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Editorial Team: Puspa Aryal and Uma Dhungel

For the 665 – 666 issues of Headlines Himalaya, we reviewed researches from eight sources and selected 15 researches from five countries. We selected three researches from Nepal and 12 researches from other Himalayan countries (India, China, Bhutan and Pakistan).

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Bimala Dumar, Sadhana Pradhanang Kayastha, and Vishnu Prasad Pandey

Environmental Earth Sciences 80: 586

Springs supply water for drinking and livelihood for a vast majority of rural population in Nepal. Haphazard development activities are affecting springs adversely in hills and mountains of Nepal. This study aims to map springs, characterize their status from visual inspection and local/indigenous knowledge, characterize water quality, and then evaluate their suitability for drinking and irrigation in the Thuligaad watershed, western Nepal. Analysis of 160 springs mapped within four Wards (Ward is the smallest (fourth level) Administrative Unit in Nepal) in the Joraya Rural Municipality in the Thuligaad watershed indicated that most of the springs are perennial (95%), located in less than 1,200 or within 1400–1600 m above the sea level elevation (70.6%), and have discharge less than five liters per minutes (80% during pre-monsoon season). Multiple tools such as Gibb's diagram, Piper's diagram, and principal component analysis were used to characterize water quality. Forty springs selected for spring water quality analysis indicated that it is dominated by $\text{Ca}^{2+} > \text{Mg}^{2+} > \text{Na}^+ > \text{K}^+$ and $\text{HCO}_3^- > \text{Cl}^- > \text{SO}_4^{2-}$ water types, thus revealing rock–water interaction as dominant process controlling the spring water quality. Furthermore, water chemistry is dominantly Ca–HCO₃ (52% in pre-monsoon) and Mixed Ca–Mg–Cl (28% in pre-monsoon) types. Finally, suitability analysis revealed that spring water quality is of excellent quality for drinking and concentration of various parameters comply with national and World Health Organization's standard for drinking water quality. Similarly, the water is safe against various hazards for use in irrigation. Results of this first study in the study area provided valuable baseline information for spring water source protection and management.

Further Reading: <https://doi.org/10.1007/s12665-021-09826-w>**POPULATION STATUS AND DISTRIBUTION OF THE CRITICALLY ENDANGERED BENGAL FLORICAN HOUBAROPSIS BENGALENSIS IN THE GRASSLAND OF KOSHI TAPPU WILDLIFE RESERVE, NEPAL**

Ritika Prasai, Hemanta Kafley, Suraj Upadhaya, Swosthi Thapa, Pratistha Shrestha, Alex Dudley, and Yajna Prasad Timilsina

Journal of Threatened Taxa 13: 19293–19301

The Bengal Florican *Houbaropsis bengalensis* is one of the most threatened terrestrial bird species, listed as 'Critically Endangered' by the IUCN. This species is protected globally and locally due to very low population (global population is approximately 250–999 individuals), and little is known about its distribution and habitat use. We assessed population status and distribution of floricans in Koshi Tappu Wildlife Reserve, Nepal (KTWR). We surveyed 57 1-km² randomly distributed blocks across the reserve to record as many individuals as possible during their breeding season (March–May). We walked 2,964 transects (52 transects on each block) each of length 1 km on 57 blocks of 1-km² to estimate their population. We surveyed when the birds are most active during early morning (0600–0930 h) and later afternoon (1530–1900 h). We calculated grass importance value index (IVI), grass species composition, grass height, relative frequency of grass species, relative density of grass species, percent of grass ground coverage, presence/absence of human activity, and presence/absence of livestock to assess the habitat condition. We recorded 18 individuals (16 males and 2 females) inside the core of the reserve, where the habitat is dominated by *Imperata cylindrica*. Human disturbance had a negative impact on occurrence of the florican. We recommend implementing a Bengal Florican-specific conservation action plan to promote community-based conservation and restrict human encroachment in the grassland habitat.

