

Making sense of domestic wildlife and CITES legislation: The example of Nepal's orchids

Abstract

Governing wildlife resources is a global challenge, with illegal domestic and international trade a leading threat to biodiversity. This has prompted a range of international conservation commitments and domestic legislation, including protected species lists and legislation associated with the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES). Despite their importance, heavy focus on national-level legislation potentially belies the complex networks of sub-national legislation that often inform on-the-ground wildlife management decisions. We highlight the need for detailed understandings of sub-national legislation in order to meaningfully understand legal and illegal wildlife trades. We demonstrate this using the example of orchids—which represent more than 70% of all CITES-listed species—and focus on Nepal, a wildlife trade hotspot. We describe the available evidence on the country's overlapping legal and illegal orchid trade and provide a structured analysis of 56 pieces of domestic legislation that govern the country's orchid resources. It is likely that other countries and taxa face similar levels of complexity, and we propose an approach for more thorough and systematic evaluations of sub-national legislation—across areas of law, hierarchical levels of governance, and types of legislation.

Key words: CITES management, environmental law, governance, illegal, orchids, wildlife trade

1. Introduction

Governing wildlife resources remains a huge challenge (Phelps et al. 2016; Sas-Rolfes et al. 2019; Fuller et al. 2020); illegal trade is a key threat to biodiversity (Biggs et al. 2017; Moshier et al. 2019), and legal sustainable use of wildlife resources is often challenging to regulate (Abensperg-Traun 2009). Efforts to reduce illegal trade and support legal trade often focus on strengthening criminal sanctions (e.g., Challender and MacMillan 2014; Biggs et al. 2017; Paudel et al. 2020), and operationalising international commitments and related legal frameworks, notably through the Convention on International Trade of Endangered Species of

Wild Fauna and Flora (CITES) (e.g., UNODC 2016). This is vital, but potentially belies the complexity of national and subnational legislation (laws, regulation policies, plans) that govern wildlife harvest, management, trade, taxation, processing, and use.

We highlight the need for detailed understandings of domestic, sub-national legislation—not only across the hierarchy of legislation, but also areas of laws and types of legislation—in order to meaningfully understand legal and illegal wildlife trades (see Pascual et al. 2021). We do this using the example of orchids—which represent more than 70% of all CITES-listed species—and focus on Nepal, where legal and illegal orchid trade overlap and are governed through a complex network of laws.

1.1. Legal frameworks governing wildlife resources

Wildlife harvest and trade legislation in many countries are often tightly linked to domestic wildlife and protected areas legislation and to national commitments to CITES. Established in 1973, it is one of the oldest environmental multilateral agreements and has 183 Parties (CITES 2021). The challenges of CITES implementation are well-documented in the literature (Phelps et al. 2010; Dongol and Heinen 2012; Oldfield 2013; Olsen, 2005). Critically, CITES implementation depends on each signatory country developing national legislation that operationalizes its commitments. In other words, CITES rules have limited legal power in a country unless that government has developed relevant domestic legislation.

However, wildlife legislation covers many other areas of law (see Pascual et al. 2021) including a complex legal framework that extends to provincial, and site-level rules. Moreover, at least 72 CITES signatory countries have not made legislative progress needed to meaningfully incorporate CITES commitments into their national legislation (CITES, 2021a). A strong focus on international commitments and national legislation, although vital, potentially belies the complexity of sub-national legislative frameworks meaningful governing wildlife resources.

We use the example of orchid trade from Nepal, exploring the ways in which international and then national-level CITES legislation abuts with a range of other national and sub-national legislation, on which implementation heavily relies (Laird et al. 2009). We propose that

strengthening CITES implementation and wildlife governance requires work to further disentangle various national and sub-national legislation, including guidelines and strategies, and sub-national plans that often help govern resources on the ground.

1.2. Orchid trade in Nepal

Orchids, perhaps more than any other plant groups, hold unique legal protections--under both international and domestic law--that regulate their wild harvest and trade (see Hinsley et al., 2018). Orchids comprise more than 70% of all species listed on the CITES Appendices. A small number of species are on CITES Appendix I, for which commercial international trade is prohibited and, at the national level, harvest and domestication in most countries are usually also not permitted (Hinsley et al., 2015), which is the case in Nepal (Upreti et al., 2021; Dongol and Heinen 2012; Bhuju et al., 2009). The vast majority of orchid species are listed on CITES Appendix II, which allows legal international trade if it is regulated and based on Non-detriment Findings (NDFs) evaluations that verify trade will not harm species survival.

Nepal hosts >500 species of orchid and has a long-standing, commercial trade in wild orchids, notably of medicinal species for local uses and international trade (Pant and Raskoti 2013; Subedi et al., 2013; Vaidya, 2019). This includes the export of wild plants, including orchids, to Southeast Asian countries, China, North America, and Europe (Pyakurel et al., 2019; He et al., 2018), notably medicinal orchids trade to India (Ghimire et al., 2021) and to China for Traditional Chinese Medicine (Lama et al., 2001).

This trade, however, faces complex legality: Some forms of harvest and trade are long-standing and pre-date current regulations (Chapagain et al., 2021; Subedi et al., 2013), then became legal and regulated under the Forest Act and Orchid Collection and Cultivation Directive, and now face shifting national CITES regulations; Although a signatory of the CITES Convention for more than 40 years, Nepal only established a CITES Act in 2017 (ratified in 2019). This had profound implications for how orchid species and resources are governed, as the new legislation interacts with a range of national and sub-national legislation.

We highlight what is currently known about the nature of the legal and illegal orchid trade in Nepal, with reference to the analysis of the seizure records of the last 10 years and analysis of the legal trade data from the CITES Trade Database. Then, we conduct a structured analysis of the national and sub-national legislation governing orchid resources in Nepal. We consider what these mean for both governing orchid resources in Nepal, and its broader illustration of the challenges of implementing wildlife and CITES legislation across the hierarchy of legal frameworks.

2. Methods

To understand legal international trade, we reviewed the CITES Trade Database (UNEP-WCMC, 2021) records from 1977-2018 using the terms: exporting countries: Nepal; importing countries: all; source: all; purposes: all; trade terms: all terms, taxon: Orchidaceae. We did not omit re-exports, personal or scientific items. We used comparative tabulation outputs instead of net/gross outputs of the CITES Trade Database. Where shipment units were not listed, we assumed the volume referred to the total number of specimens (cf. CITES User Guide Version-8). To calculate trade volumes, we used Nepal's reported trade (exporter reported quantity) and also looked at importer reported trade because there were many discrepancies, including key known importing countries (e.g., China, UK, USA) for which there were import records but no record from Nepal side.

To examine illegal trade, we collected seizure records between 2010-2020 for insights into trade dynamics. We reviewed published reports of seizures from Nepal's major English and Nepali language newspapers: The Kathmandu Post, Kantipur daily, Gorkhapatra Daily, The Himalayan Times, and Republica Daily. We used keyword searches in their online databases (terms in English and Nepali: orchids, wildlife trade, plant seizures, Sunakhari, *Dendrobium*, 'sungava'). For each case identified, we collected information (as available) on plant origin, trade volume, destination, and the agencies involved. We reviewed identifying characteristics for each case (i.e., dates, sites) and removed any duplicates. We also collected seizure data for the same period by contacting Nepal's Central Investigation Bureau (CIB) and Division Forest Offices of Gorkha, Dhading, Nuwakot, Rasuwa, Makwanpur, Chitwan, Kaski, and Manaslu Conservation Area, Annapurna Conservation Area, Chitwan National Park, Langtang National Park within the

Chitwan Annapurna Landscape area. We also used Division Forest Office data of Kathmandu, Sindhupalchok, Kavrepalanchok, and Dolakha. Of these, 18 cases only mentioned the amount seized with very few details; 6 others did not mention the amount seized (which we excluded from our list) while 4 cases repeated listings of the same case. Also, practitioners confirm that the majority of seizures are likely underreported or misreported as “forest/plant products” (B.Paudyal. Pers comm. 21 July, 2021).

To understand legislation governing orchids in Nepal, we collected all national and provincial legislation, and the district-level legislation for three Districts (Kaski, Gorkha, and Makawanpur) related to forests and wildlife. Documents were obtained from the official websites of the Department of Forest and Soil Conservation (DoFSC), Department of Plant Resources (DPR), Ministry of Forest and Environment (MoFE), Law Commission, all searched from January to April 2021. We contacted orchid researchers and environmental lawyers in Nepal to identify further relevant pieces of legislation. District-level legislation was collected from Division Forest Offices during site visits. This yielded 113 pieces of legislation, including acts, policy documents, directives, regulations, guidelines, and management plans (including their amendments at different times).

We manually reviewed each document to identify the relevance to the collection, trade, and/or conservation of orchids (most documents were scanned copies in Nepali and not keyword searchable). The detailed review was necessary because, although orchids were not mentioned in many documents, they often still related because they mentioned specific species (e.g., Gorkha’s 5-year district-level forest management plan mentions the orchid species *Brachycorythis obcordata*, *Flickingeria* spp.), medicinal plants, non-timber forest products, plants, and/or CITES-listed species. This narrowed our list to 56 pieces of legislation.

We extracted content from each document, summarising the specific rules related to orchid harvest conservation, and/or trade. We faced a number of confusing/unclear statements in legislation as well as conflicts among documents, which we resolved through consultation with an environmental lawyer and several senior government officials. The research was conducted with permission from Nepal’s Department of Forest and Soil Conservation.

We grouped legislation according to 1) their position in the legal hierarchy (i.e., national, provincial, site-specific); 2) into one of five categories of legislation (Table 1), and 3) into one of six themes that describe the major topic covered (e.g., CITES compliance, import/export rules).

