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# IRRIGATION INTERVENTION: A STRATEGY FOR CONSERVING BIO-DIVERSITY AND IMPROVING FOOD SECURITY IN ROYAL CHITWAN NATIONAL PARK BUFFERZONE, NEPAL<sup>1</sup>

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## **ABSTRACT**

In Royal Chitwan National Park (RCNP) Bufferzone, Nepal, a study was conducted to assess how irrigation development and method of water sharing have increased household food security and reduced pressure on park resources. The findings indicate that with some variations between communities, increased water availability and reliability through irrigation development has improved food sufficiency, returns to farmers, crop diversity, and cropping intensity. Community attributes, leadership and dynamics were the decisive factors that determined the success of government intervention program. Small holders and low-income groups in dry areas have received greater benefits from small groundwater pumping schemes. However, many rural poor still lack access to resource opportunities. Although the Park People Program (PPP)/RNCP successfully improved public relations, grievances still persist among the water user groups that take water directly from the East-Rapti, the boundary river for irrigation. Crop insurance against wildlife depredation continues to be a major factor influencing the relationship, which has not been adequately emphasized by RCNP.

## **1. BACKGROUND**

Nepal has created an extensive network of national parks, wildlife areas, hunting reserves, and conservation areas that cover nearly 15% of the country's total area (Keiter, 1995). RCNP is the second largest park (932 sq. km) with annual tourism revenue of NRs 48.3 million (UNDP, 1994). The surrounding bufferzone (76,750ha) population had free access to this forest reserve before park declaration in 1973. Initially, the local people had voiced their disapproval of legal recognition of RCNP because of denied access to extract natural resources including forest products and water resources from the park area. The Department of National Parks and Wildlife Conservation under Ministry of Forest and Soil Conservation came into being in 1980, with the authority to administer the protected areas. Contingents of the Royal Nepal Army have been deputed to enforce many of the park regulations. The Ministry of Tourism improves tourism-related facilities and regulates the flow of tourists to the different parts of the country, including the RCNP. Even after its recognition as a site of World Heritage in 1984, the people continued unauthorized extraction of forest products presumably because the original concept of RCNP had not adequately considered the needs of local people. This prompted the development

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of a legal system by which both people and park could co-exist.

This gave rise to the development of the Bufferzone Management concept, which recognizes the role of the local community in RCNP conservation and utilization. The government passed the Bufferzone Management Act in 1996 and delineated the bufferzone boundary that included area of 35 Village Development Committee (VDC) and two municipalities in four districts. The Act made provision of bufferzone management council with representation mostly of farmers user committees, and one from each of the offices of Local Development Committee, and the RCNP itself. In the council, farmers' representative enjoys the position of the chairman and the warden of the RCNP is member secretary. In early 1995, the government had already introduced Park People Program, a bufferzone support unit of RCNP with the aim of improving biodiversity conservation of RCNP through people's participation and to provide them with various incentive measures. Irrigation development intervention was one of the important activities to provide local communities access to water resource through support for development of small-scale surface and groundwater irrigation. This was aimed at improving household food security and reduce dependence of people on park resources.

This paper will 1) start with a brief review of government policy on irrigation intervention and environment protection, 2) present the methodology of the case study carried out in RCNP bufferzone, 3) discuss processes and outcomes of irrigation intervention made by RCNP/PPP in the bufferzone, 4) provide examples of successful and failure intervention cases of groundwater irrigation schemes and their effect on household food security, 5) elaborate on the context of existing water allocation between park and community managed surface irrigation systems, 6) describe community participation in biodiversity conservation, 7) equity concerns, and 8) conclude with key points and observations useful for future directions.

## **2. POLICY REVIEW ON IRRIGATION INTERVENTION AND ENVIRONMENT**

All national irrigation policy documents appear to have been driven by the same goal of improving irrigation performance to contribute to national food security while providing adequate protection measures to the natural environments. However, in many instances, underperformance of irrigation systems and faulty development of irrigation infrastructure with negative environmental consequences have been reported frequently (Shukla, 2000; Ostrom, 2000; Bryan Bruns, 1993). However since 1980s, the government has been looking for a cost-effective solution of ever-increasing O&M expenses. A number of policy reforms have been made including the Basic Need Program of HMG/N. In 1988, the government introduced a working policy on irrigation development for the fulfillment of basic needs. This working policy along with Water Resource Act that was passed in 1992 and revised in 1997 gave a new direction to irrigation sector and implemented the concept of participatory management as a distinct policy initiative for improving the irrigation performance in Nepal. The impact of these policies is that management function of medium and small sized irrigation systems have been handed over to local users committees with mechanism of collecting fund (fee and fines) for meeting the recurrent O&M cost of the system and develop a feeling of resource ownership.

