

Community Experiments with Sustainable Management of Wild Frogs in Salavan Province, Lao PDR

by Rachel Dechaineux, March 2001

1. Introduction

In rural areas of Lao PDR there is a high dependency on non-timber forest products for local food security. In southern areas frogs and fish are the most valuable non-timber forest products, harvested from the wild for rural household subsistence and the most important source of protein in the diets of the Lao people (Clendon 2000). Yet their availability in recent years is the most rapidly declining of food resources. Until recently there have been few examples of managing wildlife at the community level for food besides fish. Over-exploitation of frogs is one of the direct causes leading to the reduction of wild frog populations and in turn increasing risks of food insecurity of local people.

This case study describes the community efforts of Konglunoi Village in Salavan Province in Lao PDR to improve food security through managing wild frog populations. In particular, it describes an action research initiative engaging the local people in frog resource management. The IUCN NTFP Project has been working in this area since 1996 promoting community well being and people's participation to manage forest resources in a sustainable way. This report is based on the Project's experiences in supporting to facilitate participatory research, monitoring, and analysis of sustainable management wild frogs. In particular, the case study focuses on results of work done over two wet seasons in 1999 and 2000. Participatory techniques were used to elicit much of the information, and regular interactions with the villagers were conducted. A case is made for exploring local indigenous and scientific knowledge to determine sustainable exploitation of frogs.

2. Frogs and Rural Livelihoods

2.1. Setting of Konglunoi Village

Konglunoi Village is located on the southern boundary of Xe Bang Nouan National Biodiversity Conservation Area (NBCA), in Wapi District, Salavan Province. Katang ethnic peoples established Konglunoi Village in early 1983 after two moves since original settlement inside the conservation area, along the Xe Bang Nouan River. Then, they were regarded as forest dwellers by lowland Lao, and largely practiced upland rice cultivation and maintained forest gardens. Since resettlement, the community of 27 families relies on the production of rain-fed rice on very fragile lands. The clearing of forest for agriculture production on sandy soils in the area has induced rapid decline of soil fertility and devastating soil erosion, contributing to low productivity and serious rice shortages for Konglunoi residents.

Livestock is important for capital security in particular buffaloes are critical for rice cultivation. However, degradation of dry *dipterocarp* forests, called in Lao language '*paa khork*', has reduced grazing lands and now livestock is released to the mountains, a practice requiring less labour and avoiding the need for fodder collection. The disadvantage is that forest and bamboo regeneration is impaired, tree and grassland is subject to regular burning (though officially prohibited) and the livestock is exposed to predation by tigers. Also less dung is utilised to fertilise agricultural fields.

Food sufficiency is the villager's overwhelming concern. Villagers recognise a trend of depleting food supplies, both wild and cultivated, due to changing ecological conditions and accelerated depletion of forest resources. The opening up of the cash economy is increasing the need for cash and new opportunities to acquire it. Communities rely increasingly on forest products for cash income and subsistence needs and free access remains the main mode of forest use.

Neighbouring larger villages also have a major impact on the depletion of forest resources. All these pressures have increased uncertainty of local food security.

2.2. Importance of NTFPs and Forest Foods

Konglunoi community has a high dependency on forest products. Marketable products such as '*khiisii*' damar resins, bamboos and rattans in handicraft production contribute to 60% of cash income. However most important are the forest food products collected on a daily basis for consumption, exchange and trade.

The NTFP Project conducted a Forest Food Study in 1998-9 to gain a deeper understanding of the contribution of forest food resources to food security and community well (Clendon, 2001, forthcoming). This study revealed that in Konglunoi village forest food is 13% of total food consumption per household. Forest food products average at 70-80% by weight of all foods consumed after the staple glutinous rice. Products such as fish, frogs, bamboo shoots, mushrooms, tree leaves, wild meats and insects are obtained from natural forests, rice fields and associated aquatic environments.

