Special Section : Man-Nature Relationship

Non-palatable Medicinal Plants as a Solution to Crop Raiding by Wild Herbivores around Protected Areas

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Abstract

The Tadoba-Andhari Tiger Reserve (TATR) is an important nature conservation area for the country having a good population of wild animals. However, on the fringes of this national park, there are issues of human-wildlife conflict such as crop raiding by wild animals, which is an underestimated problem. The constant threat of crop predators and perceived loss in crop produce has discouraged agriculture in close vicinity of the park. Farming is the main livelihood for the people living near TATR, therefore it is an urgent need to keep under review the alternative options that can contribute to farmers' welfare. Considering the developing medicinal plant demand, there is potential in cultivating non-palatable traded medicinal plant species that are resistant to crop-raiding by wildlife. The paper suggests such a model for farmers. We focus on research, awareness, motivation, facilitation and establishing market linkages.

Introduction

Agriculture plays a vital role in India's economy. Over 58 per cent of the rural households depend on agriculture as their principal means of livelihood, our study area adjoining Tadoba Andhari Tiger Reserve (TATR) not being an exception. But at the same time, agricultural lands close to protected areas (PAs) often face crop raiding by wild herbivores, which is a serious problem for farmers whose livelihoods depend on agricultural produce (1,2,3,4). In order to avoid economic loss, farmers apply a range of protective measures. They include manual guarding, various types of fences, trenches and other devices. However, these measures often come with high associated costs and risks (5,6,7). The traditional fences are made using wooden poles and thorny branches lopped from nearby forests causing substantial damage to the forest. Destructive measures such as traps can kill or injure animals. Highly sophisticated means such as electric fences are expensive and need contin-

ued maintenance. Although a number of measures have been developed they seem to be failing at some or the other point of time (8). The traditional practices which generally keep raiding at bay and even culling are not advisable to avoid this conflict.

Compensating for loss is practised in India but the compensation amount given to victims is often inadequate (7,8) and hence management of wildlife is increasingly losing its harmony with local people (10). We still need to discover and implement ideas for fringe area management through various relevant means of livelihood which will positively contribute towards conservation. When we already know that management in such projects needs conservation with a focus on community participation, then changing their attitude toward it is of great significance. There is a positive link between the pertinent knowledge and attitudes to conservation (12,13,14). Consequently, it becomes self-evident to build interventions that raise awareness about conservation strategies. Strategies like medicinal plant based alternative liveli-

hood will amplify the knowledge and behavioural attitudes of the existing livelihood strategies (12).

The newly implemented restrictions on non-agricultural land use in the buffer area are likely to further worsen the conflict (22,25). The aim behind such restrictions is no doubt to promote coexistence between wildlife and human activity, with due recognition of livelihood, developmental, social and cultural rights of the local people. But now with many other options being cut off, alternative farm-based livelihoods need to be explored as a promising and workable option for these communities (1,4). Medicinal plants have the potential to contribute to output growth of agriculture in rural areas. Agriculture based additional livelihood generation will be important to achieve desirable quality of life for farmers. Executing such plantation of medicinal plants could intensify the introduction of simple new application-based technologies, which will have access to new markets (13, 16,17,18). For example, if farmers in such areas grow *Tulsi* plants, which is a non-palatable medicinal plant species, followed by a very simple value addition technique (i.e. drying) and with due training if they follow herbal infusion packing processes, it can directly contribute to their livelihood generation thanks to all the tourists visiting national parks who can become customers for such products.

Therefore, we felt that improving of existing livelihoods should be dealt in an innovative way. Considering the need for conservation and sustainability in the medicinal plants sector, a solution that combined both of these would be ideal. We initiated development of short-scale market strategies followed by training sessions for local people in this region. Diversification of such marketing strategies and their expansion at a larger scale was emphasized during the project period. Formation of a co-operative society of these communities can lead them towards fetching beneficial opportunities. They can achieve this through the National Medicinal Plant Board and other promotional schemes. Such livelihood creation, if linked to the co-operative groups will be a win-win model for local farmers.

Study area and relevance

Tadoba Andhari Tiger Reserve in Chandrapur district of Maharashtra state in central India is one of the 47 Project Tiger reserves in India. It is situated approximately 150 km south of Nagpur city. It was declared as a National Park in 1955. Tadoba National Park (116.55 Sq. Kms.) and Andhari wildlife sanctuary (508.85 Sq. Kms.) together form the Tadoba-Andhari

Tiger Reserve. 625.82 sq.km. is the extent of the core area. In addition there is 1101.77 sq.km. of buffer area. The total legal area of the tiger reserve is 1727.59 km². (Source: Website of NTCA).

There are over 79 villages in and around this tiger reserve. Villages along the western boundary of Tadoba Andhari Tiger Reserve, Chandrapur, Maharashtra including Ashta, Mudholi, Chandankheda, Vadala, Viloda were the focus of our study. The research site is shown in Figure 1.

