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Editorial Team: Aarati Khatri and Shreyashi Bista

For the 689-690th issues of Headlines Himalaya, we reviewed researches from three sources and selected 13 researches from five countries. We selected four researches from Nepal and 9 researches from other Himalayan countries (India, China, Bhutan and Pakistan).

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Nepal-Himalaya

NET PRECIPITATION, INFILTRATION AND OVERLAND FLOW PRODUCTION IN THREE TYPES OF COMMUNITY-MANAGED FOREST IN THE MID-HILLS OF EAST CENTRAL NEPAL

Manoj Badu, Chandra Prasad Ghimire, L. Adrian Bruijnzeel, Ian Nuberg, and Wayne S. Meyer

Trees, Forests and People 8: 100218

It is widely believed that community forest management concurrently improves the social, ecological and economic conditions of local populations. Accordingly, large areas of Nepal's Mid-hills' forests are used and managed by local Community Forest User Groups (CFUGs). The CFUGs plant seedlings as well as thin and prune forest trees at varying intensities as determined by local forest conditions and the need for forest product (mainly timber, firewood, livestock fodder and compostable litter). However, the hydrological effects of these activities are uncertain. We present results of through fall (Tf), stem flow (Sf) and overland flow (OF) measurements made between June 2015 and December 2016 (including two consecutive rainy seasons) in three types of community-managed forests subject to different levels of community usage in the Kavre district (East Central Nepal): (i) regenerating natural broad-leaved (BF), (ii) predominantly-planted pine (PF), and (iii) mixed pine-broad-leaved (MF). The BF and MF were used more intensively than the PF. Overall Tf fractions were 72.0%, 73.7% and 77.5% of incident precipitation (P) for the BF, MF and PF, respectively, with corresponding Sf fractions of 1.6%, 1.3% and 0.6%. Overall rainfall interception fractions were 26.4%, 25.1% and 21.9% for the BF, MF and PF, respectively, and reflected the trend in leaf area index. Total amounts of OF constituted 11.4%, 9.8% and 4.7% of net precipitation (Tf+Sf) inputs to the forest floor in the BF, MF and PF, respectively and broadly followed the relative intensity of forest usage. Observed amounts of OF in the study forests represent ca. 50–115 mm of foregone infiltration opportunity per year under average rainfall, implying reductions in the recharge of soil and groundwater reserves of ~6% in the PF to 12–14% in the MF and BF. Our results thus show that regular harvesting of litter, fodder and firewood combined with surface compaction by human traffic constitute important determinants of hill slope hydrological functioning, particularly regarding amounts of foregone infiltration and runoff as OF in the more intensively used community-managed forests of Nepal's Mid-hills.

For Further Reading: <https://doi.org/10.1016/j.tfp.2022.100218>

TRADE POTENTIALITY OF OILS EXTRACTED FROM *PRUNUS DAVIDIANA* (WILD APRICOT), *SAPINDUS MUKOROSSII* (SOAPNUT) AND *ZANTHOXYLUM ARMATUM* (NEPALESE PEPPER) IN KAILASH SACRED LANDSCAPE, NEPAL

Dipesh Pyakurel, Bijay Raj Subedee, Chandra Kanta Subedi, Janita Gurung, and Ram Prasad Chaudhary