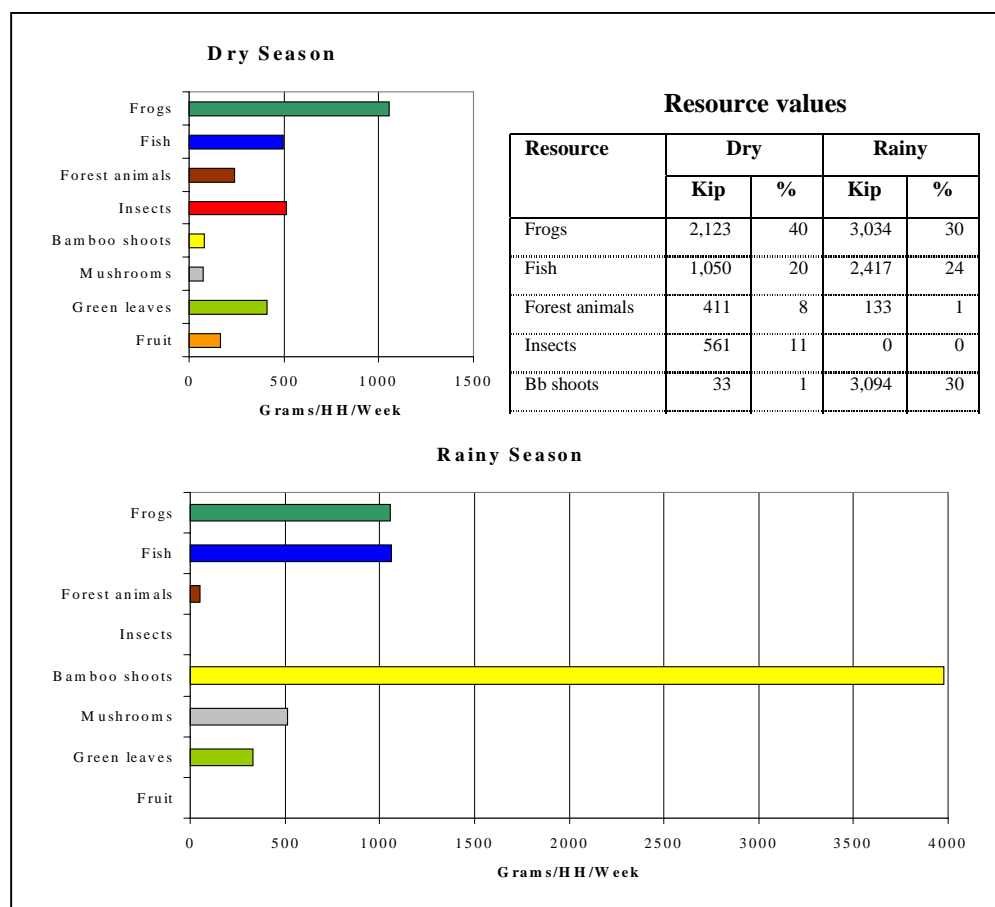
During the study of villagers' dependency on forest foods, villagers ranked various species of frogs as the most important forest food. It is the most frequently harvested, consumed, sold and most rapidly declining of all wild food resources. Discussions with villagers during the study raised awareness among Konglunoi villagers on the value, importance and causes of resource decline. In early 1999, the villagers decided to regulate control over resources in order to reduce the impacts of competitive and destructive harvesting.

2.3. Frogs contribution to community well-being

Frogs are consumed on a daily basis more frequently and abundantly than all the wildlife as well as the most regularly traded or exchanged of all forest food products. Men, women and children collect frogs throughout the year mainly in quantities to satisfy the next meal. This is not due to economizing but rather to declines of resource availability. Frogs are ranked as the most valuable forest food resource harvested in both dry and rainy seasons amounting to of 40% and 30% economic value respectively, see figure 1.

Figure 1 below shows the average values of most important forest foods harvested during the two seasons. This data was obtained from recording of forest foods harvested, over one week by nine case study households contributing to the forest food study.

Figure 1: Seasonal harvesting and valuation of forest foods, (Clendon, 2000).



2.4. Trends in frog collection

Frog collection is free access for all local people including those adjacent villages. Frogs are usually collected in rice paddy areas, stream margins and lowland open forests. Commercial trade in frogs started in 1991, when battery run headlights became available on the local markets. Soon after, frogs were collected by the buckets full and sold to outside traders. Very rapidly, availability of frogs started to decline. Konglunoi villagers estimate that two persons could easily catch 15-20 kg (30-40 frogs) in one hunting session lasting only 1.5-3 hours in 1991. In 1999, a similar couple of persons would only be able to collect 3-7 kg in a similar session. In the villagers' opinion, the conversion of open forests into paddy fields and general forest degradation in other village areas has caused a decline in frogs in those areas. In turn, increased numbers of people from adjacent villages come to collect frogs inside Konglunoi village lands.