The 20-Year Agricultural Perspective Plan (APP) of HMG/Nepal that was adopted in 1995 focuses on ways to improve food deficit situation by increasing food production in the country.

The APP gave top priority to groundwater development policy mainly through shallow tube wells in Terai. But, the 9<sup>th</sup> five year planning period (1997-2002) experienced poor demand of the farmer for shallow tube wells due to removal of subsidy policy and weakening trend of government investment on repair and maintenance of irrigation infrastructure. Therefore, in the current 10<sup>th</sup> five year planning period (2003-2008), great emphasis has been laid again onto the expansion of mainly shallow groundwater irrigation and small surface irrigation development as well as encourages pond irrigation, micro irrigation and rain harvest for irrigation. The base line planning document also gives priority to empower the local water user groups for participatory and effective irrigation management.

The Environmental Action Plan of 1994 provided some guidelines for both integrated water management and maintaining the water quality at the river basin level. Although the revised Environment Protection/Conservation Act (EPA) came in 1996/97, the task of formulating working rules and defining accountability at various levels of governance and line agencies to implement the Act is yet to come. Nevertheless, the government has given due consideration to the protection of environment, for instance, while developing water resources government cancelled out the construction of huge weir in East Rapti River in 1990s which could have affected adversely the RCNP resources and functioning of many traditional irrigation systems downstream. In lieu of weir, building of a continuous embankment along the river protected locally developed and managed age-old irrigation infrastructures.

### **3. METHODOLOGY**

The case study data was collected in a retrospective manner conducting semi-structured group interviews with executive members of water users groups and sixteen household surveys in eight water user groups to document the past and ongoing activities. Documenting intervention process of PPP and evolution of local user group were the past activities and information on how groundwater irrigation systems been functioning and being used by groups of user farmers was recorded as on-going activity. At broader bufferzone level, information was elicited from a group discussion with representatives of the RCNP, Bufferzone Council, District Development Committee and King Mahendra Trust for Nature Conservation including local leaders. It is hoped that this ground-based information would contribute to draw lessons useful for dialogue on integrated management and utilization of water for food and environment policy in the basin.

### **4. THE RCNP/PPP IRRIGATION INTERVENTION**

#### **4.1 Process**

In the beginning when PPP was launched in 1995 and bufferzone council was yet to come, the former had already made substantial efforts to create mass scale awareness in the surrounding of park area so that the activity could provide foundation to initiate the process of forming users group through which PPP could reach to the people for implementing the development projects including irrigation intervention.

As it was a bufferzone support unit of RCNP, PPP first carried out a survey in the bufferzone involving rangers and social mobilizers of RCNP to understand the perception of local people which could be helpful to identify pressing needs of the people and develop action plan with priority of PPP support area, people's willingness to share project cost, commitment to contribute to biodiversity conservation activities of RCNP, and readiness to sign the project agreement and handover document and assets created after the completion of the project.

From this information, the Bufferzone Development Officer (BDO) and Chief Warden of RCNP prepared a five-year action plan and its annual breakdown. They discussed and made the decision on the action plan in the presence of army staff of RCNP, as well as people representatives including both male and female local leaders.

The same process was adopted in supporting projects such as drinking water, repair of road, animal preventive infrastructure (API), and community forestry and irrigation development. The following provides the step-by-step support process using the case of irrigation intervention.

- PPP assisted to the Water User Groups (WUG) in the community in drafting/developing proposal to request for the support. Institutionalization of the WUG was mandatory for receiving support. Therefore, PPP helped users in developing/drafting their constitution.
- Users submitted a list of their names to include in the constitution to set a boundary rule that guaranteed their water use rights.
- The constitution so developed was registered in the office of chief conservationist of RCNP. With the stamp of RCNP put on the constitution document and signed by the warden, a copy of it was returned to WUG
- WUG then requested to RCNP for the support by including a copy of the proposal along with a copy of the constitution.
- With recommendation, the BDO forwarded the project request document to the chief warden for approval. The support was provided on installment basis. PPP had its own bank account and BDO and chief warden used to sign the check jointly and handed-over to the WUG in the presence of local VDC representative.
- For the remaining installments, WUG had to make request showing the expenditure status of the earlier payments. For supports that were made after the formation of bufferzone council, a recommendation of VDC chairman was mandatory and the request had to come via user committee of the same VDC.
- Details of expenditure had to be audited by the authorized person/agency as per the rule of RCNP.
- Support was provided on the basis of cost sharing principle where user groups were required to contribute resource equal to 40 percent of the total cost. The rest of the 60 percent corresponded to the financial support to cover the procurement cost of all materials and equipments that user groups had to purchase from the market.
- A construction/supervision committee was formed from within the members of user groups in which PPP/RCNP representatives were supposed to supervise the work progress. In the case of operating pumpset for irrigation, PPP provided technical training to the members of the user groups.
- After the intervention activity was complete as per the agreement, PPP handed over the infrastructure and management responsibility to WUG in the presence of local leaders.