Environmental Challenges 7: 100490

Currently, 80–90% of Nepalese medicinal and aromatic plants (MAPs) are exported in crude form to more than 50 countries worldwide. The prospects of exporting processed MAPs have been discussed but the progress is slow. This paper analyses the trade and prospects of secondary processing of two vegetable oils, *Prunus davidiana* and *Sapindus mukorossi*, and an essential oil of *Zanthoxylum armatum* from Baitadi, Bajhang, Darchula and Humla Districts of the Kailash Sacred Landscape (KSL) in Nepal. A wide range of literature was referred and telephone interviews were conducted with traders and exporters to collect information on the trade value, volume and prospects of these three species. *Prunus davidiana* is a non-native species found in Humla District. *Prunus davidiana* oil is exported along with Chuli (*Prunus armeniaca*) oil with market price of USD 26/kg and an estimated export volume ranging around two tons in 2020 from Nepal. *Sapindus mukorossi* is cultivated and abundantly found in Baitadi, Darchula and Bajhang Districts. Crude *S. mukorossi* is one of the highly exported MAPs of Nepal (1,300–2,550 tons per annum) and from KSL Nepal (estimated 500 tons per annum), but the domestic trade and export of its oil is not yet commenced in the country. *Zanthoxylum armatum* is a widely cultivated native medicinal plant of Nepal with estimated annual export volume (crude) of 1,400–1,700 tons, KSL area in Nepal contributing 4–16 tons per annum. *Zanthoxylum* oil extracted from its fruits is exported to India and European countries. The market price of *Zanthoxylum* oil ranges between USD 110–130/kg, and the export volume ranged between 3.5–7.7 tons. There are no records of processing of *Zanthoxylum* oil in KSL Nepal. The prospects of *P. davidiana* oil in cosmetics and *S. mukorossi* oil in bio-fuel exists but few issues need to be addressed such as inclusion of *P. davidiana* in the Government of Nepal's royalty list to legalize the trade of its oil. Further research on yield and trade potential, and developing efficient processing technology are also needed to build on the trade potential of these three oils.

For Further Reading: <https://doi.org/10.1016/j.envc.2022.100490>

FOREST—PEOPLE NEXUS IN CHANGING LIVELIHOOD CONTEXTS: EVIDENCE FROM COMMUNITY FORESTS IN NEPAL

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Trees, Forests and People 8: 100223

Community forestry in Nepal has set an example of people's participation in forest management. The direct dependency of local people on forest resources for livelihood activities has been one of the key adhesive factors for collective efforts in forest management. Changing livelihood strategies from agriculture-based livelihoods to migration (and remittances thereof) and the service sector, introduces a new dispensation which is yet to be sufficiently understood. This paper explores the changing livelihood strategies of forest users and analyses their effects on participation in forest management. The structured household survey (n = 106), key informant interviews (n = 6), and focal group discussions (n = 3) in three community forest user groups in the mid-hills of Nepal were employed to analyze the changing livelihood strategies in the last 15 years, and to underscore their implications for forest management. We followed the recall process, and in order to ease the recall process, the reference events were discussed with the respondent. The result showed an increasing switch to non-forest dependent livelihood strategies, characterized by the emergence of non-agriculture (remittance, business, service) sectors. While there is no change in the number of CF meetings attended, and the average time spent per meeting by user households, a decreasing dependence on forests, as well as the willingness to participate in forest

management was recorded. These were associated with the change in livelihood strategies from agriculture to non-agriculture-based practices. This context justifies the need for a re-think on how to stabilize the rural sector to limit rural exodus and the management of community forest resources in the mid-hills of Nepal.

For Further Reading: <https://doi.org/10.1016/j.tfp.2022.100223>

DO REMITTANCES MAKE POOR HOUSEHOLDS MORE RESISTANT TO 'NATURAL DISASTERS'? EVIDENCE FROM THE 2015 EARTHQUAKE IN NEPAL

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International Journal of Disaster Risk Reduction 73: 102858

Although many studies have found negative associations between GDP per capita and damage caused by nature's shocks, evidence suggests that this negative association is obscure among low-income countries. By utilizing detailed household (HH) survey data from rural areas of Nepal, we investigated whether rising HH incomes, mainly through remittances, mitigated the damages caused by the 2015 devastating earthquake to houses. We confirmed that remittances were positively associated with house structures using concrete. Our analyses, however, did not show that houses using concrete displayed strength against the seismic shocks in 2015 compared with the masonry houses that were commonly used in the study areas. Our estimates further indicated that those HHs receiving more remittances maintained houses that were more vulnerable to the 2015 earthquake. We consider that the most likely factor by which remittances weakened houses against the seismic shocks are less maintenance and minor repairs in the remittance-dependent HHs. For example, remittance-dependent HHs tends to suffer from the shortage of working-age male workers needed for maintenance work. Our results suggest that using modern construction materials with remittances does not necessarily help HHs withstand nature's shocks.