3. Steps towards wild frog management

The NTFP Project team assisted the Konglunoi community by providing facilitation skills and simple tools to allow the community to plan, implement, manage and monitor their own resources. The main steps in the process were:

- a) forest foods study
- b) participatory analysis of frog management options
- c) understanding the frog lifecycle
- d) area and site selection
- e) formulating protection rules
- f) implementation and monitoring

3.1. Entry point: the forest foods study

A study was conducted in Konglunoi Village on the role of forest foods in livelihoods, over dry, wet and cold season during 1998-99. It raised the community's awareness of the benefits of sustainable resource use and management by providing villagers the opportunity to be actively involved in recording and analysis of resource harvesting and use. For Konglunoi villagers, this study provided the impulse to work on frog resource management initiatives for food security due to:

- ❑ It is extremely important resource for local livelihood (consumption and sale). It contributed to 30% & 40% value of forest foods consumed in dry and wet seasons respectively;
- ❑ Frogs are most frequently gathered resource (all year round) by men, women and children;
- ❑ Frogs are the most rapidly depleting resource due to over use and unsustainable harvesting practices;
- ❑ No management attempt has been made till date.

3.2. Frogs in the landscape

Konglunoi Village land area is 584,975 ha, of which about 75% is *dipterocarp* forest and 20% paddy fields. There are three main streams and many field channels. According to villagers, frogs are mainly found in the following land use types: rice fields, streams, lowland open forests and upland streams. Table 1 summarizes the occurrence of various frog species in each habitat and local harvesting patterns.

Table 1: Site Typology for Habitats of Declining Frog Populations

Sites	Characteristics	Frog types	Frequency of Collection
Rice fields and margins, field channels, ponds	Flat land, rice paddy, close to village, recently cleared fields in open lowland. Water available is dependent on rains and upland runoff	Kop Khiat mohr Khiat luaeng Tadpoles	Daily Daily/often Sometimes/Infrequently Sometimes
Lowland streams, stream margins	Seasonal streams, natural ponds, marshes. Dammed ponds on streams. Sandy, rocky stream beds, moist shady margins. Trees, bamboo, scrub. Water dependent on rainfall and upland runoff.	Kop Khiat mohr Khiat saay	Daily Daily
Lowland open forest 'paa khork'	Dry <i>Dipterocarp</i> / mixed forest on low nutrient sandy soils. Degraded forest, secondary growth. Subject to surface erosion.	Khiat mohr Khiat leuang	Daily/Often Sometimes/Infrequently
Upland streams, stream banks	Perennial streams, XBN tributaries inside NBCA. Permanent water holes. Damp shady margins. High forest. Increased water flow during rains.	Kop	Sometimes

3.3. Participatory analysis of management options

Upon request of the community, the NTFP Project facilitated brainstorming sessions and community group discussions to understand management options available and select most appropriate local measures to obtain the communities needs, see Table 2. Two or more representatives from each household attended the meeting. The chief of village and key person for food study activities presented results, feedback from the forest food study to the community. Separate men and women's discussion

groups were conducted and presented in a forum. A few young children aged between 8-12 years also joined the discussions with the women's group. Outcomes from the two groups revealed women's ideas playing a crucial role in providing solutions.

Domestication of frogs was considered not appropriate because of the risks of introducing new frog species in the environment, relatively high investment costs and lack of equitable benefits for all households. The community felt that natural frog management was a more realistic option to be tested.

Table 2: Analysis of Frog Management Options

Management Option	Advantages	Disadvantages	Feasible?
Domestication: <i>Raising Frogs</i>	Potential high production of frogs for sale and consumption	<ul style="list-style-type: none"> • Requires new technical expertise/ training • Unknown risks of introduced frog species • High & regular inputs e.g. Must purchase processed food • Uncertainty of recovery funds/ small market 	NO
Semi domestication: <i>Captive frog breeding</i>	<ul style="list-style-type: none"> • Catch & raise wild frogs in egg in family fish pond areas • Small investment of netting area 	<ul style="list-style-type: none"> • Low productivity • Only wealthier families have fish ponds/ few benefit • Labour to forage frog food • Hard to stop frogs escaping 	Not sure
Resource Conservation and Management: <i>seasonal harvesting, protection area for breeding, rules and regulations</i>	<ul style="list-style-type: none"> • Low costs for signs • Natural breeding process to enhance frog populations • No inputs required • Equitable sharing of benefits 	<ul style="list-style-type: none"> • Adjacent villagers not abide by rules 	Yes

3.4. Understanding wild frog lifecycles

Villagers decided to study the impacts of harvesting on various stages on the frog life cycle, see Table 3. Frog reproduction begins in June with frog mating calls, and eggs are laid between July and August. By late September frogs are mature and migrating from the wetlands to higher grounds to seek food. Frogs are recognized to be mature at 6 months and by one year are capable of breeding.