Table 1: Categories of legislation

Legal delineation	Definition
Acts	Legally binding, national-level legislation (approved by Federal Parliament and/or President of Nepal) and province-level legislation (approved Provincial Parliament and/or provincial governor)
Regulations, Rules and Notices published in Gazette	Legally binding legislation that helps to operationalise Acts (e.g., the scale of fines, whether quotas must be set, amount of taxes). They can be national or provincial and are usually prepared by the relevant Ministries, with parliamentary/cabinet approvals. The Gazette is the government's official journal of record that lists statutory notices.
Directives, Procedures, Guidelines	Detailed guidance that helps to further implement the specific rules of the Acts and Regulations/Rules/Notices (e.g., the procedure for applying for quotas, harvest techniques). They are generally published by the relevant Ministries and their departments to inform resource users and government officers.
Policy and Strategy	Documents that discuss broader, strategic directions for the government at the national and provincial levels. These are usually developed by the relevant Ministries and their departments, and planning commissions. They are generally non-binding but guide priorities, decision-making, and legislation-making.
Action, Management, Work, and Operational Plans	Documents that guide a specific plan of work to achieve a particular management or conservation goal (e.g., species conservation action plan, site management plan, community forest plan). They can be set at any level, but are usually taxa and/or site-specific.

3. Results

3.1 Legal orchid trade in Nepal

Over the period 1977-2016, a total of 38 species from 15 genera were exported from Nepal. Only 4 of these genera (*Dendrobium*, *Coelogyne*, *Cymbidium*, *Otochilus*) were reported by Nepal to the CITES database, with all of the remaining genera reported only by the importing countries (*Aerides*, *Agrostophyllum*, *Arachnis*, *Arundina*, *Bulbophyllum*, *Calanthe*, *Gastrochilus*, *Paphiopedilum*, *Pleione*, *Vanda*). However, the trade volumes associated with these exports were often unreported, or used inconsistent metrics; 27% of importer-reported specimens were reported only as orchid spp. (7% exporter-reported), and the source of 54% (191 out of 351) of the records was not reported.

Recent trade reporting has become more detailed because, starting in 2008, the country began reporting with standard units (kilogram). Over the 2008-2016 period, Nepal reported 49,789kg of orchids (the importer-reported volume was 44,194kg), with volumes fluctuating across years (Supplementary Table 1). The majority of reported trade was as stem (82%) followed by live plants (16%), and a very small amount as dried roots (2%) and a few shipments of individual live specimens.

Contemporary export was limited to only 4 genera, dominated by the genus *Dendrobium*. The vast majority of exported orchids since 2008 were wild-harvested (96%), with only 4% (1,699.5kg) from artificial propagation. No CITES Non-detriment findings (NDF) were conducted for wild-harvested orchids over this period, as confirmed by the CITES Focal Point at the Department of Forest and Soil Conservation (Kathmandu); in Nepal, NDFs are currently conducted only for species that have an established quota system (i.e. *Nardostachys grandiflora*).

Nepal reported only three countries as its importer during 2008-2016: Thailand (80%, 39,900kg), Switzerland (16%, 7,992kg), and China (4%, 1,897kg), although if we consider importer-reported data, China ranked as the largest importer (36,187kg reported by China).

3.2 Illegal orchid trade in Nepal

We identified 36 seizure records between 2010-2020, involving at least 28,315kg of orchids, with seizures ranging from 7 individual plants to 9,364kg (Supplementary Table 2). The seized orchids were reportedly collected from the wild, from forests of central, mid-western, and far-

western Nepal. In one case involving 4,536kg of orchids, the plants were reportedly collected from different parts of Nepal, stored in a central location, and then seized during transportation. Indeed, most seizures occurred during transportation, detected at police check posts, except in two cases that were raids on store houses. They were mostly transported in public buses or trucks, where orchids were bundled in sacks, plastic, or clothes, either on their own or in mixed form with other herbs. Several newspaper articles described unique ways used by traders to avoid detection, such as hiding orchids in the engines of buses or storing them in sealed drums. The majority (n=19) of the seizure cases occurred by the police upon a tip-off from their informer or a report from a member of the public. Discussions with experts suggest that this is likely a common pattern, with plants collected across sites and locally aggregated by local nursery owners who not only grow plants but also process and dry wild plants. Plants are then transported to district centres, then to Kathmandu and on to final destinations.

Only two records had species-level details, both involving the protected species *Dactylorhiza hatagirea* for which all harvest is banned. The largest seizure occurred in Gorkha District, with 75kg of dried *D. hatagirea*, representing 19,538 individuals with an estimated market value of approx.US\$166,280. Several enforcement agencies are involved in wildlife seizures in Nepal and, in the dataset Division Forest Offices, Central Investigation Bureau (CIB), Nepal Police/Army check-posts, Conservation/Protected Area management agencies, were involved in cases involving orchids. Except one case that involved both Chinese and Nepalese, most seizures involved Nepali nationals from indigenous communities (Gurung, Sherpa and Tamang).

Beyond the seizures, we also made a number of observations of illegal trade associated with the mis-identification of orchids as unprotected taxa. For example, *Pleione praecox* is harvested and traded at local levels in parts of Central Nepal in the name of “pani amala”, the common fern species *Nephrolepis cordifolia* known as Himalayan Gooseberry that is neither protected nor CITES listed. Local management plans list certain orchid species as permitted for legal harvest, but do not acknowledge that these are in the family Orchidaceae, for which legal restrictions should apply (discussed in Section 3.3.3). Although these cases may be the result of mistaken identifications, it is likely these are intentional misidentifications used in order to evade legal restrictions and taxations. Also, many district-level authorities have included orchid species like

Satyrium nepalense, *Brachycorythis spp.* in their harvest plan under the name of *Gamdol* and issued collection permits thinking they are not orchids.

3.3 Legislation governing wild orchid conservation, use, and trade in Nepal

Nepal has at least 56 pieces of legislation governing (directly/indirectly) orchid resources, across the legal hierarchy, across different categories of law (Fig.1). This includes legally-binding legislation and “guiding” documents such as strategies and action plans that are non-binding but are nevertheless important to policy and implementation. Legislation related to six key themes: 1) CITES compliance, 2) Import and export rules 3) Management of natural resources 4) Environmental impact assessments,, 5) Policing and enforcement, and 6) Designated rights and responsibilities under the Federal system

Notably, Nepal’s Constitution states the intention to conserve, promote, and make sustainable use of forests and wildlife. Following that, Nepal has a number of national legally binding legislation that governs orchid conservation, harvest, and trade. Much of this legislation applies to Non-Timber Forest Products (NTFPs) and plant resources that include, but do not specifically mention orchids.

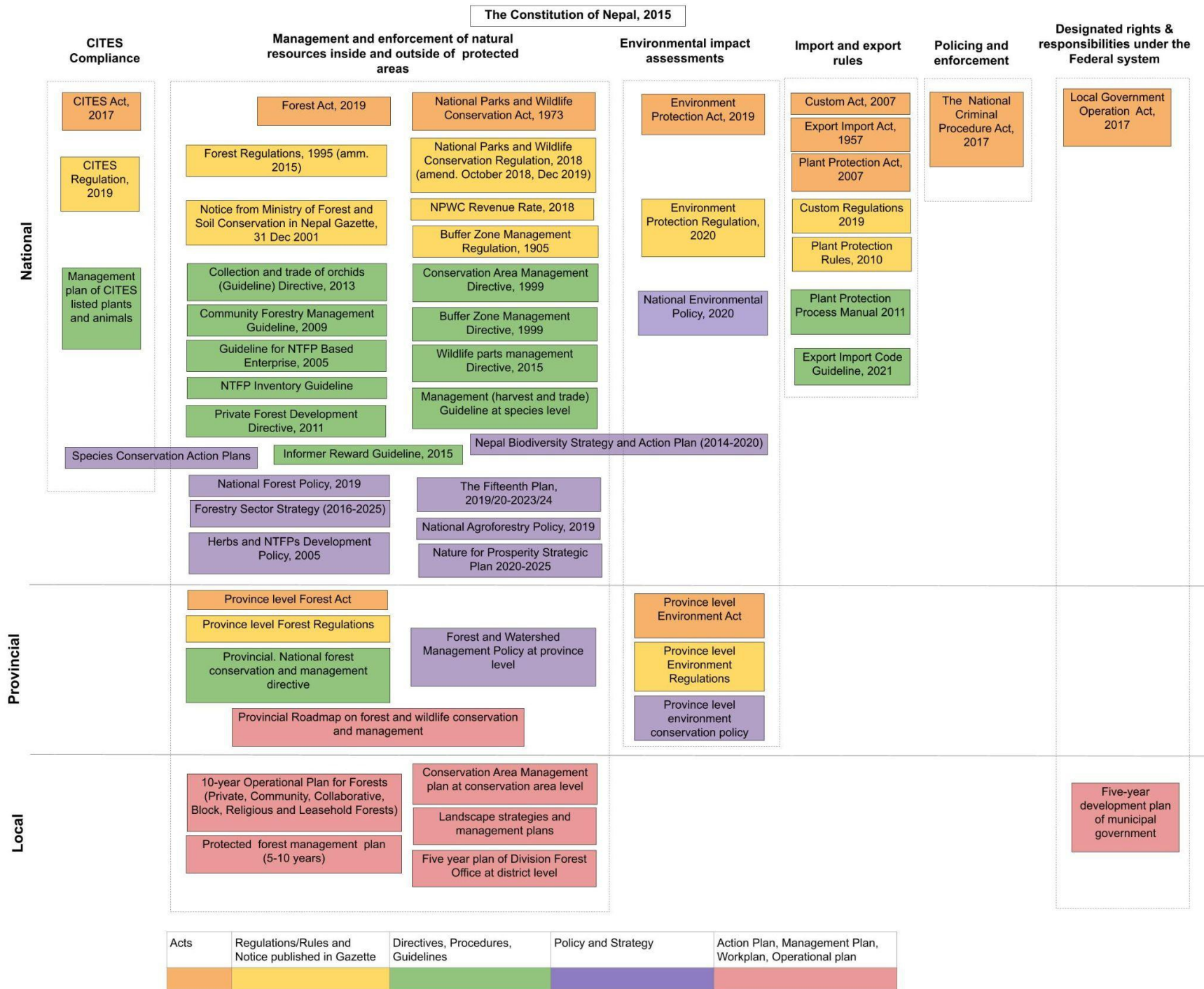


Figure 1: Laws and regulations guiding wildlife trade in Nepal (with a specific focus on orchids)

3.3.1 CITES legislation, and other import/export rules

Nepal joined CITES in 1975 and started documenting international trade records including all Appendix II listed orchids (Supplementary Table 1). Nepal also hosts two Appendix I listed orchids for which international commercial trade is banned (*Paphiopedilum* lady slipper orchids, *P. insigne*, *P. venustum*).

