International *Journal* of Applied Research

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Conservation needs of medicinal plants: An analysis of stakeholders' perspective

Narasimha Baba Brindavanam, Gurinderjit Singh Goraya and Santosh Pal Singh

Abstract
Medicinal plants (MPs) are associated with high degree of socio-economic value. In view of the growing sustainability threats, there is a need for their conservation. Stakeholder analysis and engagement are considered important for any Conservation effort. Due to the multistakeholder structure of MP sector, it is desirable to engage a broad-based consultative process.
With the objective to obtain the perspective of diverse stakeholders on conservation needs of MPs in Indian context, two online surveys were conducted involving (a) the users of medicinal plants (RUG) and (b) the resource managers and experts (RME). An online survey platform, Surveymonkey.com was used for this study. Chi-square test was used for statistical analysis of scoring and ranking questions.
A total of 93 responses were received from these surveys. Most of the respondents acknowledged the prevailing threats to the MP species. Loss of habitats due to diversion of forest lands and lack of strategic management plan were scored high as the factors for sustainability threats. RME group opined in general that present policy framework and the existing knowledge base are inadequate to handle the conservation needs of MPs. Both the groups acknowledged the need for focused models for conservation of MPs. In this direction, the respondents favoured the use of Medicinal Plants Conservation Areas (MPCAs) model. RME group further suggested participative models for efficient management of MPCAs. Based on the outcomes of this dipstick survey, it is possible to consolidate further suggestions on MPCA models. At the same time, it is desirable to consider the limitations of these surveys. These analyses need to be further supported by scientific data for strategic management of the category.

Keywords: Conservation, medicinal plants, medicinal plants conservation areas, MPCA, resource users, resource managers, stakeholders, survey

1. Introduction
From a socio-economic perspective, medicinal plants (MPs) constitute an important category of biological resources. An average of 467,000 tons per annum of dried medicinal plants were traded in global markets between the years 1991-2003 (Lange, 2006) [12]. The value of this trade was pegged at US$ 1.2 billion per annum. In another study, the global trade of medicinal plants was pegged at US$ 6.2 b. by 2013 (Tripathi *et al*, 2017) [17].
India stood as the second largest exporter of medicinal plants with an average annual export of 44,000 MT between 1991-1993 to 95 countries. The annual revenue from this global trade was pegged at US$ 61 million (Lange, 2006) [12]. Further, it is reported that 1178 species are utilized in India for health care purposes and the cumulative volumes of their use sum up to an estimated 5,12,000 tons per annum including household consumption, domestic and export trades. The estimated value from this trade is about Rs. 20,000 crores (Goraya & Ved, 2017) [6].
Medicinal plants sector contributes to social good in two dimensions. Firstly, on account of livelihoods. Like other types of forest produce, the category contributes to the livelihoods of marginal communities like collectors, cultivators, small traders, etc. (Byron & Arnold, 1999) [3]. A study commissioned by the National Medicinal Plants Board reported that the MP sector generates about 60 m. man-days of employment to the needy people (Ved & Goraya, 2007) [20]. Further, the category contributes to positive health through healthcare products - leading to improvement in economic productivity.

The economic value of such social good practically could be six-times of the annual trade value (Srivastava *et al.*, 1996) [21].

1.1 Pressures on the Resource
Intense commercial extraction often from selected areas, destructive nature of harvesting and global loss of habitats due to alterations in the land use etc. are considered as major threats to the sustainability of MP category (Lange, 2004) [22]. Considering the socio-economic importance in combination with the persistent pressures on the resource- it may be argued that MPs require focused attention in terms of conservation and sustainable use. Perhaps, due to these considerations, the World Health Organization (WHO) called for a concerted effort in this direction through Chiang-Mai declaration (Akerele, 1993) [1].

1.2 Stakeholder Engagement in Conservation
Conservation as a process engages governments, local people, institutional groups, and charities, etc. (Mason M.). Though challenging, it is considered critical to incorporate stakeholders' inputs for understanding the status and the human pressures on natural resources (Gray *et al*, 2020) [7]. Since the domain of natural products involves multiple sectors, and sub-sectors thereof, it might be arduous to collate and analyse stakeholders' perspectives for each of the sectors and sub-sectors that too, for each country.

Surveys may be considered as a preliminary tool and a steppingstone in the stakeholder's engagement. Stakeholders' analyses are reported to obtain the views on biodiversity management (Varma *et al*, 2015, Eriksson & Klapwijk, 2019) [19, 5]. In the context of MPs, it is generally seen that the surveys have mostly been used for eliciting ethnomedicinal uses. In recent decades, however, surveys are also being used for other purposes like assessment of threat perceptions, conservation and sustainable use and policy framework thereto (Larsen *et al*, 2005, Osemeobo, 2010 and Uprety *et al*, 2011) [13, 15, 18]. In most of these studies, the participants are drawn from the dependent communities.

In the Indian context, the value chain of medicinal plants continues to follow traditional practices and involves multiple stakeholders polarized between producers at one end and the end-users at the second pole. Any strategic programme or project for conservation of this category would be incomplete without their involvement. However, there are no reliable reports analysing the perspectives covering both segments of stakeholders simultaneously, on conservation of MPs.