For Further Reading: <https://doi.org/10.1016/j.ijdrr.2022.102858>

India-Himalaya

INVASIVE SPECIES SERVICES-DISSERVICES CONUNDRUM: A CASE STUDY FROM KASHMIR HIMALAYA

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Journal of Environmental Management 309: 114674

Invasive species and their management represent a multi-faceted issue affecting social and natural systems. People see the advantages and risks of these species through various value structures, which influences decisions on whether and where they can be managed. While many studies have focused on the ecological effects of invasive species, their impact on human livelihoods and well-being is less recognized. Understanding the effects (benefits and costs) of invasive species on livelihoods and human well-being, as well as people's perception, is important for guiding policy formulation and devising management strategies. Here we present a case study of Dal Lake - a freshwater urban lake of Kashmir Himalaya - providing various ecological, biological, and hydrological functions that offer economic, aesthetic, recreational, educational, and other values to the local populace. In the context of a gradually increasing attention on the impacts of Invasive Alien Plant species (IAPs) on this ecosystem, we conducted Focal Group Discussions (FGDs) to determine the perception of people living inside and around Dal

Lake regarding two invasive species, namely, *Nymphaea mexicana* and *Hydrocharis dubia*, and their capacity to provide ecosystem services (ES) and disservices (EDS). Following that, a discursive scenario assessment tool multi-criteria mapping (MCM) was used to involve stakeholders in ranking their priorities in two scenarios of the lake- 'status quo' vs 'clean lake with limited weeds' in the Dal Lake social-ecological system. We found that their perception of the impact of invasive species varies with factors such as the location of invasive plants in the lake, and people's occupation, and household characteristics. Most participants perceive these species positively (i.e., agreeing that they create ecosystem services in the form of cattle feed), but some recognize their importance in providing ecosystem disservices. Their primary concern and priority were the sustenance of their livelihood in any scenario, and most respondents did not oppose the eradication of two IAPs if their livelihood is secure. We conclude that a more nuanced strategy to IAS management is required, one that combines both local livelihood demands and broader environmental and social considerations.

For Further Reading: <https://doi.org/10.1016/j.jenvman.2022.114674>

PREDICTING WASTEFUL SPENDING IN TREE PLANTING PROGRAMS IN INDIAN HIMALAYA

Pushpendra Rana, Forrest Fleischman, Vijay Ramprasad, and Kangjae Lee

World Development 154: 105864

Tree planting is widely promoted as a cost-effective natural climate solution, yet there are few evaluations of the implementation of tree planting. Our analysis of a unique dataset on tree planting in the Indian Himalayan state of Himachal Pradesh shows that over half of the state's budget for tree planting is wasted on plantations that are unlikely to survive and/or are poorly designed to achieve the state's goal of increasing forest cover. Himachal Pradesh (and India more generally) has been identified as a high potential area for natural climate solutions due to high government capacity, adequate funding, and government agencies with extensive planting experience. We combine data on the location and financial outlay for plantations, which allow us to analyze the relationship between plantations and social and biophysical conditions, with a machine learning model, trained on past land cover change, which predicts the likelihood of future tree cover loss in plantation areas. Our finding that even in this high potential area tree planting programs involve considerable wasted expenditure on ineffective plantations raises questions about optimistic assessments of the potential for tree planting to serve as a cost-effective natural climate solution. We suggest deemphasizing the target-based approaches that dominate present policy-making and high-profile scientific publications, which we argue are the cause of wasted expenditures in Himachal Pradesh. Instead policy-makers and scientists interested in natural climate solutions should focus on developing solutions that respond to local biophysical, social, and economic realities, and are implemented through transparent procedures that increase accountability to and reinforce the rights of forest dependent people.

For Further Reading: <https://doi.org/10.1016/j.worlddev.2022.105864>

PLANFORM CHANGES AND ALTERATIONS OF LONGITUDINAL CONNECTIVITY CAUSED BY THE 2019 FLOOD EVENT ON THE BRAIDED BRAHMAPUTRA RIVER IN ASSAM, INDIA

