *Butyan* were recorded in the plots of 2150 meter in other transect. The biggest transects have been established in *Rammapur* BZCF in which the record shows that there exists 20 trees species and 65 types of *Butyan.* The record of transects record shows 12 trees species and 31 types of *Butyan.* Similarly Amohiya transect have recorded seven tree species and 30 types of Butyan.

Wetland monitoring

In *Satkhaluwa Tal* between 19 November 2002 and 20 April 2003, sixteen different bird species were

Table 5: Summary of Permanent plots' vegetation status

Name of UC	BZCF Areas ha	Transects (meters)	No of Trees	Tree /ha	No of, appling and (Poles)	Regeneration /ha	No of total plots
Rammapur	503.94	5,365	153,655	305	2,098,910	4,165	53
Khaireni (Satkhaluwa CF)	609.27	2,957	157,801	259	2,728,920	4,479	29
Amohiya (Baghkhor)	731.88	2,340	53,427	73	3,018,273	4,125	23
Ranjhabichtole (a)	320.78	3,500	83,083	259	1,414,319	4,409	35
Ranjhabichtole (b)	320.78	2,150	116,122	362	2,150,830	6,705	21

Sources: Fieldwork, PBM groups 2003

recorded in and around the lake tracks some other mammals were noticed near the wetland area.

Forest Flora in BZCF & Farmland

The PBM teams have recorded different plant species in the buffer zone community forest. A total of 134 different plant species were recorded in *Ranjhabichtol* and similar number of plant species identified in *Baghkhor (Amohiya)* BZCF. The team also identified 185 and 155 number of plant species in *Rammapur and Satkhaluwa* CF respectively. A total of 127 timber, fodders, firewood, and medicinal plants, thorny species that can be used for live fence were recorded in the farmland. The highest number of plants species were recorded in *Ranjhabichtole.* Similarly 88, 87 and 77 different varieties of plant species were recorded in the farmland of, *Rammapur, Khareni and Amohiya* respectively.

Livestock status in four UCs

PBM noticed that local people were rearing cow, buffalo, sheep, goat, pig, hen, duck, and horse in the buffer zone for their income generation. The PBM team also recorded the highest number of chicken in four UCs. The number of buffalo, cow, and goat were also high. Most of the livestock are of local breeds.

Agricultural flora in farmland

Focus group discussion during the PBM noticed that total of sixty-eight of different agricultural crops were recorded both in Karelia *(Rammapur)* and Bhadda *(Khaireni)* UCs respectively. Baghkhor (Amohiya) and Basghkhor (Ranjhabichtol) 45 and 66 agricultural crops were recorded by the PBM teams respectively.

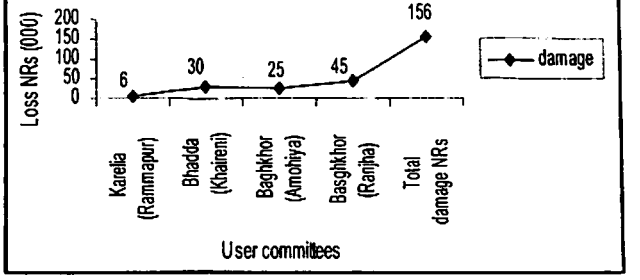
People and Wildlife Conflicts in the BZ

Local people residing in the vicinity of buffer zone forest and core area were adversely affected due to livestock and crop depredation. On the other hand BZ and core area were also affected by local people due to illegal cutting and stealing of natural resources from BZ and core areas (Jnwali, 1989; Sharma, 1991; Bhatta, 1994). Following are some evidence regarding people and wildlife conflicts:

Economic loss due to livestock depredation

A total of 105 households in four UCs were affected due to livestock depredation by wildlife. The total loss in four UCs was *NRs.* 155,850.00 (U$ 2135). Out of four UCs, the highest economic loss equivalent to *NRs.*44, 800 (U$614) occurred in Baghkhor *(Ranjhabichtol)* UC due to its close proximity with the park and partly being located to the interior compare to other UCs. Karelia *(Rammapur)* had the least economic loss equivalent to NRS. 30,307.00 (U$ 415) compare to other UCs, as the area being farther away from the park and it also lies in the South of the high way. (Figure 2)

