



1st International Conference on Climate Resilient Mountain Agriculture (CRMA-25)

“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

ABSTRACTS BOOK



Edited by

Prof. Dr. Hidayat ur Rahman
Dr. Khuram Nawaz Sadozai
Dr. Hafiz Khurram Shurjeel

Dr. Hidayat Ullah
Dr. Misbahullah
Dr. Jawad Anwar

ORGANIZED BY

**CENTER FOR CLIMATE RESILIENT MOUNTAIN AGRICULTURE
THE UNIVERSITY OF AGRICULTURE SWAT, PAKISTAN**



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025



PATRON-IN-CHIEF
PROF. DR. DAWOOD JAN
Vice Chancellor

Message of the Patron-in-Chief

It is a matter of great pride and pleasure to extend my warm greetings to all the delegates, researchers, policymakers, and participants of the *1st International Conference on Climate Resilient Mountain Agriculture “Innovating Together for Sustainable Livelihood”*.

This conference comes at a crucial time when mountain ecosystems - home to unique biodiversity and traditional heritage - are facing unprecedented challenges due to rapidly changing climate. The fragility of mountain agriculture, combined with the socio-economic vulnerabilities of the depending communities demands collective scientific innovation, resilient practices, and integrated policy interventions.

I commend the organizers for creating a platform where global and local experts can share their knowledge, research findings, and innovative solutions to address the multifaceted challenges in mountain agriculture. The abstract book, which compiles the wealth of contributions presented during this event, is a testament to the shared commitment to sustainability, resilience, and inclusive development.

I am confident that the expertise and insights gained from this conference will contribute significantly to shaping future strategies for climate-resilient agricultural practices in mountainous regions. Let this be a stepping stone toward collaborative efforts that not only safeguard mountain agriculture but also empower the communities that steward these landscapes.

I wish the conference great success and look forward to the impactful outcomes it will inspire.

Prof. Dr. Dawood Jan

Patron-in-Chief

Vice Chancellor

The University of Agriculture Swat



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025



CHIEF ORGANIZER
PROF. DR. MUHAMMAD ZULFIQAR

Message of the Chief Organizer

It is an honor and pleasure to extend my warm welcome to all participants of the *1st International Conference on Climate Resilient Mountain Agriculture “Innovating Together for Sustainable Livelihood”*.

This event brings together a diverse community of experts, researchers, practitioners, and policymakers committed to strengthening the resilience of mountain agriculture in the face of evolving climate challenges. Mountain regions, while ecologically rich and culturally diverse, remain among the most vulnerable to climatic shifts, and there is an urgent need for climate resilient, adaptive, and inclusive agricultural strategies.

The objectives in hosting this conference will provide a focused platform for the agriculture scientists, and development partners to engage in constructive dialogue, share research findings, and foster collaborative approaches tailored to mountain ecosystem.

The abstract book reflects the depth and diversity of contributions from national and international experts across multiple disciplines and regions. I believe it will serve as a valuable resource for both academic and applied work in the years ahead.

I extend my sincere appreciation to the technical committee, review panel, speakers, and all delegates whose participation and commitment have shaped the strength of this conference. Special thanks are due to our institutional partners and organizing team for their tireless efforts.

Looking forward to productive discussions, knowledge sharing, and building long-term partnerships that will strengthen climate resilience in mountain agriculture.

Warm regards,

Prof. Dr. Muhammad Zulfiqar

Chief Organizer

Advisor Academics

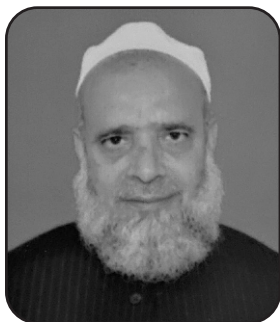
Center for Climate Resilient Mountain Agriculture

The University of Agriculture Swat



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

CONFERENCE CHAIRS



Prof. Dr. Hidayt ur Rahman



Prof. Dr. Farman Ullah



Prof. Dr. Mohammad Jamal Khan



Prof. Dr. Noor ul Amin



Dr. Roshan Ali



Dr. Irfan Ullah
Conference Secretary



CONFERENCE ORGANIZERS

- Prof. Dr. Shahid Sattar
- Prof Dr. Yousaf Hayat
- Mr. Akbar Khan
- Dr. Ibrar Ul Haq
- Dr. Jawad Anwar
- Dr. Hidayat Ullah
- Dr. Misbahullah
- Dr. Nazish Khan
- Dr. Muhammad Fayaz
- Dr. Asfandyar Khan
- Dr. Javed Iqbal Bangash
- Dr. Khurram Nawaz Sadozai
- Dr. Rizwan Ahmad
- Dr. Farhana Gul
- Dr. Durrishahwar
- Dr. Abdul Waheed Khan
- Dr. Riaz Alam
- Mr. Khwja Jawad
- Mr. Shah Saud



CONFERENCE THEMES

- 1. CLIMATE CHANGE IMPACT ON MOUNTAIN AGRICULTURE**
 - Glacial melt and water availability
 - Changing precipitation patterns
 - Impact on crop and livestock productivity
 - Emergence of new pests and diseases
- 2. CLIMATE RESILIENT AGRICULTURAL PRACTICES**
 - Traditional and indigenous farming system
 - Climate smart agriculture (CSA)
 - Agroecology and land management
 - Water harvesting and soil conservation
 - Agro- Forestry
 - Biodiversity
- 3. INNOVATION AND TECHNOLOGY IN MOUNTAIN AGRICULTURE**
 - Digital tools and ICT for adaptation
 - Remote sensing and GIS
 - Smart irrigation systems
 - Crop diversification and improve seed
- 4. POLICY, INSTITUTION, AND FINANCING CLIMATE CHANGE RESILIENCE**
 - Policy framework for mountain agriculture
 - Climate financing and green investments
 - Role of cooperatives and NGOs
 - Public-Private Partnerships
 - Role of markets
- 5. COMMUNITY ENGAGEMENT AND GENDER**
 - Empowering small holder for farmers
 - Women and youth in resilience building
 - Participatory planning
 - Climate justice and equity
- 6. CROSS-BORDER AND REGIONAL COOPERATION**
 - Transboundary watershed management
 - Regional knowledge-sharing
 - Disaster risk reduction
 - Case studies from mountain systems



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

KEYNOTE SPEAKERS



PROF. DR. SAJJAD AHMAD

Agri-Business Management Program
& Sustainable Agriculture
Lambton College, Sarnia, Canada.



PROF. DR. ASHFAQ AHMAD CHATTA

Vice Chancellor,
Ghazi University, Dera Ghazi Khan



MR. SANAUULLAH KHAN

Chief Conservator of Forests (Retired)
Forest Department,
Govt. of Khyber Pakhtunkhwa, Pakistan



PROF. DR. EJAZ QURESHI

Fenner School of Environment & Society,
Australian National University, Australia



PROF. DR. MUHAMMAD ASHFAQ

Dean, Faculty of Management Studies,
The University of Faisalabad - Pakistan



PROF. DR. DIANA CHALIL

Magister of Agribusiness
Universitas Sumatera Utara, Indonesia



MS. HUMAIRA DANIEL

Climate Resilience Specialist
Aga Khan Development Network,
Afghanistan



DR. ADEEL AHMED

Department of Economics and Finance
RMIT International University,
Vietnam Campus



DR. JAWAD ALI

Deputy Country Director,
Helvetas Swiss Inter-Cooperation, Pakistan



PROF. DR. HARUN UCAK

Alanya Alaaddin Keykubat University,
Türkiye



MR. MELAD UL KARIM

Program Director - RD,
Aga Khan Foundation, Kabul,
Afghanistan



DR. GIRI R KATTEL

The University of Melbourne,
Australia



DR. FREDRIC ANDREW

Rabadan Academy, UAE



DR. WAHEED ULLAH

Rabadan Academy, UAE

CRMA-25-vi

CENTER FOR CLIMATE RESILIENT MOUNTAIN AGRICULTURE
THE UNIVERSITY OF AGRICULTURE SWAT-PAKISTAN



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

ABSTRACTS



TABLE OF CONTENTS

S.NO.	ABSTRACT TITLE	PAGE NO.
KEYNOTE ABSTRACTS		
1	BUILDING CLIMATE RESILIENCE IN MOUNTAINS THROUGH INTEGRATED NATURAL RESOURCE MANAGEMENT (INRM)	CRMA-25-01
2	FUTURE OF OUR AGRICULTURE IN THE SCENAR IO OF CLIMATE CHANGE AND SOLUTIONS VIA QUALITY EDUCATION	CRMA-25-02
3	MOUNTAIN AGRICULTURE IN NORTHERN PAKISTAN: CLIMATE DYNAMICS AND MONSOON VARIABILITY	CRMA-25-03
4	HOW RESILIENT ARE WATERWAYS OF THE ASIAN HIMALAYAS FOR SUSTAINABLE MOUNTAIN AGRICULTURE? ARE TH ERE ADAPTIVE MEASURES?	CRMA-25-04
5	INORGANIC CARBON: AN OVERLOOKED POOL IN GLOBAL SOIL CARBON RESEARCH	CRMA-25-05
6	WOMAN AND YOUTH CLIMATE RESILIENCE BUILDING IN ZONES OF CONFLICT AND FRAGILITY.	CRMA-25-06
7	VEGETABLES PRODUCTION USING WALK -IN TUNNEL TECHNOLOGY UNDER RESOURCE EFFICIENT FOOD PRODUCTION IN PAKISTAN – RE-FOOD PROJECT BY HELVETAS SWISS INTERCO -OPERATION PAKIS TAN	CRMA-25-07
8	IRON CHLOROSIS MANAGEMENT BY TREE INJECTION: AN INNOVATIVE APPROACH IN PEACH ORCHARDS OF SWAT VALLEY	CRMA-25-08
9	IMPACT OF CLIMATE -SMART AGRICULTURE ON CROP PRODUCTION AND MITIGATION OF GREENHOUSE GAS EMISSION	CRMA-25-09
10	PREVAILING RUNOFF VARIATIONS AS INFLUENCED BY CLIMATIC CH ANGES IN THE UPPER INDUS, HINDUKUSH-KARAKORAM-HIMALAYA	CRMA-25-10
11	FORECASTING THE IMPACT OF GLOBAL CLIMATE CHANGE ON THE HABITAT SUITABILITY OF A THREATENED SPECIES - <i>HERACLEUM CANDICANS</i> WALL. EX DC.; A SPECIES DISTRIBUTION MODELING APPROACH	CRMA-25-11
12	VULNERABILITY ASSESSMENT OF 2022 FLASH FLOOD USING HEC RAS: A CASE STUDY OF DEH KAMANGAR, DADU SINDH	CRMA-25-12