Joy Rajbanshi, Sharmistha Das, and Priyank Pravin Patel

Geomorphology 403: 108174

The longitudinal connectivity of rivers facilitates the downstream transfer of discharge and sediment. Any alterations to this component can potentially impair/block sediment movement, resulting in deposition

and planform alterations. This effect is more enhanced in braided rivers, which usually convey large sediment volumes. In this study, we use Graph Theory to analyze the impact of a big flood event (July 2019 flood) on the channel planform configuration of the Brahmaputra River in the eastern Indian state of Assam. The in-betweenness centrality and structural sediment connectivity of the nodes (channel confluences/diffluences) and links were computed using different indices. The node accessibility was enumerated using the Shimbel Index. Sedimentographs were devised to simulate the likely sediment outflow volumes and its duration in the post-flood scenario. Our results reveal that significant changes in the channel planform were caused by this flood event, which repositioned mid-channel and bank-attached bar deposits and realigned the river's entwined multiple threads. These engendered alterations in the existing channel bifurcations and inter-node connections, thereby impacting on how the sediment was transferred and its pathways. The enumerated accessibility index and simulated sediment volumes reflected the above changes, with reach-wise variations apparent in these aspects. This study helps comprehend the flood-induced planform morphological changes in braided streams, which has implications for navigation. The framework used here can also be applied to assess other braided rivers.

For Further Reading: <https://doi.org/10.1016/j.geomorph.2022.108174>

ASSESSING THE VULNERABILITY OF PROTECTED AREAS IN THE EASTERN HIMALAYAS BASED ON THEIR BIOLOGICAL, ANTHROPOGENIC, AND ENVIRONMENTAL ASPECTS

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Trees, Forests and People 8: 100228

Protected areas are the cornerstone for biodiversity conservation in present times. Considering this, the post-2020 global biodiversity framework aims to expand the network of protected areas to cover 30% of the earth's terrestrial surface by 2030. For effective biodiversity conservation, it is essential to bring in more areas under protection and systematically conserve the areas with greater biological diversity that are relatively more vulnerable to various environmental and anthropogenic stresses. In the present study, we assess the vulnerability of montane forest ecosystems in the protected areas of the eastern Himalayan region of India. Our study specifically classifies the protected areas by their relative vulnerabilities, using established methods based on the number of imperilled species, anthropogenic pressure, and the degree of climate change. The results show that a quarter of the protected areas contain a high species richness of imperilled species; 36% of the protected areas are highly affected by climate change, while only 10% are highly influenced by anthropogenic pressures. Outlining the specific vulnerabilities for protected areas would help determine the required management interventions and promote the judicious use of conservation resources. The analytical framework used in our study can be more widely applied to map the important sites for biodiversity conservation and identify the areas ideal for future expansion.

For Further Reading: <https://doi.org/10.1016/j.tfp.2022.100228>

FUTURE POTENTIAL DISTRIBUTION AND EXPANSION TRENDS OF HIGHLAND BARLEY UNDER CLIMATE CHANGE IN THE QINGHAI-TIBET PLATEAU (QTP)

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Ecological Indicators 136: 108702

Highland barley is an important grain crop in the Qinghai-Tibet Plateau (QTP) of China. However, rare knowledge is available on the spatial pattern of habitat suitability across QTP and how it would be affected by future climate change. Based on 191 presence records, the probability of highland barley across the QTP under climate change is simulated by using the maximum entropy (MaxEnt) model. And the critical environmental variable (s) affecting the distribution of highland barley and the hotspots of habitat degradation/expansion during the 21st century are investigated. The results show that the daily minimum temperature of coldest month and annual precipitation are determined as the two most important environmental variables for predicting habitat distributions. Across the QTP, future climate change may result in an increase in the suitable area for planting highland barley northward, westward, and upward during the 21st century. Highland barley in river valleys of the south-eastern and northeast plateau, where areas of medium and optimal suitable habitats are concentrated, may experience contractions in areas of habitat suitability during the 21st century. By the late 21st century, the average expansion and contraction of suitable habitat areas are 0.46 and 0.14 million km², respectively, and the upper limit elevation suitable for planting barley may increase by 215 m. Our results could provide valuable distribution information to the national and local administrators for developing the special industry of highland barley in the QTP.