Therefore, a dipstick study was planned to obtain the views of these two sets of stakeholders with respect to sustainability threats posed to MPs and modalities for their conservation in the Indian context. Medicinal Plants Conservation Areas (MPCA) is the youngest model for In-situ conservation of the category (Biswas *et al*, 2017) [2]. Hence, the model was included as a subject of inquiry into this survey.

Objectives of the Study
- To obtain the opinions of stakeholders regarding sustainability threats to medicinal plants
- To collate views of resource managers with reference to existing framework for management of medicinal plants
- To obtain broad perspectives of both the groups on the modalities for conservation of medicinal plants including the MPCA model

2. Methodology
Separate online surveys were conducted to gather perspective of the two sets of respondents.

2.1 Survey.1
The Survey-1 was aimed at gathering perceptions of the "user's segment", cumulatively referred to as the Resource User's Group (RUG). Six categories of RUG respondents *viz.* wholesale traders in national markets, industrial users, industry associations, Ayurvedic practitioners, teachers, and researchers of Ayurvedic system and industry consultants were included in this study. It was launched on the hosting portal during June 2019 and collection of responses was closed in December 2019 (Portal's Reference: SurveyMonkey_180058115). A total of 151 requests were sent to the prospective participants.

2.2 Survey.2
The respondents for Survey-2 comprised of foresters, forest policy and administration, conservation researchers, consultants, professionals functioning in corporate social responsibility (CSR) wings and NGOs, cumulatively referred to as the Resource Managers and Experts (RME). This survey was conducted online between May and September 2020 (Portal's reference: Survey Monkey_282694721). A total of 98 individuals were requested for participation in the survey.

Both the questionnaires comprised of YES or NO type, multiple choice, Likert Scale (5-1) and Ranking (1- 5) types of questions. In addition, personal information was gathered in the beginning of questionnaires.

The participants for both these surveys were selected through judgmental sampling. Further, they were also requested to refer the surveys among their own circles - for a snowballing effect. This combination was chosen since the nature of study required respondents having hands on knowledge of the medicinal plants sector. The prospective respondents were approached through e-mails or through web-links.

The questionnaires for these two surveys were different in general with an exclusion to the personal details to be collated from the respondents. However, two of the core questions were common to both categories with some variance in the choices for scoring or ranking. In addition, one question of Survey-2 was drawn based on outcomes from Survey-1. Results of both the studies are presented together, in view of the broader objectives of the surveys as also in consideration to common questions.

2.3 Ethical Considerations
The participants were identified from the professional contacts of the investigators. The participation was ensured to be voluntary without any obligations. The covering e-mail contained a briefing on the scope of survey. The survey page of the portal was set to send a single reminder after 2 weeks of the first communication in case of non-response. No other form of communication was used for repeated reminders.

The participants were assured about the confidentiality and non-disclosure of identities. The covering mail also carried

an assurance that their opinions would not be attributed to the institutions, which they are affiliated to and shall be construed as their personal opinions.

2.4 Statistical Analysis

For 'Yes' or 'No' and 'True' or 'False' questions and for multi-choice questions, the views expressed by simple majority (expressed as % age of the total respondents) was accounted for. Where ranking system was used for obtaining graded responses, the survey platform converted the ranks to scores. The output documents of the survey portal provided the data in the form of weighted average scores converted from ranks. Similarly, weighed average was taken as the basis for scoring questions. In the cases of Ranking and Scoring questions, Chi-square test was used to analyse the significance at 0.05. Statistical test was performed using SPPS software (Version. 21).

The results are presented individually for both surveys in Part-1 and Part-2. Responses for questions which are common to both are presented and discussed in a linking manner under results, Part-3.

Results

3.1. Part-I (For RUG Segment)

3.1.1. Participants' profile

A total of 56 participants responded in Survey-1, of which 7 responses were incomplete with less 50% queries answered hence excluded from analysis. The data is, thus, presented in respect of 49 respondents. The participants' profiles are presented in shown in Tables – 1. a and 1. b

3.1.2 Traded Species & Origin of Supplies

The questionnaire for Survey-1 contained questions to record perception of respondents on general trends of trade and supplies of medicinal plants.

As to the diversity of medicinal plants in trade, most of the respondents (17 out of 49; 34.69%) approximated that 250-499 species of MPs were in trade. 15 participants (30.61%) assumed that over 1000 species were in trade and utilization. As to the source of medicinal plants in trade and usage, 22 participants (44.90%) felt that tropical species predominated the usage patterns in the country, whereas 18 respondents (36.73%) felt that it was the Himalayan species that were dominant in trade and usage.

3.1.3 Threat Perceptions

The RUG respondents were asked if they agreed that the medicinal plants as a category faced a high-degree conservation and sustainability threats (CST). The outcome is shown in Figure-1.

3.1.4 Overall trend of Conservation and Sustainability Threats (CST)

Responding to the degree of threats, 19 respondents (38.78%) considered that 16-29% of traded species faced a high-degree conservation and sustainability threats; 16 respondents (32.65%) opined that 30-59% of traded species were vulnerable. In response to a related question, a vast majority (71.43%) indicated that Himalayan medicinal plants faced the highest degree of conservation and sustainability threats (CST).