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

THEME -1		
CLIMATE CHANGE IMPACTS ON MOUNTAIN AGRICULTURE		
13	PROSPECT OF MOUNTAIN AGRICULTURE IN NORTHERN PAKHTUNKHWA - “THREATS AND OPPORTUNITIES”	CRMA-25-14
14	ANALYZING THE CLIMATE CHANGE IMPACT AND FARMER’S ADAPTABILITY STRATEGIES IN KHYBER PAKHTUNKHWA, PAKISTAN	CRMA-25-15
15	NIAB-BURAQ: BOLD SEEDED AND HIGH YIELDING KABULI CHICKPEA VARIETY FOR ENHANCED FOOD SECURITY IN CLIMATE CHANGE SCENARIO	CRMA-25-16
16	CLIMATE CHANGE AND POPULATION TREND OF RICE LEAF FOLDER, <i>CNAPHALOCROCIS MEDINALIS</i> G. (LEPIDOPTERA: CRAMBIDAE) IN DISTRICT SWAT	CRMA-25-17
17	EMERGENCE AND MOLECULAR EPIDEMIOLOGY OF GEMINIVIRUSES INFECTING DIVERSE PLANT SPECIES IN SWAT	CRMA-25-18
18	EFFECT OF PHOSPHORUS AND SULFUR ON MAIZE PRODUCTIVITY AND NUTRIENT ABSORPTION	CRMA-25-19
19	YAK: A CLIMATE -SENSITIVE SPECIES AND A LIVELIHOOD RESOURCE FOR HIGH-ALTITUDE COMMUNITIES	CRMA-25-20
20	HEAT SHOCK PROTEINS, DYNAMIC BIOMOLECULES TO COUNTER PLANT ABIOTIC STRESSES UNDER CHANGING CLIMATE	CRMA-25-21
21	INSECT POLLINATORS ASSOCIATED WITH APPLE ORCHARDS AT DISTRICT CHITRAL, KHYBER PAKHTUNKHWA -PAKISTAN	CRMA-25-22
22	GROWTH OPTIMIZATION AND REARING OF MEALWORM (TENEBRIO MOLITOR L.) AS A SUSTAINABLE FOOD SOURCE	CRMA-25-23
23	THE IMPACT OF CLIMATE CHANGE ON THE POPULATION DYNAMICS OF VECTOR BORNE DISEASES	CRMA-25-24
24	THE IMPACT OF CLIMATE CHANGE ON FOOD SECURITY: A REVIEW	CRMA-25-25



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

25	IMPACT OF CLIMATE CHANGE ON MOUNTAIN AGRICULTURE: INFLUENCE ON CROP AND LIVESTOCK PRODUCTION	CRMA-25-26
26	CLIMATE-INDUCED STRESS ON CROP AND LIVESTOCK PRODUCTIVITY IN MOUNTAIN AGRO ECOSYSTEM: TRENDS, CHALLENGES AND ADAPTATION	CRMA-25-27
27	GLACIAL MELT AND CRISIS OF WATER SECURITY: IMPLICATIONS FOR IRRIGATION DEPENDENT - AGRICULTURE IN MOUNTAINOUS REGIONS	CRMA-25-28
28	MANAGING GLACIER LAKE OUTBURST FLOODS (GLOFS) THROUGH REGIONAL DISASTER RISK REDUCTION FRAMEWORKS IN THE HINDU KUSH HIMALAYAN REGION	CRMA-25-29
THEME -2 CLIMATE RESILIENT AGRICULTURAL PRACTICES		
29	DEVELOPMENT OF PULSES CULTIVAR BEST SUITED FOR CLIMATE RESILIENT AGRICULTURE UNDER CHANGING CLIMATE	CRMA-25-31
30	ROLE OF MICROBES IN IMPROVING SEED YIELD AND QUALITY OF VEGETABLES	CRMA-25-32
31	COMPARISON OF CLIMATE SMART AMENDMENTS ON PLANT PHYSIOLOGICAL AND GRAIN YIELD ATTRIBUTES OF WHEAT GROWING UNDER WATER LIMITED CONDITIONS	CRMA-25-33
32	IMPACT OF PHOSPHATE SOLUBILIZING BACTERIA ON MAIZE PRODUCTIVITY IN PESHAWAR AREA	CRMA-25-34
33	BIOAGENTS ASSISTED ROCK PHOSPHATE ENRICHED VERMICOMPOST AS A CLIMATE SMART TECHNOLOGY IMPROVED ONION GROWTH AND NUTRIENTS UPTAKE UNDER POT AND FIELD TRIALS	CRMA-25-35
34	THE ROLE OF ORGANIC AGRICULTURE IN ENHANCING BIOLOGICAL AND ENZYMATIC PROPERTIES OF SOIL AND MAIZE GROWTH	CRMA-25-36
35	CLIMATE-RESILIENT AGRICULTURE: CHALLENGES AND ADAPTIVE STRATEGIES	CRMA-25-37
36	PHOSPHORUS NUTRITION MANAGEMENT FOR BETTER FORAGE GROWTH AND SEED YIELD OF CLIMATE RESILIENT CROP; CLUSTER BEAN (<i>CYAMOPSIS TETRAGONOLOBA</i> L.)	CRMA-25-38



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

37	CLIMATE -SENSITIVE DISTRIBUTION PATTERNS OF <i>IRIS HOOKERIANA</i> IN SUBALPINE AND ALPINE HABITATS OF THE HINDU -HIMALAYAS	CRMA-25-39
38	THE SILENT SHIFT: CLIMATE CHANGE AND SWAT VALLEY'S INSECTS	CRMA-25-40
39	MICROPLASTICS CONTAMINATION IN MOUNTAINOUS ECOSYSTEMS: THREAT TO APIS MELLIFERA IN SWAT VALLEY, PAKISTAN	CRMA-25-41
40	DISTRIBUTIONAL NOTES AND SPECIES DIVERSITY OF DUNG BEETLES (<i>SCARABAEIDAE</i>) FROM DISTRICT MALAKAND KHYBER PAKHTUNKHWA, PAKISTAN	CRMA-25-42
41	MEALWORM (<i>TENEbrio MOLITOR</i>) REARING AND GROWTH OPTIMIZATION AS A SUSTAINABLE FOOD SOURCE USING VARIOUS LARVAL DIETS UNDER LABORATORY CONDITIONS	CRMA-25-43
42	TARNAB GANDUM-I: A CLIMATE -RESILIENT, ZINC-ENRICHED, AND RUST-RESISTANT WHEAT VARIETY FOR RAINFED AND IRRIGATED SYSTEMS OF KHYBER PAKHTUNKHWA	CRMA-25-44
43	PULSES PRODUCTION UNDER CLIMATE VARIABILITY IN THE DRYLAND ZONES OF SOUTHERN KHYBER PAKHTUNKHWA: EVIDENCE FROM PANEL DATA ANALYSIS	CRMA-25-45
44	SOCIOECONOMIC IMPACT OF INTRODUCING TEA AS A COMMERCIAL CROP IN HILLY REGIONS OF KHYBER PAKHTUNKHWA PROVINCE	CRMA-25-46
45	CLIMATE-RESILIENT FLORICULTURE AS A SUSTAINABLE LIVELIHOOD STRATEGY IN THE MOUNTAINOUS REGION OF SWAT VALLEY, NORTHERN PAKISTAN	CRMA-25-47
46	MOUNTAINS IN A TEST TUBE: CLIMATE -SMART CONSERVATION OF MEDICINAL FLORA IN SWAT VALLEY - A REVIEW	CRMA-25-48
47	INTEGRATING CLIMATE RESILIENT PRACTICES FOR MANAGING PEST AND DISEASE OUTBREAKS IN HIGH-ALTITUDE AGRICULTURE	CRMA-25-49
48	EVALUATING THE EFFECTIVENESS OF CLIMATE SMART AGRICULTURE (CSA) TECHNOLOGIES IN ENHANCING SOIL HEALTH AND WATER USE EFFICIENCY UNDER CHANGING CLIMATE	CRMA-25-50



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

49	CLIMATE -RESILIENT FLORICULTURE AS A SUSTAINABLE LIVELIHOOD STRATEGY IN THE MOUNTAINOUS REGION OF SWAT, NORTHERN PAKISTAN	CRMA-25-51
50	INTEGRATING CLIMATE - RESILIENT CROPS AND IMPROVED SEED SYSTEMS INTO NATIONAL AGRICULTURE POLICY: A CASE STUDY FROM A CLIMATE HOTSPOT REGION	CRMA-25-52
51	CLIMATE CHANGE AND THE EMERGENCE OF PESTS AND DISEASES IN MOUNTAIN AGRICULTURE, ASSESSING RISKS AND DEVELOPING CLIMATE - RESILIENT MANAGEMENT STRATEGIES	CRMA-25-53
THEME -3		
INNOVATION AND TECHNOLOGY IN MOUNTAIN AGRICULTURE		
52	THE EFFECT OF BIOCHAR ON NITRATE LEACHING NITROGEN UPTAKE AND YIELD OF WHEAT	CRMA-25-55
53	SELENIUM NANOPARTICLES ENHANCE SESAME'S BIOTIC STRESS TOLERANCE AND OIL BIOACTIVES IN A CHANGING CLIMATE	CRMA-25-56
54	EFFECT OF SEED PRIMING WITH ZINC NANOPARTICLES AND SALINE IRRIGATION WATER ON YIELD AND NUTRIENT UPTAKE BY WHEAT PLANTS	CRMA-25-57
55	BIOFORTIFICATION OF CROPS: A WAY TO ENGINEERING CLIMATE RESILIENCE IN MOUNTAIN AGRICULTURE	CRMA-25-58
56	ADDITIONS TO THE PAKISTANI FAUNA: NEWLY REPORTED GENERA IN THE PLANTHOPPER TRIBE DELPHACINI	CRMA-25-59
57	ON MATHEMATICAL MODEL FOR PINE WILT DISEASE USING FRACTIONAL ORDER DERIVATIVE	CRMA-25-60
58	EFFECT OF PHOSPHOROUS APPLIED WITH BIOCHAR AND POULTRY MANURE ON YIELD AND NUTRIENT UPTAKE IN MAIZE CROP	CRMA-25-61
59	FRUITS OF MICROPROPAGATED STRAWBERRY (FRAGARIA ANANASSA) PLANTS EXHIBITED HIGHER ANTIOXIDANT METABOLITES AS COMPARED TO IN VIVO GROWN PLANTS	CRMA-25-62
60	PLANT BASED BIOGENIC NANOPARTICLES AS AN EFFECTIVE TOOL FOR BIOTIC AND ABIOTIC STRESS TOLERANCE IN PLANTS: A REVIEW	CRMA-25-63



