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DRAFT PROPOSAL FOR THE CONDUCT AND APPLICATION OF VEGETATION ECOLOGY STUDIES AT CHITAWAN, NEPAL

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January, 1984

This document was produced for the Environmental Planning and Management Project of the International Institute for Environment and Development under the Advisory Services Contract No. AS-33

The Environmental Planning and Management Project is a cooperative agreement between the International Institute for Environment and Development and the U.S. Agency for International Development to respond to requests for assistance from developing countries in a variety of environmental and natural resource management problems.

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INTRODUCTION

Nepal is a place of surpassing interest to the western world if the following citations serve as any indication:

- foreign assistance donor presence (9 donors for 7 current integrated rural development projects representing a $110 million investment--Simmons et al. 1983)

- foreign-based private volunteer organizations (at least 17 cited by USAID FY 85 ABS 1983)

- tourism contributing nearly $52 million in foreign currency in 1981

Much of the interest derives from Nepal's position at the watershed of about 25% of the earth's human population. The resource--based and aesthetic issues which are a corollary of such unique placement have commanded donor attention and spending for thirty years.

In some instances such assistance has been both measurable and salutory. Near $1 million a year of USAID money and effort has been a major factor in a rise in national literacy from 2% in 1954 to about 20 percent today (USAID FY 85 ABS 1983, Simmons et al. 1983).

In other cases the effects are measurable but of questionable (or at least questioned) utility. The USAID sponsored malaria eradication effort of the 1950's resulted in a tripling of the population of the terai due to massive translocation from the densely populated hill regions (Wegge 1975). This has continued (e.g. some 400,000 in-migrants between 1901-1971; IBRD 1979) until well over half of the lowland forests have been removed (Bajracharya, pers. comm.). Much of the indigenous fauna and representative ecosystems are at risk, and HMG has decided to reverse these earlier policies in an attempt to retain residents in the hills (HMG 1981).

Finally, some of the development assistance is not readily measured or even assessable. Alterations of the quality or maintenance of life due to unexpected, unknown or counter-intuitive effects of many foreign assisted interventions can not be audited, often because the basic elements of local ecological, economic, and cultural systems are not known. A faunal survey of Nepal has never been conducted and some regions such as Dolpo and Mugu are zoologically unexplored--a genuine oddity for our time. The more important corollary to this ignorance of biophysical <u>components</u> is a per-

vasive lack of even rudimentary understanding of systemic processes. Thus, when development generates unexpected or unfortunate results, it is frequently because Leopold's Law of intelligent tinkering has been violated--viz. in messing around with a complex apparatus, don't throw away any of the parts! Truly, Nepal can be considered one of the few places where the parts have yet to be catalogued.

Which brings us to the point. Some very simple applied research is desparately necessary to guide sustainable development. Even three decades into the process it is not too late to benefit from the essential insights the research suggested below can generate.

RESEARCH STRATEGY

The proposed research is primarily designed to quantitatively assess all human uses of the natural vegetation, inventory the vegetation resource, and identify economically acceptable methods of concentrating cattle and buffalo on less acreage. The land released from use then becomes available for preservation, exploited but essentially wild buffer zones, and reforestation sites. Through studies of forage plant ecology and responses, grazing systems can be devised appropriate to local species, soils and conditions which can economically permit more livestock on less range and pasture--a carrot rather than a stick. These studies will not only be important around the remnant wildlands of the terai but will be critical

to establishing those farmers who are translocated from parkside areas to land supplied by HMG such as is being contemplated for the 8,000 residents of Padampur Panchayat, a salient penetrating well into the Chitawan Park system. As recommended in the RCUP evaluation (p. 11) some consideration should be given to range management because "the greatest threats to the ecosystem are undoubtedly free-ranging, grazing and the existence of unmanaged grazing land" (Wyatt-Smith 1982). The evaluation then goes on to note that livestock provides about 30% of farm income and natural forage constitutes 75% of the feed (in the hills). However the resiliancy of these areas is much greater than in temperate regions and there "...is reason to believe that proper range management could greatly improve the situation."