The removal of all stages of frog life cycle reduces opportunity to sustain populations. Villagers decided that most severe impacts on declines of frog populations caused by harvesting of eggs (spawn), tadpoles and small frogs. The community wants to have larger frogs available for food consumption rather than increasing the amounts of harvestable tadpoles. For that reason, the conservation measures concentrate on the early stages of the frog cycle.

Table 3: Investigating Sustainable Harvesting Systems (SHS) for Frogs

Part Used	Impacts causing decline	Source of repopulation	Harvesting impacts on growth	Recom. Harvest age/size	Methods proposed to achieve SHS	Influencing Factors
Spawn/egg, Tadpole All parts of frog	<ul style="list-style-type: none"> Over-harvesting Harvesting of gestating females, eggs, larvae, tadpoles, immature frogs 	Spawn/eggs, tadpoles	<ul style="list-style-type: none"> Use of battery torches leads to over-harvesting Removal of all life stages causes reduced breeding Over-harvesting of frogs for sale 	Mature frogs 6 < 12 months	<ul style="list-style-type: none"> Restrict harvesting to 6 months per year Females lay eggs aged 6<12 months so take females 1 year < Establish village boundaries, define use areas for each village Control harvest to specified areas Don't take for sale. Reduce use of battery light. Don't use hooks 	<ul style="list-style-type: none"> Cooperate with neighbours to form shared rules and regulations Collaborate with other villages, NTFP Project, District & Provincial authorities in planning, establish rules and ensuring enforcement of mutually agreed rules.

Figure 2: Illustration of the Frog Life Cycle developed with villagers



3.5. The selection of “Thong Na Di” as the trial area

Early February 1999, Konglunoi community held a village meeting to discuss and select a suitable area as the village frog conservation and management Area. It was agreed that an area of land east of the village called ‘Thong Na Di’ was to be the most appropriate area, for the following reasons:

- ◆ Ecological Aspects: Tong Na Di area is a suitable frog breeding habitat as it includes paddy field areas holding water suitable for spawning, two stream margins lined with trees and under shrubs allowing frogs retreat from wet-paddy post spawning.
- ◆ Equity issues: The paddy fields in this area are owned by wealthier families in the village, who are willing and able to seek alternate food supplies and refrain from frog harvesting during early stages of frog life cycle as required.
- ◆ Convenient access: Villagers hunt frogs in Thong Na Di on a daily basis as the area is easily accessible. Another advantage is that paddy owners’ accommodate field houses during the wet season and can contribute to regulating harvesting and monitoring activities.

Thong Na Di area is located on the east border of Konglunoi village housing area and covers land through to the border of neighbouring Nong Boua Village. Two streams pass through the area called ‘hong naa dii’ and ‘hong nam kham’, both lined with 20-50m of forest shrub either side. The total land area for frog conservation inside Thong Na Di is 43.39 ha. There are eleven paddy field owners in this area including one from the adjacent village.

Sign posts were placed along the boundary at access points to indicate the boundary area for “frog conservation and management area” and display regulations on restricted harvesting measures in the area. The Project supported Konglunoi community to clarify and delineate the boundaries of this area by:

1. Facilitating participatory mapping exercises, in groups of men and women;
2. Conducting land area survey and boundary demarcation with villagers;
3. Providing paint for sign posts on boundary and access points;
4. Mapping the area onto Forest Land Allocation baseline map.

3.6. Developing rules and regulations

The community developed rules and regulations on the harvesting of frogs inside the selected conservation and management area. Based on the participatory group discussions groups of women and men determined a number of rules and prohibitions such as:

- ◆ Prohibited harvesting May-November (7 months) inside Thong Na Di conservation & management area, open season harvesting December - April;
- ◆ In the open season permits harvesting of all frog types, yet prohibits more destructive practices such as use of spot lighting, hooks, nets, scoop/funnel baskets or other harmful techniques;
- ◆ During the open season only Konglunoi community residents and all landowners inside Thong Na Di are allowed to harvest frogs in the area;
- ◆ Infringements will be regulated with first time warnings; second fines based on double the market value of resource collected; and third both fines and sent to district level for conviction.