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

61	SMART GRID TESTBED FOR LAUNCHING DOS ATTACKS AND IMPACT OF DOS ATTACKS ON ENERGY MANAGEMENT SYSTEM	CRMA-25-64
62	METABOLOMICS AND BIOCHEMICAL ANALYSIS OF TWO POTATO (SOLANUM TUBEROSUM L.) CULTIVARS EXPOSED TO IN-VITRO OSMOTIC AND SALINITY STRESSES	CRMA-25-65
63	APPLICATION OF AI TOOLS FOR DEVELOPING NUTRACEUTICALS IN MOUNTAINOUS REGION	CRMA-25-66
64	SECURING IOT ARCHITECTURES FOR CLIMATE CHANGE MONITORING: A CYBERSECURITY-DRIVEN APPROACH	CRMA-25-67
THEME -4 POLICY, INSTITUTIONS, AND FINANCING CLIMATE RESILIENCE		
65	IMPACT OF CLIMATE -SMART AGRICULTURE ON CROP PRODUCTION AND MITIGATION OF GREENHOUSE GAS EMISSION	CRMA-25-69
66	UNLOCKING CLIMATE RESILIENCE: A STUDY OF INSTITUTIONAL BARRIERS REGARDING COMPETENCIES ENHANCEMENT IN ADAPTATION STRATEGIES OF EXTENSION WORKERS IN PAKISTAN	CRMA-25-70
67	INTEGRATED SOIL NUTRIENTS (NP) MANAGEMENT; TRAILS OVERVIEW	CRMA-25-71
68	FROM STRESS TO STRATEGY: MAPPING CLIMATE RISK AND FARMER RESPONSE IN MOUNTAIN CROPPING SYSTEMS	CRMA-25-72
THEME -5 COMMUNITY ENGAGEMENT AND GENDER		
69	DETERMINANTS OF INCOME INEQUALITY IN URBAN AND RURAL AREAS OF DISTRICT PESHAWAR, KHYBER PAKHTUNKHWA	CRMA-25-74
70	EFFECT OF DIGITAL FINANCIAL LITERACY ON FINANCIAL INCLUSION OF WOMEN ENTREPRENEURS IN PUNJAB, PAKISTAN	CRMA-25-75
71	CLIMATE RESILIENCE IN AGRICULTURE EXTENSION: AN ASSESSMENT OF AGRICULTURE OFFICERS CAPABILITIES IN KHYBER PAKHTUNKHWA PAKISTAN	CRMA-25-76



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

72	UNRAVELLING THE LINK BETWEEN WOMEN’S EMPOWERMENT AND HUMAN DEVELOPMENT IN DEVELOPING COUNTRIES	CRMA-25-77
THEME -6 CROSS-BORDER AND REGIONAL COOPERATION		
73	CLIMATE CHANGE MITIGATION THROUGH SOIL ORGANIC CARBON SEQUESTRATION UNDER LONG-TERM FERTILIZATION IN A PROFILE OF CHINESE LOESS PLATEAU SOIL	CRMA-25-79
74	TAXONOMIC STUDY OF ORDER COLEOPTERA FROM DISTRICT CHARSADE, KHYBER PAKHTUNKHWA, PAKISTAN	CRMA-25-80
75	TAXONOMIC STUDY OF FAMILY CARABIDAE (COLEOPTERA) FROM DISTRICT MOHMAND	CRMA-25-81
76	ANALYZING THE CLIMATE CHANGE IMPACT AND FARMER’S ADAPTABILITY STRATEGIES IN KHYBER PAKHTUNKHWA, PAKISTAN	CRMA-25-82
77	A CROSS-BORDER AND NATIONAL COOPERATION FOR SUSTAINABLE COOLING SOLUTIONS FOR MARGINALIZED COMMUNITIES IN PAKISTAN	CRMA-25-83
78	IRON NANOPARTICLE-INDUCED MODULATION OF SALINITY TOLERANCE IN <i>CAPSICUM ANNUUM</i> L.	CRMA-25-84
79	SUSTAINABLE FOOD PRESERVATION TECHNOLOGIES FOR MOUNTAINOUS REGIONS ENHANCING RYING, FERMENTATION, AND COLD STORAGE TO REDUCE WASTE	CRMA-25-85
80	CROSS BORDER CONFLICT OR COOPERATION? A STUDY OF THE INDUS WATERS TREATY AND ITS RELEVANCE TO MOUNTAIN WATERSHED MANAGEMENT AND DRR	CRMA-25-86
81	PROSPECTS OF GROWING KIWI FRUIT AS DIVERSIFIED FRUIT CROP IN THE MID HILLS OF NORTHERN PARTS OF KHYBER PAKHTUNKHWA	CRMA-25-87
82	EFFECT OF PHOSPHORUS AND SULFUR ON THE YIELD AND NUTRIENTS UPTAKE OF WHEAT	CRMA-25-88
83	LEGUME/GRASS INTERCROPPING AT LOW NITROGEN INPUT: A CLEANER STRATEGY FOR ACHIEVING THE DUAL GOALS OF HIGH-QUALITY FORAGE PRODUCTIVITY AND LOWER ENVIRONMENTAL FOOTPRINTS IN ARID REGIONS	CRMA-25-89



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

84	EFFECT OF BORON ON GROWTH AND SEED YIELD OF PEA CULTIVARS	CRMA-25-90
85	HYBRID BRIQUETTING OF LOW-RANK KPK COAL WITH COCKLEBUR BIOMASS: STRENGTH AND THERMAL PERFORMANCE STUDY	CRMA-25-91
86	DROUGHT STRESS-MEDIATED TRANSCRIPTOME PROFILE REVEALS NCD AS A KEY PLAYER MODULATING DROUGHT TOLERANCE IN <i>POPULUS DAVIDIANA</i>	CRMA-25-92



BUILDING CLIMATE RESILIENCE IN MOUNTAINS THROUGH INTEGRATED NATURAL RESOURCE MANAGEMENT (INRM)

Mr. Sanullah Khan

Ex Chief Conservator of forests

Forest Department, Govt. of Khyber Pakhtunkhwa

Abstract

Climate change is one of the most significant environmental challenge faced by the world. Greenhouse gas emissions resulting from human activities, particularly fossil fuel consumption and deforestation have increased the concentration of these gases in the atmosphere, leading to irreversible damage to natural resources and ecosystems. Accounting for only 0.9 percent of global Green House Gas (GHG) emissions, Pakistan is one of the most vulnerable nations to be affected by climate change. The country faces unpredictable weather patterns, resulting in flash floods, droughts, glacial lake outbursts, intense heat waves and erratic rainfall. Forest ecosystems and landscape are deteriorating and forest fires are increasing, animal species are migrating and water bodies and wells are depleting due to intensified incompatible practices. The frequency of climate related disasters has alarmingly risen in Pakistan in general and Khyber Pakhtunkhwa in particular. The flood of 2010 and 2022 and earthquake of 2005 created substantial economic losses, casualties, infrastructure damages and rehabilitation cost. Addressing environmental issues is of pressing nature, this is not just combating land degradation, but also preserving ecosystem functions, ensuring food security, securing water resources within the land and confronting the climate change issues through mitigation and adaptation measures. The negative consequences of the climate change are more pronounced in mountains, both for the communities and environment requiring more awareness, more attention and quicker reaction than elsewhere. Equally the consequences of negative impact are going beyond the boundaries of mountains, and affect people and ecosystems in the surrounding low land/ down- stream. The concerns are more migration, negative impact of reduce snow, loss of quality of agricultural products from mountains, reduced potential for tourism and recreation. Mountains' pastoralism also supports the economy of Khyber Pakhtunkhwa which is also affected by the climate change. Addressing the above issues through participatory integrated/holistic approach is the only remedy. Green sector departments work normally in close compartments and lack appropriate inter and intra-departmental coordination mechanism at planning and operational level. Each sector is undertaking planning and management of its own sector without effective and meaningful consultation with sister sector and involvement of the local communities. More specifically lacking inter departmental coordination. Examples are Pasture/ Rangeland where the custodian is the Forest Department but no coordination with Livestock and Agriculture Extension departments. Similarly, the outputs of Irrigation departments are the inputs for Agriculture department. Similarly, Agriculture Extension and Agriculture Research, Soil and Water Conservation, Plant Protection, OFWM and Cooperatives. Also, there is a lack of coordination between Seed Producers, Irrigation and Food Department. A farmer needs cereal crops, horticulture, and poultry rearing, livestock, and fuelwood, water from nature and aquaculture development. Hence natural resources are inter-dependent and inter related and need to be managed in integrated fashion.