Although nominally described as suggestions for a vegetation ecology and management research project, some of the work described below touches disciplines which are difficult to separate from the basic focus on vegetation. These include, for example, soils, agriculture, human and wildlife ecology, systems ecology and database management. However the focus of the work will center on livestock-crop interactions addressing the genesis of the present difficult situation of farmers adjacent to Chitawan National Park. In this sense the research will serve

- as a paradigm of solutions for a pervasive land husbandry problem throughout the terai. The results should permit extrapolation

- to foster the USAID goal of addressing the "search for viable fuel and fodder..." which to date "...has been inconclusive for Nepalese conditions (USAID FY85 ABS 1983, p. 17);

- promote the preservation of biological diversity by generating protective measures for one of the world's most diverse wildlands--Chitawan National Park. This will be accomplished by addressing the root issue of accommodation with regional farmers who otherwise constitute competitors for common resources and a potential corps of Robin Hoods;

- to develop at this site comparative data on undisturbed as well as heavily exploited ecosystems. This is essential for establishing baselines, quantifying effects of disturbance and suggesting appropriate development, mitigation or compensation.

- It is located in an area of long-standing interest and involvement of USAID.

The essential elements of the vegetation ecology and management research described below are generic enough to be applied to other areas of the terai as well as to montane and hill regions. In fact, the range ecology and management work should probably be initiated as soon as possible in the hills where ad hoc range use and the unfortunate sequelae are difficult to manage because of many processes which are known imperfectly and anecdotally.

THE SITE

Details of the truly unique natural system of ungulates (deer such as sambar, chital and muntjak; bovids such as gaur, and the only population of the endangered one-horned rhino), elephants, tiger, leopard and a sal, riverside, grassland, vegetation mosaic can be found in Laurie (_____), Seidensticker (1976), Mishra (1983) and Troth (1977). The real challenge lies not only in perceiving and managing the Chitawan ecosystem but in reconciling its presence with the needs of human neighbors. If this can be systematically attempted the lessons will be of use throughout South Asia. For example, the problems tend to be a close analogue of those at the Gir Forest (Berwick 1976), Dudhwa (Saharia 1980), and many other locations. Common elements include grazing, tourism, wild animal damage or danger, fuelwood and timber harvest, usurpation and confiscation of property, minor forest product needs for ayurvedic medicine or construction (e.g. thatch) essential for management. Milton and Binney (1980 p. 8) state that "until a great deal more is known about the complex array of factors leading to development and maintenance of grasslands and riverine forests---including past and present human populations--developing sound park management policies for wildlife will be difficult, if not impossible." The constitution of the Park in 1973 and subsequent restrictions have greatly reduced the available grazing for residents nearby. There are acute shortages of grass and abuse of remaining land. Additionally, Milton and Binney found that loss

of crops to park wildlife ranged from 28 to 90% for over 4,000 people in the study area who held land (about 60% of the total population). Because of such depredation and the danger and effort of stemming it, agri- cultural productivity has plummeted often to 1/2 of the 1975 figure because of crop loss (primarily due to rhino, chital, boar or para- keets) or conversion to grazing. The results of such recent land use shifts include severe erosion and flooding by the Rapti River. Yet 80% of the people would prefer to remain where they are if the wildlife-related problems could be resolved. Their perspective "...is unanimous on the point: the Park has radically lowered their agricultural productivity and disrrupted their lifestyle (Milton and Binney 1980, p. 18)." These authors note that (p. 27) "Research on the patterns and dynamics of plant succession at Chitawan are badly needed to provide an intelligent base for ecologically sound manage- ment practices. Very little is currently known concerning succes- sional processes, yet the survival of many species dependent upon certain vegetation types may require such understanding for effec- tive habitat management. Seasonal burning, thatch collection, mon- soon flooding, sedimentation and flooding by streams and river, domestic elephant impacts, and introduction of large herbivores formerly present (such as wild buffalo) are examples of subjects needing to be carefully researched and developed as tools for main- taining optimum vegetation types for wildlife." I would add that such data are necessary to manage agricultural depredation, devise optimal grazing systems, maximize forest products and generally integrate the human residents into various forms of wildland use from tourism in national parks to reserve forest exploitation.