Further Reading: <https://doi.org/10.11609/jott.6503.13.9.19293-19301>

ON THE IMPACT OF EARTHQUAKE-INDUCED LANDSLIDES ON RED PANDA AILURUS FULGENS (MAMMALIA: CARNIVORA: AILURIDAE) HABITAT IN LANGTANG NATIONAL PARK, NEPAL

Yogesh Rana Magar, Man Kumar Dhamala, Ajay Mathema, Raju Chauhan, and Sijar Bhatta

Journal of Threatened Taxa 13: 19191–19202

In addition to the threats of human encroachment, infrastructure development, tourism activities, habitat fragmentation, and human-wildlife interactions, natural disasters also pose a threat to the habitat of endangered species such as the Red Panda. This study aims to assess the impact of the 2015 Gorkha earthquake-induced landslides on the Red Panda's habitat in Langtang National Park (LNP), central Nepal Himalaya. Remote sensing and geographical information system were applied to estimate the potential and core habitats of the Red Panda, and collect information on earthquake-induced landslides. Field sampling and verification of remotely collected data were done within a year of the earthquake. Considering preferred vegetation types, elevation range, aspects, distance from water sources, and Red Panda presence points, an area of 214.34 km² was estimated as the potential habitat of Red Panda in the Park. Thirty-nine landslides were identified in LNP triggered by the Gorkha earthquake, 14 of which occurred in the core Red Panda habitat. As a result of the earthquake-induced landslides, a significant decrease in tree density was observed in the areas affected by the landslides. Similarly, the bamboo cover was observed to be significantly lower in the areas affected by landslides compared to the unaffected adjacent areas. The average size of the landslide, causing damage to the Red Panda habitat was 0.8 ha. The potential habitat damaged by the earthquake-induced landslide was estimated to be 11.20 ha which is equivalent to the habitat required by one Red Panda. The findings could be useful in initiating restoration of the damaged Red Panda habitat in LNP.

Further Reading: <https://doi.org/10.11609/jott.6451.13.9.19191-19202>

PLANT RESOURCES UTILIZATION AMONG DIFFERENT ETHNIC GROUPS OF LADAKH IN TRANS-HIMALAYAN REGION

Shiekh Marifatul Haq, Umer Yaqoob, Eduardo Soares Calixto, Inayat Ur Rahman, Abeer Hashem, Elsayed Fathi Abd_Allah, Maha Abdullah Alakeel, Abdulaziz A. Alqarawi, Mohnad Abdalla, Musheerul Hassan, Rainer W. Bussmann, Arshad Mehmood Abbasi, Sami Ur Rahman, and Farhana Ijaz

Biology 10: 827

The nomadic pastoral indigenous communities of the Ladakhi people share roots with Tibetan culture in terms of food, clothing, religion, festivals, and habits, and rely widely on plant resources for survival and livelihood. This survey was conducted during 2019–2021 to document the indigenous knowledge about plant resources of the Balti, Beda, and Brokpa communities of the Ladakh region, trans-Himalayas. Open- and close-ended semi-structured interviews (N = 184) and group discussions (N = 17) were used to collect the data. Quantitative data was further analyzed using various statistical tools. A total of 105 plant species belonging to 82 genera and 39 families were used as medicine, fuel wood, fragrance, oil, food, flavor, fodder, decoration, and dye. Among these, medicinal use was most prevalent, with 70% of use reports, followed by fodder and fuel wood. Leaves (27%) were the most preferred plant part used, followed by roots and flowers. The principal component analysis revealed five clusters of ethnobotanical usage, i.e., food, medicine, fuel wood, fodder, and fragrance, oil, dye, and flavor. The maximum number of plant species used was reported by the Brokpa, while the Beda reported the minimum number of plant species uses. *Delphinium brunonianum*, *Waldheimia tomentosa*, and *Juniperus indica* played a significant role in the cultural and religious ritual aspects, whereas *Allium przewalskianum*, *Waldheimia tomentosa*, *Juniperus indica*, and *Hippophae rhamnoides* were commonly used as a livelihood source among Ladakhi communities. The local people collected most plants (65%) for self-consumption, while the rest (35%) were sold in markets as a source of income. The sustainable utilization and management of plant resources by local people is a strategy to boost livelihoods and food security and alleviate poverty.