The primary occupation for people in these fringe villages is agriculture. The agriculture is monsoon dependent. Although the rainfall is high, it is erratic and affects crop productivity. Under a traditional agricultural system composed of two separate seasons, namely *kharif* (monsoon crops) and *rabi* (winter crops), the following crops are grown here: Rice (*Oryza sativa*) and soybean (*Glycine max*) are the primary *kharif* crops whereas wheat (*Triticum aestivum*) and chickpea (*Cicerariae tinum*) are primary *rabi* crops. Apart from these, cotton (*Gossypium arboreum*), turmeric (*Curcuma longa*), flax or linseed (*Linum usitatissimum*), and grass pea or sweet blue pea (*Lathyrus sativa*) are other secondary crops taken to a lesser extent (8).

Figure 1 : Study Area

The study

Our current study is based on the background of a study conducted by a research team from IISER, Pune on crop raiding by wild animals along the western boundaries of TATR (9, 10).

The study comprised of four phases :

- Phase 1 : Selection of species
- Phase 2 : Trial plantation
- Phase 3 : Techniques for value addition and investment scenario
- Phase 4 : Market linkages

Phase 1 : Selection of species

Selection of species for propagation was done with the criteria of growth, minimum care, and non-palatable to herbivores. These species are as follows :

1. *Cymbopogon Sp.* (Citronella and Gavati chaha)
2. *Stevia rebaudiana* (Candy leaf/ Sweet leaf/Stevia)
3. *Andrographis paniculata* (Kalmegh)
4. *Asparagus racemosus* (Shatavari)
5. *Cassia angustifolia* (Sonamukhi)
6. *Withania somnifera* (Ashwagandha)
7. *Oscimum sanctum* (Tulsi)
8. *Cissus quadrangularis* (Hadjodi)
9. *Vetiveria zizanioides* (Vala)
10. *Acorus calamus* (Vekhand)

Phase 2 : Trial plantation of 10 species

We tried to grow selected medicinal plants which are in high trade in the study area to test their suitability for the soil and climatic conditions. Some of these can give yield year around and others with a short crop-like life cycle.

Table 1 : Economics of select plant crops

Name of crop	Kalmegh	Tulsi	Vekhand	Stevia
Type of crop	One time	Recurring	Recurring	Recurring
Harvesting cycle	7-9 months	Every 6 months for 3 years	Every year for 3 years	Every year for 5 years
Origin of planting stalk	Seeds	Seeds	Rhizome cuttings	Lower stem cuttings
Planting material	2000	500	32000	32500
Land Preparation cost	1200	1200	3000	1200
Weed Management	1500	3000	4000	6000
Sowing	1000	2000	2500	3500
Fertilizer	4000	5000	6000	6000
Harvesting	3000	5000	6000	3000
Post harvest Management	1500	2000	3000	8000
Total cost (Rs/acre)	14,000	18,700	56,500	60,200
Market rate/kg Year -2015-16	40	35	70	100
Yield per acre (according to standardized NMPB norms)	700 kg	1500–2000 kg	1000-1500 kg	1200 kg
Total income (Rs/acre)	28,000	52500	70,000	1,20,000
Economic benefit (Rs/acre)	14,000	33,800	13,500	59,800

Phase 3 : Techniques for value addition and investment scenario

In the trial plantation phase, some crops showed luxurious growth in the given experimental plots suggesting the suitability of that crop as a viable alternative. We could standardise the return on investment for these crop options. e.g. Kalmegh, Vekhand, Tulsi and Stevia.

Based on the data collected, the economics of these select species is given in Table 1 – all costs are in Rupees.

With further experimentation, we hope to finalise investment and return for other species like Citronella, Sonamukhi, Ashwagandha, Hadjodi and Vala, as we could see that they too have significant

potential as plant crops for alternative livelihood.

With some crop options like *Cissus* sp. and *Asparagus* sp. we failed to get required growth in our experiment. So we could not conclude positively on few such species, which will need further investigation.

We then established a systematic approach in managing the alternative crops with the expertise provided by relevant experts in the medicinal plant field. The techniques of propagation, detailed cultivation methods, suggestions about raising of the planting stock, post planting treatments, manure/compost application, method of harvest, post-harvest management, and value addition techniques were developed as part of this phase. For the benefit of farmers, these were addressed in detail using the local language

Table 2 : Awareness and motivation workshops

Sr No.	Dates	Participants	Activities	Discussion/Outcome
1	May 2015	25	Common meeting for promotion of the concept	Farmers got to know for the first time about such crops which are in high trade (other than alternatives like Haldi which they have known)
2	10 July 2015	50	Meeting with local NGO and Biodiversity management committee representatives	Is the proposed model possible in Tadoba fringe and what will be the cost for such plantation
3	8 and 9th May 2016	150	A workshop with farmers having representation from all villages	Booklet with cultivation options was released, buyback guarantors for small crop yield visited this workshop