3.1.5 Impacts of CST: A scoring question was framed to elicit the perceptions of stakeholders on the impacts of CST.

7 options were enlisted for scoring between 5 and 1. The weighted average of scoring against each option has been considered for comparison. The outcomes of this question are summarized in Table – 2:

3.1.6 Conservation Needs

Forty-two respondents (85.71%) advocated for development and use of specialized models for conservation of MPs- in response to the related question.

3.2. Part-II (RME Segment)

3.2.1. Participants Profile

In case of Survey-2, a total of 98 individuals were approached for participation in the survey. Each one of them was also requested to refer the survey to other experts for wider outreach. A total of 40 responses were received through the first line requests. Further 4 responses were obtained through referral channels, thus making the final number to 44 responses. All the responses were complete and valid. The profiles of the participants are presented Tables – 3.a and 3.b.

3.2.2. Conservation and Sustainability Concerns: Perceptions of RME group

The concerns expressed by RUG respondents, as drawn from Survey-1, were posed to the respondents of the RME group and they were asked to offer their level of agreement to these concerns through in a multiple-choice question. Figure-2 captures the essence of their responses.

3.2.3. Prevailing Regulatory and Policy Framework

Three questions were posed in the context of regulatory and policy framework for conservation. 32 respondents (72.73%) opined that there was a need to create specialized network of Conservation Areas for floral diversity in the country; 33 respondents (75%) showed their disagreement to the statement that "the existing regulatory and policy framework is conducive, encouraging and sufficient enough for conservation of threatened flora - irrespective of economic importance"; and 28 respondents (63.64%) disagreed to the presumption that "the regulatory and policy framework is self-sufficient since, it considers the existing and emerging conservation needs of the country". Thus, it may be inferred from the responses received that the existing regulatory and policy framework is not conducive to address issues pertaining to conservation of medicinal plants and that there is a need and opportunity to improve upon it.

3.2.4. Manpower & Knowledge Base

Adequately trained manpower and a sound knowledge base is one of the key factors necessary for ensuring conservation of medicinal plants. To a query as to the adequacy and level of manpower and knowledge base in our country to address this issue, 36 respondents (81.82%) felt that the present situation was inadequate to address the issue and needed improvement. Detailed outcome against this query is presented in Table-4.

3.2.5. Effective Tools for in-situ conservation

In situ models for conservation of medicinal plants is believed to be cost effective tool for the purpose. The respondents of the RME group were asked to opine about efficacy of the different ways to effectively employ *in situ*

conservation tool. The opinions expressed by the respondents of this group on this count are given in Figure-3:

3.2.6. Ranking for Role of Stakeholders in Conservation of MPs

The responsibility of conservation of forests and biodiversity contained therein has been assigned to the forest departments of the respective states. Functional efficacy of this authoritarian model has come to be questioned, especially in respect of its role in conservation of biodiversity. Medicinal plants, being an important component of the biodiversity, the RME respondents under this survey were asked for their perspective on the roles of different stakeholders in conservation processes, and their views are presented in Figure-4.

3.2.7. Ideal Practices for Conservation of medicinal plants

As to the preferred practice of conservation of medicinal plants, a large majority of respondents (88.64%) felt that the current regulatory instruments needed to be applied in combination with traditional practice of conservation through glorification of species and/ or habitats (like sacred tree/ sacred groves) - for better involvement of the local communities and for visible outcomes of the conservation efforts.

3.2.8. Management of MPCA Models for Conservation

Medicinal Plants Conservation Areas (MPCAs), specially set aside for conservation of single or a cluster of medicinal plant species, have emerged as a practical and cost-effective method for *in situ* conservation of medicinal plants. Their management practices, however, are still evolving. A large number of respondents, as evident from Table-5, feel that PPP model might be better suitable for management of MPCAs.

3.3 Part-III: (Questions Common to Both S.1 and S.2)

In addition to group specific questions, respondents from both the RUG and the RME groups were posed two common questions to gather holistic views on the perceived causes for threat to medicinal plants and on the suitability of *in situ* medicinal plant conservation models in practice. The views expressed by the respondents are discussed below:

3.3.1. Causative factors for CST

Eight factors commonly considered contributing to the threat to medicinal plants were listed for seeking response from the respondents from both the groups. Loss of habitat due to changing land use patterns was identified as the foremost cause of threat to the medicinal plants. Whereas the RME group factored lack of strategic management plan as the second important factor for the threat to medicinal plants, both the groups also attributed CST to lack of awareness on scientific harvesting practices (Table-6).

3.3.2 in situ Conservation Models

Responding to the query on feasible and efficient *in situ* conservation models, the respondents from both the RUG and the RME groups collectively rated the Medicinal Plants Conservation Areas (MPCA) model high for its perceived efficiency in conservation. Respondents from the RME group, however, assigned a bit higher score to sacred groves

and temple forests than their choice for the MPCA model. Both the respondent groups rated the village forests/ van panchayats rather low in their preference for suitable model for conservation of medicinal plants. The detailed outcomes of the responses are captured in Figure-5.

4. Discussion

The importance of stakeholders' engagement in natural resource management is well emphasized. Stakeholder analysis (SA) defining their roles in resource management have evoked substantial interest in the last few decades and appropriate guidelines are also described (Grimble & Chan, 1995, Grimble & Wellard, 1997 and Grimble, 1998) [8-10]. Further, stakeholder-based approach to conservation is also recommended to make use of "collective intelligence" of individuals with specific interests (Gray *et al*, 2020) [7].