Further Reading: <https://doi.org/10.3390/biology10090827>

ASSESSING BIODIVERSITY AND PRODUCTIVITY OVER A SMALL-SCALE GRADIENT IN THE PROTECTED FORESTS OF INDIAN WESTERN HIMALAYAS

Shiekh Marifatul Haq, Eduardo Soares Calixto, and Manoj Kumar

Journal of Sustainable Forestry 40: 675-694

Biodiversity and productivity are the two most important attributes linked to the functioning of forest ecosystems. Understanding how diversity and productivity of a forest ecosystem change at a regional scale is crucial for conservation priority. We present an investigation of the structural attributes of forest with respect to biodiversity and biomass through a case study of Dachigam National Park (DNP), a protected forest in Indian Kashmir Himalaya. Systematic random sampling was performed in 60 forest stands of five different forest types of the study region. To compare the biodiversity and biomass attributes among forest types, we used Gaussian error distribution followed by the chi-square Wald test. We estimated structural attributes of the forest to visualize how they relate to the changing biodiversity across different forest types within DNP. The highest values of aboveground, below ground and total biomass were found in *Pinus wallichiana* forest, while it was lowest in scrub forest. *Pinus wallichiana* and *Quercus robur* tree species stocked the largest amounts of biomass, 24.83% and 17.20% respectively, and is a dominant carbon sink. The study would assist in evaluating the forested ecosystems by considering two important attributes of forests represented by diversity and productivity.

Further Reading: <https://doi.org/10.1080/10549811.2020.1803918>

IS HABITAT HETEROGENEITY EFFECTIVE FOR CONSERVATION OF BUTTERFLIES IN URBAN LANDSCAPES OF DELHI, INDIA?

Monalisa Paul and Aisha Sultana

Journal of Threatened Taxa 13: 19302–19309

The present study which was conducted in 2015–16 and 2016–17 emphasizes the nine different types of habitats used by 40 listed butterflies in six different urban landscapes of Delhi. Assessment of flowerbeds, grasses, hedges/crops/bushes, artificial light, wet soil/damp patches/humus, trees, open spaces/grounds, bird droppings, and roads/pavements/concrete spaces in conserving butterfly diversity in highly urbanized landscapes by testing the hypothesis that diversity of butterflies across all the habitats are similar, was the focal point of the study. Except for the artificial light and the paved roads or concrete spaces, all other habitats were natural in surroundings. The families Lycaenidae and Nymphalidae had the largest habitat share (26%), whereas the family Hesperidae had the minimum share (9%). Aravalli Biodiversity Park, New Delhi maintained the serenity of natural ones. Species richness and diversity was the highest at flowerbeds and lowest at the artificial light. The study highlights the choice of heterogeneous habitats by city butterflies to integrate the concept of the urban green spaces into a wide variety of urban development projects which in turn can help their own sustenance.

Further Reading: <https://doi.org/10.11609/jott.6412.13.9.19302-19309>

DIET OF LEOPARDS *PANTHERA PARDUS FUSCA* INHABITING PROTECTED AREAS AND HUMAN-DOMINATED LANDSCAPES IN GOA, INDIA

Bipin S. Phal Desai, Avelyno D'Costa, M.K. Praveen Kumar, and S.K. Shyama

Journal of Threatened Taxa 13: 19239–19245

The diet of leopards occupying human-dominated and protected areas (PAs) in Goa, India was analyzed through scat analysis. A total of 117 scats, 55 from wildlife sanctuaries/ national parks and 62 from human-dominated areas were collected and analyzed. Analysis of 55 scats from protected forest revealed the presence of only wild prey in the leopard diet, whereas 61% of scats collected from human-dominated areas consisted of only wild prey, 29% of domesticated animals, and 10% a mixture of both wild prey and domesticated animals. Of the prey biomass consumed in human-dominated areas, domestic animals constituted only 33% of the leopard diet. Among all leopard scats, 71% contained only one prey species, 28% contained two species, and 1% contained three.

Further Reading: <https://doi.org/10.11609/jott.4618.13.9.19239-19245>

LIVESTOCK VACCINATION PROGRAMME PARTICIPATION AMONG SMALLHOLDER FARMERS ON THE OUTSKIRTS OF NATIONAL PARKS AND TIGER RESERVES IN THE INDIAN STATES OF MADHYA PRADESH AND ASSAM

Andy Hopker, Naveen Pandey, Rosie Bartholomew, Abigail Blanton, Sophie Hopker, Aniruddha Dhamorikar, Jadumoni Goswami, Rebecca Marsland, PrakashMetha, and Neil Sargison