Table 3 : Experts who participated in the workshops

Name of expert	Institute/NGO/Other affiliation	Expertise
Dr. Rajendra Kale	Upvan	Buyback and cultivation of medicinal plants
Dr. Vrinda Kate	Shri Shail Medi farms	Cultivation and planting stalk
Poorva Joshi	Bio concepts	Medicinal plant trade and cultivation need
Ambarish Ghatate	Ayurvan foundation	Cultivation, buyback
Dr. Diwakar	State Horticultural and Medicinal Plant Board	Medicinal plants and role of government
IISER facilitators	National Medicinal Plant board	Grant options for individual farmers : Printed information on various grants
Vijay Dethe	Paryavaran mitra	Biodiversity Management Committee, People's Biodiversity Register, and community rights

Figure 2 : Marathi booklet and information sharing

Figure 3 : Workshop

Figure 4 : Training farmers

Figure 5 : Field training and technique standardization

(Marathi) in a booklet “Aushadhi vanaspatinche krushikaran : Ek garaj, Ek upay” (24).

Phase 4 : Awareness and motivation program

To disseminate the above information and to carry out meaningful interaction with locals we organized multiple workshops, facilitated by the research team. These workshops also helped us to validate and work through the suitability of the concept. The schedule, structure, and outcomes of these workshops are summarized in Table 2. The experts who participated in these workshops are listed in Table 3.

The booklet developed for these workshops will act as a tool that can be used to replicate this innovative and practical model for all forest fringes and creating best-practice guidelines. This booklet is developed with special focus on all local farmers as target audience. It gives all information related to cultivation methodology and buy back in the local language.

Figures 2-5 show a few glimpses of meaningful interactions during the workshops and fieldwork.

Discussion and recommendations

Owing to the vicinity of forests, buffer zones of Protected Areas have distinct advantages in agriculture such as good ground water levels and availability of green manure. The main problem of these areas is crop-raiding animals. The problem needs to be addressed at multiple levels including measures to reduce the damage, encouraging alternative crop species which are non-palatable to herbivores, along with alternative livelihood options (9). The innovative solution proposed here will help in supporting the current agriculture based livelihoods and also support conservation of wildlife by reducing human-wildlife conflicts. With simple value addition techniques, the

produce can be made available for small scale medicinal industry establishing new employment strategies for the youths in such affected regions. Farmers can scale up the production if they form their own co-operative society and adopt appropriate post-harvest technologies, value addition and QPM (Quality Planting Materials) management. It is also possible to have purchase tie-ups with the herbal medicine industry.

It is expected that the venture will be independently run by the community after a certain period of intervention and guidance from the research team, thus improving their standard of living.

One major advantage of the TATR forest is that being a tiger reserve, it attracts a large number of tourists. Subsequently, selling some value-added produce from these medicinal herbs to tourists can provide additional business to the locals. For example, herbal tea or dried medicinal produce in packets can be sold to tourists.

The core concern of the study was to offer a solution to reduce the crop raiding and subsequently to provide economic alternative to the farmers to fulfil their livelihood necessities. So we developed a workable model that involves local people towards wildlife conservation and will contribute towards mitigating man-wildlife conflict issues. Our study addresses biodiversity conservation, human-animal conflict, rural development, crop raiding, employment strategies, diversification, and behavioural development of the community over their territory.

In this study, we also analysed the value chain for medicinal plants produced by village-based marginal farmers and homestead growers. We established linkages with buyers and made the information available to farmers (24). The booklet produced in this study addresses the distribution channels, purchase locations for seeds and fertilizer, water supply for the plants, technology inputs, etc. We also suggest an improved value chain system through economic coordination that links production with the enhancement of the producers' livelihoods. Through the research, we could do a market survey for the produce. With two potential buyers interested, we took forward the concept in a meeting between farmers and buyers. Commitment of buying the produce was offered by buyers. During this meeting, to avoid middlemen, buyers even promised farmers to the pick-up of primary processed harvest. With this successful intervention, now we want to help further in strengthening such linkages for the benefit of farmers.

As a future prospect, the diversification of this project and commencement of further research and

development pertaining to this project will be initiated to sustain the livelihood option in the form of medicinal plant cultivation. This innovative enterprise may contribute in formalizing the informal medicinal plant sector in several ways. Policy supporting the formalization of such businesses and subsidies (a few are already available through National Medicinal Plant Board, Delhi for clusters of farmers) for medicinal plant growers in wildlife conflict areas may contribute to the betterment of these communities.

Conclusion

The research suggests that the diversification of agriculture in man-wildlife conflict areas will be useful for livelihood enhancement. A closer linkage between the producers and processors of medicinal plants through direct farmer participation could result in a multitude of benefits to both, in terms of price, quality, lead time and overall improvement of the supply chain.

This work will create awareness regarding alternative livelihood options in the form of non-palatable medicinal plant cultivation, and in meeting the demand of raw materials required for herbal medicine industries. This pilot study has provided an important starting point for research, training, and knowledge sharing about cultivation and post-processing practices of medicinal plants. It is important to develop and adopt these plants as a crop species to create a successful model for alternative livelihoods.

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