FUTURE OF OUR AGRICULTURE IN THE SCENARIO OF CLIMATE CHANGE AND SOLUTIONS VIA QUALITY EDUCATION

Shujaul Mulk Khan

Department of Plant Sciences, Quaid-i- Azam University Islamabad

Member Pakistan Academy of Science

Corresponding author Email: shuja@gau.edu.pk

Abstract

Climate change is affecting every sector of life including our ecosystem which is mainly based on plant products. It's changing the weather pattern, increasing drought, creating floods, and bringing wildfires in natural forests. Acceleration in soil erosion, depletion, and deterioration of aquifers are the indirect impacts of these changes that in turn threaten food security as well as safety. Climate change is a long-term shift in weather patterns driven by natural and human activities, leading to global warming and extreme weather events. Education - both formal and informal, plays a crucial role in climate change mitigation by enhancing awareness, fostering critical thinking, and promoting sustainable practices. It equips individuals with the knowledge and skills necessary to understand the complexities of climate change and engage them in informed decision-making. Education also promotes innovation and solutions, supports policy and advocacy, builds resilience, and empowers vulnerable populations. Climate change mitigation strategies align with Sustainable Development Goal 13 (SDG 13) “Climate Action”, but they also present synergies and trade-offs with other SDGs. Large-scale implementation of technologies can positively impact economic growth and job creation, but environmental issues linked to mineral extraction can detract from other SDGs. Careful management is essential to balance these interactions and minimize trade-offs. Educational institutions play a crucial role in achieving Sustainable Development Goal 13 (SDG 13) by fostering knowledge, research, advocacy, and sustainable practices. Apart from long-term solutions, some short-term remedies include, supporting small-scale food production, minimizing the agro-fuel expansion, and enhancing food sovereignty – that is recognizing the right of all people to healthy and culturally appropriate food produced through ecologically sound methods within the umbrella of their own food and plants systems. There is also a dire need of combating the climate crises by achieving the other sustainable development goals as well. It's also the right time to have negotiation on Carbon, stocks, Carbon currency and Carbon Tax at national, regional and global levels among all the stakeholders especially academicians and researchers.

Keywords: Climate change; Global warming; Deforestation; Urbanization; Industrialization; burning issue for academia and research.



MOUNTAIN AGRICULTURE IN NORTHERN PAKISTAN: CLIMATE DYNAMICS AND MONSOON VARIABILITY

Waheed Ullah

Associate Professor, Rabdan Academy

*Corresponding author's Email: wullah@purdue.edu

Abstract

Mountain agriculture in northern Pakistan faces significant challenges from climate variability, particularly through complex interactions between Himalayan Plateaus thermal processes and South Asian monsoon dynamics. This study examines the critical role of soil moisture and atmospheric circulation patterns in determining precipitation variability that directly impacts agricultural productivity in Pakistan's mountainous regions. Using multi-source datasets including in-situ observations from Pakistan Meteorological Department, remotely sensed data from CHIRPS and SSM/I, and reanalysis products from ERA5, MERRA-2, and NCEP during 1981-2018, we investigate mechanisms linking Himalayan Plateaus Spring soil moisture conditions to South Asian Summer Monsoon precipitation patterns. The analysis reveals that interannual variations in South Asian precipitation are significantly influenced by Himalayan Plateaus soil moisture conditions, with explained variance ratios of 0.3-0.4 at 99% confidence level. Composite analysis demonstrates that dry spring soil moisture conditions over the Himalayan Plateaus lead to positive precipitation anomalies in South Asia during subsequent summer months, while wet conditions produce opposite effects. Empirical Orthogonal Function analysis reveals that 60% of precipitation variance is explained by the leading EOF mode. The underlying mechanism involves Himalayan Plateaus soil moisture regulation of near-surface energy balance and diabatic heating profiles, which subsequently influence South Asian High positioning and monsoon onset timing. Early monsoon onset, associated with positive soil moisture anomalies over the Himalayan Plateaus, shows advancement of 20-25 days compared to late onset years, significantly impacting agricultural planning and crop management strategies in northern Pakistan's mountain valleys. These findings provide valuable insights for developing climate-informed agricultural practices and water resource management strategies, with direct implications for food security and sustainable agricultural development in high-altitude regions where communities depend heavily on monsoon-fed agriculture.

Keywords: Climate Variability, Monsoon dynamics, Atmospheric Circulation System.



HOW RESILIENT ARE WATERWAYS OF THE ASIAN HIMALAYAS FOR SUSTAINABLE MOUNTAIN AGRICULTURE? ARE THERE ADAPTIVE MEASURES?

Giri R Kattel

The University of Melbourne, Parkville, Melbourne 3010 Australia

*Corresponding author's Email: giri.kattel@unimelb.edu.au

Abstract

The waterways of the Asian Himalayas have faced critical challenges during the 21st century. The high-mountain system, the areas of global freshwater source supporting important ecosystem services including fisheries and crop production to more than two billion people, is facing unprecedented rates of climate warming. The impacts include seasonal variations in precipitation, glacier melting and snow avalanches. Climate warming together with urbanization, industrialization, and engineering works for hydropower and irrigation has transformed waterways. These changes have caused tremendous setbacks in water resource development including natural and agricultural systems downstream basins. Drier areas are facing absolute water scarcity with limited access of water for irrigation, crop production, and ecosystem functioning. The areas with adequate quantities of water are not usable due to prolonged eutrophication and pollution. The increased summer snow melts have altered downstream flow regimes causing direct and indirect flood related disasters. Floods have also intensified water pollution by mixing nutrients and other chemicals from agriculture, household wastes and industries, releasing them into waterways and causing public health crises. With projected future climate warming, the waterways in the high mountain system have witnessed niche agricultural and ecological shifts endangering regional food productivity and societal resilience. The relative increase in water demand reflects substantial challenges that the freshwaters will face in future for the maintenance of infrastructure and associated services. Increased investments in strategies such as expansion of better infrastructure facilities, new water pricing policies, innovative technology, a part of waterways development program, will further intensify the impacts. The fundamental challenge of waterways of the Asian Himalayas today is therefore how to tackle this hydro-meteorological transformation caused by climate change and anthropogenic perturbation and find avenues for sustainability of agriculture in future. Detailed accounts of knowledge on sustainability of waterways in the region is, however, scant. It requires a framework which can potentially diagnose threats at temporal and spatial scales and provide strong adaptive measures to future sustainability. Failure to tackle these challenges can have larger consequences in the agriculture and people's lives. Provision to economic benefits brought upon by managing the waterways such as by avoiding the crossing critical hydro-metrological thresholds through various actions such as research and development, technological advancement and adaptive management strategies can ensure resilience of mountain agriculture. The UN's 2030 Agenda for Sustainable Development Goals (SDGs) provide a shared blueprint for peace and prosperity for people and the planet, where water resources, energy and food in the high mountain systems have received an urgent call for action through a global partnership. This paper will present the research focusing on waterways management in the Asian Himalayas addressing the key questions such as, how recent climate warming has threatened waterways and sustainable mountain agriculture, and how the society have reacted to those changes in the region. Given the key drivers of waterways changes are being identified, how the society be configured or adapted to those changes by providing effective measures through people's participation and integration of knowledge is significant.

Keywords: Resilient Water Ways, Sustainable Mountain Agriculture, Downstream Basin.



INORGANIC CARBON: AN OVERLOOKED POOL IN GLOBAL SOIL CARBON RESEARCH

Sajjad Raza,

Research Scientist, Nottingham University UK

*Corresponding author's Email: sajjad.raza@nottingham.ac.uk

Abstract

Soils play a critical role in the global carbon (C) cycle and climate dynamics, acting as either a sink or source of atmospheric carbon dioxide (CO₂). The largest terrestrial C reservoir exists in soils, comprising two primary pools: soil organic carbon (SOC) and soil inorganic carbon (SIC), each with unique functions and fates yet receiving vastly different levels of research focus. This study employs a bibliometric analysis to evaluate global soil C research trends, highlighting the disproportionate emphasis on SOC versus SIC. Since 1905, over 47,000 publications (>1.7 million citations) have addressed soil C, with SOC dominating (>96% of publications and citations) while SIC remains underexplored (<4%). About 40% of soil C research relates to climate change, with SIC studies, despite fewer publications, showing greater per-document citation impact than SOC studies. Recent SOC research (2020–2023) emphasizes mineral-associated organic carbon, machine learning, soil health, and biochar, while SIC trends focus on digital soil mapping, soil properties, acidification, and calcite. SOC research spans 151 countries, compared to 88 for SIC, with 70% of global soil C research concentrated in just nine countries, led by China and the USA (45% of publications, 37% of collaborations). Despite SIC's longevity (turnover >1000 years in natural systems), intensive agriculture accelerates its losses, underscoring its significance in the global C cycle and climate change. The limited focus on SIC threatens efforts to achieve the 1.5–2.0 °C targets of the 2015 Paris Climate Agreement. This study urges greater research investment in SIC, emphasizing its inclusion in carbon budgets and models to ensure a comprehensive understanding of the global C cycle.

Keywords: Carbon Cycle, Climate Dynamics, Biochar.



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

**WOMAN AND YOUTH CLIMATE RESILIENCE BUILDING IN ZONES OF
CONFLICT AND FRAGILITY.**

Fredrick Andrew Lacker.

*Corresponding author's Email: flaker@ra.ac.ae

Rabdan Academy UAE

My talk will focus on climate and sustainable livelihoods in conflict zones. The presentation will detail the nature and challenges of violence and fragility for women and youth, how climate accentuates existing tension, the policies and practices of the World Bank and the UN system and, finally showcase grassroots initiatives to build resilience by women and youth in Africa in Asia.



VEGETABLES PRODUCTION USING WALK-IN TUNNEL TECHNOLOGY UNDER RESOURCE EFFICIENT FOOD PRODUCTION IN PAKISTAN – RE-FOOD PROJECT BY HELVETAS SWISS INTERCOOPERATION PAKISTAN.