Konglunoi villagers believe that the exclusion of outside users access to harvesting frogs in Thong Na Di area is feasible, as forest land allocation has defined village boundaries and advocates a role for village level resource management. Allowing all village residents rights to collect during open season is significant for equitable access to resources by the community and contributing to food security for poorer households. All community members and, in particular, landowners inside the conservation and management area are responsible for reporting on any infringements. A village agreement on these

rules was endorsed by the district governor and disseminated to neighbouring communities by relevant local authorities. Implementation of frog protection began in June 1999.

Figure 3: Sketch map of wild frog conservation area-Thong Na Di



4. Monitoring Methods

4.1. Developing appropriate monitoring tools

The Project team found little information on wild frog conservation and management activities in Lao PDR. There is no evidence of activities to monitor frogs, depletion and harvesting, or cases of rural people attempting to sustain natural frog populations. There is, however, some work on identification of frog species and their habitats by World Conservation Society (WCS). Although this team is not involved in monitoring wild frog populations, they did come up with a few useful suggestions:

- a) Clipping of frog toes as a tagging method cited in literature.
- b) Total counts of all frogs in 5x5 m. sampling blocks

- c) Total counts of frogs seen at regular intervals along transects
- d) Adding counts outside the protected area as a benchmark for comparison

In addition the Project worked with local knowledge to design and trial monitoring tools based on harvesting methods. Ten villagers (four women) formed a group responsible for implementing and follow up monitoring. Details of the frog monitoring methods implemented are outlined below in table 4 and described in full in the following sections.

Table 4: Frog Monitoring Methods & Sites Selected

No.	Methods	Sites Selected	Season
1	Survey Transects (permanent) <ul style="list-style-type: none"> • Length 200m/ a count at 20 metre intervals for 5 metre diameter • Weekly surveys x 8 weeks • Record count of all kop/khiat caught & sighted, site conditions, gender 	Inside conservation area & out of conservation area <ul style="list-style-type: none"> • 1 transect/site in paddy fields • 1 transect/site in lowland open forest, stream margins 	Wet Sept/Nov
2	Tagging <ul style="list-style-type: none"> • Marked by toe cutting according to site of survey count of all <i>kop /khiat</i> caught 	Community report location & detail of tagged frogs harvested to monitoring team	Wet Sept/Nov Dry
3	Catch per effort <ul style="list-style-type: none"> Dig out holes (<i>kop, khiat mohr</i>) Spot lighting (<i>kop, khiat mohr, khiat nam tao</i>) Turn up sandy soils (<i>khiat saay</i>) Spot lighting (<i>kop, khiat mohr, khiat leuang</i>) Uncover leaves (<i>kop</i>) Using hooks (<i>kop</i>) 	Paddy fields, streams, channel margins. Streams channels, margins, dug out ponds, natural ponds. Stream margins channels Paddy fields, ponds ‘ <i>paa khork</i> ’, mixed forest, stream margins, channels Lowland open forest, ‘ <i>paa khork</i> ’, channels	Dry Early rains/ Wet

4.2. Monitoring by transects

A village meeting was held to invite all community members to understand the objectives for developing a monitoring system with the expectation to build a strong monitoring group to carry out related activities on a regular basis and clearly define communal tasks. An open discussion developed a list of criteria for making up a monitoring group, such as:

- 1) The group needs at least four members who can read and write
- 2) All members need to be truthful and determined to carry out the activities
- 3) Members need to have good relations
- 4) Members are preferably from poorer households
- 5) The group should consist of men and women and children

A total of ten persons including four women volunteered. These people were highly skilled in frog catching and fitted to the agreed criteria. A two-day training was held for this group on transect

monitoring activities providing tools for making counts, recording information, tagging, selecting and establishing transects inside and outside the village frog conservation area. The monitoring group divided into two sub-groups: one for inside and one for outside the frog conservation and management area. Each sub-group appointed a leader responsible for recording data, one person identifying, counting and tagging and three persons as frog catchers.

A total of eight permanent transects were set out: four inside and four outside the conservation area. Transects were marked out with posts at 20m intervals for 200m, leaving ten data collection points. A simple form was designed to record the following data: date and time, weather conditions, species, point number caught, male or female and totals.