For Further Reading: <https://doi.org/10.1016/j.ecolind.2022.108702>

ESTIMATION OF ALPINE GRASSLAND ABOVE-GROUND BIOMASS AND ITS RESPONSE TO CLIMATE ON THE QINGHAI-TIBET PLATEAU DURING 2001 TO 2019

Ju Zhang, Shibo Fang, and Hanhu Liu

Global Ecology and Conservation 35: e02065

The Qinghai-Tibet Plateau (QTP) grassland is a critical part of the carbon pool of terrestrial ecosystems and provides important animal husbandry resources. To embody the stability of grassland ecology and the response of grassland above-ground biomass (AGB) to climate change on the QTP, four estimations models (partial least squares regression (PLSR), random forest (RF), Back-Propagation neural network (BPNN) and deep belief network (DBN)), which are based on statistics, machine learning and deep learning regression methods, respectively, were established to estimate the alpine meadow and alpine steppe AGB from 2001–2019. The results showed that: (1) the RF model performs well on the AGB estimation with the highest accuracy ($R^2=0.84$, $RMSE=8.51gC/m^2$, $MAE=6.46gC/m^2$) and stability ($R^2=0.76$, $RMSE=9.24gC/m^2$, $MAE=8.30gC/m^2$); (2) in spatial pattern, the AGB decreased from southeast to northwest on the QTP, and present a significant increasing with a rate at $0.19gC/m^2a$ and $0.06gC/m^2a$ on alpine meadow and alpine steppe during 2001–2019, respectively; (3) in the past 19 years, the AGB variations on the QTP showed a relatively stability with the average CV of 0.1; (4) the sustainability of the AGB show a weak anti-persistence (Hurst = 0.43), and it indicates that the future trend of the AGB is opposite to the current trend and the AGB is likely to be decreased in the future; (5) temperature and precipitation have a positive promotion on the most alpine meadow and alpine steppe vegetation growth on the QTP, while warming and wetting have negative promotion effects on the northwest of the plateau. These research results can provide

useful reference materials for the study of the impact of climate change on alpine meadow and alpine steppe on the QTP.

For Further Reading: <https://doi.org/10.1016/j.gecco.2022.e02065>

AGRICULTURAL PRODUCTION UNDER RURAL TOURISM ON THE QINGHAI-TIBET PLATEAU: FROM THE PERSPECTIVE OF SMALLHOLDER FARMERS

Yang Lun, Sun Jing, Liu Moucheng, and Min Qingwen

Land Use Policy 103: 105329

Rural tourism has been the leading alternative livelihood of farmers on the Qinghai-Tibet Plateau in recent years. However, the trade-off between agricultural production and rural tourism has been gradually serious. Therefore, we selected the Zhagana Village, an example of rural tourism on the Qinghai-Tibet Plateau, to discuss the agricultural production under rural tourism from smallholder farmers' perspective, and analyze its existence severity of the trade-off. Based on the comparative analysis of smallholder farmers' agricultural production behavior (including the production scale, agricultural input, agricultural output, and production efficiency), we reviewed the agricultural production in the whole study region in 2005–2019. The results show a certain degree of trade-off between agricultural production and rural tourism on the Qinghai-Tibet Plateau. At the level of smallholder farmers, under the background of rural tourism development, agricultural production efficiency (mainly the production efficiency of grassland) has significantly increased due to the further expansion of the scale of livestock husbandry by smallholder farmers. At the regional level, with the development of rural tourism, the regional production structure has gradually changed from the integrated management of farming, forestry, and animal husbandry into the mode of taking animal husbandry as a dominant industry, farming and forestry as supplementary industries, but the regional agricultural productivity has not been stagnated or weakened.

For Further Reading: <https://doi.org/10.1016/j.landusepol.2021.105329>

Bhutan-Himalaya

EMPIRICAL EVIDENCE OF THE LIVELIHOOD VULNERABILITY TO CLIMATE CHANGE IMPACTS: A CASE OF POTATO-BASED MOUNTAIN FARMING SYSTEMS IN BHUTAN

Pradeep Rai, Yadunath Bajgai, Jimba Rabgyal, Tirtha Bdr Katwal, and Anthony Ryan Delmond

Sustainability 14: 2339

Potato (*Solanum tuberosum*) is an indispensable commodity, mainly cultivated by high-altitude mountain households, that sustains and supports the livelihood of an overwhelming 51% of the Bhutanese population. The popularity of potato cultivation among Bhutanese farmers can be attributed to the crop's adaptability to a wide range of agroclimatic conditions such as a rainfed crop, high productivity, an assured market, and a reliable source of income for the farming families. We hypothesize that the changing climate would make the livelihood associated with potato cultivation in Bhutan more vulnerable. We tested this hypothesis to identify the sources of vulnerability of smallholder farming households using the Livelihood Vulnerability Index (LVI) and LVI-IPCC (Intergovernmental Panel on Climate Change) approaches in six potato growing districts of Bhutan: Bumthang, Chukha, Gasa, Mongar, Tashigang, and Wangdue. Primary data were generated through a semi structured sample survey of 240 households on the seven major livelihood components of socio-demographic profiles, livelihood