## 4.2 Outcomes

Irrigation intervention was part of poverty alleviation approach of PPP for biodiversity conservation, which is also understood as part of productive investment (PI) for increasing agriculture productivity. Up to 2000, PPP made its efforts mainly on the following programs:

1. Poverty alleviation for conservation
2. Policy support in biodiversity conservation
3. Institutional strengthening at the local level
4. Mainstreaming gender in conservation
5. Piloting conservation activities at the grass-root level
6. Networking and resource mobilization

Although irrigation was relatively a small component of PPP in relation to other programs, support on irrigation focused mainly on developing small groundwater, pond irrigation systems as well as repair and maintenance of existing community irrigation systems. In this paper, we have presented two case studies chosen from groundwater and pond/fish irrigation system and compared how they have contributed to household food security, change in economy and poverty as well as matters related to equity in resource development, distribution and differential benefits accrued thereof across the water user groups.

### 4.2.1 Socio-Economic Characteristics of the Selected Water User Groups

Two types of groundwater irrigation user group cases were selected with contrast social structure, the one considered to be highly successful (Nayabihani Water User Group) and the other, failure case (Pragati Water User Group). Similarly, a highly successful pond irrigation system (Satakholi Water User Group) has also been presented as an unique case (Table 1).

Table 1. Social structure of the selected water user groups

	Ground water Irrigation system*	Pond/Fish Irrigation system**	Groundwater Failure case***
No. of households	54	33	63
Ethnicity (%)			
Bramhin and Chhetri	47	100	16
Gurung and Magar	7	x	5
Kuman and Chaudhary	18	x	x
Giri puri	11	x	x
Untouchable	x	x	79
Others	17	x	x

\*, Naya Bihani WUG; \*\*, Satakholi Fish Pond Irrigation WUG; \*\*\* Pragati WUG

Nayabihani WUG has fairly mixed community, whereas Pragati WUG is dominated by

untouchable so called lower cast people and fishpond WUG is absolutely homogenous group where only upper cast people (Bramhin) operate the system. The forgoing discussion will explain how this variation has influenced the performance of PPP intervention on irrigation development.

Agriculture being the major occupation in the bufferzone area, landsize is one of the determinants of household income, social status, access to development opportunity and also make the individuals capable of influencing the government officials. Similar is the case of cast system. The track record of Nepal also indicate that Bramhan and Chhetri, being the upper cast have so far been more privileged in terms of access to development opportunity. Nayabihani, a successful ground water irrigation system is better off in terms of landholding, literacy, family size and tenancy than Pragati, groundwater failure case dominated mostly by untouchable. Therefore, it is essential that most of the users of the Pragati WUG be forced to go for share cultivation (Table 2). Users of pond/fish system are all Bramhins with highest literacy, and landholding and therefore all are owner cultivators.

Table 2. Average landsize, familysize, literacy and tenancy situation of the WUG

	Ground water Irrigation system	Pond/fish Irrigation system	Ground water Failure case
Avg. landsize (ha)	0.33	0.66	0.2
Avg. familysize	6	6	8
Avg. literarcy(%)	80	93	50
Tenancy			
Owner cultivator(%)	75	100	33
share cultivator (%)	15	x	66
Contract (%)	10	x	x
Lease	x	x	x
Others	x	x	x

#### 4.2.2 Effect on performance of irrigated agriculture and productivity

Change in cropping pattern, cropping intensity, crop productivity, benefit cost ratio, and food sufficiency, as well as livestock heads and changes in source of firewood have been considered as indicators of performance of irrigated agriculture. Some new crops were introduced into the cropping system and increased the cropping intensity from 200 to 300 percent in successful groundwater irrigation case. In pond/fish system, land area that used to be cultivated only once for rice in a year and was left fallow for other two seasons has now changed dramatically to fish production round the year (Table 3).