PLoS ONE 16: e0256684

Effective livestock vaccination has the potential to raise prosperity and food security for the rural poor in low and middle income countries. To understand factors affecting access to vaccination services, and guide future policy, smallholder farmers in three locations in India were questioned about vaccination of their cattle and buffalo, with particular reference to foot and mouth disease (FMD), haemorrhagic septicaemia (HS) and blackquarter (BQ). In

the three regions 51%, 50%, and 31% of respondents reported vaccinating their livestock; well below any threshold for effective population level disease control. However, within the third region, 65% of respondents in villages immediately surrounding the Kaziranga National Park reported vaccinating their cattle. The majority of respondents in all three regions were aware of FMD and HS, awareness of BQ was high in the Kanha and Bandhavgarh regions, but much lower in the Kaziranga region. The majority of respondents had positive attitudes to vaccination; understood vaccination protected their animals from specific diseases; and wished to immunise their livestock. There was no significant association between the age or gender of respondent and the immunisation of their livestock. Common barriers to immunisation were: negative attitudes to vaccination; lack of awareness of date and time of vaccination events; and difficulty presenting animals. Poor access to vaccination services was significantly associated with not vaccinating livestock. Fear of adverse reactions to vaccines was not significantly associated with not vaccinating livestock. Respondents who reported that vets or animal health workers (AHWs) were their main source of animal health knowledge were significantly more likely to have immunised their livestock in the last twelve months. Participants cited poor communication from vaccinators as problematic, both in publicising immunisation programmes, and explaining the purpose of vaccination. Where vaccinations were provided free of charge, farmers commonly displayed passive attitudes to accessing vaccination services, awaiting organised “immunisation drives” rather than seeking vaccination themselves. Based on these findings the following recommendations are made to improve participation and effectiveness of immunisation programmes. Programmes should be planned to integrate with annual cycles of: disease risk, agricultural activity, seasonal climate, social calendar of villages; and maximise efficiency for vaccinators. Dates and times of immunisation in each village must be well publicised, as respondents frequently reported missing the vaccinators. Relevant farmer education should precede immunisation programmes to mitigate against poor knowledge or negative attitudes. Immunisation drives must properly engage beneficiaries, particularly ensuring that services are accessible to female livestock keepers, and sharing some responsibilities with local farmers. Payment of a small monetary contribution by animal keepers could be considered to encourage responsibility for disease prevention, making vaccination an active process by farmers.

Further Reading: <https://doi.org/10.1371/journal.pone.0256684>

China Himalaya

A STUDY INTO THE SPATIOTEMPORAL DISTRIBUTION OF TYPHOON STORM SURGE DISASTERS IN CHINA

Ke Wang, Yongsheng Yang, Genserik Reniers, and Quanyi Huang

Natural Hazards 108: 1237–1256

In this study, we collected the data of 172 typhoon storm surge disasters that occurred in China during 1983–2018 to show the temporal and spatial distribution of their frequency and damage. Our results indicated that: (1) there was an increase in the frequency of typhoons storm surge disasters during 1983–2018, and 98% of these disasters occurred from June to October; (2) the damage decreased over time, especially after 1997; (3) the frequency and damage caused by typhoon storm surge disasters were higher in the southern and eastern regions than in the northern regions; (4) Guangdong, Fujian, and Zhejiang experienced the highest disaster occurrences and damages, and the number of disaster occurrences and damages in these three regions accounted for approximately 57% and 80% of the total disaster occurrences and damages, respectively. Furthermore, we mainly analysed the spatiotemporal characteristics of typhoon storm surge disasters from three aspects: contributors and damage records of extreme typhoon storm surge disasters, mitigation measures, and tropical cyclone tracks. These findings and analyses can help disaster managers improve their understanding of typhoon storm surge disasters and strengthen protection in disaster hotspots and sensitive months.

Further Reading: <https://doi.org/10.1007/s11069-021-04730-9>

IMPACT OF ANTHROPOGENIC ACTIVITIES ON MORPHOLOGICAL AND DEPOSITION FLUX CHANGES IN THE PEARL RIVER ESTUARY, CHINA

Xing Wei, Shuqun Cai, and Weikang Zhan

Scientific Reports 11: 16643

The evolution of the Pearl River Estuary (PRE), China in recent decades has been dominated by human activities. Historical admiralty charts and remote sensing images indicated that from 1936 to 2017, the tidal flat area and water area decreased by $23.6 \times 10^7 \text{ m}^2$ and $60.7 \times 10^7 \text{ m}^2$, respectively. The average advancing rate of the coastline of the PRE to the sea from 1972 to 2017 reached approximately 64.8 m/year, which is several times or even dozens of times that since the mid-Holocene. Land reclamation was the main reason for the dramatic changes in the water area and coastline. Although the water volume of the PRE showed a decreasing trend from 1936 to 2017, the water volume reduction rates for 1996–2005 and 2005–2017 were only 29% ($1.27 \times 10^7 \text{ m}^3/\text{year}$) and 12% ($0.53 \times 10^7 \text{ m}^3/\text{year}$), respectively, of that for 1936–1972. The combined influences of channel dredging, sand mining, and sediment load reduction caused by dam construction have contributed to this change. From the perspective of the filling up of the estuary, channel dredging, sand mining, and dam construction in the river basin are beneficial for prolonging the life of the estuary.