However, it was not until 2017 that it established domestic national legislation to align with CITES commitments. Although the CITES Convention aims to regulate legal, sustainable trade, the CITES Act 2017 banned wild harvest and trade of all CITES-listed species, including Appendix II species, temporarily shutting down legal export of all orchids (Article 6 [Cha] and [Chha]). In 2019, amendments to the CITES Act and ratification of the CITES Rules clarified that Appendix II species can be legally harvested and traded in accordance with the preparation and approval of management plans by the CITES Management and Scientific Authorities (CITES Rules, Article 4 [Ka, 1]). As such, Nepal's domestic CITES regulations not only regulate international trade, but also guide in-country conservation and management of CITES-listed species. For example, if someone wants to harvest or open a nursery that grows CITES-listed plants, they require CITES Authority permission (CITES Rules, Article 18). Species Management Plans estimate population sizes, identify threats and priority areas, and stipulate conditions for sustainable use such as harvestable stocks and techniques (see CITES Rules, Article 22). Such plans have been prepared for some plant species (e.g., *Taxus*, *Nardostachys*), but not yet orchids, until which no legal trade can occur.

Domestic CITES legislation also has provision of punishments for violating any rules. It is designed based on the CITES Appendix; fine of NPR 100,000 to 500,000, or 1 to 5 years imprisonment or both for App I plant species; NPR 50,000 to 100,000, or 6 months to 1-year imprisonment or both for App II plant species; NPR 1,000 to 50,000, or 1 month to 6 months imprisonment or both for App III plant species (CITES Act, Article 21).

In addition to CITES legislation, Nepal has national-level legislation that governs the import and export of plant material. Customs and export legislation sets out general standards related to

product identification, tracking and taxation. Parallel legislation on plant health and pest control provides few additional regulations, but does set a minimum level of genus-level identification for exported plants/plant products (Plant Protection Act, 2007).

Table 2. Examples of key domestic legislation and summaries of implications for orchid governance (Full summary in Supplementary Table 3)

Legislation	Key points regulating orchid conservation, harvest, and trade
<i>Constitution</i>	
Constitution of Nepal 2015	It envisions to conserve, promote, and make sustainable use of forests and wildlife (Part 4, Article 51, g, 5).
<i>CITES compliance</i>	
CITES Act, 2017 and CITES Rules 2019	<ul style="list-style-type: none"> • Regulate the conservation, harvest and trade of the CITES-listed species. • State that harvest and trade are only possible if Management Plans have been prepared by the CITES Scientific and Management Authorities with setting quotas. No such plans have yet been prepared for any Orchid species. • List sanctions for violations: For Appendix I-listed species, NPR 100,000- to 500,000 (USD835-4175), or 1 to 5 years imprisonment or both. For Appendix II-listed species, NPR 50,000-100,000 (USD417-835), or 6 months-1-year imprisonment, or both.
<i>Import and export rules</i>	
Customs Act, 2007 and Custom Regulations, 2019 Export Import Act, 1957	<ul style="list-style-type: none"> • Do not mention orchids or plants, but covers general import-export rules, including for forest products. • State conditions for legal trade, including that shipments should comply with CITES legislation, and be properly tagged to enable the proper tracking of shipments (and necessary paperworks) from exporting countries.
Plant Protection Act, 2007 and Plant Protection Rules,	<ul style="list-style-type: none"> • Focus on plant quarantine and the prevention of biological pests during the import/export of plants and plant products, • State requirements for tracing signs/codes, phytosanitary

2010	<p>certifications of plants or plant products.</p> <ul style="list-style-type: none"> Require a minimum of genus-level identification for plants and plant products.
<i>Conservation and management of natural resources</i>	
Forest Act 2019 and Forest Rules 1995	<p>This Act does not include anything specific to orchids but it addresses forest products inside all forests. It specifies that the use, sale, and distribution of forest products (including timber, wood, and NTFPs) shall be made as prescribed and only after the permission of Division Forest Office Plans (Section/parikched 10, 36 (2)). This likely refers to rules set out in local management plants. Based on this legislation, the Government of Nepal has banned the harvest and trade of orchid sp. <i>Dactylorhiza hatagirea</i>.</p> <p>It also sets a national taxation rate for NTFPs. For orchids, it specifically sets taxation for:</p> <ul style="list-style-type: none"> <i>Dactylorhiza hatagirea</i> taxed at NPR500 per piece [Khanda (cha) Article/anuchuchi 3, (ka, no. 25), page 6]. The rate is doubled if it is harvested for export. <i>Gastrodia elata</i> taxed at NPR10 per kilogram [Khanda (ka, no. 54), page 3] Rates are tripled for export (Article 3, Summary, SN 3, page 10)
National Park and Wildlife Conservation Act and Its Regulation	<p>It applies primarily inside the protected areas. It has provision that no one can harvest and harm wildlife including plants inside the protected area without obtaining written permission from the authorized official (Article 5). Each protected site has its own regulations approved by the Department of National Parks and Wildlife Conservation (Article 3). Unlike animals, there are no separate provisions of sanctions for illegal harvest and trade of plants and orchids inside the protected areas. In such cases, the prevailing rules apply (i.e., CITES Act, Forest Act). If the offense is not described in other laws, imprisonment up to six months and a</p>

	fine up to NPR 20000 (USD163) applies (NPWC Act, Article 26.6).
Regulations of each protected area	<p>Each of the protected areas has its own regulations and management plans. Which controls the conservation and use of wildlife including orchids. For example:</p> <ul style="list-style-type: none"> • Himali NP Regulation, 2009 (first amendment 2014) provisions the harvest and trade of NTFP are allowed for a maximum of 30 days/ /harvest season/year. However, this excludes banned/restricted species and species that do not have a national CITES Management Plan. They also collect a royalty and other permission from the Division Forest Office (Article 24, Ka) • Panchase Protected Forest (2012) was established specifically to protect orchid species. Does not allow for harvest of orchids at this site
Conservation Area Management Directive, 1996	It mentions NTFPs but does not specifically mention orchids. It sets out rules for the formation, rights, duties of user groups and says that they should work in collaboration with the CA and their operation plan, collection permit should be authorized by the CA authority
Buffer Zone Management Directive, 2015	It does not specifically mention orchids, but mentions user groups (e.g., Community Forest User Group) that have rights to use and conserve resources in these sites, including NTFPs. It states that harvest must follow the user groups' guidelines
Collection and trade of orchids (Guideline) Directive 2013 (2069)	Promotes the commercial cultivation of orchids in Nepal (see Supplementary Table 3). It includes provisions for wild orchid harvest, including the orchid inventory and site selection, provisions for block divisions, collection/harvest, and commercial development.
Guideline for the	The guideline sets methods for developing NTFP inventories for

collection and trade of NTFPs (2073 BS) 2016 AD	Five Year Plans of Division Forest Office, but does not mention orchids specifically (see Supplementary Table 3)
Five Year Plans of Division Forest Office, Gorkha (district level management plan) and Ten Year Operational Plans for Forests (site-level, by Community forest User Groups)	<p>Management of the forests outside protected areas are governed by Five Year Plans of Division Forest Office at district level for the government managed forests, and community forests are governed by its Tenear Operational Plan. It also includes orchid spp. conservation and harvesting plans. Species that are not listed in the plans cannot be harvested and traded.</p> <p>For example,</p> <ul style="list-style-type: none"> • Five Year Plans of Division Forest Office, Gorkha (2021) mentions specific orchid species as plants that can be legally harvested, but does not recognise that these are in the family Orchidaceae (e.g., “gamdol” harvest [<i>Brachycorythis</i> spp., probably <i>B. obcordata</i>] is permitted). For each species, they also identify the total stock and harvestable amount, and where the resources are located within the District. They also allocate a certain amount of taxation as per Forest Act, protocol for harvest and harvesting seasons. • 10 Year Operational Plan of Bhume Mantuli Devasthan Community Forest in Dharche Ward 4, Gorkha District (2075/76-2084/85) states orchid stock and harvestable quotas, which we interpret as: the available orchid (“sungava”, all orchid species) stock is 400kg (equivalent to 140kg dry weight), of which 40% is allowed for harvest and trade, twice a year.
<i>Environmental impact assessments</i>	
Environment Protection Act 2019 (2076) and	Establishes requirements for conducting environmental impact assessments for the harvest and process of forest products includes orchid spp.

