

# The impact of climate change on pest damage to subsistence agriculture in the Pamir Mountains, Tajikistan

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## I. Introduction - agriculture in the Pamirs



Typical Pamiri village, Shugnan valley

**Rich agricultural biodiversity** - The Western Pamir's is a remote mountain region in the South of Tajikistan. Due to its harsh and varied environment and many centuries of active crop selection and domestication by farmers, the region is rich in agrobiodiversity. Traditional crops such as grains (e.g. wheat, rye, barley), beans, and fruits (mulberry, apricot, walnut, apple), the latter brought to the region through the ancient Silk Road, are well adapted to the caprices or their surroundings. Many of these species are represented with more than 50 landraces, or varieties. Vegetable crops have been introduced relatively recently and their (genetic) diversity is small.

**Climate, vulnerability and food security** - notwithstanding its diversity and high degree of local adaptation, Pamiri agriculture remains vulnerable to extreme or unpredictable weather events and crop damage from insect pests can severely damage harvests. This affects the livelihoods and food security of the Pamiri people, almost all of whom depend on agriculture.

**Recent humanitarian and development efforts** aimed at income generation may exacerbate this situation by increasing farmers' reliance on introduced fruit varieties and vegetables that are less able to cope with climatic changes and pests.

### WESTERN PAMIRS - TAJIKISTAN



**The objective** of this study was to investigate how pest insects might affect the production of vegetable and fruit crops under future climate conditions in the Pamirs.

## II. Methodology

Over a period of 10 years the Pamir Biological Institute has gathered data on the abundance and phenology of agricultural pest insects, with an emphasis on vegetable pests and how they impact vegetable and fruit growing. Insect and plant behaviour were investigated along an elevation gradient to gain insight into potential future climate patterns and to determine their relative capacity for adaptation to these changing patterns. In the absence of reliable meteorological data, a number of sources, including farmer observations, were combined to gain an idea of climatic changes already underway.

## III. Results

**Climatic changes** - No reliable meteorological data exist for the Pamir region. Dramatic, spatially heterogeneous, evidence of climate change exists, however:

- **Melting glaciers** increase the risk of **natural disasters**, including floods and landslides. **Summers have become colder and more humid**, creating conditions that prevent ripening of crops such as (water)melons and wheat at higher elevations.
- **Winters have become warmer**, snow fall is decreasing while summer rains have intensified.
- Farmers complain that they can **no longer predict the weather** and that **seasons change more erratically**. Ploughing, sowing, and harvesting happen 15-20 days earlier than a decade ago.

**Pest insects** - 67 species of pest insects, belonging to 8 orders and 23 families were identified at elevations between 1100 and 3200 m above sea level. See table 1.

- Pest species are unevenly distributed across the Pamirs, with dry areas having low and humid areas high abundance of most species.
- Most species appear highly mobile, able to travel long distances and inhabit diverse habitats.
- The **behaviour and daily activities** of some insect species **change according to elevation and climatic conditions**.
- Increasing humidity in summer creates favorable conditions for pest insects at higher elevations or in new habitats previously not inhabited by these insects.