On the other side, where groundwater irrigation intervention was failed in Pragati WUG, they still grow the same crop, and no improvement in cropping intensity was observed because of devoid of irrigation facility. Where farmers could irrigate their crops, they have raised their crop productivity from a minimum of 32% in pond fish system WUG and maximum of 42% in Pragati WUG.

Table 3. Change in cropping pattern and cropping intensity

Irrigation system	Crops before		Crops after	Percent increase in cropping intensity
Ground water irrig. system	Sisam -mustard-fallow		Rice-maize-maize	100
	Maize-mustard-fallow		Rice-mustard-rice	100
Pond/fish irrig. system	Rice-fallow-fallow		Fish farming round the year	NA
Ground water failure case	Maize/sisam-mustard or wheat-fallow		Maize/sisam-mustard or wheat-fallow	No change

NA= Not applicable

In Pragati WUG where irrigation could not be developed, crop productivity is still stagnant and very low (Table 4). Such a distinct difference in crop productivity due to irrigation per se provides explanation to why farmers always consider irrigation to be the matter of their top priority whenever any external support programs are taken to the rural areas.

Like others, Pragati WUG was also registered in RCNP under the PPP initiatives. This WUG received one pumpset (Rs32000.00) from PPP support. The WUG purchased a pipe of Rs. 15000.00 and bore a hole at the bank of the Rapti River to pump water to supply in the adjoining uplands located near the riverbank. They encountered rock 15ft below the surface and stopped further drilling, as they could not break the hard rock even after laborious manual effort for 30 days. They thought they had no capacity to afford more money to invest for rock-cutting. The chairman of this WUG reported that PPP did not make any further effort to revisit the group and evaluate the situation for making the intervention successful. Similar to this case, Nayabihani WUG had also encountered hard bedrock while drilling but the members contracted out further drilling work to a private drilling company located in nearest market, Narayanghat. The drilling work was made successful and they paid to the company @NRs. 1900/meter of drilling depth.

Table 4. Type of crops grown and average productivity (tons/ha)

Type of crops	Ground water irrigation system		Pond/fish irrigation system		Ground water irrigation failure case	
	Before	After	Before	After	Before	After
Rice	-	3.0 <sup>1</sup>	3.4 <sup>1</sup>	4.5, Fish*	-	-
Maize	1.4	2.0	-	-	0.09	0.09
Sisamum	-	-	-	-	0.02	0.02
Wheat	-	-	-	-	0.045	0.045
Mustard	0.45	0.45	1.5	<0.3**	0.045	0.045

\*. Part of area is changed to fish farming, and some parcel of land of each households is still under rice and where productivity has grown to 4.5tons/ha due to irrigation.

\*\* , grown in uplands where irrigation is not applied.

<sup>1</sup> Even after irrigation becomes available, rice productivity remains usually lower in uplands than in lowlands.

The question arises why the same intervention produces differential outcomes? Probably the answer can be sought in the realm of our understanding about the differences in institutional



capability, socio-economic structure, knowledge about natural resources endowment and commitments towards objectives of the intervention program.

### 4.2.3 Improvement in Farmers Income and Food Sufficiency

A comparison was made between major crops for cost and benefit before and after irrigation development (Table 5). A given unit amount of input cost gave significantly higher benefit in crops like early season rice, normal season rice, winter maize when replaced mustard, spring maize when irrigation was made available.

Table 5. Change in ratio of total cost and total benefit (Rs.) of major crops after irrigation

Crops	Before irrigation			After irrigation		
	T cost	T benefit	B/C ratio	T cost	T benefit	B/C ratio
Early rice (spring season)	16792	17218	1.03	17117	31180	1.82
Normal rice (monsoon season)	19322	23548	1.22	22985	40882	1.78
Before mustard, after maize	9342	9929	1.06	13443	23129	1.72
Spring maize	9570	9264	1.00	14807	19376	1.31
Fish replacing monsoon rice	19322	23548	1.22	131349	418526	3.19

Dramatically higher output was obtained when vast area under traditional normal rice was developed for rearing fish after partial support from PPP in making the ponds, procuring pumpset and forming users group for pond management in Satakholi fish pond WUG Low lands where soils remained mostly submerged mostly provided farmers with a natural opportunity of rearing fish. On the other side, very low crop productivity (Table 4) due to lack of irrigation water has obviously given negative return to farmer in failure ground water case (Pragati WUG). The reported crop productivity values were so low that we did not think it essential to make economic analysis. Given that other employment opportunities are rare, difference in availability of water for irrigation has led to a significant difference in livelihood and food security conditions in households between failure and successful cases presented in this paper.