Regulations 2020	
<i>Policing and enforcement</i>	
The National Criminal Procedure Act, 2017	Identifies wildlife trade crimes as having high importance. It states that once cases are filed in court, they cannot be withdrawn. It is not clear if this applies to plants, but plants and orchids are not specifically mentioned.
<i>Designated rights and responsibilities under the federal system</i>	
Local Government Operation Act, 2017	This Act does not specifically mention orchids but it mentions details on the natural resource use/revenue generation including NTFPs at the local level
Five year management plans of municipal government	Municipal governments at the local level prepare a five year development plan and yearly work plan. This plan directs the local development and management of the resources. For example: <ul style="list-style-type: none"> • Dharche Rural Municipality Five-year Plan (2019 - 2024): This FYP indicates that they will promote NTFPs including orchids cultivation and trade (specifically “gamdol”, <i>Brachycorythis</i> spp.) to support local livelihoods (Article 6.1.5) • Policy and Program of Annapurna Rural Municipality 2020 prioritizes the cultivation and promotion of medicinal plants for research, conservation, and eco-tourism development (strategy 1.10)

3.3.2 Governing orchids *inside* protected areas

Orchid governance includes legislation spanning inside and outside protected areas. Inside protected sites, The National Park and Wildlife Conservation Act (NPWC) 1973 prohibits any wildlife harvest inside National Parks and Reserves. This is further reiterated in a number site-specific management plans, some of which specifically highlight the conservation and research of NTFPs, particularly orchids. For example, Panchase Protected Forest was designated in order to protect its orchid diversity. No legal harvest is allowed, although the Central Government

conducted an evaluation of the value/supply chain of orchids of Panchase (MoFSC, 2014). The Chitwan Annapurna Landscape Strategy and Action Plan 2016-2025 recognize that orchid species are highly threatened with small or declining populations due to poaching, unsustainable harvesting, or other ecological threats such as extensive habitat loss or degradation and climate change (pg. 32), yet calls for science-based management of orchid resources (pg. 47). These studies likely reflect the on-the-ground realities of orchid harvest, even in and around protected areas.

Violations of the Act inside protected areas are enforced by park rangers and the Nepal Army and are heavily sanctioned (see Paudel et al. 2020). However, no sanctions are listed for plants, unlike for fauna, where specific-specific penalties are listed. Instead, the Act references that other prevailing Acts should apply. For orchids, this would be the CITES Act and Forest Act or, if the offense is not described, then the sanction shall be imprisonment up to six months and a fine up to NPR 20,000 (NPWC Act, Article 26.6).

The NPWC Act also regulates Conservation Areas and Buffer Zones, where it allows and regulates NTFP harvest, relegating details to site-level plans. National regulations subsidiary to the Act governing buffer zones and conservation areas are also very general, stating that harvest should follow local plans set by site managers and/or local Buffer Zone or Community Forest User Groups (BZFUG, CFUG). For example, Api Nampa Conservation Area Management Plan estimates a stock of 2,632kg of *Dactylorhiza hatagirea* across the entire protected area, and sets the harvestable amount at 1,974kg annual harvestable quantity (draft, 2022-2026, section 9.2). It also references a stock of 54 kg of “orchids” (various species), yet sets the harvestable amount at 410kg annual harvestable stock of Orchids (in SN 42)-presumably a mistake. However, the plan also clearly states that no harvest permit will be provided for species that are banned for collection and trade by other legislation.

3.3.3 Governing orchids *outside* protected areas

Two key pieces of national legislation govern orchid harvest outside of protected areas, including on national forest, private lands, and community forest areas: the CITES Act 2017

(discussed above) and The Forest Act 2019, which further subsidiary Regulations, Directives/Procedures/Guidelines, Provincial Acts, and many site-specific plans.

The Forest Act does not mention orchids specifically, but sets out broad provisions for legal harvest of timber and NTFPs. It states that these should follow CITES legislation (thus including orchids), and site management plans, notably the Five Year Plans prepared by Division Forest Offices, and 10-year operation plans prepared by different forest users groups, as approved by the corresponding Provincial or Division Forest Office. The regulation is more specific about setting specific taxation rates for orchids in general, and for two orchid species of high historical economic importance (*Gastrodia elata* and *Dactylorhiza hatagirea*) these rates are tripled for plants intended for export (Table 2). Subsidiary documents, including the National Forestry Policy 2019 and Forest Sector Strategy 2016-2025 actively promote sustainable harvest and trade, but provide no guidance on orchids.

The Gorkha Division Forest Office Management Plan 2021 is an example of one of these site management plans that mentions specific orchid species as plants that can be legally harvested, and also sets the taxation as per Forest Act,. However, it does not recognise that these are in the family Orchidaceae (e.g., “gamdol” harvest is permitted, i.e. *Brachycorythis* spp., *Satyrium* spp., possibly other terrestrial orchids). For each listed species, they also identify the total stock and harvestable amount, and where the resources are located within the District (site names, not mapped). These are reportedly developed using the national NTFP Inventory Guideline 2012, which includes methods for establishing inventories based on predictions informed by past/current trends and the establishment of sample plots. However, informal discussions with practitioners at several sites make clear these methods are referenced, but are not actively used in practice.

The 10 year operational plan of Bhume Mantuli Devasthan Community Forest in Dharche 4, Gorkha (2075/76-2084/85) also includes orchid harvest (sunghava) (in SN. 4). It estimates an orchid density at 800kg/ha, and a total available stock in the community forest of 400kg fresh weight (140kg dry weight). They set the harvest quota at 40% of available stock for harvest two times annually (i.e. 320kg/year).

A notable exception is *Dactylorhiza hatagirea*, the only orchid species specifically mentioned in legislation outside of the CITES Act 2019; the Forest Regulation 2015 and the Notice from the Ministry of Forest and Soil Conservation 2001 banned trade, production and trade of this economically valuable medicinal orchid. For other orchid species, the Collection and Trade of Orchid Directive 2013 promotes the cultivation, and it granted two companies permission to commercially produce orchids for export (trades listed in CITES records, Supplementary Table 1). The Directive also promoted the harvest and trade of wild orchids, and guides managers to develop inventories of wild orchid stocks; instructs that sites should be divided into “blocks” that are harvested on a 5-year rotation, and orders for royalty payments to the Division Forest Office. However, these local plans must now comply with the additional requirements of the recent CITES Act 2017.

Importantly, such violations operate in parallel with the Criminal Procedure Act 2017, which governs investigation and prosecution of all criminal acts, including illegal wildlife harvest and trade, which are designated as “high priority” crimes that can't be compromised, mediate and withdrawn once submitted to the court, although it is unclear whether plants are included under the definition of wildlife.

3.3.4. Environmental Assessments

The Environmental Protection Act stipulates that Environmental Assessments must be conducted on projects likely to impact physical, biological, socioeconomic and cultural environments, to determine the scales of impact and possible mitigation (Bhatta and Kahanal, 2009). Assessments are thus required for extractive activities, including timber and NTFP harvest, and development of plantations and medicinal plant nurseries and processing units. Assessments are also referenced in parallel legislation, including the Collection and Trade of Orchids (Guideline) Directive.

Nepal's has a tiered approach to assessments, determined by the scale and sensitivity of the project; Environment Impact Assessment (EIA), Initial Environmental Examination (IEE) and Brief Environmental Study (BES). It has no specific provisions for orchid spp. though in the case of NTFPs, this is determined by the volume of harvest in particular sites (EPR, Article 3).

EIAs are required for large-scale harvest of forest-based products (e.g., > 50 metric ton of roots; > 150 metric ton of bark or leaf or stem or flower, > 200 metric ton of fruit or seeds), all the harvest less than this requires IEE (EPR Schedule 1, 2 and 3). Where EIAs are approved by the Federal Government, IEE are approved by the provincial government or concerned government departments, BES are approved by the local government.

3.3.5 Designated rights & sub-national management

A number of pieces of national legislation (Table 2) reference the establishment of local-level management plans, to direct wild harvest of timber and non-timber forest products—both within and outside of protected areas, and at landscape, province, district, or municipal or site/forest-level (Table 2, Supplementary Table 3). This local autonomy over resources was strengthened in 2015, with Nepal’s transition to a Federal system (Local Government Operation Act, 2017). As such, there is a wide diversity of sub-national management plans, a number of which mention NTFPs and orchids, and reflect different levels of detail and management approaches.

At the provincial level, legislation is often similarly general as, and employs similar (or copied) language in national-level regulations/rules, in that they delegate responsibility for management to local management plans and concerned authorities, implicitly the Division Forest Offices that operate at the District-level. For example, Bagmati Provincial Forest Policy, 2019 states that forest products can be traded as instructed by the concerned authority (Article 18, 1-4); herb research centers can be established (Article 21), and commercial cultivation of herbs is allowed. However, taxonomic groups are not indicated (Article 22, 1-2). Moreover, a number of the reviewed sub-national plans used local names that correspond to the orchid family (“sungava” or “sunakhari”); one term to refer to multiple genera of terrestrial tuberous orchids (“gamdol”, including *Brachycorythis* spp. and *Satyrium* spp.).

Below the district-level, there are also Five-year Municipal plans/strategies that often mention NTFP harvest. For example, the Dharche Rural Municipality Five-year Plan, identifies specific orchid species for harvest, notably “gamdol” (*Brachycorythis* spp. *Satyrium* spp., or all tuberose orchids) to support livelihood development.

4. Discussion

4.1 Complex framework, beyond just CITES

The focus of wildlife trade governance is usually on CITES implementing legislation and a small number of other national-level laws, but our analysis revealed 56 pieces of legislation immediately relevant to orchid harvest and trade. These cross different areas of law and many agencies across the hierarchy, governing orchid harvest and trade in a seemingly disjunct incrementalist fashion that characterizes much policymaking (Lindbolm 1959; see Atkinson 2011). This forms a surprisingly complex framework (Table 2). Indeed, throughout discussions with experts, traders and officials in Nepal, no one could articulate Nepal's current rules for orchid trade (Greenhood Nepal 2021).