¹ **Munawar Khan Khattak**, ² Mr. Qazi Muhammad Ajwad and ³ Dr. Arjumand Nizam

¹ Provincial Coordinator Helvetas

² Agriculture Expert Helvetas

³ Country Director Helvetas

*Corresponding author's Email: munawar.khattak@helvetas.org

Abstract

This study assesses the economic viability, productivity, and climate resilience of vertical farming (vegetables production) using walk-in tunnels (plastic & anti-insect net) in Peshawar valley semi-urban areas, focusing on both tomato and cucumber farming. Conducted under the Re-Food Project initiative, the research highlights how this innovative farming method offers a transformative approach to agriculture, particularly benefiting smallholder farmers, including women. For tomato farming, the findings reveal that tunnel farming delivers significantly higher yields of 185% more crop per marla along with better-quality produce, which commands a 42% higher market price. Despite higher initial establishment costs, farmers achieve an average profit margin per kilogram approximately 70% greater than traditional farming methods. This makes tunnel farming a highly profitable and sustainable agricultural practice over the long term. This method also offers strong climate resilience by protecting crops from environmental hazards such as erratic rain, hailstorms and heavy wind, which often devastate traditional farming systems. Furthermore, tomato farmers using walk-in tunnels experienced minimal losses and improved productivity, even under challenging climatic conditions. In the case of cucumber production, tunnel farming similarly demonstrates marked advantages. This method yields 81% more per marla and produces cucumber crops of superior quality, commanding a market price 167% higher than those grown using traditional farming methods. Tunnel farming also drastically reduces post-harvest yield losses, from 30-35 % in traditional farming (open bush farming) to as low as 4 - 5 %. Resource efficiency is another key benefit, with tunnel farming using 35-45 % less water and optimizing fertilizer use, which enhances both environmental sustainability and economic returns. Profit margins for cucumber farmers are significantly higher, with an average of Rs. 33.7 per kilogram compared to traditional farming. The long-term profitability of tunnel farming is underscored by its return on investment (ROI) over a 15-year lifespan. Both tomato and cucumber tunnel farming are notably resource-efficient, using less water per marla and optimizing fertilizer and pesticide applications. Additionally, these methods offer robust protection against extreme weather conditions, pests, and diseases, contributing to enhanced climate resilience. A significant 92% of participating farmers in the tomato study were women, showcasing the potential for tunnel farming to empower women in agriculture, foster livelihoods, and promote socioeconomic equity. This also holds true for cucumber farmers, where the method has proven beneficial in enhancing the economic participation of women. In conclusion, tunnel farming represents a scalable, climate-smart solution to enhance food security, increase farmer incomes, and reduce environmental footprints for both tomato and cucumber production. The study recommends providing financial and technical support to farmers, particularly women, to expand the adoption of this innovative farming approach.

Keywords: Tunnel Farming, Innovative Farming, Sustainable Agriculture.



IRON CHLOROSIS MANAGEMENT BY TREE INJECTION: AN INNOVATIVE APPROACH IN PEACH ORCHARDS OF SWAT VALLEY

Dr. Roshan Ali, Ajmal Khan & Dost Muhammad

Abstract

Tree health management is a critical aspect of urban and natural ecosystems maintenance, and the utilization of trunk injection techniques has emerged as a significant innovation in this field. Trunk injection enables the targeted delivery of essential nutrients, micro nutrients, pesticides, and fungicides directly into a tree's vascular system, thereby addressing specific nutrient deficiencies, managing pests and diseases, and overcoming soil constraints. The experiment was designed in soil and plant nutrition section of Agricultural Research Institute Mingora, Swat starting from field survey and laboratory analysis followed by iron application of different sources through trunk injection and foliar spray. Results of twelve orchards showing iron chlorosis symptoms showed that the soils had sufficient Fe ($> 5\text{mg kg}^{-1}$) but due to strongly calcareous nature (12.5-19% lime) and high pH (>7.8) the plant had Fe in deficient range ($<60\text{ mg kg}^{-1}$). On the basis of these results orchard of private farmer at Kotlai, Kabal Swat was chosen for the experiment. Iron from three sources i.e. liberal Fe, (13% Fe), $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$, (20% Fe) and This Fe, (6% Fe) was injected at 0.13 % Fe in 500 mL water twice in a season first at December, 2020 and second in March 2021 along with control. Treatments were arranged in randomized complete block (RCB) design with three replications where each replicate consisted of single tree of a similar ages. Trunk injection significantly improved the leaf iron and peach production as compared to control. Injection of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ raised leaf Fe to (326 mg kg^{-1}) with higher fruit weight (167.4g), fruit length (68.9 mm), fruit diameter (65.7 mm), fruit yield (67.4 kg tree^{-1}) and total soluble solids (13.9°Brix). However, fruit firmness (5.00 kg cm^{-3}) and fruit juice pH (3.43) did not vary with treatments. The foliar application consisting of 0, 250, 500 and 750 mg L^{-1} from $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ and nano-Fe were applied to plants twice in the year March 2021, where the treatments were arranged in randomized design in the same orchard. Foliar application of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ at 750 mg L^{-1} significantly increased iron in leaf (300.8 mg kg^{-1}) as well as exhibited highest fruit weight (147.17g), fruit length (65.23mm), fruit diameter (62.10mm), fruit yield ($58.32\text{ kg tree}^{-1}$) and total soluble solids (13.20°Brix). Conclusively, the trunk injection was found better with additional advantage of lower requirement and environmentally safer than foliar. However, in both methods the FeSO_4 was better than other tested sources of Fe and hence may be recommended. Further investigation both *in planta* and field including other fruit trees is required.

Keywords: Trunk Injection, Peach, Iron Chlorosis, Micronutrients.



IMPACT OF CLIMATE-SMART AGRICULTURE ON CROP PRODUCTION AND MITIGATION OF GREENHOUSE GAS EMISSION

Abdul Shakoor^{1*}, Maqsood Qamar¹, Zahid Mehmood¹, Syed Haider Abbas¹, Samman Gul Vaseer¹, Sundus Waqar¹, Imtiaz Hussain², Humaira Iqbal¹ and Taj Naseeb Khan³

¹Wheat Program, National Agricultural Research Centre, Islamabad, Pakistan

²Pakistan Agricultural Research Council, Islamabad, Pakistan

³Crop Sciences Institute, National Agricultural Research Centre, Islamabad, Pakistan

*Corresponding author's Email: shakoor2914@gmail.com

Abstract

Worldwide climate changes has posed serious threats to agricultural production. Long-term changes in climate variability, vulnerability, a rise in average temperature, and changes in precipitation patterns including sea level rise, floods, droughts, and extreme weather events threaten crop productivity, food security and the livelihoods of people across the globe. One of the main contributors to climate change is the release of greenhouse gases (GHGs) into the atmosphere. Lower crop yields with higher dependence on food imports, global economic shocks and climate change exacerbate more challenges to food security, specifically in developing countries. Pakistan has an agro-based economy with a high dependency on the sector, contributing 19.2% to the country's GDP. Therefore, adaptation to climate change is necessary to promote farmers' sustainable livelihoods and mitigate carbon emissions. A technologically sophisticated solution to the problems facing agriculture due to climate change is called Climate-Smart Agriculture (CSA). Crop rotation, crop residue management, and soil and water conservation are called Climate-Smart Agriculture practices. It is reported that Climate-Smart Agriculture practices increased water use efficiency and total water storage by 9-68% and 1-13%, respectively. Furthermore, implementation of Climate-Smart Agriculture practices increased wheat yield by 30-45%. The adoption of Climate-Smart Agriculture practices can potentially help reduce greenhouse gas emissions without compromising agricultural production. Using advanced internet technology to ensure agricultural information security, improvement of cropping patterns and management techniques, carrying out “internet + weather” service and improving the agricultural service are considered as the main direction of future development of Climate-Smart Agriculture. Researchers, extension workers and policymakers can benefit from synthesizing all this information as it may help provide favorable plans to boost crop production by selecting and using relevant CSA practices in Pakistan.

Keywords: Climate-Smart Agriculture; Crop Yield; Adaptation; Greenhouse Gases.



PREVAILING RUNOFF VARIATIONS AS INFLUENCED BY CLIMATIC CHANGES IN THE UPPER INDUS, HINDUKUSH-KARAKORAM-HIMALAYA

Azfar Hussain

Institute for Advanced Study & Tiandu-Shenzhen University Deep Space Exploration
Joint Laboratory & Space Science Center, Shenzhen University, Shenzhen 518060, China

*Corresponding author's Email: azfarhussayn@gmail.com

Abstract

This study systematically investigates changes and variability in runoff across the Kabul River Basin (KRB), Upper Indus Basin (UIB), and Jhelum River Basin (JRB) in northern Pakistan, along with their potential regional and large-scale climatic drivers. Using the Monotonic Mann-Kendall trend test and Sen's Slope estimator, we analyzed seasonal and annual trends in runoff, maximum and minimum temperatures, and precipitation from 1961 to 2016. Wavelet transform coherence analysis was applied to explore the relationships between runoff and key climate indices, including the North Atlantic Oscillation (NAO), El Niño–Southern Oscillation (ENSO), Indian Ocean Dipole (IOD), and Pacific Decadal Oscillation (PDO). The results reveal a consistent increase in maximum temperature and a decrease in minimum temperature across all basins, while precipitation and runoff trends varied spatially. An abrupt change point in the UIB led to increased discharge, whereas flows in the KRB and JRB remained relatively unchanged. The KRB exhibited dominant precipitation variability from interannual to decadal scales, while interannual cycles were prominent in the JRB. Interannual temperature cycles were observed in the KRB and UIB, with a clear decadal signal emerging from 2000 to 2016. Climate indices showed interannual associations with runoff in the KRB and JRB, and both interannual and decadal influences in the JRB. These findings highlight evolving hydroclimatic dynamics in northern Pakistan and provide crucial insights for informing water resource management, policy development, and disaster risk reduction strategies in the region.

Keywords: Runoff Variation, Climatic Changes, Upper Indus Basin.