Figure 2 : Economic loss due to livestock depredation

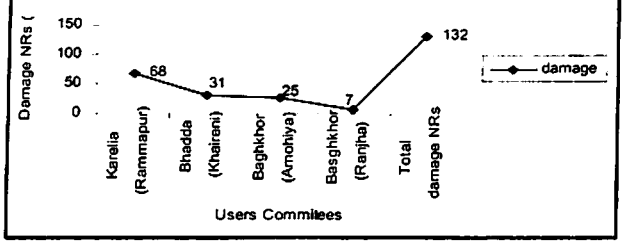


Economic loss due to crop damage by wild animals

Crops like maize, rice, lentils, wheat, and sugarcane generally damaged by wildlife. So far forty-four households were affected due to crop damage by wild animals in three UCs. The total estimated economic loss in three UCs was found to be NRs.131,509.00 (U$ 1800) due to crop loss. Karelia (Rammapur) UCs was heavily affected due to crop loss (7 households) and the amounts equivalent to NRS 68,000.00 (U$ 931). Similarly two UCs namely Bhadda *(Khaireni)* and Baghkhor *(Amohiya)* were also affected with an economic loss equivalent to NRS. 31,200.00 (U$ 427) and NRS. 25,309.00(U$ 347) respectively. One

household in *Ranjhabichtol* has lost equivalent to NRS. 7000.00 (U$ 95) (Figure 3). The estimates of economic value of crop damage was based on the discussion with focus group and through direct observations by the PBM team in the farm.

Figure 3 : Economic loss due to crop damage in 2002



Comparison of economic loss due to crops and livestock depredation

The livestock depredation is high in Ranjhabichtol and thus the population of tiger and leopard was high in *Ranjhabichtol* area. While, population of the mega herbivores such as elephant, rhinoceros and spotted deer is high number in Karelia *(Rammapur)* UC. That was the main reason for the high crop damage in Karelia (Rammapur) UC.

The economic loss due to livestock depredation by carnivore in *Rammapur* was low (NRS 6,520.00) in compare to *Ranjhabichtole* (NRS 48,800). Similarly, NRS 7,000.00 economic loss was recorded from crop damage by wild herbivores in *Ranjhabichtol* was lower in comparesion to Rammapur UC (NRS. 68,000.00).

Wildlife havoc

Livestock depredation

The PBM teams recorded the following livestock killing in three user committee. Number of livestock killed in Baghkhor *(Amohiya)* UC was higher (45) than in Karelia *(Rammapur)*. The loss of she-goats was high (54) and loss of other domesticated animal ranges from 4-14 heads only.

Killing intensity of carnivores

The predators (viz. tiger, leopard, hyena, wolf, and wild dog) were recorded in four-user committees and were reported to kill goats, cows, oxen, pigs, buffalos and sheep of the local people. Tiger generally killed oxen and buffalos (27 kills) whereas; the leopards, hyena, wolf, and wild dog killed small livestock. Intensity of Leopard's kills was very high (90 kills) compare to tiger and others. The reasons for increasing level of killing of small livestock by leopard in Amohiya was that it is very close the national park. Whereas the killing of small animals inRammapur was low as it is a bit far away from the core area.

Places of evidence

A total of 121 animals were killed in three user committee. Killing of livestock was found to be higher on stall-feeding than in the forest. The statement also explains that the grazing trend in the forest by livestock was decreasing due to stall-feeding. As the prey–base was low inside the forest, the carnivore used to come out from .the forest and used to kill domestic animals. So far a total of 94 cattle were killed at the stall-feeding.

Recommendations

Participatory biodiversity monitoring a new concept/ system in the developing countries. This system has now been implemented to gather baseline data in four BZCF of the buffer zone of RBNP. This system should be continued for future assessment of changes in biodiversity status. Some important recommendations are as follows:

Study on people/wildlife conflicts

PBM records the people affected due to crops and livestock around the buffer zone community forest. Thus Royal Bardia National Park together with BZDC should also investigate the people and wildlife conflicts in the buffer zone areas. Based on the assessments of damage, the compensation to the community should be arranged (Yadav 2002).

Compensation for livestock depredation

Such compensations should be provided to the victims on the actual basis. Baghkhor *(Ranjhabichtol) UC* has large number of livestock depredation. Similarly Baghkhor *(Amohiya)* and Bhadda *(Khaireni)* UCs fall under second category of livestock depredation by wildlife.

Wildlife deterring measures

The local people those who are unable to buy scaring devices to chase large wild animals (elephants, rhinos, and tiger) are the ones most affected from crop and livestock depredation. The park management and BZDC need to be aware of these problems should provide and necessary support particularly to farmers training on chasing the big animals, and necessary logistic (Yadav 2002).

Continuation of PBM

Participatory Biodiversity Monitoring investigate the overall condition of the BZCF so it needs to be taken in consideration that PBM is an integral part of community forestry in the buffer zone of any protected area. Thus all BZCF and PAs should incorporate PBM into annual work plan with arrangement of financial resource. It can be regulated through BZMC allocating the separate annual funds. RBNP and BZMC should take responsibility for overseeing the implementation and supervision of the biodiversity monitoring system.