*Pieris brassicae ottonis* on cabbage leaves



Table 1: Relative pest abundance at different elevational gradients

+++ high abundance/serious harm; ++ low abundance/some damage; + not present

| Order, Family, Species                               | Elevation (m) | 1100-1500 | 1600-2300 | 2400-2800 | 2900-3200 |
|--|---------------|-----------|-----------|-----------|-----------|
| <b>Podura</b>  |               |           |           |           |           |
| <i>Sminturidae</i>                                   |               |           |           |           |           |
| <i>Bourleteilla hortensis</i> Fitch                  |               | -         | ++        | +         | -         |
| <b>Orthoptera</b>                                    |               |           |           |           |           |
| <i>Tettigoniidae</i>                                 |               |           |           |           |           |
| <i>Decticus albifrons</i> P                          |               | ++        | -         | -         | -         |
| <i>Tettigonia caudate</i> Charp.                     |               | ++        | +         | +         | -         |
| <i>Ceracrocercus fuscipennis hindukushanus</i> Rme.  |               | ++        | +         | -         | -         |
| <i>Cyrtidae</i>                                      |               |           |           |           |           |
| <i>Acheta deserti</i> Pall.                          |               | +         | -         | -         | -         |
| <i>Archididae</i>                                    |               | ++        | -         | -         | -         |
| <i>Anacridium aegypti</i> L.                         |               | +         | -         | -         | -         |
| <i>Calliptamus italicus relictus</i> Rme.            |               | ++        | ++        | +         | +         |
| <i>Calliptamus barbarus cephalotes</i> F             |               | ++        | +         | +         | +         |
| <i>Chorthippus biguttulus pamiricus</i> Rme          |               | ++        | ++        | +         | +         |
| <i>Locusta migratoria migratoria</i> L. ph solitaria |               | ++        | +         | +         | +         |
| <b>Homoptera</b>                                     |               |           |           |           |           |
| <i>Cicadidae</i>                                     |               |           |           |           |           |
| <i>Empoasca meridiana</i> Lachv.                     |               | ++        | ++        | +         | +         |
| <i>Psyllidae</i>                                     |               |           |           |           |           |
| <i>Trioxa nigricornis</i> Forst.                     |               | +         | ++        | +         | -         |
| <i>Aleyrodidae</i>                                   |               |           |           |           |           |
| <i>Aleyrodus prolella</i> L.                         |               | ++        | ++        | -         | -         |
| <i>Aphididae</i>                                     |               |           |           |           |           |
| <i>Aphis gossypii</i> Glov                           |               | ++        | ++        | +         | +         |
| <i>Aulacorthum solani</i> Kalt.                      |               | +         | +         | ++        | -         |
| <i>Brevicoryne brassicae</i> L.                      |               | +         | ++        | +         | -         |
| <i>Dysaphis crataegi</i> Kalt                        |               | +         | +         | ++        | +         |
| <i>Myzodes persicae</i> Sul.                         |               | ++        | ++        | ++        | +         |
| <i>Semiaphis dauci</i> F.                            |               | +         | +         | -         | -         |
| <b>Heteroptera</b>                                   |               |           |           |           |           |
| <i>Pentatomidae</i>                                  |               |           |           |           |           |
| <i>Graphosoma lineatum</i> L.                        |               | ++        | +         | -         | -         |
| <i>Graphosoma consimile</i> Horv.                    |               | ++        | +         | +         | -         |
| <i>Dolycoris penicillatus</i> Horv.                  |               | ++        | +         | +         | -         |
| <i>Carpocoris coreanus iranum</i> Tam.               |               | ++        | ++        | +         | -         |
| <i>Eurydema ventralis</i> Kol.                       |               | ++        | +         | +         | -         |
| <i>Eurydema ornate</i> L.                            |               | ++        | +         | -         | -         |
| <i>Eurydema gussakovskii</i> Kirr.                   |               | ++        | +         | -         | -         |
| <i>Eurydema olivaceum</i> L.                         |               | ++        | +         | -         | -         |
| <i>Miridae</i>                                       |               |           |           |           |           |
| <i>Lygus pratensis</i> L.                            |               | ++        | ++        | +         | +         |
| <i>Lygus genillatus</i> R.-S.                        |               | ++        | +         | +         | -         |
| <i>Pyrrhocoridae</i>                                 |               |           |           |           |           |
| <i>Scantius aegyptius</i> Schill.                    |               | +         | +         | -         | -         |
