Project Update: July 2018

The previous update summarised the collection of occurrence points, variables selection and initial model building for six highly traded MAPS, *Aconitum spicatum*, *Dactylorhiza hatagirea*, *Nardostachys grandifolia*, *Neopicrorhiza scrophularifolia, Paris polyphylla* and *Valeriana jatamansii*. Our preliminary mapping showed that the focal species widely distributes in the hilly and middle mountainous region from east to west.

Result and Discussions: Species Distribution Modelling

The MaxEnt modelling successfully delineate the potential distribution of six highly traded MAPs in the Nepal Himalaya using a subset of explanatory variables. The selection of these variables is based on Variance Inflation Factor (VIF), Pearson's correlation (r), Jackknife analysis, Percent contribution in the MaxEnt model. These predictive variables are species specific, additionally, all six MAPs respond to Bio4 (Temperature Seasonality (standard deviation *100)), Bio8 (Mean Temperature of Wettest Quarter), Bio11 (Mean Temperature of Coldest Quarter) and Bio15 (Precipitation Seasonality (Coefficient of Variation)). The model revealed temperature as the primary factor affecting the distribution of focal species. The response curve from MaxEnt result indicates that the prime suitable habitat for focal species is Grassland (cat. 6). The habitat suitability seems increasing in Evergreen/Decidious needleleaved forest for *Paris polyphylla* and *Valeriana jatamansii*. The predictiveness, validity and performance of the model were assessed through AUC (>0.9), TSS (>0.7) (Rana et al., 2018; unpublished paper).

The potential distribution and predicted suitability of selected MAPs under the current environmental conditions are presented in Figure 1. The model projected highest suitability area for *Neopicrorhiza scrophularifolia* under current (current/RCP8.5; 20.39/22.71 % of the Nepal's area) and lowest for *Aconitum spicatum* (current/RCP8.5: 9.92/6.42 % of the Nepal's area) and future (2070) RCP 8.5 (see Figure 2; 3 for details). They mostly occur in the mid-hills to mountainous regions. The projected suitability for future (2070) reveals highest suitability above hilly regions and species specific for West-Central-East region (Figure 3) and indicates northward expansion, likewise north-westward for certain species based on RCPs (Figure 4). It shows that MAPs respond to climatic oscillations with population moving vertically i.e. downslope expansion and slow upslope range contraction. However, there is certain evidence which suggests that the migration of population towards north might stop as it reaches to summit, prone to 'summit trap phenomena' (Rana et al., 2017; 2018). Besides physiological and biological tolerance climatic factors broadly influences plant distributions. The ground validation for six highly traded MAPs indicates the southward reduction of species range is mainly due to human/animal encroachment and increasing trade pressure. Based on IUCN vulnerability assessment of suitability projection, it is likely that species become endangered in increasing temperature however, under the climate change scenarios by 2100 with medium stabilisation or intermediate scenario RCP 4.5, most of the species remains least concerned and/or near threatened (Rana et al., 2018; unpublished paper). So it is essential that we implement sustainable harvesting for stable areas; apply management/conservation strategies for contraction prone/risk areas; and test for cultivation and domestication for expanding areas of their availability in future scenarios.