Replication of PBM

Participatory Biodiversity Monitoring in community forest is cost effective tools and techniques for the management of biodiversity in the BZ areas of Nepal. For better management of biodiversity in BZCF this system should be replicated in other BZCF as well as in other PAs of the country.

Training to more UCs members

Two persons have been trained in each UCs, which is not enough for the PBM work. Due to economic problem fifty percent of trained monitors have discontinued who were involved in monitoring in buffer zone community forest. An additional user's committee members need to be trained to continue participatory biodiversity monitoring in the buffer zone of RBNP.

Training on wetland monitoring

Wetland monitoring is a scientific monitoring and difficult than other monitoring methods. The monitoring teams also suggested that wetlands monitoring needs more skills than other monitoring. Wetland monitoring requires human resource with additional skill. The Aquatic fauna and flora may not be identified easily. It needs trained and educated person so the special training on wetland monitoring should be provided to the concerned members.

Monitoring of PBM teams

Some of the members of PBM monitors could cheat to the UCs, BZMC and park authorities. That is why, making effective PBM, the park management, BZMC and UCs should be monitored the activities carried out by the PBM teams frequently.

Coordination among PBM and concerned institutions

During a one-day interaction workshop PBM teams came up with suggestion to have a coordination forum of different PBM teams. Coordination meeting between BZMC, Park and PBM teams should be organized every 3-4 months. Buffer Zone Management Committee and RBNP are the responsible institutions for the management of buffer zone. So the BZMC and RBNP should play lead role in the process of coordination.

Report production

Data collected by monitors should be published in the report in time and provide feedback. The English report should be translated into Nepali, which will be more beneficial for local people

Review of Biodiversity Monitoring Guidelines 2002

The Biodiversity Monitoring Guidelines are the first and comprehensive guidelines. It is not perfect so it needs changes in wordings, formats and heading overlaps, which are confusing. Participatory biodiversity Monitoring is designed to record the forest flora; and natural faunas, so the records (format-7) of agricultural crops is not necessarily to be considered in the PBM. The diary (methods-5): The field diary for recording information in the field cannot be considered the method of PBM. The confusing formats: (format-8 & 10) of Guideline 2002 having same functions are also same. Only permanent line transect has been established in the real field so format 8 & 10 should be deleted (Yadav 2004).

Conclusion

PBM is a fairly new concept implemented in theRBNP to conserve and manage the biodiversity in the buffer zone of the Park is the most important tool to assess the forest condition, wildlife status of Buffer Zone Community Forest (BZCF) and conflicts between park authorities and local people. This also serves as the baseline data, which provides the information on vegetation cover and wildlife depredation trends in and around the BZCF (Jnwali 1989; Stusrod & Wegge 1995). The involvement of local communities in the monitoring of biodiversity is an innovative approach that takes into consideration the issues such as sustainability and cost effectiveness. Frequent monitoring conducted over the period of time also provides information on illegal activities inside BZCF.

The training on PBM to the local communities and park staff enabled them to carry out monitoring work jointly. As local people carry out most of the work, the process will help transfer PBM knowledge to the local communities to conduct such assessments (Finn, et al. 2000). This is an innovative management system of biodiversity conservation that should followed by other BZCF of Royal Bardia National Park and replicated other PAs of the country as well. Coordination among Royal Bardia National Park, Buffer Zone Management Council, User Committees and BZCF must be formalized to regulate this system. Continuation of PBM depends on the active participation of park staff, user groups' member and BZMC. The frequent supervision of park authority is also important. The compilation of raw data and report production is other important jobs

Acknowledgements

The author acknowledges the followings for helps:

Institutions: Department of National Parks and Wildlife Conservation, Royal Bardia National Parks, RBNP Buffer Zone Council, Users Committees (Karelia, Bhadda, Baghkhor), Care-Nepal ,

Persons: Dr. Tirtha Man Maskey, Director General DNPWC , Mr. Narayan Poudel, DDG, DNPWC, Mr. Shyam Bajimaya Ecologist DNPWC, Mr. Puran Bahakta Shrestha Chief Warden RBNP , Mr. Gopal Prasad Upadhyay, Planning officer DNPWC, Dr. Annapurna Nand Das, Research officer DFRS, Kanchan Thapa Terai Arc Landscape, Ramesh Kumar Thapa Park Ranger RBNP, Moti Prasad Sharma LFP. Gobind Bahadur Rimal Project Manager, Rajendra Khanal Program officer, Surya Prasad Upadyay, Finance officer, Man Bahadur BK Field officer and Murari Mohan Adhikari field officer Care-Nepal. Field monitors.

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