FORECASTING THE IMPACT OF GLOBAL CLIMATE CHANGE ON THE HABITAT SUITABILITY OF A THREATENED SPECIES - *HERACLEUM CANDICANS* WALL. EX DC.; A SPECIES DISTRIBUTION MODELING APPROACH

Jawad Hussain¹, Shujaul Mulk Khan^{1,2}, Muhammad Shakeel Khan¹

¹ Department of Plant Sciences, Quaid-i-Azam University-45320 Islamabad, Pakistan

² Member of Pakistan Academy of Sciences

Abstract

Heracleum candicans (hogweed) is under the influence of huge anthropogenic pressure in terms of multipurpose collection coupled with climate-driven environmental changes in the region. It was hypothesized that establishment of *H. candicans* with plant associations was due to the complex biotic and abiotic interactions which play a crucial role in its present as well as future distribution. Therefore, we aimed to find out the impact of biotic and abiotic interactions as well as habitat suitability of hogweed, under the current and future climatic scenarios. The association pattern and biotic interactions were evaluated via cluster analysis (CA) and two-way cluster analysis (TWCA). GLM and CC analyses were carried out to assess *H. candicans* in relations to biotic and abiotic variables, simultaneously. Findings showed that abundance of the plant increased with increase in soil pH, EC, OM, N, P, K, sand and silt while decreased with increase in soil erosion and elevation from sea level. *H. candicans* exist in three different plant associations ranging from elevation of 1800 to 3000 m.a.s.l. For the distribution modelling of the *H. candicans* three machine algorithms such as RF, CART and SVM were used to predict potential habitats suitability till the end this century. Future distribution of the considered species is primarily influenced by temperature and precipitation seasonality. Ensemble modelling-RF achieved high performance based on AUC-ROC values with training and test data of 1 and 0.979, respectively. The suitable habitat of the plant is expected to show contrasting range changes from 2040 and 2070 under both SSP126 and SSP370 scenarios. By the year 2100, the range of suitable habitat is expected to expand under, and to shrink under a pessimistic scenarios, SSP126 and SSP370, respectively. The predictive modelling approach could be beneficial for assessing the conservation importance and devising the future management strategies and policies for this and number of other endemic and threatened species especially the medicinal plants.

Keywords: Global Climate Change, Habitat Suitability, Atmospheric Pressure, Hogweed.



VULNERABILITY ASSESSMENT OF 2022 FLASH FLOOD USING HEC RAS: A CASE STUDY OF DEH KAMANGAR, DADU SINDH

Dr Samiullah

Department of Geography and Geomatics University of Peshawar

Abstract

Globally, Pakistan has been ranked in the top ten countries most affected by climate change in the past 20 years by German Watch. Further, the Global Climate Risk Index annual report for 2020 has pointed out that within 1999-2018 period, Pakistan witnessed 152 extreme weather events. In terms of climate change, according to IPCC and other scenarios and projections, the country is to face further warming to its already hot climate at a rate considerably above the global average. The current study assess vulnerability of the Kamangar area to flash floods and map it. It further identified various zones in the area according to their varied vulnerability (high, medium, and low) to floods by mapping them. The data was collected from diverse sources. Boundary map of Kamangar was obtained from the district revenue department. Digital Elevation Model (DEM) ASTER (12.5m) was downloaded from Copernicus free source. River discharge data was collected from irrigation department. Precipitation data was obtained from Pakistan Meteorology department Islamabad. Soil data was obtained from Pakistan Soil survey reports. HEC RAS software was used for the hydrological analysis and vulnerability of the study area to flood. The analysis was based on various flood scenarios like 300mm, 400mm and 500mm rainfall in various time periods for area inundated by flood and velocity of flood water. The analysis indicate that Kamangar area was badly affected by flood in 2022. The results indicate that due to very low relief, most of the area is highly vulnerable to flash flood originating from the Kirther ranges located in the western side of the region. The hydrological analysis indicated that when there is three-meter-high flood, all the area will be inundated. This study will hopefully serve as the bedrock for future local climate adaptation plans and assist in developing flood resilient settlement planning. The study will provide technical assistance for resilient recovery, rehabilitation, and reconstruction in post-flood development.

Keywords: Flood, Sindh, Bedrock, Climate Adaptation.



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

THEME # 1
CLIMATE CHANGE IMPACTS ON
MOUNTAIN AGRICULTURE



PROSPECT OF MOUNTAIN AGRICULTURE IN NORTHERN PAKHTUNKHWA- “THREATS AND OPPORTUNITIES”

Prof. Dr. Mohammad Jamal Khan

Chairman, Department of Soil and Environmental Sciences, The University of Agriculture
Swat email *Corresponding author's Email: jamal@aup.edu.pk

Abstract

Mountain agriculture in Pakistan faces a range of natural, economic, and social threats. These regions including northern Pakhtunkhwa, Gilgit-Baltistan, and Azad Jammu & Kashmir are vulnerable due to their fragile ecosystems and isolation. Agriculture in mountain of northern Pakhtunkhwa holds immense potential due to its diverse agro-ecological zones, rich biodiversity, and unique traditional farming practices. However, it faces numerous threats that hinder its sustainability and productivity. The key threats includes soil erosion and land degradation, conversion of mountains for residential area, climate Change, socioeconomic challenges, overgrazing and deforestation, lack of diversification, policy neglect and the outmigration of youth. The infrastructure deficiencies including limited road access, market connectivity, poor extension services and lack of access to agricultural inputs, inadequate irrigation systems, and heavy dependence on seasonal water sources further aggravate the threats. Despite these issues, the region offers substantial opportunities for resilient agricultural development. The promotions of climate-smart practices, organic farming, high-value crops, agro forestry, and ecotourism have the potential to transform the region's agricultural economy. Strengthening local institutions, investing in rural infrastructure, and empowering mountain communities—especially women and youth are essential for unlocking this potential. This review explores the dual landscape of threats and opportunities shaping the future of mountain agriculture in Northern Pakhtunkhwa, emphasizing the need for an integrated and sustainable approach to ensure food security, livelihoods, and environmental conservation in the region. Mountain agriculture at present is at a crossroads, balancing the dual pressures of environmental vulnerability and socio-economic challenges. With strategic investment in infrastructure, technology, and sustainable practices, alongside leveraging its unique advantages, mountain regions can transform their agricultural systems into models of resilience and innovation.

Keywords: Mountain, Resilience, Degradation, Gilgit Baltistan.



ANALYZING THE CLIMATE CHANGE IMPACT AND FARMER'S ADAPTABILITY STRATEGIES IN KHYBER PAKHTUNKHWA, PAKISTAN

¹Aiman Altaf, ¹Khuram Nawaz Sadozai, ²Sonia Jan Alam and ³Fida Muhammad

¹Department of Agricultural & Applied Economics, The University of Agriculture, Peshawar, Pakistan

²Department of Economics, University of Reading, UK

³IDS The University of Agriculture, Peshawar, Pakistan

*Corresponding author's Email: aimanaltaf069@gmail.com

Abstract

Agriculture sector is deemed as more vulnerable to climate change as its variation can directly affect the crop's productivity. However, climate change impact and farmers adaptation strategies are not appropriately figured-out in Khyber Pakhtunkhwa Province, Pakistan by previous researchers and formed the rationale for this research endeavor. This research has assessed the Climate Change impact on wheat productivity and farmers adaptability strategies. The non-climatic variables such as wheat yield and area under wheat cultivation and climatic variables that include temperature, precipitation and humidity were taken into consideration. The Panel Data of 30 years (1990-2020) about non climatic and climatic variables was obtained from different secondary sources. However, primary data was collected from sampled farmers to assess their climate adoptability strategies. Econometric diagnostic tests were encompassed to confirm the validity of the data. Chow test was employed to underscore the structural breaks. Fixed Effect Model was adopted as suggested by the estimates of Hausman Test. The salient findings express that temperature has significant but inverse relationship with wheat productivity. This implies that by soaring one Celsius degree Centigrade ($^{\circ}\text{C}$) temperature can plunge down the wheat productivity by 0.074 percent. Similarly, the association of precipitation was also observed negative with wheat. Contrary to this, humidity is reported as positively associated with wheat productivity. This research study concludes the substantial association of climate change with wheat crop, whereas, farmers had less awareness about the adoptability strategies. Most of the farmers have less knowledge about the climate change adoptability strategies for their crops that can result in reduction of crop productivity. It is recommended that high temperature resistant wheat varieties may be provided to farmers and disseminate the exalted adaptation strategies with respect to climate change to overhaul their existing crop management practices.

Keywords: Climate Change, Crop Productivity, Wheat, Fixed Effect Model, Temperature.



NIAB-BURAQ: BOLD SEEDED AND HIGH YIELDING KABULI CHICKPEA VARIETY FOR ENHANCED FOOD SECURITY IN CLIMATE CHANGE SCENARIO

Mariyah Aslam* and Muhammad Azeem Asad

Nuclear Institute for Agriculture & Biology (NIAB), Faisalabad

Corresponding author Email: mariyahaslam@gmail.com

Abstract:

Chickpea (*Cicer arietinum* L.) is the second most extensively cultivated food legume worldwide. However, in Pakistan specifically in KPK province, chickpea production is declining due to effects of climate change either in the form of extremely cold foggy weather in early growth stages, water scarcity at flowering stage, high terminal temperature at pod setting stage or erratic rainfalls at maturity. All these factors pose a detrimental impact on the overall chickpea production. Therefore, a new and improved kabuli chickpea variety named *NIAB-Buraq* has been developed by crossing a high yielding advanced line, K70022 with a superior mutant variety, CM2008. It is a bold seeded, climate resilient, high yielding, and disease tolerant variety with wider adaptability across diverse agro-ecological zones of Pakistan. NIAB-Buraq demonstrated exceptional performance, with yield gains ranging from 11% to 22%, in multiple yield trials conducted at provincial, and national levels. Agronomically, it is characterized by consistent /vigorous vegetative growth during prolonged cold foggy weather, a longer flowering duration, exceptional pod development, and seed setting. It is resistant to *Ascochyta blight* and *Fusarium wilt diseases*. Morphologically, this variety shows early leaf senescence and wide canopy spread, supporting better photosynthesis for yield stability. Grain size is bold, with 100 seed weight of 29-30g and beige seed color. Seed nutritional profile indicates 18.9% protein with enhanced fat, fiber, and mineral contents. DUS studies conducted for two consecutive years confirmed its varietal integrity. DNA fingerprinting confirms that it is a genetically unique chickpea variety, clearly distinguishable by multiple SSR markers. This variety is recommended by the VEC for commercial cultivation across Pakistan. With its agronomic performance, seed quality, resistance to major biotic stresses, and tolerance to the deteriorating effects of climate change, NIAB-Buraq is well suited to abridge the chickpea supply and demand gap in Pakistan to promote sustainable pulse production.