Further Reading: <https://doi.org/10.1038/s41598-021-96183-0>

Bhutan-Himalaya

BIRD DIVERSITY AND CONSERVATION THREATS IN JIGME DORJI NATIONAL PARK, BHUTAN

Pema Dendup, Leki Wangdi, Yenten Jamtsho, Pema Kuenzang, Dorji Gyeltshen, Tashi Tashi, Ugyen Rigzin, Yeshey Jamtsho, Rinzin Dorji, Rinzin Dorji, Yonten Jamtsho, Choki Lham, and Bep Tshering

Global Ecology and Conservation 30: e01771

The diversity of bird populations serve as a strong indicator for the overall health of an ecosystem. This study was aimed to understand and document bird diversity in different forest types and its conservation threats in Jigme Dorji National Park, Bhutan. Across the period of winter 2019 through autumn 2020, we used MacKinnon lists to collect data on birds along a total of 535.92 km transects (existing trails and roads) within the altitudinal range of 1300 – 5100 m inside the park. A total of 12363 individuals of birds belonging to 59 families, 143 genera, and 272 species were recorded. Two vulnerable species (Chestnut-breasted Partridge and Wood Snipe) and six near-threatened species (Bearded Vulture, Himalayan Vulture, River Lapwing, Satyr Tragopan, Yellow-rumped Honeyguide and Ward's Trogon) as per IUCN Red List have been recorded. The survey also recorded 57 migratory bird species as per Birdlife International. Of the forest types surveyed, highest species richness index was recorded in subtropical forest (17.4) followed by warm temperate (16.7), cold temperate (16.2), cool temperate (13.3), and rhododendron scrub (12.7). During the survey, five species were recorded as new species to the park (Wood Snipe, Yellow Wagtail, Pink-browed Rosefinch, and Spotted Bush Warbler) with one species being a new record for the country (Desert Wheatear). The large number of species recorded reveals the importance of the national park to serve as a critical habitat for birds. To conserve this rich bird diversity of the national park, we suggest better

management of habitats through reduction in habitat destruction, conservation awareness programmes and enhanced monitoring of illegal activities.

Further Reading: <https://doi.org/10.1016/j.gecco.2021.e01771>

ON THE HIGH BIRD DIVERSITY IN THE NON-PROTECTED REGIONS OF TRASHIYANGTSE DISTRICT IN BHUTAN

Lam Norbu, Phuntsho Thinley, Tandin Wangchuck, Ugyen Dechen, Lekey Dorji, Tshering Choephel, and Pasang Dorji

Journal of Threatened Taxa 13: 19274–19292

Birds are ecological indicators of ecosystem health. Baseline information on bird diversity are, therefore, important for ecological monitoring. Such information is, however, sorely lacking for many areas outside the protected areas. Here, we explore the avian diversity and present a comprehensive checklist for the non-protected regions of Trashiyangtse District in northeastern Bhutan. We also categorise the bird species by their residency pattern, feeding guilds, abundance, and IUCN Red List status. We conducted an avifauna exploration for a period of four years from 2017 to 2020, mostly through opportunistic encounters coinciding with regular field visits. We recorded a total of 273 bird species belonging to 173 genera, 69 families and 19 orders. Passeriformes was the most dominant order with 41 families and 174 species and Muscicapidae was the most dominant family with 12 genera and 32 species. Most birds were altitudinal migrants (39%), insectivorous (45%), and occasional (44%) in terms of residency pattern, feeding guild, and abundance, respectively. Only one species (*Ardea insignis*) was listed as Critically Endangered and one (*Haliaeetus leucoryphus*) as Endangered. Our study identified the non-protected regions of Trashiyangtse District as an important bird diversity area in Bhutan.