strategies, social networks, health, food, water, natural disasters, and climate variability. The results showed that the LVI (range 0.302 to 0.375) and LVI-IPCC (range -0.005 to 0.030) differed significantly ($p < 0.001$) across the districts. The districts of Tashigang and Mongar were less vulnerable than the other four districts by the LVI approach, whereas Bumthang was also revealed to be less vulnerable using the LVI-IPCC approach. The degree of vulnerability in a district differed according to their level of exposure and adaptive capacity to the climate change impacts of the potato farming household. The results are expected to serve as empirical evidence for designing a future course of actions to mitigate the negative impacts.

For Further Reading: <https://doi.org/10.3390/su14042339>

Pakistan- Himalaya

INDIGENOUS KNOWLEDGE AND QUANTITATIVE ETHNOBOTANY OF THE TANAWAL AREA, LESSER WESTERN HIMALAYAS, PAKISTAN

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PLoS ONE 17: e0263604

Ethnobotanical field surveys were carried out in the Tanawal area of the Lesser Himalayan Region, Khyber Pakhtunkhawa, Province from April 2016 to October 2017. The area is located between 34.36 (34° 21' 30 N) latitude and 73.07 (73° 4' 0 E) longitude with an average elevation of 1374 meters above sea level. Ethnomedicinal data were collected through Participatory Rural Appraisal (PRA), and participants were selected through the snow-boll technique. Semi-structured, in-depth and open-ended interviews were conducted. The data were quantitatively evaluated using ethno-medicinal indices i.e. Relative frequency of citation (RFCs), Fidelity level (FL), and Use Value (UV). The ethno-botanical data were also comparatively analyzed through the Jaccard Index (JI). The study yielded 66 medicinal plants in 62 genera and 43 families. Asteraceae and Solanaceae were the most important families with five medicinal taxa each. Regarding medicinal plant part utilization, leaves (43.28%) were used predominantly, followed by whole plant (14.92%) and fruits (14.92%). Decoction was the main drug formulation applied to 21 species (31.15%) and the oral route was most common (56.1%) while 31.2% of medicinal plants were used for both oral and topical applications. Fifty health disorders were recorded and grouped in 15 categories. Maximum species were used to treat gastrointestinal disorders i.e. 13 species, dermal problems (12 species), and respiratory tract ailments (9). The calculated RFCs ranged between 81 to 31. The most important medicinal plants were *Acacia modesta*, *Citrullus vulgaris*, *Tamarindus indica*, and *Momordica charantia* with an RGFC of 81 each. The UV ranged between 0.58 and 3.6. Medicinal taxa with the highest UV were *Dioscorea deltoidea* (3.6), *Withania coagulans* (3.3), *Momordica charantia* (3.5), *Silybum marianum* and *Pyrus pashia* (3.2). FL values showed that 28 (41.79%) species had a FL value below 50 (74.62%) while 39 (58.20%) had higher FL values. *Momordica charantia*, *Tamarindus indica*, *Acacia modesta* and *Citrullus vulgaris* were 95.2 each. The Jaccard Index (JI) values ranged from 16.77 to 0.98. The current study also reported 16 medicinal plants, commonly used around the globe, have been rarely documented for their medicinal values in the local ethnomedicinal literature i.e. *Althaea officinalis*, *Plantanus orientalis*, *Jasminum sombac*, *Maytenus royleana*, *Cucurbita maxima*, *Phyllanthus emblica*, *Citrullus vulgaris*, *Polygonatum verticillatum*, *Casaria tomentosa*, *Cistanche tubulosa*, *Bambusa arundinacea*, *Schinus molle*, *Tamarindus indica*, *Pongamia pinnata*, *Citrus limon* and *Catharanthus roseus*. However, 48 medicinal plants had been reported in the literature but the current study reported their novel medicinal uses. Important taxa should be established in botanical gardens for in-situ

conservation, chemical investigation and sustainable utilization. It would also be effective to improve the livelihoods of the local population.

For Further Reading: <https://doi.org/10.1371/journal.pone.0263604>