The monitoring group agreed on key rules to abide by whilst carrying out activities:

- | <i>Do's</i> | <i>Don'ts</i> |
|--|--|
| <ul style="list-style-type: none">• Always monitor in groups• Follow plans• Release frogs after tagging• Make accurate observations | <ul style="list-style-type: none">• Survey during the day• Count frogs heard only• Spotlight too far ahead or make loud noise• Change numbers in monitoring group |

4.3. Tagging

Frogs surveyed inside the conservation and management area were tagged by cutting the long toe on the right –hand side on the front web for frogs surveyed in paddy, at the back web for those surveyed in stream margins, shrub areas. All those frogs surveyed outside the area were tagged similarly on the left-hand side. This activity motivated humor in frog monitoring.

4.4. Local Monitoring Techniques (catch per effort)

After the first rounds of monitoring by transects, villagers identified some weaknesses of the transect method:

- Lack of accuracy: with only ten persons, it was difficult to achieve a full counts
- Fixed transects are difficult to apply: frogs move to different places at different stages. Fixed transects would be more difficult to cover stages such as when frogs start hibernating in holes.
- Time consuming: with a small group of surveyors, it takes a long time to complete a transect.
- Difficult to interpret data: one needs to make calculations to understand the counts, which is not easy for most participants.
- The method was perceived as tedious and not much fun.

The community worked out an alternative method, based on counting the time needed for one person to catch a fixed number of frogs (e.g. 20 or 30) within a certain habitat, using traditional harvesting methods, following frogs as they move from habitat to habitat. This method had the following advantages:

- Traditional harvesting methods are fine-tuned to follow the movements of frogs during their various life stages
- Everybody could join and understand the purpose and method (including children)
- Because the whole village joined, the job became much lighter
- The frequency of sampling was increased because people did it more often
- This method could be applied at times convenient to all participants
- It was much more fun to do

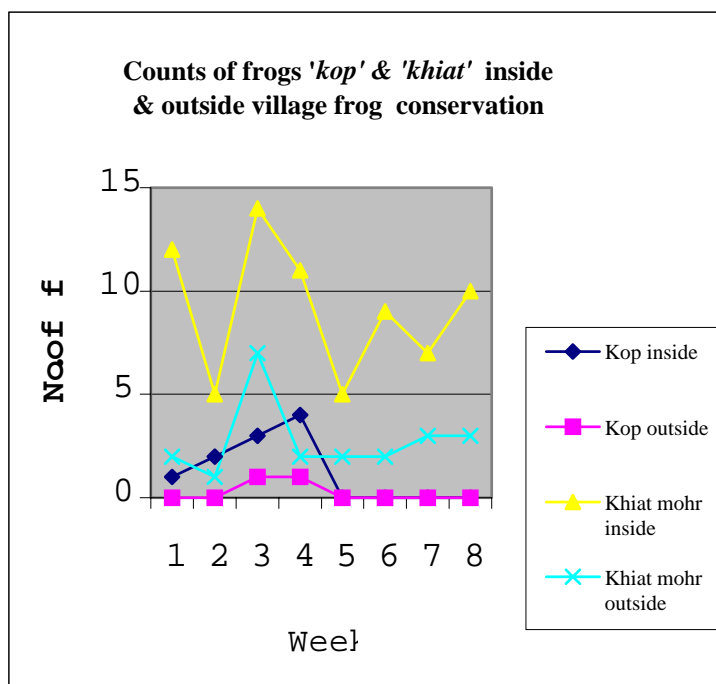
The Project conducted two participatory evaluation meetings with the monitoring group and key village informants to draw together results.

5. Results

5.1. Analysis & Results of Technical Monitoring

The data from monitoring by transects over eight consecutive weeks (late September to early November, 1999) was collated and graphed to show explicitly the difference between frog types and populations inside and outside the village frog conservation area. These results revealed 83% of total frogs surveyed came from inside the village frog conservation area. Numbers of *'khiat mohr'* were overall high in both areas yet noticeably higher by 70% inside the conservation area. Numbers of *'kop'* species were also much higher inside by 80% of all *'kop'* counts, see figure 4 below.

Figure 4:



The few recordings of smaller species all came from inside the conservation area, three *'khiat saay'* and four *'kiat leuang'*. The trends of counts over eight weeks reflect weather conditions that villagers endured during survey activities. For instance, surveys conducted in week two and week five during moderate to heavy rains made it difficult for villagers to carry out efficient counts.