| <i>Coridae</i>                                       |               |           |           |           |           |
| <i>Brachycarenum tigrinus</i> Schill.                |               | +         | +         | +         | -         |
| <b>Coleoptera</b>                                    |               |           |           |           |           |
| <i>Scarabaeidae</i>                                  |               |           |           |           |           |
| <i>Amphimallon solstitialis mesasiaticus</i> Medv.   |               | ++        | ++        | +         | -         |
| <i>Amphicoma kuschakevitschi</i> Ball.               |               | ++        | +         | -         | -         |
| <i>Potosia culabensis</i> Reitt.                     |               | ++        | +         | -         | -         |
| <i>Melyridae</i>                                     |               |           |           |           |           |
| <i>Lobonyx turkestanicus</i> Kr.                     |               | +         | +         | -         | -         |
| <i>Chrysomelidae</i>                                 |               |           |           |           |           |
| <i>Longitarsus pellucidus</i> Found.                 |               | ++        | ++        | +         | -         |
| <i>Longitarsus succineus</i> Frd.                    |               | ++        | +         | -         | -         |
| <i>Phyllotreta fucata</i> F.                         |               | ++        | +         | -         | -         |
| <i>Psylliodes chrysocephala</i> L.                   |               | ++        | +         | -         | -         |
| <i>Cucullariidae</i>                                 |               |           |           |           |           |
| <i>Lixus limnei</i> Est.                             |               | +         | +         | -         | -         |
| <b>Lepidoptera</b>                                   |               |           |           |           |           |
| <i>Papilionidae</i>                                  |               |           |           |           |           |
| <i>Papilio machaon centralis</i> Stgr.               |               | +         | ++        | -         | -         |
| <i>Pieridae</i>                                      |               |           |           |           |           |
| <i>Pieris brassicae ottonis</i> Roeb.                |               | +         | ++        | +         | +         |
| <i>Pieris rapae debilis</i> Alph.                    |               | +         | ++        | +         | +         |
| <i>Leucochloe daplidice</i> L.                       |               | +         | +         | +         | +         |
| <i>Yponomeutidae</i>                                 |               |           |           |           |           |
| <i>Plutella maculipennis</i> Curt.                   |               | +         | ++        | +         | +         |
| <i>Noctuidae</i>                                     |               |           |           |           |           |
| <i>Agrotis obesa</i>                                 |               | ++        | ++        | +         | +         |
| <b>Hymenoptera</b>                                   |               |           |           |           |           |
| <i>Apidae</i>  |               |           |           |           |           |
| <i>Megachile genalis</i> F. Mor.                     |               | +         | ++        | +         | +         |
| <b>Diptera</b>                                       |               |           |           |           |           |
| <i>Syrphidae</i>                                     |               |           |           |           |           |
| <i>Eumerus strogatus</i>                             |               | ++        | ++        | +         | -         |
| <i>Eumerus sogdiana</i> S.                           |               | +         | ++        | +         | -         |
| <i>Agromyzidae</i>                                   |               |           |           |           |           |
| <i>Phytomyza atricornis</i> Mg.                      |               | ++        | ++        | ++        | +         |
| <i>Muscidae</i>                                      |               |           |           |           |           |
| <i>Delia brassicae</i> Bouche                        |               | -         | ++        | ++        | +         |
| <i>Delia platura</i> Mg.                             |               | -         | +         | +         | -         |

## IV. Conclusion

The distribution and adaptive behaviour of a number of pest species suggest that climatic changes in the Pamirs are likely to positively influence pest incidence and activity. **Pest damage to crops can be expected to increase.**

Further decline of vegetable and fruit diversity (agrobiodiversity), loss of valuable traits such as pest resistance, will decrease their ability to adapt to new conditions created by climate change. **Maintaining the diversity of traditional crops** and increasing their resistance to pests and climate variability through traditional and innovative farming practices **can increase the resilience of subsistence farming in the Pamirs.**

While some observations regarding the phenology of vegetable/fruit crops and pest insects were made, much uncertainty remains about their respective ability to withstand and adapt to seasonal changes and sudden weather events. This is an area for further study.

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