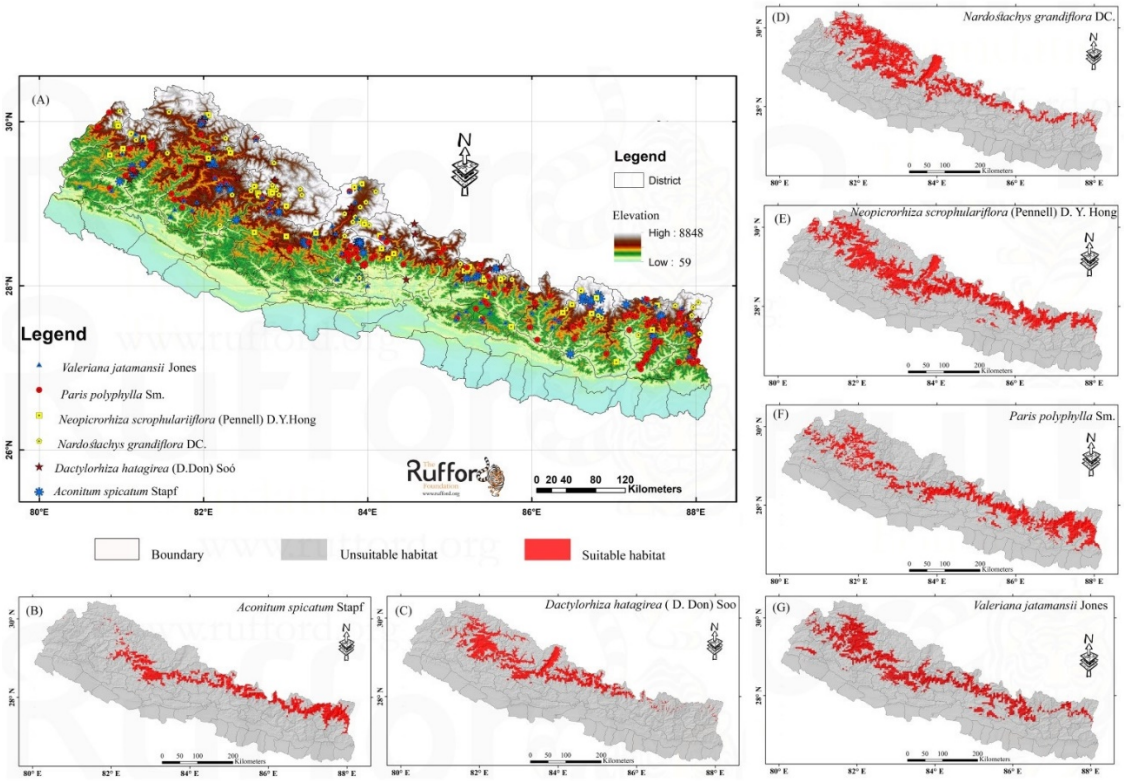

Figure 1: Map of Nepal showing distribution of six highly traded MAPs indicating their respective GPS locations (A) and current suitability of six highly traded MAPs. (B), Aconitum spicatum; (C), Dactylorhiza hatagirea; (D), Nardostachys grandiflora; (E), Neopicrorhiza scrophularifolia; (F), Paris polyphylla;and (G), Valeriana jatamansii.

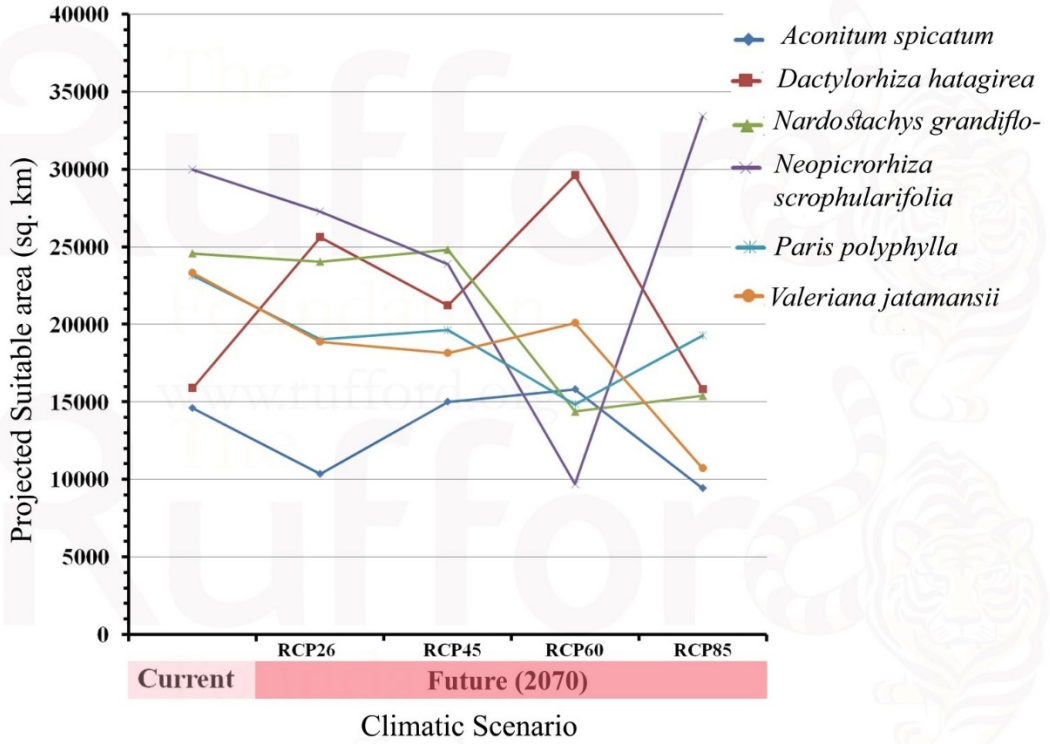

Figure 2: Changes in the projected suitable area of six highly traded MAPs in Nepal under current and future climate change scenarios of 4 RCPs.