Though these methods and guidelines may not be specifically for the sector, it may be said that the available framework may be extended in a tailormade fashion to conservation of medicinal plants too. Surveys of stakeholders for specific purposes could be the steppingstone in these processes. This survey is a modest attempt to analyse the perspectives of two sets of stakeholders in medicinal plants sector *viz*. the user segment- RUG and resource managers RME. The questionnaires were specifically designed with subtle variations for both the respondent groups in such a way as to elicit their considered views on various issues pertaining to conservation of medicinal plants based on their experience/ interests in the sector.

The questionnaires comprised of some scoring and ranking questions. While framing these questions, care was taken to enlist the factors/ choices which have an equal importance, so that the expected values for score or a rank should have an equal distribution. It was also kept in view that the human opinions would not support this null hypothesis and that the observed values might show a variance in relation to the expected values. Therefore, Chi-Square test was used to analyse the variance between expected and observed values for these questions.

Responding to the conservation and sustainability threat issue of medicinal plants, the RUG group expressed alarm on the issue, especially in respect of the possible impact on the herbal sector. The REM group took a balanced view about the issue with a visible degree of division in the opinions. In as far as the issues concerning the causes for sustainability threats for medicinal plants, the RUG groups opined that change in land-use pattern was the major factor. Respondents from the RME group, on the other hand, opined that the lack of strategic management plan was an equally important factor for sustainability threats to medicinal plants.

Responding to the query about country's preparedness to meet the conservation challenges faced by the medicinal plants resources, the RME group emphasized upon the need for strengthening the policy and regulatory framework to meet the emerging challenges. Further, the RME group pressed on the need for promoting our knowledge base and suitable institutional network for conservation sciences.

The Medicinal Plants Conservation Areas (MPCAs) model, a relatively a new model for *in situ* conservation of medicinal plants (Biswas *et al*, 2017) [2], has emerged as a possible answer to address issues concerning conservation needs of medicinal plants. Both the RUG and the RME

groups assigned a high rank to this conservation model, even as this ranking by both the groups is very closer to the ranks of sacred groves which are managed by faith-based glorification. Responding to a related question, the RME group also advocated for a 'multi stakeholder management' of the MPCAs.

Thus, it may be stated that the study has served the purpose to a great extent. At the same time, it is important to consider the limitations of surveys and interviews with the stakeholders in environmental decisions like conservation. Concerns are expressed on the effectiveness of public involvement tools particularly when there are inadequacies in the technical information's to strengthen the public opinion (Darnal & Jolly, 2004) [4].

Table 1a: Participants Profile (in terms of category) in the Survey.1- Resource Users Group (RUG)

S. No.	Category	No. of Participants	Percentage
1	Manufacturers/ Industry	14	28.57%
2	Traders & Exporters	4	8.16%
3	Clinical Practitioners	9	18.37%
4	Researchers - both Industry & Academia & Teaching (Ayurveda)	17	34.69%
5	Associations (Trade & Industry)	2	4.08%
6	Others (As per the following Break-up)	3	6.12%
	Consultants	*2*	*4.08%*
	Government Service (Regulatory)	*1*	*2.04%*

Table 1b: Age and Academic Backgrounds of Respondents in RUG

Age Range	No	Percentage
25 – 34 Yrs	6	12.24%
35 – 44 Yrs.	9	18.37%
45 – 54 Yrs.	12	24.49%
55 – 64 Yrs.	15	30.61%
65 Years and above	7	14.29%
Totals	49	100%
Academic Background of Respondents		
Qualification Levels	No	Percentage
Diploma/ Undergraduate	1	2.04%
Graduation	4	8.16%
Post-Graduation	21	42.86%
Doctorate	12	24.89%
Post-Doctoral*	11	22.45
Totals	49	100%

*Mostly in Ayurveda field having completed MD (Ay.), Ph. D

Table 2: Impact of CST on the Herbal medicines sector: Scoring by Respondents in RUG

Option Ref:	Summary of Option for Scoring	Weighted Av. Score	Significance*
C1	Medical assistance will be jeopardised for certain diseases	3.51	0.004
C2	Ayurvedic products may be perceived as environmentally disastrous products	2.96	0.440
C3	When plant species are endangered, connected products would become rare commodities	3.59	0.001
C4	Risk of adulteration at marketplace increases	4.00	0.015
C5	Non-availability of quality herbal medicines, impacts the services of practitioners	4.14	0.000
C6	Adverse impact on business of exporters, traders and manufactures	4.18	0.000
C7	Adverse impact on livelihood means for dependent communities	3.98	0.000

*Chi Square Test: Asymptotic significances are displayed. Significance level: 0.05. Except for C2 rest of scores are significantly different to the expected values.

It comes out from the above table that conservation and sustainability threats to medicinal plants are perceived to be of high significance by the respondents on various use parameters, pointing to the need to address this issue. The respondents also rejected the C2.