Cumulative impact of irrigation development on cropping intensity, productivity and cost benefit could be seen on changes in food sufficiency situation in the households (Table 6). Irrigation development has shown highly positive impact on food sufficiency. In successful groundwater irrigation WUG, most of users (60%) produced food sufficient only for <3 months before irrigation. But, the present situation is quite reverse in that majority households grow food sufficient for nearly whole year and some also produce surplus food. All user households in fish pond system grow food required for the entire year and all households have surplus food that would be sufficient for another six months. Very pathetic situation appears in the case of failure groundwater WUG where number of food deficit households is increasing which was attributed mainly to unavailability of irrigation facility, due to increasing household population overtime and lack of other employment opportunities in the area.

Table 6. Change in households (%) with food sufficiency in the selected WUGs

Food sufficient for	Ground water irrigation system		Pond/fish irrigation system		Ground water Irrigation failure case	
	Before	After	Before	After	Before	After
<3 months	60	20	20	x	40	50
<6 months	20	25	20	x	20	20
<9 months	10	15	50	x	37	27
<12 months	10	40	10	100	3	3
Surplus HH	5	40	10	33	x	x
Surplus months	5	6	x	6	NA	NA

#### 4.2.4 Impact on Firewood Collection and Animal Grazing

A significant number of farmers from successful groundwater WUG and fishpond WUG have reduced their frequency and dependency on forest for collecting firewood and also reduced frequency of animal grazing (Table 7 and 8) both in community forest and in the RCNP. As an alternative, many have started using biogas, purchasing saw-dust and wood from nearby private saw-mill for cooking food. Interesting to note, most of the firewood in the mill comes from the illegal extraction from the national park (personal communication). This could be cross-checked by the fact that illegal wood extraction practice from RCNP and community forestry combinely has increased overtime (Fig 1). In a medium sized family of 5-7 members in the household, a simple calculation was that sawdust of less than NRs.100 would be sufficient for purchasing firewood required for cooking food for one month.

Table 7. Change in household (%) with sources of firewood for cooking

Type of forest	Ground water irrigation system		Pond/fish irrigation system		Ground water irrigation failure case	
	Before	After	Before	After	Before	After
Private	20	15	-	5	25	25
Community	-	-	-	5	-	-
RCNP forest	80	10	90	40	100	100
Govt. forest	-	-	-	-	-	-
Other sources	-	75*	50**	50**	-	25*

\*, biogas, purchase of wood from private, sawdust from saw-mill

\*\* , logs collected from the boundary river (Riew Khola) during flood

But where groundwater effort has failed in Pragati WUG, members reported that although RCNP rule has denied people access into the forest, almost all households have still continued their dependency on RCNP forest for firewood and take animals inside park area for grazing and for watering and swimming in the East Rapti River (Table 8). Reasons for decreased livestock number and forest encroachment is partly explained by the RCNP rule of denied access, but it is also due to the effect of irrigation development in the area because irrigation increased cropping intensity and thereby reduced the fallow period between any two consecutive crop seasons. This is the reason why farmers rear significantly small number of livestock heads where irrigation

effort became successful in Nayabihani and Pond/Fish irrigation WUG. Impact of irrigation is thus seen on the type of livestock they keep. Therefore instead of rearing many local animal heads in the household, the trend is increasing to keep a few improved cattle and buffalo under semi-stall feeding system. Irrigation has thus contributed positively on household income generation through selling milk and also produced manures for crop cultivation.

Table 8. Change in ratio of household to livestock number after irrigation development

	Ground water irrigation system	Pond/fish irrigation system	Ground water irrigation failure case
Present livestock number/household	maximum 3	minimum 5	minimum 5
Is it a significant reduction in livestock number	Yes, this is 1/5 <sup>th</sup> of the past livestock number	Moderately reduced	Slightly reduced
Why? Main reasons?	RCNP rule and no land fallow for grazing	RCNP rule and no land fallow for grazing	RCNP rule
Sources of fodder and grazing sites	Straw, grass, <10% users bring fodder from RCNP forest	Rice straw and bran; community forestry, least no. of users go to RCNP	Private land during fallow season and many use RCNP forest for grass and woods

## 5. WATER SHARING MECHANISM AND ASSOCIATED PROBLEMS IN THE RIVER

Although PPP supported the repair and maintenance of very few surface irrigation systems that are close to RCNP boundary, its objective was not to involve itself in resolving the management aspect or related issues of already existing surface irrigation systems that offtake water from the East-Rapti, a boundary river between RCNP and the rural bufferzone. However, our purpose of discussion in this section is that much of the farmers livelihood in this bufferzone depends on the water these surface irrigation systems divert into their croplands. A series of nine surface irrigation systems, with service areas ranging from 100 to >500ha, offtake water from this river for irrigation round the year. If they divert much water particularly during dry season, which is of course needed, for spring rice or maize irrigation, RCNP officials hold strong notion that significant reduction in river flow due to such diversion would affect adversely the ecosystem functioning and tourism of the RCNP. This would therefore cause to decrease the amount of revenue collection and degrade the natural environment of RCNP. Here comes the issue of water rights and water sharing mechanism between agriculture and environment. Therefore, how has this concept being practiced here would receive more attention in the forgoing discussion.