Keywords: Climate resilience, Induced mutation, Chickpea variety, Food security, Improved seed.



**CLIMATE CHANGE AND POPULATION TREND OF RICE LEAF FOLDER,
CNAPHALOCROCIS MEDINALIS G. (LEPIDOPTERA: CRAMBIDAE) IN
DISTRICT SWAT**

Khawaja Junaid¹ and Shah Alam Khan¹

¹Department of Plant Protection, The University of Agriculture, Peshawar, Peshawar-25120, Pakistan

*Corresponding author's Email: kjppr@aup.edu.pk

Abstract

The rice leaf folder (*Cnaphalocrocis medinalis* G.) is a significant pest of rice in Asia. In recent years, climate change has emerged as a critical factor influencing the pest's population dynamics, distribution, and outbreak patterns, Resulting the losses in paddy fiels of an areas like swat where this pest was not considered as a major pest in recent past. The population trend of *C. medinalis* larval and adult/moth were observed on the commercial rice cultivar 'Kashmir Basmati-100'. The Larvae infestation was recorded as average number of larvae per 10 hills at weekly interval from its initial appearance at vegetative stage till the maturity of the crop in paddy field. During the month of August noticeable larval infestation was observed on plants. The number of larvae increases gradually and reached to its peak during the third and fourth week of September (last two weeks of September). After that the larval population started to decrease and disappeared in the beginning of November. The moth's appearance was observed during the last week of July onward. The population of moths increases and reached to its peak during September (17-23). After that the moth's population gradually started decreasing till and disappeared in the beginning of November.

Keywords: Rice Leaf Folder, Population Trend, Paddy Field.



EMERGENCE AND MOLECULAR EPIDEMIOLOGY OF GEMINIVIRUSES INFECTING DIVERSE PLANT SPECIES IN SWAT

Fazal Akbar^{1*}, Asadullah^{1,2}, Chand Bibi^{1,3}

¹ Centre for Biotechnology and Microbiology, University of Swat, Pakistan

² Department of Biotechnology and Genetic Engineering, Hazara University, Mansehra, Pakistan

³ Department of Biotechnology, Abdul Wali Khan University, Mardan, Pakistan.

*Corresponding Author's Email: fazalakbar@uswat.edu.pk

Abstract

Geminiviridae is one of the most important family of plant-infecting viruses that has been classified into fourteen recognized genera. Amongst these, *Begomovirus* is the largest and economically most important genus. Viruses of the genus are further categorized into monopartite (single genomic component or DNA-A) and bipartite (two genomic components called DNA-A and DNA-B) begomoviruses. These viruses infect a wide range of plant species in tropical and sub-tropical regions of the world. Different plants such as *Amaranthus retroflexus*, *Cannabis sativa*, *Capsicum annum*, *Glycine max*, *Mentha longifolia*, *Parthenium hysterophorus* that showed symptoms indicative of begomovirus infection were sampled in several districts of Khyber Pakhtunkhwa. Begomoviruses, mastreviruses and their associated alphasatellite and/or betasatellite present in these samples were amplified by RCA and PCR, cloned, and sequenced. The phylogenetic and biogeographic analyses of virus components were performed by various bioinformatics tools. Complete genome sequences of begomoviruses and satellites obtained in this study showed the highest sequence identity with chili leaf curl virus, tomato leaf curl virus, tomato leaf curl New Delhi virus, chili leaf curl betasatellite, parthenium leaf curl alphasatellites and papaya leaf curl betasatellite. *Tomato leaf curl virus* and *Tomato leaf curl New Delhi virus* were the prominent viruses, whereas, *Papaya leaf curl betasatellite* and *Parthenium leaf curl alphasatellite* were the prominent betasatellites and alphasatellite, respectively in the region. The existence of these viruses/satellites in numerous diverse important plant hosts might be a sign that future epidemics are possible in the area and is an alarming signal for future food security in the region. The study also provides an understanding of the origin and evolution of both monopartite and bipartite begomoviruses and highlights the need for further research on developing management strategies.

Keywords: Geminiviruses, Begomoviruses, Satellite, KP, Pakistan, Diversity.



EFFECT OF PHOSPHORUS AND SULFUR ON MAIZE PRODUCTIVITY AND NUTRIENT ABSORPTION

Ishaq Ahmad Mian¹, Suleman Ali¹, M. Tariq¹, Khadim Muhammad Dawar¹
and Bushra Khan²

¹Department of soil and environmental Sciences, The University of Agriculture Peshawar

²Department of Environmental Sciences, University of Peshawar

*Corresponding author's Email: ishaqmian@aup.edu.pk

Abstract

Balanced nutrition is essential for effective management of nutrients and plays a significant influence in increasing crops production. This investigation was carried out to examine the combined impact of phosphorus and sulfur on maize growth and nutrient assimilation during the summer of 2023, at the University of Agriculture's Research Farm in Peshawar. The experiment was ordered in a randomized complete block design with a factorial setup and replicated three times. The plot size was maintained at 3×3 m. Maize variety "Azam" was planted and seed rate of 25 kg ha⁻¹. Phosphorus (P) was treated at levels of 0, 60, 90, & 120 kg ha⁻¹ from diammonium phosphate (DAP), whereas sulfur (S) was applied at rates of 0, 30, 60, & 90 kg ha⁻¹ from the gypsum. All treatment plots received a basal dose of (N) in amount of 120 kg N ha⁻¹ from the urea. Statistical analysis indicated that phosphorus and sulfur had significant impacts on yield of maize and all yield components. Maximum plant height (171 cm), grains cob⁻¹ (376), thousand grains weight (294 g), grain yield (3521 kg ha⁻¹), stover yield (7851 kg ha⁻¹) and biological yield (10239 kg ha⁻¹), were recorded in plots treated with 120 kg P₂O₅ ha⁻¹ and 60 kg SO₄-S ha⁻¹, while maximum soil AB-DTPA extractable K (109 mg kg⁻¹) and P (8.19 mg kg⁻¹) and CaCl₂ extractable sulfur (32.2 mg kg⁻¹) was recorded with high doses both of phosphorus and sulfur, the same higher levels of phosphorus and sulfur produced maximum sulfur concentration (0.40 %) and phosphorus concentration (0.27 %) in maize. Overall results showed that the dose of phosphorus at the rate of 120 kg ha⁻¹ and SO₄(S) at the dose of 60 kg ha⁻¹ is suggested for enhancing both the yield and the components of summer maize crop under the weather conditions of district Peshawar.

Keywords: Plant Nutrition, Nutrient Assimilation, Biological Yield.



YAK: A CLIMATE-SENSITIVE SPECIES AND A LIVELIHOOD RESOURCE FOR HIGH-ALTITUDE COMMUNITIES

Tanveer Hussain*, Hammad Qaiser, Muhammad Wasique Shahid, Zainab Mubeen,
Sana Fazal, Nafees Fatima, Muhammad Ans
Animal Genomics & Biodiversity Research Group, Department of Biological Sciences,
Virtual University of Pakistan, Islamabad

*Corresponding author's Email: tanveer.hussain@vu.edu.pk

Abstract

Yak (*Bos grunniens*) is an indispensable livestock specie, profoundly intertwined with the livelihoods, cultural heritage, and food security of high-altitude communities in northern Pakistan. Adapted uniquely to harsh alpine environments, yak populations are increasingly vulnerable to climate change impacts, including rising temperatures, altered precipitation patterns, degradation of alpine pastures, and intensified heat stress. Understanding these emerging threats, our research focuses on enhancing the adaptive potential, genetic resilience, and productivity of yak through rigorous scientific and community-based interventions. At Animal Genomics & Biodiversity Research Group at the Virtual University of Pakistan, comprehensive genetic screening has been conducted targeting key adaptive genes such as *ANK1* (associated with meat quality), *IL2* (immune response), *DGAT1* (fat metabolism), *PPARA* and *PRKAA1* (energy homeostasis), *HIF1A*, and *VEGFA* (hypoxia tolerance and vascularization). These studies have uncovered both known polymorphisms and novel genetic mutations, potentially useful for enhancing adaptive traits. Concurrently, we identified emerging health threats, notably the molecular prevalence of tick-borne parasites, including *Anaplasma marginale* and *Theileria ovis*, underscoring the necessity for effective disease monitoring. Collaborative engagements with the Livestock and Dairy Development Department of Gilgit-Baltistan, Bahauddin Zakariya University, Multan, and University of Veterinary & Animal Sciences, Lahore have facilitated the integration of scientific research and traditional pastoral knowledge into sustainable conservation and breeding strategies. Our ongoing efforts prioritize sustainable pasture management, genetic conservation, and adaptive breeding techniques, reinforcing yak's resilience in changing climates. Protecting yak populations goes beyond biodiversity, it supports economic stability, food security, and cultural heritage in mountain communities in Gilgit-Baltistan region. Science-based and community-driven efforts are much needed to preserve this climate-sensitive species and sustaining livelihoods in Northern Pakistan's high-altitude region.

Keywords: Yak, High-Altitude Adaptation, Heat Stress, Sustainable Productivity.a



HEAT SHOCK PROTEINS, DYNAMIC BIOMOLECULES TO COUNTER PLANT ABIOTIC STRESSES UNDER CHANGING CLIMATE

Dr. Saeed ul Haq

Department of Horticulture, University of Agriculture Peshawar, Pakistan

*Corresponding author's Email: haq@aup.edu.pk

Abstract

In present scenario of climate change, plants have to evolve strategies to survive and perform under a plethora of biotic and abiotic stresses, which restricts plant productivity. Plants respond at molecular level to different stresses to maintain plant protein functional confirmation and preventing non-native proteins from aggregation which leads to metabolic disruption are of prime importance. Plant Heat Shock Proteins (HSPs), as chaperones, play a pivotal role in conferring biotic and abiotic stress tolerance. Besides, HSPs also enhance membrane stability and detoxify the Reactive Oxygen Species (ROS) by positively regulating the antioxidant enzymes system as well as use ROS as signal molecules to induce HSPs production. In this study, a genome-wide identification and analysis of HSP60 gene family in pepper was performed to explore the gene structure, phylogenetic relationship, evolution, gene ontology and relative expression profile. Tissue specific expression under normal condition using transcriptomic RNA - Seq data and tissue specific profile under HS, were compared to elucidate the possible role of this gene family in pepper growth and development beside as molecular chaperone. The functional analysis of *CaHSP60-6* by knockdown showed that, this gene acted as positive regulator in plant defense against heat and other abiotic stresses.