Table 3a: Showing the categories of respondents in Survey.2 (Resource Managers and Experts - RME Segment)

S. No.	Category of Respondents	No**.	Percentage
1	Forestry Sector & Forests management	21	47.73%
2	Policy & Administration*	10	22.73%
3	Non- Government Organizations	5	11.36%
4	Research/ Academics & teaching (primarily dealing with conservation) #	17	34.69%
5	Others (As per the following Break-up)	7	15.91%
	Consultants	*3*	6.82%
	Corporate (from CSR functions)	*4*	9.09%
*Four respondents from Forestry and Forest management sectors have overlapping experience in Policy and Administration experience as well			

Five respondents from Forestry and Forest Management sectors have overlapping experience in Research/ Academics/ Teaching Areas also.
An additional 7 respondents have working experience in multiple functions Research, policy and administration. Thus, 16 participants (out of 21) from Forestry and Forests Management- have varied working experience in multiple areas. **Due to these overlaps, the totals shown above sum up to 66-as against actual figure of 44.

Table 3b: Participants Profile in Survey.2- Age & Academic Backgrounds *(RME Group)*

Age Range	No	Percentage
30 – 39 Years	4	9.09%
40 – 49 Years	12	27.27%
50 – 59 Years	13	29.55%
60 Years and above	15	34.09%
Totals	44	100%
Academic Background of Respondents		
Qualification Levels	No	Percentage
Graduation	2	4.55%
Post-Graduation	11	25.00%
Dual Masters	8	18.17%
Doctoral	21	47.73%
Post-Doctoral	2	4.55%
Totals	44	100%

Table 4: Views of resource managers & experts on Knowledge Base on Medicinal plants conservation in Survey.2

Choice Ref.	Answer Choices	Responses	
		Number	% Age
C1	We have the best of talent pool and knowledge base. In fact, one of the best in the world	5	11.36%
C2	Our knowledge base/ talent pool may be small, but it is world-class	3	6.82%
C3	We have limited expertise & also limited places of learning for this purpose	25	56.82%
C4	It is not bad. But We have a long way to build our expertise	10	22.73%
C5	Unfortunately, we are in a sorry state on this account	1	2.27%

With a majority of respondents agree to, country needs to build-up expertise in conservation sciences. For this purpose, there is also a need for increasing institutions of learning in the sphere.

Table 5: Showing preferences for Management of MPCA in Survey.2 (RME Group)

S.2- Q. Designated sites of MPCA can be managed effectively if:		
Choice Ref.	Description	No. (% age)
C1	Protection is conferred through a regulatory instrument	2(4.55%)
C2	The area is glorified like the way sacred groves are revered	2 (4.55%)
C3	Both approaches are used together	10 (22.73%)
C4	Management is entrusted to a partnership between communities and user industries	5 (11.36%)
C5	PPP model comprising of Forests Departments, Communities, and user Industries	25 (56.82%)

It comes out that a distinct majority of participating experts favoured a tripartite management framework for MPCA sites.

Table 6: Contributory factors for CST- Scoring by respondents in RUG and RME groups

Fact. Ref.	Description of Factors	S.1 (RUG)		S.2(RME)	
		Score	Sign.	Score	Sign.
F1	Traditional use of unsustainable plant parts (like roots, rhizomes, tree bark etc.)	3.857	0.000	3.227	0.736
F2	Increasing demands in domestic markets	3.939	0.000	NA	NA
F3	Increasing demands in export markets	3.592	0.030	NA	NA
F4	Changing lifestyles and related financial needs of communities	2.776	0.146	NA	NA
F5	Increasing popularity of herbal products leading to rampant harvests	NA	NA	3.977	0.002
F6	Lack of awareness on sustainable harvesting methods	4.000	0.000	4.295	0.020
F7	Lack of regulatory checks on collection and trading	NA	NA	4.091	0.000
F8	Global warming and climate changes	3.306	0.016	2.932	0.203
F9	Lack of strategic management plan for such an important resource	NA	NA	4.409	0.000
F10	Diversion of forest lands for non-forestry purposes and resultant habitat loss	4.163	0.000	4.068	0.000
F11	Natural limitations of regeneration in wild plant species	3.429	0.199	3.727	0.385