### 5.1 Farmers Water Rights in the East-Rapti River

In the case of use of East-Rapti river water for irrigation, we can view water rights from two levels; one, rights of the WUG to use and develop water resource for irrigation from Rapti River. FMIS have been using this water since long before the establishment and recognition of national park (RCNP in this case). Hence any other institutions including RCNP cannot challenge prior water use rights of WUG. This is inter-institutional perspective. Next, when water is allowed to supply into a given irrigation canal, it then is the matter of entitlement of water rights by

individual appropriators. In all surface irrigation systems surveyed, more or less similar pattern of use rights was found to be followed by the users organizations, i.e., they establish their rights to withdrawal of water by contributing resources in terms of either labor, cash or in kind. Temporary denial of water supply is practiced when users do not contribute resources or do not pay fine imposed on them. Graduated sanctions are also practiced to make the user follow the rules-in-use. In some cases, farmers located near the intake (head-enders) claim their prior rights against the tail-enders for getting water turn first and vice-versa. Because of sufficient water availability and water distribution rules-in-use, situations of conflict occur only at negligible extent and users organizations have been managing these disputes within the system.

In such context where water resource is used for irrigation, it is common property where a group of farmer-members collectively holds the rights over a resource system and detailed rights may be formulated within the group. Here, an interesting concept of property rights comes into effect when we talk about irrigation in Nepal that is also applied in the case of this bufferzone irrigation, i.e., water rights is linked to land rights and when the later is inherited to offspring or others who buys it, water rights is maintained automatically with the inheritance of land rights. Our large number of field observations and experiences has informed us that there must have been substantial efforts by farmers due to which a given piece of land could have acquired access to irrigation. Therefore, who and how much invested the resource to initially acquire water and develop irrigation scheme provide explanation to the concept of establishing prior rights to access water. Legal Code of Nepal (1963) and Water Resource Act (1993) have made legal provision for determining ownership, control, conflict management as well as exclusion related matters of water rights. These Acts have recognized local or customary rights practiced by people in their own local environments and also fixed the priority of water uses in which drinking water has the top priority followed by irrigation, industrial uses and hydro-power, etc.

## **5.2 Water Sharing Mechanism between Irrigation and the Park**

No written official documents exist related to water sharing mechanism between irrigation and the national park of the study area. Because of legal recognition by the Legal Code of Nepal concerning the prior use rights and importance of irrigation in subsistence farming in this bufferzone community, these nine irrigation systems have been using water since long from this river. For these reasons including the anticipated peoples' role in biodiversity conservation of the park resource, the park authorities cannot deny farmers' access to use the river water for irrigation. However, RCNP can plays decisive role to permit or restrict the development of new irrigation systems by bufferzone community that intend to draw water from this river.

Based on the discussion above and our field observations, two types of water sharing mechanisms have been practiced based on crop growing season and level of water flow in the river. These mechanisms are given below:

- 1) Although not quantified, when level of waterflow in the river is high, farmers can divert as much water as they want into the irrigation system because any amount of water they divert does not affect the environmental needs of the park.
- 2) Towards dry season, the level of waterflow in the river is low. Therefore, RCNP appears to go in short supply to meet all environmental needs downstream for conserving bio-diversity and to carry out park activities including tourist boating by hotels if irrigation

systems upstream divert much water for irrigation giving rise to at least short lived conflicts or invisible grievances with the farmers towards RCNP. Therefore, military guards and RCNP authorities become vigilant about farmers behavior of diverting more water into their canals in dry season.

There have been cases where armed RCNP staffs and hotel staff have dismantled the temporary headwork structures of the WUG when they diverted, in RCNP staff general sense, much river water into the canals particularly during dry seasons. Farmers reported that such cases however, have not been repeated frequently in recent years that signaled improving mutual relationship over the years. But, there is no documented precise water sharing mechanism in place and thus the sharing mechanism is very poorly defined. However, water requirement of both sides is second to none in priority because farmers are concerned with solving basic need of hand to mouth problem and RCNP with maintaining biodiversity and its name in the record of World Heritage. Therefore, need for effective institutional arrangement should be emphasized for accounting changes in water use overtime (Molden et.al, 2000).