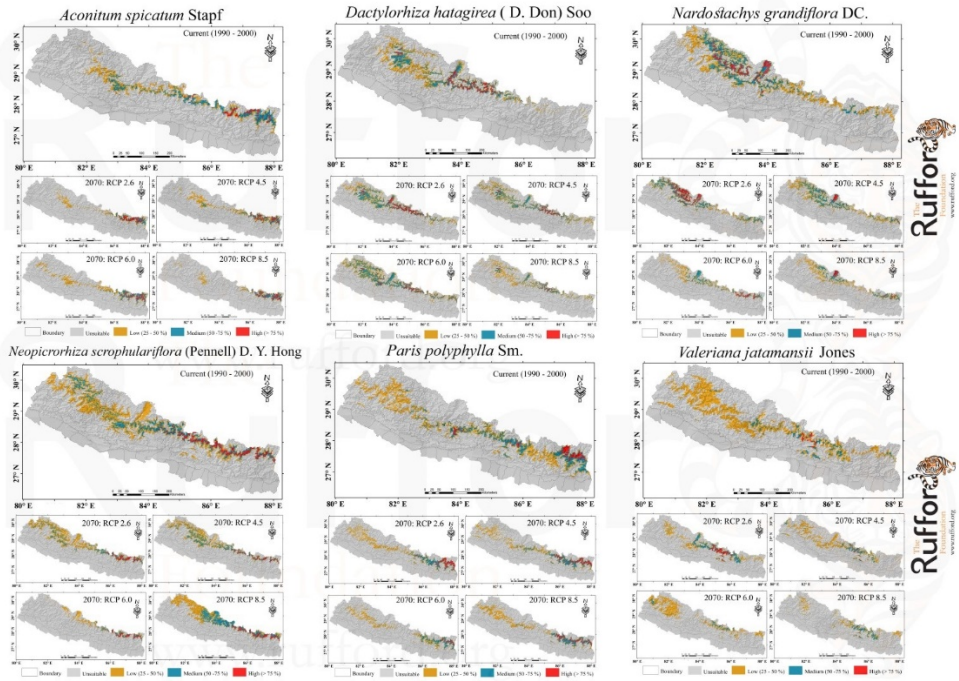

Figure 3: Suitability level of six highly traded MAPs under current and climate change scenarios.

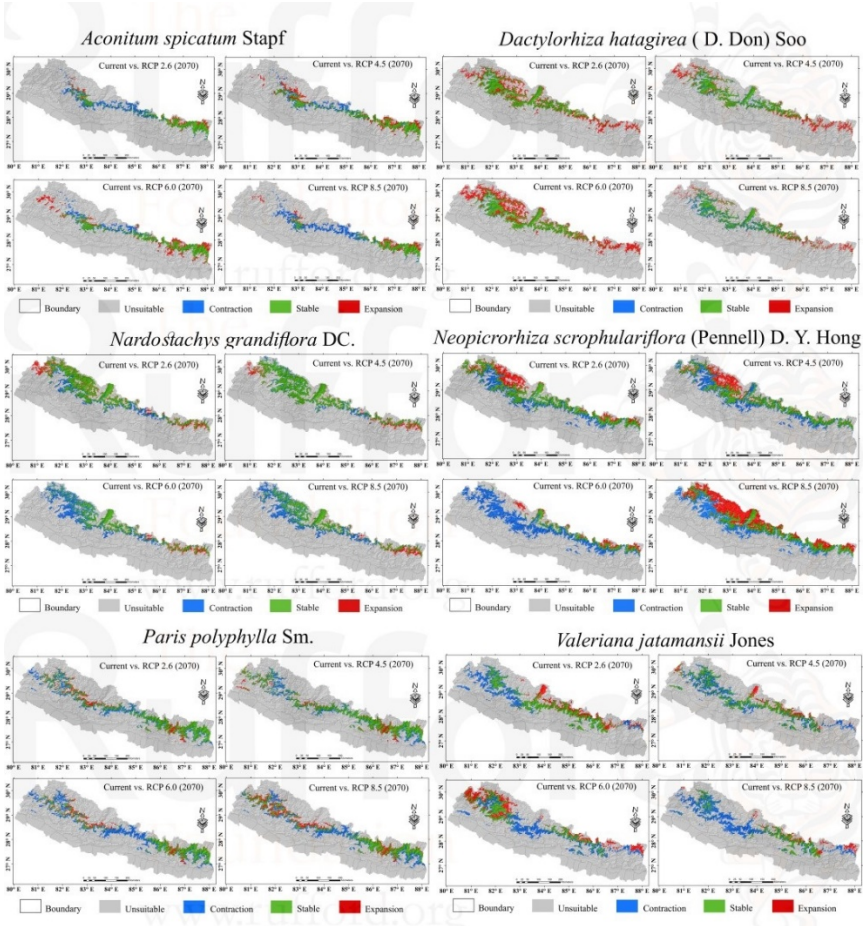

Figure 4: Climate change simulation for contraction-stability-expansion based on two climate scenario (current versus future (2070) 4 RCPs)

Figure 5: Principal investigator interviewing about trade of MAPs.

Figure 6: Harvested rhizome of Dactylorhiza hatagirea at Taplejung.

Figure 7: Trade of MAPs towards Olangchukgola -China at Taplejung