Governance of orchids was made significantly more complex by the addition of the 2017 CITES Act, which, in an attempt to internalise CITES commitments into national legislation, banned all trade in Appendix II species, including all orchids. The law's revision now again allows for trade of Appendix II species, contingent on the development of a national-level management plan for each species (none yet exists for orchids). However, such national-level changes have not cascaded down to sub-national legislation or policy documents, some of which continue to actively promote harvest and trade, and encourage both conservation and have set local harvest quotas. The resulting legal framework has apparently confused both enforcement bodies, site managers, and both legal and illegal traders. The current legal framework thus includes national-level legislation that allows for orchid harvest if a national species management plan (none yet exists), alongside policies.

There is no reasonable expectation that the current framework could be successfully navigated by practitioners. This is a particular concern given that many NTFP harvesters in Nepal are, in general, poor (Ghimire et al., 2021). Indeed, most of the identified orchid seizures involved Indigenous marginalised communities (Supplementary Table 2) and sub-national plans that reference orchid harvest usually do this with a focus on improving rural incomes (Supplementary Table 3). This also has concern with respect to the existing capacity of enforcement to monitor the harvest and trade, exaggerated due to remoteness.

Yet, as the CITES data (Supplementary Table 1), seizure records (Supplementary Table 2, although see Underwood et al. 2013; Paudel et al. 2020), literature (e.g., Pyakurel 2019; Chapagain et al. 2021) and field observations indicate Nepal continues to have a commercial trade in wild orchids. Although possibly compliant with some sub-national guidelines, this trade violates national legislation and international CITES commitments. The current legal complexity seems likely, if unintentionally to encourage illegal trade because the regulations are too difficult to understand and are likely bureaucratically complex.

4.2 Responsibility shifted to local site managers

Much of the reviewed legislation was dominated by statements that deferred technical decisions to other, usually sub-national levels. For example, the Forest Act 2019 and Buffer Zone Management Directive 2015 both state that NTFP harvest should be done in compliance with local harvest rules. National acts, regulations and policies mention principles of sustainable harvest, but provide no guidance. As a result, site-level managers are responsible for identifying orchid stocks and quotas, but without clear methods, and quota-setting for plant harvest in Nepal is often not based on robust science (Timoshyna and Drinkwater 2021). Indeed, there is very little published information on sustainable orchid harvest globally, although based on limited information available from proposed quotas and observations of seizures and in the field, sub-national harvest quotas are greater than what is likely sustainable (see Ticktin et al. 2020). Some local managers are also including orchids in their management plans listing them as other, non-orchid taxa (e.g., Bhume CF 10-year Operational Plan, Table 2), placing it beyond national requirements.

Yet, legislation also includes a constant, if generic instruction that sub-national rules must be compliant with other existing national legislation. As mentioned, the new CITES law mandated national-level Species Conservation Action Plans, though none has been established for any orchid species. This means that site managers are not currently legally able to meet their local responsibilities, although they continue to actively develop such plans.

4.3 Coarse taxonomic identification and reporting

Management challenges are exacerbated because of the coarse nature of taxonomic identifications and data reporting. Orchidaceae is a taxonomically challenging group whose identification is based primarily on floral characteristics, yet plants are often traded without flowers and as dried pseudobulbs/stems making identification challenging or impossible (see Phelps and Webb 2015). It is unsurprising that many species are misidentified, although we also observed international misidentifications (e.g., of *Pleione praecox*) and legislation that grouped all orchids or all terrestrial orchids together (e.g., “gamdol”, “sungava”). This precluded the ability to comply with national legislation, such as the CITES Law that requires species-level identification and the plant trade legislation that requires a minimum of genus-level identification (Plant Protection Act 2007, Plant Protection Rules 2010). It also limits species-level CITES Non-Detriment Findings and the reporting required for CITES Annual Reports (Robinson and Sinovas 2018).

Taxonomic challenges aside, there is very limited monitoring and reporting of orchid trade. Sub-national quotas, although referenced in legislation, do not have mechanisms for inspection or reporting, nor is there related guidance (Table 2). At the national level, the CITES data highlights reporting mistakes that do not meet reporting requirements or expectations (Supplementary Table 1). This includes not only a lack of species-level reporting, but significant mismatches in reporting between Nepal and importing countries.

4.4 Improving orchid governance

Although orchids are the largest group of CITES-listed species listed, and have unique legal protections in many countries (see Hinsley et al. 2018), the governance of orchid trade is a global issue that has received comparatively little attention. This overview highlights some of the key challenges to improving their governance, in Nepal and other countries where they are commercially traded, from Mexico to China. Notably, there is a need to align for more accurate species-level level reporting, which requires new, more accessible resources for practitioners to identify them. For legal harvest, it also requires the ability to conduct Non-Detriment Findings, set quotas and undertake IUCN Red List assessments, which are exceedingly difficult with available science for many traded species (Hinsley et al. 2018). Moreover, these types of knowledge are needed not only among national-level authorities, but also need communicating to

the range of sub-national stakeholders (provincial, district, community) where most harvest decisions are made.

Conclusion

CITES plays a central role not only in regulating international wildlife trade, but also in shaping domestic management of protected species—shaping protected species lists, influencing quota setting, defining priorities and methods. Across taxa, this has prompted considerable focus on national-level CITES reporting (e.g., Robinson and Sinovas 2018; Phelps et al. 2010) and national CITES implementing legislation (e.g., Morocco, Bergin and Nijman 2014; Colombia and Brazil, Goyes and Sollund 2016; Nepal, Dongol and Heinen 2012). However, there remains little attention to how these national frameworks interact with the sub-national legislation that contend with the complex, socio-economic realities of harvesting communities (Sas-Rolfes et al., 2019), and govern a range of provincial, district and site-level management decisions that ultimately shape wildlife outcomes (see Laird 2009; Pascual et al. 2021; although see Mexico, Arroyo-Quiroz et al., 2005; China, Li 2007).

We highlight the complexity of this domestic legislation, which was far greater and more complex than the researchers had expected. There is a clear need to harmonize not only national legislation with CITES commitments, but to link national laws with sub-national legislation and implementation. It is likely that other countries and taxa face similar levels of complexity, and we propose an approach for more thorough and systematic evaluations of sub-national legislation—across areas of law, hierarchical levels of governance, and types of legislation.

If policy-makers and academics and policymakers cannot understand legislation to disentangle what trade is considered legal or illegal, we cannot reasonably expect end-users to comply with wildlife legislation.

References

- Abensperg-Traun, M., 2009. CITES, sustainable use of wild species and incentive-driven conservation in developing countries, with an emphasis on southern Africa. *Biol. Conserv.* 142, 948–963. <https://doi.org/10.1016/j.biocon.2008.12.034>
- Arroyo-Quiroz, I., Perez-Gil, R., Leader-Williams, N., 2005. Developing countries and the implementation of CITES: The Mexican experience. *J. Int. Wildl. Law Policy* 8, 13–49. <https://doi.org/10.1080/13880290590913714>
- Atkinson, M.M., 2011. Lindblom's lament: incrementalism and the persistent pull of the status quo. *Policy and Society* 30:9-18.
- Bergin, D., Nijman, V., 2014. Open, unregulated trade in wildlife in Morocco's markets. *Traffic Bulletin* 26, 65-70.
- Bhandari, P., Shrestha, K., Subedi, C.K., 2020. Orchids of Panchase Forest , Central Nepal : A Checklist. *Journal of Plant Resources* 18, 143–156.
- Bhatt, R.P. and Khanal, S.N., 2009. Environmental impact assessment system in Nepal—An overview of policy, legal instruments and process. *Kathmandu University Journal of Science, Engineering and Technology*, 5(2), p.2009.
- Bhujju, U.R., Aryal, R.S., Aryal, P., 2009. Report on the Facts and Issues on Poaching of Mega Species and Illegal Trade in Their Parts in Nepal Transparency International Nepal, TIN-WWF Agreement.
- Biggs, D., Cooney, R., Roe, D., Dublin, H.T., Allan, J.R., Challender, D.W.S., Skinner, D., 2017. Developing a theory of change for a community-based response to illegal wildlife trade. *Conserv. Biol.* 31, 5–12. <https://doi.org/10.1111/cobi.12796>
- Challender, D.W.S., MacMillan, D.C., 2014. Poaching is more than an enforcement problem. *Conserv. Lett.* 7, 484–494. <https://doi.org/10.1111/conl.12082>
- Chapagain, D.J., Meilby, H., Baniya, C.B., Budha Magar, S. and Ghimire, S.K., 2021. Illegal harvesting and livestock grazing threaten the endangered orchid *Dactylorhiza hatagirea* (D. Don) Soó in Nepalese Himalaya. *Ecology and Evolution* 11:6672-6687.

CITES, 2021. [What is CITES?](https://cites.org/eng/disc/what.php) <https://cites.org/eng/disc/what.php>. Accessed 27 August 2021.

CITES, 2021a. Status of Legislative Progress for Implementing CITES.

https://cites.org/sites/default/files/LAC/Legislative_status_table_October_2020.pdf.

Assessed 20 Oct 2021.

Davenport, T.R.B., Ndangalasi, H.J., 2003. An escalating trade in orchid tubers across Tanzania's Southern Highlands: Assessment, dynamics and conservation implications. *Oryx* 37, 55–61. <https://doi.org/10.1017/S0030605303000127>

Dongol, Y., Heinen, J.T., 2012. Pitfalls of CITES implementation in Nepal: A policy gap analysis. *Environ. Manage.* 50, 181–190. <https://doi.org/10.1007/s00267-012-9896-4>

Fuller, A., Decker, D., Schiavone, M., Forstchen, A., 2020. Ratcheting up rigor in wildlife management decision making. *Wildlife Society Bulletin* 44: 29-41.