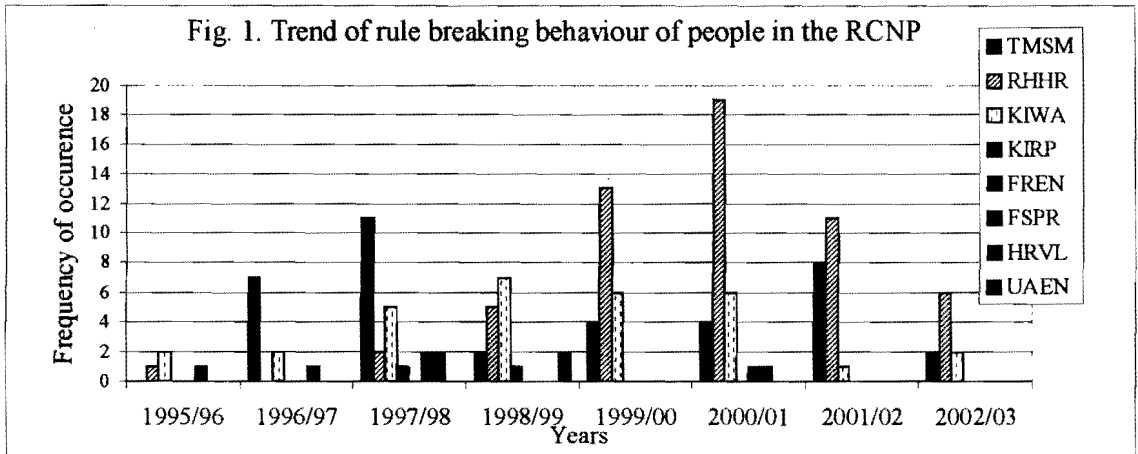
## **6. COMMUNITY PARTICIPATION IN BIODIVERSITY CONSERVATION**

As per the PPP effort in the RCNP bufferzone, one of its major contributions was seen on developing community awareness related to the local, national and international importance of RCNP resources for which biodiversity conservation is the most. The record of community participation is kept by respective users committee in VDC and also by RCNP/PPP in its Kasara Head Office. Although we have not collected this data, an analysis of it would indicate evidences of peoples' participation in biodiversity conservation. As per the PPP participatory program, role of local community was valued for such conservation programs mainly through timely communication with RCNP officials on the related issues given below:

1. Help as informant to discourage wildlife killing, smuggling of rhino horns or pilferage of wood or against poisoning of river water, and so on.
2. Inform the RCNP officials or rangers or army staff in the nearest check post if found somebody poaching wild animals or poisoning the river water for fishing.
3. Try to convince the local people in neighborhood to reduce or stop practice of going into the RCNP and bufferzone forest for collecting grass, firewood, herbals etc.
4. Try to convince local people to avoid taking animals for grazing domestic animals into the RCNP and avoid encroachment into the community forest and inform RCNP if anybody found involved in such activities.
5. Help to return wild animals into the park if found roaming outside the park area in the village or in crop areas in the bufferzone, and so on.
6. Day and night patrol of community forests in the bufferzone by the respective user members in group and checking conditions of barbed wire fences against animal and human damage.

We also collected data from RCNP office to understand rule-breaking behavior of people against conservation of biodiversity of RCNP resources and shown in Fig. 1. Because of poor documentation of information, we could trace out registered court cases only up to the past 1995/96 from the present. In the area of water resource, only the poisoning of the river water for

fishing was found recorded by RCNP. However, cases of smuggling of rhino horn, killing other endangered wild animals and pilferage of wood were found to be the major ones that pose a serious challenge to existing conservation strategy.



TMSM=Timber pilferage, RHHR= Smuggling Rhino horn, KIWA=Killing of wild animals, KIRP=Killing of reptiles, FREN=Forest encroachment, FSPR=Fishing by poisoning river water, HRVL=Collecting herbs of medicinal value, UAEN=Unauthorized entry into the park area.

Records indicated that in many cases some local people also appear to be involved. "RCNP has not been able to arrest significant portion of the total cases in which the smugglers should have become successful in their effort," says one RCNP staff. Two major reasons for this could be the inadequate number of security forces deputed in the check posts and weakness in creating conservation awareness with the bufferzone population by the concerned agencies.