*Chi-Square Test: Asymptotic significances are displayed in both the groups. Significance level: 0.05. F1, F2, F3 and F6 are significantly different from expected values in RUG. F6, F7, F9 and F10 are significantly different from expected values in RME.
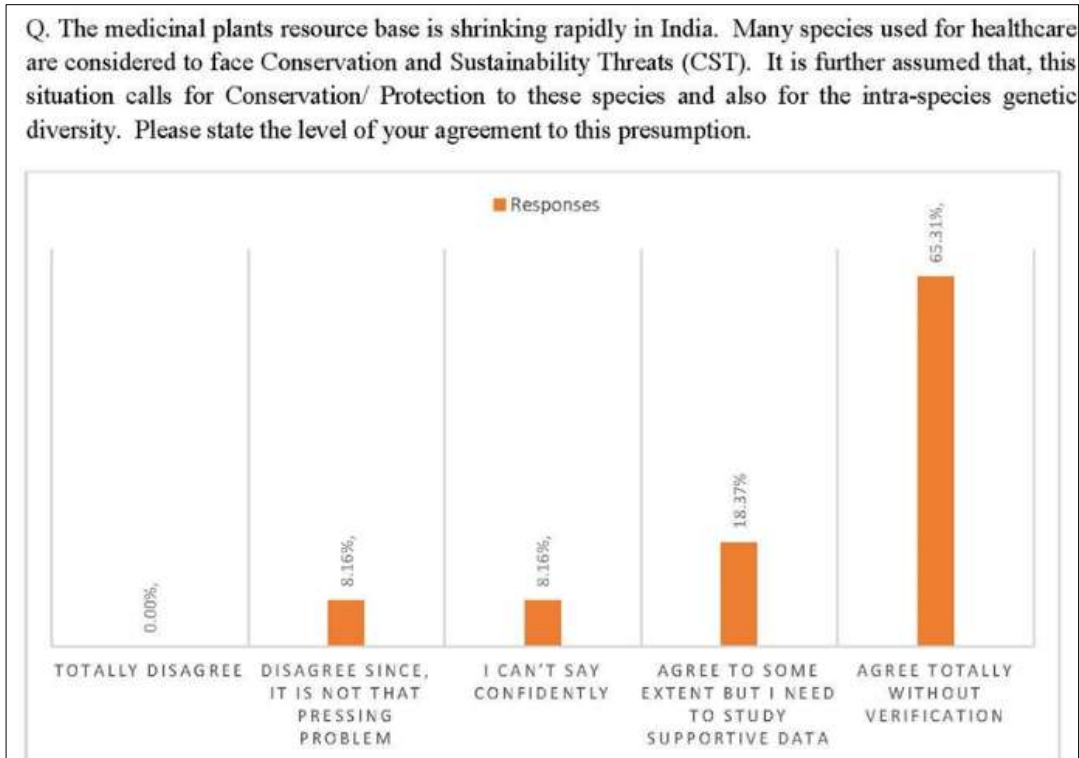
Q. The medicinal plants resource base is shrinking rapidly in India. Many species used for healthcare are considered to face Conservation and Sustainability Threats (CST). It is further assumed that, this situation calls for Conservation/ Protection to these species and also for the intra-species genetic diversity. Please state the level of your agreement to this presumption.

Fig 1: Perceptions of Resource Users Group (RUG) about sustainability threats for medicinal plants.

More than 65% of the respondents agreed to the proposition that medicinal plants were under threat, even as a few of them (about 18%) would have liked data to support their agreement.

Q.: A representative sample of stakeholders in medicinal plants sector consider that, the medicinal plants as a group face high degree of Conservation and Sustainability Threats (CST). Please state the level of your agreement to this presumption (chose any one answer)
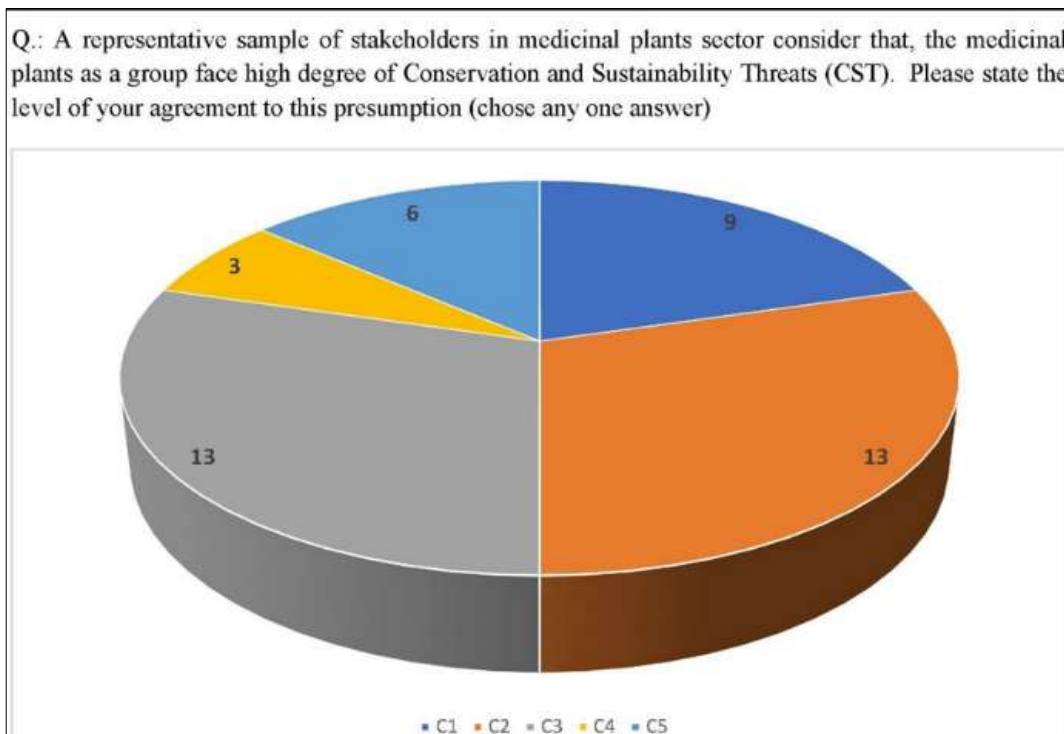
Fig 2: Conservation concerns: Respondent's perspective in RME group

LEGEND (Choices for Selection)
C1- The problem of CST is universal for all types of flora. Not for medicinal plants alone, C2- All species with economic value and market demands are prone to face CST, C3- CST in case of medicinal plants is more glaring because of their economic and social importance, C4- Stakeholders are true to some extent. But it requires supportive data, C5-I fully agree with this presumption.

