

mouth and tongue sores. Massage with oil from seeds of *Corylus jacquemontii* helps in relieving muscular pain; boiling roots of *Aconitum atrox* in oil until it forms a paste and applying this same is helpful for treating rheumatic pain. Powder made from roots of *Aconitum heterophyllum* and *Ainsliaea aptera* is useful in relieving stomach ache. Drinking juice prepared from fresh rhizome of *Curcuma domestica* along with milk is useful for relieving strains and chewing the bark of *Daphne papyracea* helps in relieving toothache. These are some examples of treating common ailments through plants. Examples of application of plants for treating common and curable ailments in the mountain areas are given refs 1 and 2. Owing to exigencies, application of seeds, leaves, bark and whole

plant for overcoming sudden health problems is intrinsic. In such cases, talking about prescription and doses are not common, and mode of application depends on availability of material and preparedness. Most of the rural people in mountain areas are more or less accustomed to use plants in a crude way. Therefore, application of locally available plants in crude way for treating some incidental and common ailments is an adaptational strategy of mountain communities for surviving in harsh environmental conditions. Scripting such folk knowledge is essential. It will be also useful if the attempts for screening of new medicinal compounds from ethno-medico-botanically important plants of the mountain areas can be initiated.

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## Climate change is affecting apple cultivation in Himachal Pradesh

Mountains are early and important indicators of climate change which depict far-reaching consequences on our ecosystem, agriculture and livelihood of the farmers<sup>1</sup>. The Himalayan mountain ecosystem is also facing serious challenges posed by climate change due to increasing aridity, warmer winter season, and variability in receiving precipitation and snow. Apple is one of the most important commercial crops of the Himalayan region and Himachal Pradesh (HP) with 1.05 lakh ha area under apple cultivation, which fetches livelihood for more than two lakh farmers. The winter temperature and precipitation in the form of snow are important and sensitive climatic factors for induction of dormancy, bud break and also to ensure proper flowering in apples. The fruit requires 1200–1500 h of chilling depending on the type of cultivar. Chilling hours <1000 lead to poor fruit formation. Prolonged delay in cold in December and January severely affects the chilling requirements.

Reports suggest that in the last three decades, apple crop is getting affected in all the hilly regions due to climate change. During this period, the Himalayan region has warmed faster than most places in the world. Mean surface temperature in the Himalaya rose by 1.5°C from 1982 to 2006 compared to a 0.6°C rise in the global mean from 1975 to

2005. Some areas in the region saw maximum mean winter temperatures going up by as much as 3.4°C from the 1980s. Since the early 2000s, average temperature in the Himalayan mountains has increased by about 1°C, which is around four times the global average<sup>2</sup>. Temperature increases are more during winter and autumn than during summer, and it clearly increases with rise in altitude. Analysis of the data<sup>3</sup> indicates that decadal temperature rise remains up to 0.2°C till 2000 m altitude, while above 2000 m it often exceeds 0.3°C. These changes have been noticed across different regions of the Himalaya. Analysis of data of the last two decades of major apple-growing areas (Shimla, Kullu, Lahaul and Spiti) indicates that minimum temperature is decreasing per year from November to April, whereas maximum temperature has been showing an increasing trend from November to April<sup>4</sup>. The chill units critical for apple production have also showed a decreasing trend. Chill units have been recorded to decrease up to 2400 m amsl from Bajaura in Kullu at 1221 m amsl to Sarbo in Kinnaur at 2400 m amsl. Analysis of rainfall for the past 41 years recorded in Kullu district showed 77 mm increase during the period from November to May. Increase in precipitation and decrease in snowfall during winter con-

sequently reflected in the low chilling hours in the region. Trend analysis indicated that snowfall is decreasing at the rate of 82.7 mm/annum in the entire region. Another study reports from the Kullu valley that rainfall has decreased by about 7 cm, snowfall by about 12 cm, the mean minimum and maximum temperatures<sup>5</sup> have increased by 0.25° and 1°C respectively, in 1990s compared to 1980s.