Ghimire, P., Pudasaini, N., Lamichhane, U., 2021. Status, Prospects and Challenges for Non-Timber Forest Products Conservation in Nepal: A Critical Review. *Grassroots J. Nat. Resour.* 4, 1–16. <https://doi.org/10.33002/nr2581.6853.040101>

Goyes, D., Sollund, R., 2016. Contesting and contextualising CITES: Wildlife trafficking in Colombia and Brazil. *International Journal for Crime, Justice and Social Democracy* 5, 87.

Greenhood Nepal. 2021. Workshop proceeding: Illegal trade and sustainable use of medicinal orchids of Nepal. URL: <https://greenhood.org/reports/workshop-proceeding-illegal-trade-and-sustainable-use-of-medicinal-orchids-of-nepal/>

He, J., Yang, B., Dong, M., Wang, Y., 2018. Crossing the roof of the world: Trade in medicinal plants from Nepal to China. *J. Ethnopharmacol.* 224, 100–110. <https://doi.org/10.1016/j.jep.2018.04.034>

Hinsley, A., Verissimo, D., Roberts, D.L., 2015. Heterogeneity in consumer preferences for orchids in international trade and the potential for the use of market research methods

- to study demand for wildlife. *Biol. Conserv.* 190, 80–86.
<https://doi.org/10.1016/j.biocon.2015.05.010>
- Hinsley, A., De Boer, H.J., Fay, M.F., Gale, S.W., Gardiner, L.M., Gunasekara, R.S., Kumar, P., Masters, S., Metusala, D., Roberts, D.L., Veldman, S., Wong, S., Phelps, J., 2018. A review of the trade in orchids and its implications for conservation. *Bot. J. Linn. Soc.* 186, 435–455. <https://doi.org/10.1093/botlinnean/box083>
- Laird, S.A., Wynberg, R., McLain, R.J., 2009. Wild Product Governance: laws and policies for sustainable and equitable non-timber forest product use.
- Lama, Y., Ghimire, S.K., Aumeeruddy-Thomas, Y., 2001. Medicinal Plants of Dolpo: Amchis' Knowledge and Conservation, First. ed.
- Li, P.J., 2007. Enforcing wildlife protection in China: the legislative and political solutions. *China Information* 21, 71-107.
- Lindblom, C.E. 1959. The science of 'muddling through'. *Public Administration Review* 19:79–88
- Mirenda, T., Wallick, K., Gabel, R.R., 2007. The role of cites rescue centers in orchid conservation: Concerns and questions raised by the collaboration on an endangered slipper orchid (*Paphiopedilum vietnamense* O. Gruss & Perner). *Lankesteriana* 7, 150–151. <https://doi.org/10.15517/lank.v7i1-2.19400>
- Moshier, A., Steadman, J., Roberts, D.L., 2019. Network analysis of a stakeholder community combatting illegal wildlife trade. *Conserv. Biol.* 00, 1–11.
<https://doi.org/10.1111/cobi.13336>
- Oldfield, S.F., 2013. The evolving role of CITES in regulating the international timber trade. *Rev. Eur. Comp. Int. Environ. Law* 22, 291–300.
<https://doi.org/10.1111/reel.12045>

- Olsen, C.S., 2005. Trade and conservation of Himalayan medicinal plants: *Nardostachys grandiflora* DC. and *Neopicrorhiza scrophulariiflora* (Pennell) Hong. *Biol. Conserv.* 125, 505–514. <https://doi.org/10.1016/j.biocon.2005.04.013>
- Pant, B., Raskoti, B.B., 2013. Medicinal orchids of Nepal. Himalayan Map House. ISBN: 9937-577-35-9
- Pascual, M., Wingard, J., Bhatri, N., Rydannykh, A., Phelps, J., 2021. Building a global taxonomy of wildlife offenses. *Conservation Biology*.
- Paudel, K., Potter, G.R., Phelps, J., 2020. Conservation enforcement: Insights from people incarcerated for wildlife crimes in Nepal. *Conserv. Sci. Pract.* 2. <https://doi.org/10.1111/csp2.137>
- Phelps, J., Biggs, D., Webb, E.L., 2016. Tools and terms for understanding illegal wildlife trade. *Front. Ecol. Environ.* 14, 479–489. <https://doi.org/10.1002/fee.1325>
- Phelps, J., Webb, E.L., Bickford, D., Nijman, V., Sodhi, N.S., 2010. Boosting CITES. *Science* (80-.). 330, 1752–1753. <https://doi.org/10.1126/science.1195558>
- Phelps, J., Webb, E.L., 2015. “Invisible” wildlife trades: Southeast Asia’s undocumented illegal trade in wild ornamental plants. *Biological Conservation* 186:296–305. <https://doi.org/10.1016/j.biocon.2015.03.030>
- Pyakurel, D., Smith-Hall, C., Bhattarai-Sharma, I., Ghimire, S.K., 2019. Trade and Conservation of Nepalese Medicinal Plants, Fungi, and Lichen. *Econ. Bot.* 73, 505–521. <https://doi.org/10.1007/s12231-019-09473-0>
- Robinson, J.E., Sinovas, P., 2018. Challenges of analyzing the global trade in CITES-listed wildlife. *Conserv. Biol.* 32, 1203–1206. <https://doi.org/10.1111/cobi.13095>
- Sas-Rolfes, M., Challender, D.W.S., Hinsley, A., Veríssimo, D., Milner-Gulland, E.J., 2019. Illegal Wildlife Trade: Scale, Processes, and Governance. *Annu. Rev. Environ. Resour.* 44, 201–228. <https://doi.org/10.1146/annurev-environ-101718-033253>

- Siriwat, P., Nijman, V., 2018. Online media seizure reports: A tool to monitor CITES implementation in regulating the international rosewood trade. *For. Policy Econ.* 97, 67–72. <https://doi.org/10.1016/j.forpol.2018.09.004>
- Subedi, A., Kunwar, B., Choi, Y., Dai, Y., van Andel, T., Chaudhary, R.P., de Boer, H.J., Gravendeel, B., 2013. Collection and trade of wild-harvested orchids in Nepal. *J. Ethnobiol. Ethnomed.* 9. <https://doi.org/10.1186/1746-4269-9-64>.
- Ticktin, T., Mondragón, D., Lopez Toledo, L., Dutra Elliott, D., Aguirre León, E., Hernández Apolinar, M., 2020. Synthesis of wild orchid trade and demography provides new insight on conservation strategies. *Conservation Letters*, 13:e12697.
- Timoshyna, A., Drinkwater, E., 2021. Understanding corruption risks in the global trade in wild plants. *Target. Nat. Resour. Corrupt.* 1–15.
- Underwood, F.M., Burn, R.W., Milliken, T., 2013. Dissecting the Illegal Ivory Trade: An Analysis of Ivory Seizures Data. *PLoS One* 8. <https://doi.org/10.1371/journal.pone.0076539>
- UNEP-WCMC, 2021. CITES trade statistics derived from the CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK"
- UNODC, 2016. World Wildlife Crime Report. United Nations Office on Drugs and Crime.
- Upreti, Y., Chettri, N., Dhakal, M., Asselin, H., Chand, R., Chaudhary, R.P., 2021. Illegal wildlife trade is threatening conservation in the transboundary landscape of Western Himalaya. *J. Nat. Conserv.* 59, 125952. <https://doi.org/10.1016/j.jnc.2020.125952>
- Vaidya, B.N., 2019. Nepal: a global hotspot for medicinal orchids. In *Medicinal plants* (pp. 35-80). Springer, Cham.

Supplementary information

Supplementary Table 1. Overview of orchid exports from Nepal (2008-2018)

Species	Origin	Form	Purpose	Leading importer	Amount traded	Year(s)
<i>Coelogyne nitida</i>	Propagated	Live	Trade	Japan	5 individuals	2013
<i>Cymbidium iridioides</i>	Propagated	Live	Trade	Japan	3 individuals	2013
<i>Cymbidium sp.</i>	Propagated	Live	Circus or exhibition	Japan	6 individuals	2013
<i>Dendrobium amoenum</i>	Wild	Stems	Trade	Thailand	9,309kg	2013
<i>Dendrobium aphyllum</i>	Wild	Stems and live	Trade	Thailand, Switzerland, China	stems 10,894kg, live 7,992kg	2008, 2010, 2013
<i>Dendrobium dixonianum</i>	Propagated	roots	Trade	China	347kg	2013
<i>Dendrobium dixonianum</i>	Wild	stems	Trade	Thailand	2,378kg	2014
<i>Dendrobium eriiflorum</i>	Propagated	stems	Trade	Thailand	3 individuals	2015
<i>Dendrobium fimbriatum</i>	Wild	Stems	Trade	Thailand	9,309kg	2013
<i>Dendrobium spp.</i>	Wild	Stems	Trade	Thailand	8,007kg	2016
<i>Dendrobium transparens</i>	Propagated	roots and stems	Trade	China	roots 650kg, stems 900kg	2013, 2015, 2016
<i>Otochilus fuscus</i>	Propagated	live	Trade	Japan	4 individuals	2013

Supplementary Table 2. Summary of orchid seizure records found in the official record of government authorities and reported by key national newspapers from January 2010 to December 2021 (Note: the table excludes 4 records from DFO that had no further details but they mentioned orchids).