The responses on this account from RME groups seemed to be well calibrated and overall opinion manifested a balanced view. Majority of respondents expressed divided opinion between 3 choices of selection.
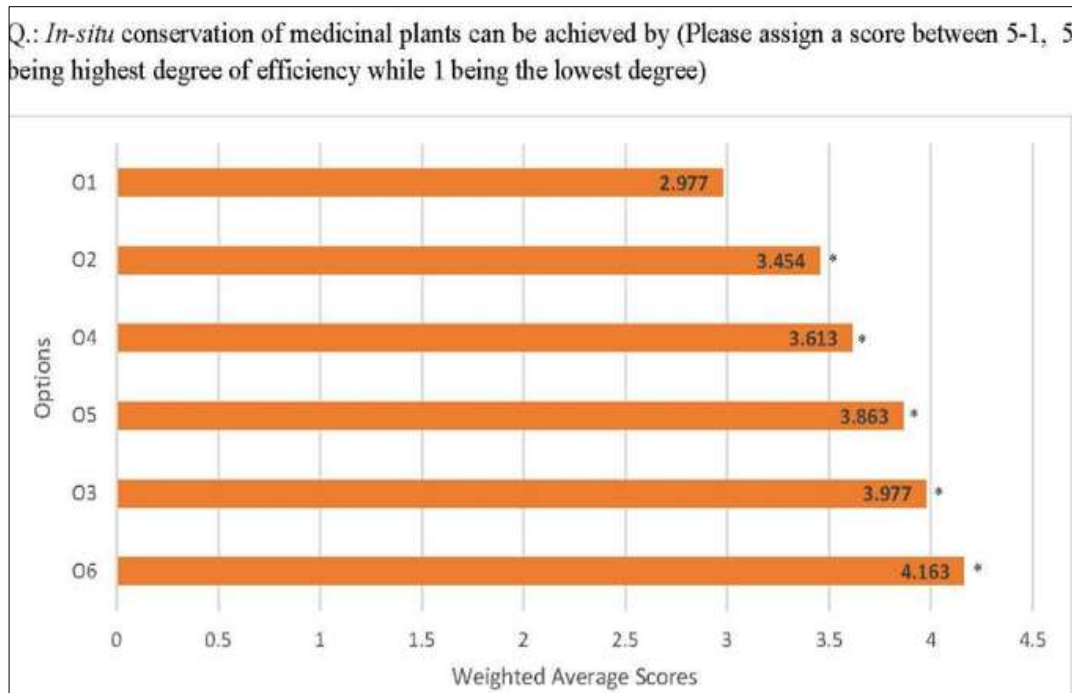
Fig 3: Scoring patterns for different Options under Effective Modalities for Conservation

Legend (Options): O1- Physical protection measures (like fencing/ security posts), O2- Regulatory regimes like Wildlife Protection Act & stringent punitive measures for trespassing, O3-Empowering Biodiversity Management Committees using Biological Diversity Act, O4- Through engagement of communities offering direct cash incentives O5- Through engagement of communities offering sustainable but indirect incentives, O6- Developing a combination of regulatory & participatory tools with tangible and quantifiable returns to the communities.

*Chi-Square Test: Asymptotic significances are displayed. Significance level: 0.05. Excepting for O1, rest of Options are significantly different to the expected values.

As is apparent from the figures above, the participatory modes (O3, O4, O5 & O6) received the highest scores and perceived to be best suited for in situ conservation of medicinal plants. The restrictive modes like physical protection (O1) and strict employment of regulatory regimes (O2) on the other hand received low scores, indicating their limited utility in achieving in situ conservation.
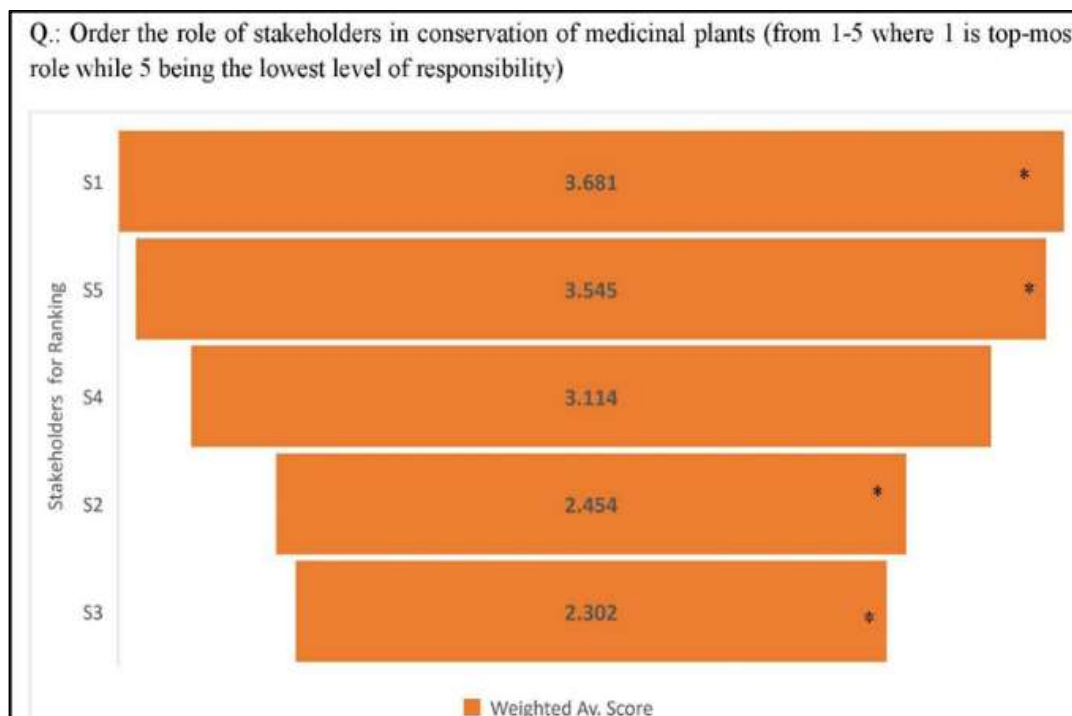