Tagging activities revealed distance of frog migration of between 600-1200 metres. A number of tagged frogs were caught by community members, who then, reported on the harvest location and tagging details to the monitoring group. In hindsight, the technical monitoring activities tested found to be not necessary to continue for future local frog management. The data collection process was inevitably complicated with a consistent 'scientific eye' and skill required for detailed observation, recording of information and analysis. It was also time consuming and fewer repetitions augmented inaccuracy. The information obtained remains of little importance to the community members.

5.2. Striking Results for Villagers

The three seasons of implementing the wild frog management system have exposed amazing results for the increase of *'kop'*. After the first season of restricted harvesting inside the conservation and management area villagers noticed remarkable increase in frog off-takes during the dry season. On the

1st December 1999, open harvesting inside the conservation area villagers struck up to ten frogs per hole as opposed to one or perhaps two in the previous year. The community was most amazed at the impact over just one season enhancing food security for the dry season.

Table 6: Changes in Catch per effort of frogs

Frog type	Location	Method of harvesting	Season harvested	No. frogs per trip	Estimated time taken 1998-9	Estimated Time taken 1999-00	Estimated Time 2000-01
<i>Kop</i>	' <i>paa kohrk</i> ', stream margins, channels	Turn over leaves	Rains-Sept/Oct.	20	120 mins.	80 mins.	No change
	Paddy fields, ponds	Spot lighting	First rains-May/June	30	180 mins.	No data	
	' <i>paa kohrk</i> ', channels	Hooks	Rains-Sept/Oct.	30	240 mins.	240 mins.	
	Paddy fields, stream margins - in conservation area	Dig out	Dry-Nov/May	5	120 mins	10 mins	120 mins
	- outside conservation area	— ” —	— ” —	5	150 mins	60 mins	30 mins
<i>Khiat mohr</i>	Rice paddy, ponds	Spot lighting	First rains-May/June	300	120 mins	No data	No change
	Stream, channel margins	Spot lighting	Dry-Jan/April	150	180 mins	120 mins	
	Paddy fields, stream beds	Dig out	Dry-Dec/April	100	120 mins	120 mins	
<i>Khiat leuang</i>	Paddy, stream margins	Spot lighting	First rains-May/June	300-400	120 mins	No change	
<i>Khiat saay</i>	Stream margins, channels	Turn-up sandy soils	Dry	200	120 mins	No change	
<i>Khiat nam tao</i>	Stream margins, natural ponds, channels	Spot lighting	Dry-Jan/March	1000	120 mins	No change	

The local monitoring system based on catch per effort is a tool that villagers easily understand and gain realistic figures to explain the success of the conservation area to outsiders. Simply based on local observation and daily harvesting ratios, villagers talk feverishly about the increase of frogs, in particular '*kop*' over each season. They recognize that the establishment of a conservation area has increased the populations of frogs along with additional benefits of good rainfall.

Local observations report little change for the smaller frog species, '*khiat*'. The Project team concludes that this is due to lesser value and, or interest placed on '*khiat*' rather than '*kop*' by villagers. There is scope for more investigation and local monitoring of the '*khiat*' types.

During rains between months of July to September 2000, villagers observed new predators, snakes '*ngu sing na*' (*Ptyas sp.*) eating frogs. Generally throughout the region a rat plague was evident and for

Konglunoi an increase of snakes perceived to stabilize the numbers with little relevant damage to crops. This is pertinent to ecological changes but the role of frogs is uncertain.

By the end of this same period, the mature frogs began to migrate out from the paddy fields to higher grounds seeking food and were most prominent in village housing area. The community members conveniently collected up to 20 frogs per 20 minutes without leaving the village area. Some local people perceive this as being the reason why there are little frogs available in the conservation area during the dry season.

The instance of the fall in harvests of frogs '*kop*' inside the conservation area, during the dry season of 2000-2001, made the villagers inquisitive. The time expenditure went back to two hours for approximately four to five frogs. However villagers observed that there was an extraordinary 8-fold increase of frogs available in the old village area, Ban Hang, beyond the east border of the conservation area. The villagers perceive that frog populations are migrating to new spawning grounds raising the question whether the conservation area should be rotated to encompass particular dry hibernation areas. Moreover, the increased off-takes during the dry season when frogs are hibernating, fulfills the aims of villagers to increase of frog populations for food security.