Yea	Seizure location	Species	Volu	Seizure	Source	Transportation	Concerned
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Id	Location	Species	Weight (kg)	Condition	Number of orchids	Mode	Destination	Responsible agency to seize
2021	Lamjung	<i>D. hatagirea</i>	15.5	People carrying in bags	Lamjung	NA	Besisahar, Lamjung	Nepal Police
2020	Dolakha	NA	22.5	NA	NA	NA	NA	DFO
2017	Arughat, Gorkha	NA	75	Transported, bus roof	Gorkha	Public	Soti	DFO, Gorkha
2016	Khalanga, Jajarkot, (Mid-West Nepal)	NA	64	NA	NA	Public	NA	Division Forest Office and Police officers
2015	Basundhara, Kathmandu	NA	4.4	NA	NA	NA	NA	NA
2014	Dolalghat, Kavrepalanchok	NA	9,364	NA	NA	NA	Kathmandu	NA
2014	Gorkha, Ghattekhola	<i>D. hatagirea</i>	8	Transported	MCA	NA	Gorkha headquarter	NA
2013	Simle (Mid-western Nepal)	NA	100	NA	NA	NA	NA	Police Officers
2012	Jomsom (Mid-west Nepal)	NA	4,536	Transported	All over Nepal	Public	Tibet- Upper Mustang, Lomanthang.	Conservation Agency, Police Officers
2012	Dhulikhel-2 (Central Nepal)	NA	51	Transported, sealed drums		Public	Khasa	Police officers
2012	Kathmandu	NA	28	Held by arrestee	Hired Villagers	Public	China	Police Officers
2012	Panchkhal Police Checkpost (Central Nepal)	NA	25	Transported, bus engine	NA	Public	Chinese Market-Khasa	Police Officers
2012	On the way: Dhading to	NA	390	Transported	NA	Public	China	Security personnel

	Bidur							
201 2	Thokarpa	NA	9	Transported	NA	Private	Khasa, China	Police Officers
201 2	Sindupalchok , Bahrabise (Central Nepal)	NA	2	Transported	NA	Public	China	Police Officers
201 2	Bahrabise, Sindhupalchok (Central Nepal)	NA	250	Transported	NA	Public	China	Security/Police Officers
201 2	Bahrabise, Sindupalchok	NA	199	Stored in house	NA	NA	NA	Security/Police Officers
201 2	Bahrabise, Sindhupalchok	NA	9	Stored in house	NA	NA	NA	Security/Police Officers
201 2	Lamosaghu, Sindhupalchok	NA	6	Abandoned	NA	NA	NA	Security/Police Officers
201 2	Bahrabise Checkpost, Sindhupalchok	NA	7.2	Transported	NA	Public	NA	Security/Police Officers
201 2	District Police Office (Bahrabise), Sindhupalchok	NA	23	Abandoned	NA	NA	NA	Security/Police Officers
201 2	Police Bahrabise, Sindhupalchok	NA	30	Transported	NA	Public	NA	Security/Police Officers
201 2	Kavrepalanchok	NA	7 ind		NA		NA	Security/Police Officers
201 2	Gorkha	NA	4.5	NA	NA	NA	NA	Security/Police Officers
201 1	Attarkhel, Jorpati (Central Nepal)	NA	4,871	Stored in house	Secret Vend ors	N/A	China	Police Officers and Division Forest Office
201 1	While transporting to Kathmandu	NA	50	Transported	Lumle forest	Public	Kathmandu	Annapurna Conservation Area Project,

								Police Officers
2011	Kapilakot village-9 (Central Nepal)	NA	3,943	Stored: House	NA	Public	NA	Division Forest office and District Police Office
2010	Ghanteshwar, Doti (Far west Nepal)	NA	50	Stored: House	NA	NA	NA	Division Forest Office
2010	Lamosaghu, Sindhupalchok	NA	45	Transported	NA	NA	NA	Lamosaghu Checkpost
2010	Lamosaghu, Sindhupalchok	NA	745	Abandoned	NA	NA	NA	Lamosaghu Checkpost
2010	Bahrabise, Sindhupalchok	NA	188	Transported	NA	Public	NA	Security/Police Officers
2010	Lamosaghu, Sindhupalchok	NA	3,200	Transported	NA	Public	NA	Security/Police Officers

Supplementary Table 3. Legislation protecting orchids and promoting legal use. * indicates legislation that specifically mentions orchids.

Policy	Key points regulating orchid conservation, harvest, and trade
Constitution of Nepal 2015 (2072)	The constitution of Nepal included the policies relating to protection, promotion, and use of natural resources and it envisions to conserve, promote, and make sustainable use of forests and wildlife (Part 4, Article 51, g, 5).
<i>CITES compliance</i>	
Signatory (1975) to Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)	Nepal's orchid species <i>Paphiopedilum insigne</i> and <i>Paphiopedilum venustum</i> are listed in App I. All other orchid species are enlisted in App II of the CITES. Trade in all the Appendix II-listed species should be supported by Non-Detriment Findings.

<p>CITES Act, 2017 (1st amendment on 2019)</p>	<p>As per the CITES Act, 2017 species listed in CITES App I and II or a specimen thereof cannot be purchased, sold, possessed, used, planted, reared, captive-bred, transported, imported, or exported without permission from the CITES Management Authority based on the recommendation from the CITES scientific authority (Article 3, 6). As such, it prohibits the international import and exports of species listed in CITES Appendix I and Appendix II for commercial trade purposes (Article 6 (Cha) & (Chha).</p> <p>This was clarified/relaxed in its 2019 amendment that states no permission is required to possess, plant, rear, and use plant species listed in CITES Appendix II and III if they originate from private property (Article 3, 6). Also, no import permit is required from the CITES Management Authority of the importing country for the exports of CITES Appendix II listed species from Nepal including for commercial purposes (Article 5). This is to align national legislation with the CITES Convention, such that import permits are only required for the trade of Appendix I listed species.</p> <p><i>But the trade has to be done based on the management plan of the CITES Authority which is yet to be prepared– hence, the trade of orchids is still theoretically illegal.</i></p> <p>Violations are sanctioned with a fine of NPR 100,000 to 500,000, or 1 to 5 years imprisonment or both for App I plant species; NPR 50,000 to 100,000, or 6 months to 1-year imprisonment or both for App II plant species; NPR 1,000 to 50,000, or 1 month to 6 months imprisonment or both for App III plant species (Article 21).</p>
<p>CITES Regulation, 2019</p>	<p>For the export of CITES Appendix I and Appendix II listed plant species, these should be harvested in volumes not exceeding the maximum quota mentioned in the Management Plan (Article 4 (Ka, 1)</p>

	<p>Management Plans are established by the CITES Management Authority in consultation with CITES Scientific Authority for CITES-listed species in trade (Article 22). This applies to all 3 CITES Appendices, and there is no detail about the scale or details required for the plans</p>
<i>Management and enforcement of natural resources</i>	
<p>Forest Act 2019 (2076)</p>	<p>This Act does not include anything specific to orchids but it addresses forest products inside all forests. It specifies that the use, sale, and distribution of forest products (including timber, wood, and NTFPs) shall be made as prescribed and only after the permission of Division Forest Office Plans (Section/parikched 10, 36 (2)). This likely refers to rules set out in local management plants.</p> <p>Punishment: If the species banned for trade is found, the NTFP is seized, violations are sanctioned with either a fine up to double of the loss as per the rate per individual or 3 years imprisonment or both (Article 50, 7)</p> <p>If the NTFP harvest permit is found to be misused to harm other plants, this violation is sanctioned with different punishments like for original amount worth ≥ 5 lakhs, fine is doubled and 2 years imprisonment or both</p>
<p>Forest Regulations 1995 with an amendment in 2015 (2072)</p>	<p>Bans harvest, trade and use of <i>Dactylorhiza hatagirea</i></p> <p>Interested parties shall have to apply to the Authorized Officer, explicitly mentioning the type of herbs (includes orchid spp.), the area of collection, the quantity, and the purpose of collection. The Authorized Officer shall tally the herbs collected according to collection permit, check quantities, collect fees and issue a release order. The royalty fee for Orchid spp. except for <i>Dactylorhiza hatagirea</i> is NPR 200 per kg (Article 11 and Annex 3)</p>

<p>Notice from the Ministry of Forest and Soil Conservation, Nepal Gazette, 31 Dec 2001 (2058/09/16)</p>	<p>This notice, prohibited the harvest, transportation, trade, and exports of certain species including <i>Dactylorhiza hatagirea</i> in and from Nepal</p>
<p>National Park and Wildlife Conservation Act 1973 (2029)</p>	<p>No one can harvest and harm wildlife including plants inside the National Park or Wildlife Reserve without obtaining written permission from the authorized official (Article 5). Each site has its own regulations approved by the Department of National Parks and Wildlife Conservation (Article 3).</p> <p>4th amendment on 9 June 1993 – The designated authority after taking a fixed charge/revenue can allow harvest of NTFP (16, ka)</p>
<p>National Park and Wildlife Conservation Regulation 2019 (amendment Dec 2019)</p>	<p>It does not mention anything specific to orchids, however, it regulates the harvest of wildlife inside the protected area under the National Park and Wildlife Conservation Act</p> <p>Violations are Sanctions according to the CITES Act, 2017. Unlike animals, there are no separate provisions of sanctions for illegal harvest and trade of the plants and orchid spp inside the protected areas. In such cases, other prevailing rules i.e. CITES Act, Forest Act are attracted. If the offense is not described in other laws, imprisonment up to six months and a fine up to NPR 20000 applies (NPWC Act, Article 26.6).</p>
<p>National Park and Wildlife Conservation Revenue Rate (Nepal Gazette paper, part 3, khanda 68, published date</p>	<p>Sets national taxation rate for NTFPs. For orchids, it specifically sets taxation for:</p> <ul style="list-style-type: none"> • <i>Dactylorhiza hatagirea</i> taxed at NPR500 per piece [Khanda (cha) Article/anuchuchi 3, (ka, no. 25), page 6]. The rate is doubled if it is harvested for export. • <i>Gastrodia elata</i> taxed at NPR10 per kilogram [Khanda (ka, no. 54), page 3]