Fig 4: Ranking of stakeholder's role in Conservation of medicinal plants.

LEGEND (Stakeholders listed for ranking): *S1-Forest* dependent communities having collection rights; S2-Industrial users deriving value added products; S3-National

Medicinal Plants Board, Ministry of AYUSH; S4-National Biodiversity Authority/ such other Institutions created under

Biological Diversity Act; S5- Forest departments of various states being the custodians of Forest Lands/ resources.

Ranks assigned by respondents are converted to scores and weighted average (for ex. Rank-1=5, Rank-2=4 etc.). Highest score is placed on the top in the figure to indicate its rank. *Chi-Square Test: Asymptotic significances are displayed. Significance level: 0.05. S1, S2, S3 & S5 are significantly different from expected values.

As is evident from the figure above, the respondents have listed the local communities, the forest departments and the national biodiversity authority as the important stakeholders that should be involved in conservation of medicinal plants.
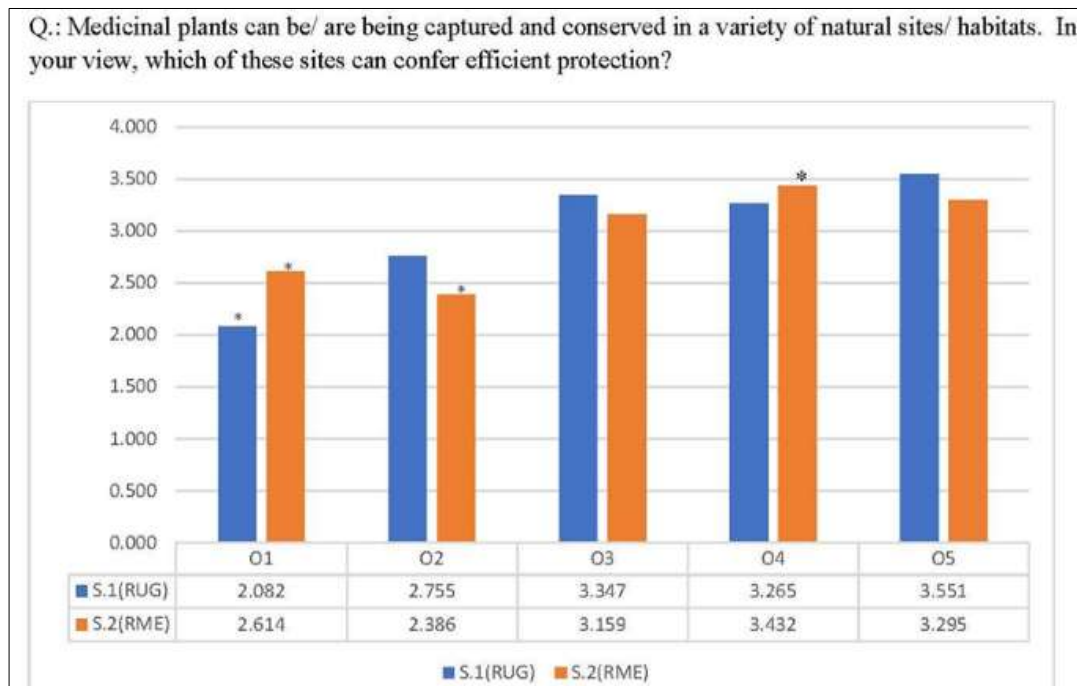

Fig 5: Ranking of different sites for perceived efficiency of conservation by the participants in both the surveys

Legend (Option of Sites listed for ranking): O1-Village forests/ Van-panchayats managed by local people (termed as Gramavana), O2- Reserve forests managed by forest departments, O3- National Parks/ Wildlife sanctuaries meant to protect endangered fauna O4- Sacred Groves protected by communities based on traditional beliefs O5: Medicinal Plants Conservation Areas

*Chi-Square Test: Asymptotic significances are displayed. Significance level: 0.05. Observed values are significantly different to expected values for O1 in case of S.1 (RUG) while O1, O2 and O4 are significantly different in case of S.2 (RME)

5. Conclusions
This study provided an insight into the sustainability threats as perceived by stakeholders. The limitations of existing regulatory and policy framework in conservation of MPs indicatively suggested by stakeholders. Further, the survey elicited favourable responses from the participants on the potential of MPCA model for in-situ conservation of the category. It is possible to mobilize and consolidate workable suggestions of stakeholders on this model.

6. Acknowledgments

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