RESEARCH

Nearly ten years of wildland research has generated an unparalleled but very eccentric data base at Chitawan. Responding to a target of opportunity (Project Tiger and the attendant frenzy of international support and concern), the research camp at Sauraha was established and studies of conspicuous and generally dramatic forms of wildlife ensued. A retrospective and planning exercise has recently generated a more structured and planned approach toward research and its support by HMG and the major foreign sponsor, the Smithsonian. A considerable data base and physical support structure does exist to build upon although most of the work has been from the "top down", e.g. large ungulates and predators. Enormous opportunities exist for productive studies of soils, vegetation and human ecology which would leverage existing facilities.

The basic research question which would give an overview of needs to plan near-term agro and wildland systems might be "why are things the way we see them?" What forces the composition, structure, patterns and trends in the vegetation types important to

1. agrarian and other local users, and

2. biological diversity and wildland character?

Finally, what happens when anthropogenic interventions change these existing patterns? The following research protocol emphasizes a system's study of major basic elements of significance in the lower trophic levels at Chitawan. The emphasis is on maximizing products of value in meeting basic human needs and maintaining Chitawan's biological diversity.

I. Minor forest product production and availability (e.g. thatch, Embilica fruits, bamboo, etc.)

A. Inventory minor forest products used by locals, how they are collected and used, how important they are and possible markets

B. Assess the effects of forest product collection

C. Study the cultural institutions, attitudes and decision-making processes which relate to natural resources

D. Inventory minor forest products with sampling by forest type.

II. Livestock forage production

A. Investigate the community patterns and autecological processes of major and preferred forage plants of cattle and buffalo

B. Determine palatability, phenology, and nutritional value of forage

C. Conduct forage species trials involving different plant responses to such treatments as varying clipping (simulated use) rates, site factors (different soils), etc.

D. Establishment and monitoring of various grazing systems based upon II A-C (e.g. short duration, deferred, rotation, etc.)

The full proposal for range research and education from which elements are extracted for this paper is appended (Annex I)

III. Successional patterns, rates and history in the different biotypes in and around the Park

The key concepts which constitute the research questions for successional studies are:

- succession and ecosystem recovery

- successional management/manipulation

Knowledge of these two characteristics of local plant ecology can be applied in the currently major problems of

- control of Rapti river erosion and stabilization of degraded small watersheds

- fuelwood production

- agroforestry

- thatch harvest

- control of livestock and wild herbivore foraging and therefore crop damage

- enhancement of visual resources for tourism.

Research would involve studies of relatively undisturbed forest and grassland for baseline data collection and use as controls in comparisons with similar research on sites degraded or otherwise altered to earlier seral stages.

A. Species composition studies through releve, transect/quadrat readings and remotely sensed data

B. Characterization of disturbance as to source, frequency and intensity

- fire
- grazing/browsing
- wood harvest
- clearing

  etc.

C. Pool of species available for colonization and their dispersal properties, e.g. buried seed vs. temporal dispersal vs. root sprouting with fire

D. Rates of invasion and growth and causal factors, e.g. fire resistance

E. Soil characteristics

- physical
- chemical (cation exchange)
- compaction
- stabilization
- fertility

As Troth (1976) noted, studies of a few major indicator species may provide insights into the current composition, structure and resiliancy of the flora. For example, the silk cotton tree (Bombax ceiba) seems to be a fire resistant opportunist occurring in three major vegetation types (mixed deciduous, riverine and savanna grassland). Inspection of fire scars in trees in each type is likely to reveal many years of fire history in the Chitawan area. Noticeable changes in patterns (e.g. with in-migration from the hills in the past 30 years) should be observable.