October 2018	This rate is tripled for export [Article 3, Summary, SN 3, page 10]
Buffer Zone Management Regulation, 1905	It mentions NTFPs but does not specifically mention orchids – it provides provisions to develop the management plans of the buffer zone of national parks, which controls the conservation and use of wildlife including orchids
Conservation Area Management Directive, 1996	It mentions NTFPs but does not specifically mention orchids. It sets out rules for the formation, rights, duties of user groups and says that they should work in collaboration with the CA and their operation plan, collection permit should be authorized by the CA authority
Buffer Zone Management Directive, 2015	It does not specifically mention orchids, but mentions user groups (e.g., Community Forest User Group) that have rights to use and conserve resources in these sites, including NTFPs. It states that harvest must follow the user groups' guidelines
Regulations of each protected area	<p>Each of the protected areas has its own regulations and management plans. Which controls the conservation and use of wildlife including orchids. For example:</p> <ul style="list-style-type: none"> • Himali NP Regulation, 2009 (first amendment 2014) provisions the harvest and trade of NTFP are allowed for a maximum of 30 days/ /harvest season/year. However, this excludes banned/restricted species and species that do not have a national CITES Management Plan. They also collect a royalty and other permission from the Division Forest Office (Article 24, Ka) • Panchase Protected Forest 2012 was established specifically to protect orchid species. Does not allow for harvest of orchids at this site • Chitwan Annapurna Landscape (CHAL) Strategy and Action Plan 2016-2025 identifies unsustainable and illegal harvest and trade of orchids including extensive habitat loss,

	<p>climate change as biggest threats (pg. 32) and it calls for science-based management of orchid resources (pg. 47)</p>
<p>Collection and trade of orchids (Guideline) Directive 2013 (2069)</p>	<p>Promotes the commercial cultivation of orchids in Nepal (see Table 3).</p> <p>Includes provisions for wild orchid harvest, including the orchid inventory and site selection, provisions for block divisions, collection/harvest, and commercial development. Based on the orchid inventory and available stock for sustainable harvesting, forests can be divided into different blocks and collections of orchids on a 5 years rotational period.</p> <p>If orchids are collected from community forests or private forests, they should be provided royalty (see Table 4)</p> <p>The guideline identifies 13 orchid species as</p>
<p>Guideline for the collection and trade of NTFPs (2073 BS) 2016 AD</p>	<p>The guideline does not say anything about orchids specifically but it is for all NTFPs mentioned in the District Forest Management Plan (see Table 4; species that are not listed in the Plan cannot be traded).</p> <p>The person, firm, or company interested in the collection and trade of a listed species should make an application to the Division Forest Office (DFO) indicating the purpose, method, and amount to be collected. Then the DFO grants permission, based on the availability of the resource in the wild, for a maximum of 2 months. In doing so, the DFO collects an advance tax prior to collection and allows the transport of the collected NTFPs only after a permit is issued</p>
<p>Private Forest Development Directive 2011 (2068)</p>	<p>Registered private firms can harvest, use and trade wild plants on private land by pre-informing the respective Division, or Sub-division Forest Office (Article 6)</p> <p>Transportation of the plants requires a leave permit from the Division Forest Office</p>

	<p>The Directive does not include anything specific about orchids but lists <i>Dactylorhiza hatagirea</i> as a banned species</p>
National Forest Policy, 2019	<p>It provisions the sustainable management of forests to enhance the regeneration rate/forest products availability and conservation as well as to improve the livelihood of user groups</p> <p>There are also province-level forest policies to regulate forest and wildlife outside the protected area. For example, Provincial National Forest Policy, 2019 of Hetauda province states that forest products can be traded as instructed by the concerned authority (Article 18, 1-4); herb research center can be established (Article 21); commercial cultivation of herbs can be done - has not indicated species though (Article 22, 1-2)</p>
Forest Sector Strategy 2016-2025	<p>Identified “sustainable production and supply of forest products” and “improvement of biodiversity conservation” as two of its five major outcomes. It does not specifically mention orchids.</p>
Herbs and NTFP Development Policy, 2004 (2061)	<p>NTFPs cultivated on private land should be registered by providing details to the Division Forest Office</p>
Landscape level strategy and action plans	<p>Chitwan Annapurna Landscape (CHAL) Strategy and Action Plan 2016-2025 identifies unsustainable and illegal harvest and trade of orchids including extensive habitat loss, climate change as biggest threats (pg. 32) and it calls for science-based management of orchid resources (pg. 47)</p>
Five Year Plans of Division Forest Office, Gorkha (district level management plan) and Ten Year Operational Plans	<p>Explain in general. For example,</p> <ul style="list-style-type: none"> • Gorkha Division Forest Office Management Plan 2021 mentions specific orchid species as plants that can be legally harvested, but does not recognise that these are in the family Orchidaceae (e.g., “gamdol” harvest [<i>Brachycorythis</i> spp., probably <i>B. obcordata</i>] is permitted). For each species, they also identify the total stock and harvestable amount, and

for Forests (site-level, by Community forest User Groups)	<p>where the resources are located within the District. They also allocate a certain amount of Taxation as per Forest Act, protocol for harvest and harvesting seasons.</p> <ul style="list-style-type: none"> 10 year operational plan of Bhume Mantuli Devasthan Community Forest in Dharche 4, Gorkha (2075/76-2084/85) includes orchids (<i>sunghava</i>) harvest (in SN. 4) as available 800kg/ha (in 0.5ha), total stock 400kg raw (140kg dry weight) 40% of which is allowed for harvest and trade i.e. 56kg (twice a year/duai barshik)
Protected Forest Management Plan	
<i>Environmental impact assessments</i>	
Environment Protection Act 2019 (2076) (EPA, Part 5, Article 29; EPA: Schedule II, Ka, 8 and Schedule III, Ka, 7)	Establishes requirement for conducting environmental impact assessments and states that this should be done in has provisions relating to the protection of national heritage and environment including sites with important plant species (Part 5, Article 29)
Environment Protection Regulations 2020 (2077)	Management plans such as a five-year district forest management plan, buffer zone or conservation area management plan, forest conservation area management plan which involves the collection of forest products require environmental impact assessments (Schedule II, Ka, 8 and Schedule III, Ka, 7)
National Environmental Policy, 2020	It does not mention anything about orchids but it mandates the local level utilization as well as conservation of the natural resources. It also promotes participatory and sustainable utilization of natural resources via equal distribution of incentives among value-chains.
<i>Import and export rules</i>	

Customs Act, 2007	It does not mention orchids or plants, but covers general import-export rules, including for forest products. This includes a requirement that these should follow CITES legislation, be properly tagged to enable tracking, letters from exporting countries.
Custom Regulations, 2019	It does not mention orchids or plants, but covers general import-export rules, including for forest products. This includes a requirement that these should follow CITES legislation, be properly tagged to enable tracking, letters from exporting countries.
Export Import Act, 1957	It does not mention orchids or plants, but covers general import-export rules, including for forest products. This includes a requirement that these should follow CITES legislation, be properly tagged to enable tracking, letters from exporting countries.
Plant Protection Act, 2007	Focuses on plant quarantine and the prevention of biological pests during the import/export of plants and plant products, particularly on phytosanitary, tracing signs/codes, certifications of plants or plant products. This includes a minimum of genus-level identification.
Plant Protection Rules, 2010	Focuses on plant quarantine and the prevention of biological pests during the import/export of plants and plant products, particularly on phytosanitary, tracing signs/codes, certifications of plants or plant products. This includes a minimum of genus-level identification.
Plant Protection Process Manual, 2011	Focuses on plant quarantine and the prevention of biological pests during the import/export of plants and plant products, particularly on phytosanitary, tracing signs/codes, certifications of plants or plant products. This includes a minimum of genus-level identification.
<i>Policing and enforcement</i>	
The National Criminal Procedure Act, 2017	Identifies wildlife trade crimes as having high importance. It states that once cases are filed in court, they cannot be withdrawn. It is not clear if this applies to plants, but plants and orchids are not specifically mentioned.
<i>Designated rights and responsibilities under the federal system</i>	

<p>Local Government Operation Act, 2017</p>	<p>This Act does not specifically mention orchids but it mentions details on the natural resource use/revenue generation including NTFPs at the local level</p> <p>The local government authorities have their own policy and programs, for eg:</p> <ul style="list-style-type: none"> • Policy and Program of Annapurna Rural Municipality 2020: Prioritizes the cultivation and promotion of medicinal plants (strategy 1.10)
<p>Five year management plans of municipal government</p>	<p>There are five year management plans to govern the harvest and trade of NTFPs including orchids.</p> <p>For examples:</p> <ul style="list-style-type: none"> • Gorkha Division Forest Office Management Plan 2021 • Dharche Rural Municipality Five-year Plan (2019 - 2024): This FYP indicates that they will promote NTFPs including orchids cultivation/trade, etc. to support the livelihood of locals thereby generating the opportunities for income and employment (Article 6.1.5) • 10 year operational plan of Bhume Mantuli Devasthan Community Forest in Dharche 4, Gorkha (2075/76-2084/85)
<p>Province-level forest acts and regulations</p>	<p>Each province has its own forest act and regulations, which regulate the forest and wildlife outside the protected area.</p> <p>For example, Provincial National Forest Policy, 2019 of Hetauda province states that forest products can be traded as instructed by the concerned authority (Article 18, 1-4); herb research center can be established (Article 21); commercial cultivation of herbs can be done - has not indicated species though (Article 22, 1-2)</p>