Further Reading: <https://doi.org/10.11609/jott.6843.13.9.19274-19292>

Pakistan- Himalaya

SPATIAL DISTRIBUTION OF THE THREATENED ASIATIC BLACK BEAR IN NORTHERN PAKISTAN

Umer Hafeez Goursi, Maqsood Anwar, Luciano Bosso, Muhammad Ali Nawaz, and Muhammad Kabir

Ursus 32e13: 1-5

The Asiatic black bear (*Ursus thibetanus*) is globally listed as “Vulnerable.” Here, we documented its current distribution and the human–bear conflict in Machiara National Park (MNP, northern Pakistan) from 2009 to 2013. Our observations indicated that this bear occurs in all areas of MNP, especially at elevations between 1,600 and 3,300 m above sea level. We recorded the greatest activity in May and September. Our questionnaire survey indicated that the majority of survey participants were not in favor of coexistence with this bear. The Asiatic black bear urgently needs effective management plans to guarantee its conservation in Pakistan.

Further Reading: <https://doi.org/10.2192/URSUS-D-19-00031.3>

IMPACT OF LAND USE/LAND COVER CHANGES ON WATER QUALITY AND HUMAN HEALTH IN DISTRICT PESHAWAR PAKISTAN

Waqas Ahmad, Javed Iqbal, Muhammad Jamal Nasir, Burhan Ahmad, Muhammad Tasleem Khan, Shahid Nawaz Khan, and Syed Adnan

The quality and quantity of groundwater resources are affected by landuse/landcover (LULC) dynamics, particularly the increasing urbanization coupled with high household wastewater discharge and decreasing open lands. This study evaluates temporal changes of groundwater quality for 2012 and 2019, its relation to Landuse/landcover, and its impact on Peshawar's residents (study area), Pakistan. A total of 105 and 112 groundwater samples were collected from tube wells in 2012 and 2019. Samples were then analyzed for seven standard water quality parameters (i.e., pH, electric conductivity (EC), turbidity, chloride, calcium, magnesium, and nitrate). Patient data for waterborne diseases were also collected for the years 2012 and 2019 to relate the impact of groundwater quality on human health. Landsat satellite images were classified for the years 2012 and 2019 to observe landuse/landcover dynamics concerning groundwater quality. Results manifested a decrease in groundwater quality for the year 2019 compared to 2012 and were more highlighted in highly populated areas. The nitrate concentration level was found high in the vicinity of agricultural areas due to the excessive use of nitrogenous fertilizers and pesticides, and thus the methemoglobinemia patients ratio increased by 14% (48–62% for the year 2012 and 2019, respectively). Besides, Urinary Tract Infections, Peptic Ulcer, and Dental Caries diseases increased due to the high calcium and magnesium concentration. The overall results indicate that anthropogenic activities were the main driver of Spatio-temporal variability in groundwater quality of the study area. The study could help district health administration understand groundwater quality trends, make appropriate site-specific policies, and formulate future health regulations.

Further Reading: <https://doi.org/10.1038/s41598-021-96075-3>

A CROSS SECTIONAL SURVEY OF KNOWLEDGE, ATTITUDE AND PRACTICES RELATED TO THE USE OF INSECTICIDES AMONG FARMERS IN INDUSTRIAL TRIANGLE OF PUNJAB, PAKISTAN

Sumera Afsheen Bakhtawer

PLoS ONE 16: e0255454

Pesticides in Pakistan are abundantly utilized for pest control in agriculture sector. The over and unsafe use of insecticides plus poor handling leads to the development of resistance, outbreak of secondary pests and hazardous impact on environment. The present study was aimed to access the current knowledge, attitude and common practices of farmers about the use of insecticides against pest in industrial triangle of Province Punjab, Pakistan. This study was conducted during October 2019 to February 2020. In this study farmers (n = 300) took part from three localities of Province Punjab (Gujrat, Gujranwala and Sialkot). Farmers were interviewed using a questionnaire to collect data about the knowledge of pest control by use of chemical method, biological method and combination of both to eradicate the pests. The result shows almost all (93%) farmers were male and they did not know about the insecticides mode of action and its chemical composition. They do not have any knowledge about the biological control of pests and did not get any assistance or help from Agriculture Extension Officer. They even did not properly dispose off the empty containers of insecticides. Statistical analysis reveals that lack of education and awareness about biological control of pest depicts development of resistance and outbreak of secondary pest including health hazards and environmental pollution. Poor understanding about pests, abundant use of insecticides, incorrect perception about application of insecticides and negligence regarding biological control shows that there is need to initiate public awareness programs to ensure the application of integrated pest management (IPM) and sustainable agriculture.

Further Reading: <https://doi.org/10.1371/journal.pone.0255454>