The influence of fire on the production of thatch as well as on the production of forage should be revealed through such studies of indicator species as well as plant community patterns and disturbance.

COSTS AND SCHEDULES

Because of the existing facilities mentioned above and the complimentary nature of much of the research, the tasking and costs can be simplified at Chitawan. Tasks would resemble the outline suggested below:

Task 1

- a pre test of existing discrete groups (by caste and tribe) and the construction of a survey addressing attitudes, knowledge, familial attitudes and history, resource-related behavior (e.g. forest product use) and social/demographic characteristics.

Task 2

- statistical analysis of pre-tests to initially catagorize respondents into discrete attitudinal strata

Task 3

- sampling these strata in a larger survey whose numbers will be determined from the variance encountered in the pre-test

Task 4

- the survey is then analyzed. The attitudes and knowledge of residents for the resources they encounter are essential to formulating educational plans and interpreting the decisions evaluated below.

Task 5

- The audio-visual demonstration of a resource problem (using the Survival Anglia movie of Chitawan) and its resolution through management decision games. This involves translation of the sound track and the post "decision" administration and analysis of a brief questionnaire.

Task 6

- The socio-demographic data (sex, age, caste, level of education, etc.) are analyzed by a form of step-wise multiple regression (path analysis) in which the contribution of each variable (e.g. level of education) to the decision is determined (e.g. 33%) and a notion of which elements of the decision are refractory to change is obtained.

Task 7

- Vegetation inventory and type mapping with releve quadrats along transects, and coordinated photo/imagery interpretation. Includes undisturbed/disturbed paired sites and mensurational data (e.g. volume, canopy, coverage, density and height of trees).

Task 8

- plant collection and herbarium maintenance.

Task 9

- penned cafeteria trials and feeding site observations of domestic and wild ungulates and rumen analysis of wildlife

Task 10

- phenological observations of plants

Task 11

- soil compaction, structure, exchange capacity and trends in different sites

- mapping soil groups

Task 12

- Annual forage productivity studies using exclosure and twig clippings and dimension analysis

Task 13

- Simulated grazing and browsing effects upon vigor, productivity and reproduction of forage plants

Task 14

- Autecological studies of several key forage species and land use history/fire indicator species (e.g. Bombax) to determine optimal adaptive grazing and revegetation systems.

Task 15

- grazing trials to test systems

Task 16

- measuring and analyzing controlled prescribed burns in different vegetation types--e.g. fire and soil temperatures, fuel loading, subsequent mortality, germination and demography of successional plants with quadrat sampling.

Task	Level of Effort		Cost (dollars incl. ODC, equip., etc. at about 80K/sr sci & 10K/tech.)
1	2 p. mos.	1 Sr.Sci/1 Tech	7,300
2	1/2 p. mos.	1 Sr. Sci.	3,250
3.	16 p. mos.	1 Sr. Sci/3 Tech	35,000
4.	1/2 p. mos.	1 Sr. Sci.	3,250
5.	4 p. mos.	1 Sr. Sci/3 Tech	8,900
6.	1 p.mos.	1 Sr. Sci.	6,500
7.	12 p. mos.	2 Sr. Sci/2 Tech	45,000
8.	4 p. mos.	1 Sr. Sci/1 Tech	8,900
9.	50 p. mos.	1 Sr. Sci/10 Tech	72,500
10.	1/2 p. mos.	1/Tech	400
11.	3 p. mos.	1 Sr. Sci/1 Tech	13,800
12.	12 p. mos.	1 Sr. Sci/2 Tech	32,400
13.	1 p. mos.	1 Sr. Sci/1 Tech	3,650
14.	6 p. mos.	1 Sr. Sci./1 Tech.	27,600
15.	6 p. mos.	1 Sr. Sci/1 Tech	27,600
16.	3 p. mos.		10,500
Secretary	24 p. mos.	1 Tech	20,000
Total Labor			327,150
ODC/Equipment			72,850
	Total		$400,000

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