Consequences of these climate changes are visible clearly in the shifting of apple cultivation from lower elevations to higher altitudes in HP. Some of those important locations are Kullu valley in Kullu district, Rajgarh in Sirmaur district, Theog and Kotkhai in Shimla district, Churag and adjoining areas in Mandi district and some areas in Solan district. Early indications to poor fruit setting and lower productivity in delicious varieties were observed in 1990s. Apple-growing areas in low altitudes like Solan<sup>6</sup> have been reduced by as much as 77% between 1981 and 2007. During the same period, apple farming began in the higher-altitude areas of Kinnaur, Lahaul and Spiti, which were earlier considered too cold and dry. Apple cultivation has shifted to higher altitudes and apple yield mainly in lower altitudes has declined due to inadequate chilling as the temperature at lower altitudes is rising.

Apple production in Kullu valley has significantly declined during 1981–2000 (ref. 5). Another significant observation has been the shift in the cropping pattern from apple to pomegranate and vegetable cultivation. Early snow (December to early January) is preferred for meeting the chilling requirement of the crop, so that it has a favourable effect on bud break and soil moisture. Overall decrease of about 2–3% in yield has been reported in Shimla, Kullu, Lahaul and Spiti districts in mid 2000s and the maximum decline of about 4% was witnessed in marginal farms<sup>4</sup>. In addition to direct impact of climate change on apple productivity, it has also aggravated infestation of some diseases and pests resulting in more losses in yield<sup>7,8</sup>. Farmers are keen observers of such changes in the climate and their perceptions also corroborate a similar point of view<sup>9</sup>. In Kinnaur district, 72% of farmers from the low hills believed that change in climate, especially increasing temperature, was responsible for decline in fruit size and quality and 39% of farmers in the high hills considered climate change as a

deterrent in maintaining fruit quality<sup>10</sup>. Such observations warrant new approaches for production of apple in the hilly regions to combat climate change.

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## Jadav Molai Payeng – the ‘Forest Man of India’

Extinction of species is one of the greatest threats to mankind. Habitat fragmentation, resource exploitation and global climate change are the major threats to majority of the species<sup>1</sup>. The successful implementation of grassroot-level conservation strategies has proven to be the best way to remedy our depleting environment<sup>2</sup>. Jadav Payeng has shown us how to save the ecosystem in today’s plastic age. It all started in 1979, when he encountered a large number of reptiles that had died after floods washed them onto a treeless sandbar<sup>3</sup>. During 1980, leaving his education and home, Payeng started growing plants and transported red ants from his village, as he believes red ants change the property of soil. Today, he claims to have developed 1360 acres of forest, popularly known as ‘Molai Kathoni’ (Molai’s Woods) after his pet name ‘Molai’ in Jorhat district, Assam, on the bank of river Brahmaputra. The Assam State Forest Department learnt about Payeng’s forest only in 2008 when a herd of wild elephants strayed into it<sup>3</sup>. Today, the Molai forests is home

to deer, rabbits, Bengal tigers, rhinoceros, several species of migratory birds, several thousand trees, including *Terminalia arjuna*, *Lagerstroemia speciosa*, *Delonix regia*, *Albizia procera*, *Archidendron bigeminum*, *Bombax ceiba*, various species of bamboo, etc.<sup>4,5</sup>. Payeng was honoured with the title ‘Forest Man of India’ by the Jawaharlal Nehru University, on 22 April 2012 (ref. 6). He was also honoured by the Indian Institute of Forest Management<sup>7</sup>. Accepting a life of isolation, Payeng still lives in the forest. He shares a small hut with his wife and three children and makes a living selling cow and buffalo milk. The legacy of Payeng teaches us that poverty and illiteracy are not a barrier for a common man to shape the future of our planet. Without acquiring any academic degree, Payeng has forced the scientific community to think in his way for grassroot-level conservation of nature.

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