## 7. EQUITY CONCERNS IN BIODIVERSITY CONSERVATION

It is widely held notion that people want equity maintained while making resources access to them in the process of government financing for developing social capital and natural resources including development of irrigation facility in the community aimed at biodiversity conservation. Creation of social problems have root in equity issues that in turn can influence the maintenance of ecological productivity and services. It would be relevant here to bring again the issue of groundwater irrigation failure case under study. They are the one who suffered a long way from such as failure of irrigation intervention by PPP and have been deprived of reaping the economic benefit that successful cases have made it. Unlike those farther away, there are others cases too who being very close to RCNP have not received due attention from the development agencies. Question then, turns to why those residing closer to RCNP who are poorer section in the society that are most vulnerable to biodiversity conservation not attended adequately? From their study in their national park of Nepal, Agrawal and Gupta (2002) reported that richer and upper caste households have a higher probability of joining and participating in government sponsored common property resource management programs. We also observed that those who participate by virtue of economic and caste status have more bargaining power than the poor in the same society. Similarly, those who interact more with government officials are more likely to generate more income out of the interaction.

Being closer to the park, poor households are exposed to greater risk of wild life attack than the community residing farther away. Although some relief funds are available from the RCNP, the more important crop insurance policy against wildlife depredation still appears to be a major factor influencing the relationship, which has not yet received adequate attention. Despite some efforts of RCNP to developing the crop loss evaluation technique, it has not gained momentum as expected. What does it mean that development activity has yet to reach the bottom in this bufferzone?

PPP has been appreciative for its efforts on initiating process for community sensitization about value of RCNP resources, peoples' role in its conservation, organizing people for mobilizing internal resources such as programs of saving and credit and made irrigation intervention successful in many cases. This effort has definitely changed the attitudes of many people for the betterment of park and people relation. However, it still seems like many initiatives were initially less participatory and thus it missed the community where the support had to be prioritized. And, where poor people were deprived of access to resource opportunity, it was partly due to their own incompetence and weak leadership not to interact more with PPP and other agencies to make the effort successful. This was evidenced by the comparison of failure and successful groundwater irrigation intervention cases presented in this paper.

## **8. KEY POINTS AND CONCLUDING OBSERVATIONS**

At both national policy and use levels, the water allocation mechanism between park and people is poorly defined. As water is considered a scarce resource in the face of increasing competition, detailed accounting of river flow would be very helpful to provide a basis for developing appropriate water-sharing mechanisms that redefines the entitlements of water rights. Such policy improvement would be complemented by initiating Rapti River Basin level dialogues involving all related stakeholders particularly the Water User Association, RCNP, Bufferzone Development Council, local industry, District Forest Office, District Water Supply Office, District Irrigation Office, and the District Development Committee to suggest short-term and long-term strategies to cope up with conflicting needs of multiple water uses. Significant focus is also needed to address how water related national, regional and local institutions could work in a better-coordinated manner.

Successful irrigation intervention cases have contributed significantly to the household economy and food security. They have reduced much of their pressure on the park resources particularly for fuelwood and fodder. Furthermore, local farmers are busier than before growing crops year round using irrigation. They are also very involved in organizational activities due to success in groundwater irrigation efforts. It is here noteworthy that farmers in Nayabihani WUG have entered into business network from where they earn good money by selling improved corn seed at a higher price every year.

In Pragati WUG where irrigation intervention projects failed because of inequities in resource distribution are also associated with incompetence in WUG leadership. These are communities characterized by low income, lower cast and less literate groups who have less bargaining power in society. Future biodiversity conservation activity of the RCNP will be more successful if their approaches place high priority on improving household food security of these vulnerable poor

sections that reside close to the park.

Development agencies can learn many lessons from successful intervention cases like those in Nayabihani groundwater WUG and Satakholi fishpond WUG. Satakholi farmers produce so much fish that if they could take most of their products to Narayanghat Bazar, income would further increase significantly. Access to big market because of their remote location, seasonal road, and RCNP forest on the way to distant market are their major problems.

The issue that has most profoundly influenced the park and people relationship is insurance against wildlife depredation of crop. This part of the relationship has not yet been adequately emphasized by RCNP. Where irrigation intervention was successful, improved economic incentives have in many ways compensated the loss in productivity due to wildlife depredation as well as removed the threat of crop loss due to long dry-spell. Irrigation development has also strengthened local institutions that participate in many biodiversity conservation activities. Therefore, if a crop insurance policy will take a long time to implement, a new plan to establish shallow groundwater sources for the communities located close to the park may be a better alternative. Such a plan would require little initial investment and have a low operating cost making it affordable on a cost-sharing basis.



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