6. Discussion on Findings

6.1. Affects of conservation measures on frog populations

This case provides a good example of community efforts to manage wild life in natural habitats. Local knowledge was the key vehicle for investigation, planning, monitoring and obtaining results. Konglunoi community perceives that this management system, set up to countervail the rapid decline of frogs has had significant impacts on sustaining and expanding frog populations. Maintaining a controlled seasonal protection area has reduced negative impacts on the growth of tadpoles allowing for higher percentage of survival of mature frogs. Success is measured by increased harvesting off-takes generating local commitment and potential expansion of the conservation system.

Ecological conditions of the protection area provide habitats for frogs at various stages of growth and are an important factor for the rapid expansion of frog populations. Stream margins, forest undergrowth and shrubs providing shade and cooler temperatures, are a retreat for maturing frogs. Villagers observe that the good rains and moderate temperatures have contributed to the success of maintaining tadpole populations in the early stages. The local people have reported sightings of deceased tadpoles on days with high temperatures and strong sun during the rainy season. Villagers' insights and observations are valuable contributions for understanding these ecological impacts.

Specialists recognize that the frog types '*kop*' and '*khiat mohr*' adapt easily to ecological changes. This trial did not reveal evidence of this, however the use of fertilisers is one factor that may have negative impacts on the survival of certain tadpoles species or maturing frogs. In so, what level of habitat maintenance is important for future success to sustaining frog populations?

6.2. Frog migration

From this trial the community has a clearer understanding on the patterns of frog migrations. Providing opportunities for reflecting and discussing the patterns of frog migration has raised local awareness and interest on habitat conditions for frog survival. Maturing frogs migrate to higher grounds to seek feed and habitats for hibernating during dry season, there seems to be no particular direction of migration. A few local recordings revealed a capacity for frogs to travel a distance up to 600 to 1,200 metres. It is uncertain that these figures represent an average distance for frog migration.

During months August and September maturing frogs migrating out of the protected area, west into the village housing area were willingly consumed by residents amazed at the frog abundance. By December, the villager's observed that availability of frogs was less inside the conservation area although increased in the Ban Hang area, east of Thong Na Di. This area has plenty of undergrowth from degraded forest. Some local people believe that prolonged rains and early cool season forced the

extensive frogs populations to hibernate on the higher grounds, rather than returning to the paddy. Such indications of frog migration patterns from the protected area are locally regarded as influences by the ecological conditions.

6.3. Evolving the management system

It is important to understand that it was the community's decision to start-up the frog conservation and management area as a trial activity. The initial results from the first trial season were critical to capturing villager's commitment to continue the protection and improved harvesting practices. The excitement of reducing time and effort 8-12 fold with increased off-takes motivated villager's interest, many households began to implement the management system on private lands as well as expanding 3+ hectares of paddy field to the existing conservation area, amounting to over 46 hectares.

During the second wet-season the community placed stronger controls on infringements. Even though there has been only one violation of the rules by a Konglunoi resident where a warning was posed, the village decided to intensify controls. A fining system for encroachers was improved, for first infringements US\$6-\$25 fine and doubled on the second. A third breach would incur a triple fine and be sent to district law courts for conviction. In addition the adapted regulations clarified benefit sharing for reporters 50%, community funds receive 20-30%, and remaining to local enforcing committee.

6.4. Tenure Issues

In this case frog resource management has been conducted on both communal and private lands with communal benefits. In large, it is because the land allocation process had settled issues of open access, defined boundaries between villages, and secured village rights to the benefits of sustainable land management the community was confident to restrict access to outsiders. Landowners voluntarily adopted the conservation measures, to the benefit of food security for all village residents. The issue of restricting outsiders' access to hunting frogs inside Konglunoi village lands became more prevalent once residents recognized successful results. Adjacent communities have requested the District forestry office to assist establishing frog conservation areas in their own village lands.

7. Conclusions & Recommendations

7.1. Local knowledge in development

The focus on using indigenous knowledge to expand existing resources shows that management solutions need not always be provided from the outside. 'Science' does not always provide appropriate answers. Good facilitators in participatory techniques, with strong information exchange networks can assist local people to provide solutions, usually more applicable to local contexts.

7.2. Linking food security to biodiversity conservation

Assistance to improve food security and livelihoods can focus on helping to manage and enhance existing natural resources, rather than focusing just on the expensive introduction of, for example, non-traditional livestock. It is valuable to understand how livelihoods are associated with ecology systems. Again, 'tapping' into the wealth of local knowledge on sustainable use of resources is necessary to develop appropriate conservation measures. The positive experience in Konglunoi could serve as a lesson for rural development specialists or local people interested in improving their food security and natural resource habitats.

8. Literature

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