Key words: Chaperone, Co-Chaperone, Heat Shock Factor, Biotic Stress, Abiotic Stress, Protein Folding, Stress Resistance.



INSECT POLLINATORS ASSOCIATED WITH APPLE ORCHARDS AT DISTRICT CHITRAL, KHYBER PAKHTUNKHWA-PAKISTAN

Muhammad Sohail Khan and **Toheed Iqbal**

Department of Entomology

Faculty of Crop Protection Sciences

The University of Agriculture, Peshawar

*Corresponding author's Email: toheed.iqbal@aup.edu.pk

Abstract

During the year 2018-19 academic year, we conducted a comprehensive survey of insect pollinators in apple orchards across three regions of District Chitral, Pakistan—Seenlast, Balach, and Shoghor. Using both hand nets and pan traps. A total of 210 samples of bees were collected (Hymenoptera) and 80 syrphid flies (Diptera). Our research led to the identification of ten bee genera viz., *Apis*, *Lasioglossum*, *Anthophora*, *Xylocopa*, *Bombus*, *Melitta*, *Dasypoda*, *Stelis*, *Megachile*, and *Andrena*—spanning seven subfamilies, including Apinae, Halictinae, Xylocopinae, Melittinae, Dasypodainae, Megachilinae, and Andreninae. Additionally, we documented syrphid flies (family Syrphidae, order Diptera) as important pollinators in these habitats. Notably, several genera, *Lasioglossum*, *Anthophora*, *Xylocopa*, *Bombus*, *Melitta*, *Dasypoda*, *Stelis*, *Megachile*, and *Andrena* were recorded for the first time in Chitral. Furthermore, *Melitta*, *Dasypoda*, *Stelis*, *Megachile*, and *Andrena* represent new records for both Khyber Pakhtunkhwa province and Pakistan as a whole. To support future research and identification, we developed an illustrated key featuring diagnostic characteristics for the families, subfamilies, and genera of Hymenoptera and Diptera encountered in this study.

Keywords: Insects, Bee, Chitral, Genera.



GROWTH OPTIMIZATION AND REARING OF MEALWORM (TENEBRIO MOLITOR L.) AS A SUSTAINABLE FOOD SOURCE

Kanwal Riaz and **Toheed Iqbal**

Department of Entomology

Faculty of Crop Protection Sciences

The University of Agriculture, Peshawar

Corresponding author's email: toheed.iqbal@aup.edu.pk

Abstract

As a sustainable food source for humans, mealworms (*Tenebrio molitor*) have a great deal of potential, due to the fact that they have great nutritional profile and a low environmental impact. For meal production, feed formulation and optimization are important. The mealworm *Tenebrio molitor* (Coleoptera: Tenebrionidae) is the most consumed insect in the world. Mealworms were given a variety of diets, including wheat bran as constant diet supplemented with different levels of Ospor (*Bacillus clausii*) at 0.002 g, 0.004 g, 0.006 g, and 0.008 g; imutec (*Lactacaseibacillus rhamnosus*) at 0.2 g, 0.4 g, 0.6 g, and 0.8 g; fungi (*Calocybe indica*) at 250 g, 500 g, and 750 g; yeast (*Saccharomyces cerevisiae*) at 50 g, 100 g, and 150 g; and wheat bran (standard diet) were examined in complete randomized design (CRD). Different parameters, i.e., the larval, pupal, and adult weight, size, life span, and nutritional profile of mealworm were studied. When compared with other insect growth promoters, only wheat bran was discovered to be the most efficient. It generated the heaviest and longest larvae at 65.03 mg and 18.32 mm, respectively, as well as pupae weighing 107.55 mg and 19.94 mm, respectively, and adults weighing 87.52 mg and 20.26 mm, respectively. It was also determined that fungi (*C. indica*) and ospor (*B. clausii*) promoted faster larval development than yeast (*S. cerevisiae*) and imutec (*L. rhamnosus*). Larval mortality was also greater in the imutec (*L. rhamnosus*) and yeast (*S. cerevisiae*) diets than the others. No pupal mortality was recorded in all diets. Furthermore, the protein content of *Tenebrio. molitor* raised on a diet including fungi (*C. indica*) was the highest at (375 g), with a content of 68.31%, followed by a concentration of (250 g) with a content of 67.84%, and wheat bran (1 kg) (normal diet) with the lowest content at 58.91%. *T. molitor* larvae fed a diet supplemented with bacterial and fungal had lower fat and ash content than bran-fed *T.molitor* larvae (standard diet). Wheat bran (normal diet) had the highest fat at 16.11%, and ash at 7.71%. Hence, it is concluded that wheat bran alone or diet containing fungi (*C. indica*) and ospor (*B. clausii*) performed better in terms of growth, and these diets and protein content are recommended for the mass rearing of mealworms.

Keywords: Fungi, Bacteria, Mealworm, Life Parameters, Diet Supplements.



THE IMPACT OF CLIMATE CHANGE ON THE POPULATION DYNAMICS OF VECTOR BORNE DISEASES

Misbahullah¹, Hidayat Ullah², Jawad Anwar³, Irfan Ullah⁴

¹Department of Entomology, The University of Agriculture Swat

²Department of Plant Breeding and Genetics, The University of Agriculture Swat

³Department of Food Science and Technology, The University of Agriculture Swat

⁴Department of Horticulture, The University of Agriculture Swat

*Corresponding author's Email: drmisbah@uoas.edu.pk

Abstract

Climate change is becoming a major driver of the changing dynamics of vector-borne diseases worldwide. Rising temperatures, shifting precipitation patterns, and extreme events are reshaping vector habitats and expanding disease risk zones. This study reveals that Climate change is altering the ecological and environmental determinants of vector-borne diseases (VBDs), accelerating their emergence, transmission, and global distribution. Vector-borne diseases, transmitted by vectors such as mosquitoes, ticks, sandflies and others account for more than 17% of all infectious diseases and cause over 700,000 deaths annually. Temperature influences vector development, survival, biting rates, and the incubation period of pathogens. For example, the extrinsic incubation period (EIP) of *Plasmodium falciparum* and *Dengue virus* shortens at higher temperatures, increasing transmission potential. However, excessively high temperatures may exceed thermal limits, reducing vector competence. Rainfall creates breeding sites for vectors like mosquitoes. In regions with intermittent rainfall, vector populations surge considerably. Conversely, heavy downpours may destroy larval habitats. Relative humidity also affects vector survival and activity levels. Floods, droughts, and torrential can displace populations, disrupt healthcare infrastructure, and alter vector habitats, increasing the risk of outbreaks. Coordinated, interdisciplinary efforts involving public health, climate science, and policy are required to build resilient health systems and safeguard populations from the growing threat of VBDs in the changing climate scenarios.

Keywords: Climate Change, Vector-Borne Diseases, Malaria, Dengue, Adaptation, Public Health, Global Health.



THE IMPACT OF CLIMATE CHANGE ON FOOD SECURITY: A REVIEW

Jawad Anwar¹, Misbahullah², Hidayat Ullah³, Irfan Ullah⁴

¹Department of Food Science and Technology, The University of Agriculture Swat

²Department of Entomology, The University of Agriculture Swat

³Department of Plant Breeding and Genetics, The University of Agriculture Swat

⁴Department of Horticulture, The University of Agriculture Swat

*Corresponding author's Email: dr.jawad@uoas.edu.pk

Abstract

Climate change directly impacts the global food security by fundamentally disrupting the agricultural systems we depend on. Altered weather patterns, including unpredictable rainfall and extreme temperatures, diminish both the quantity and quality of food harvests. Furthermore, these disruptions hinder equitable food distribution, disproportionately intensifying the challenges of hunger and malnutrition in regions already vulnerable to climate related hardships. This climate driven crisis is compounded by the dual pressures of a growing global population and the environmental footprint of our food production methods. While agricultural advancements have increased productivity, the rising demand for food strains our natural resources. Critically, conventional agriculture is a significant source of the greenhouse gas emissions that accelerate climate change, creating a dangerous feedback loop where our efforts to feed ourselves worsen the underlying problem. Addressing this complex, interconnected challenges require an urgent and decisive shift from discussion to action. To ensure a stable and nutritious food supply for the future, it is imperative to invest in and implement sustainable climate resilient agricultural practices. This approach is fundamental to mitigating the impacts of climate change and building a food system that can withstand future environmental stresses.

Keywords: Climate Change, Global Food Security, Malnutrition, Greenhouse Gas, Environmental Stress.



IMPACT OF CLIMATE CHANGE ON MOUNTAIN AGRICULTURE: INFLUENCE ON CROP AND LIVESTOCK PRODUCTION

Abdul Ghaffar

College of Fisheries, Key Laboratory of Mariculture, Ministry of Education, Ocean
University of China, Qingdao 266003, China
Institute of Evolution and Marine Biodiversity, Ocean University of China, Qingdao
266003, China

*Corresponding author's Email: abdulghaffarouc@yahoo.com

Abstract

Mountain ecosystems are particularly vulnerable to the effects of climate change due to their fragile habitats, steep slopes and isolated agricultural systems. This study examines the direct and indirect effects of climate variability on crop and livestock productivity in mountain agricultural areas, with a focus on rising temperatures, erratic precipitation patterns and extreme weather events. We assess changes in agricultural production patterns and livestock production over the last 20 years using a mixture of satellite-based climate data and questionnaires from specific highland villages. The results show a steady decline in the production of key staple crops such as wheat and maize, accompanied with shortened growing seasons and an increasing frequency of droughts. Livestock production has also been negatively affected by heat stress, reduced availability of pasture and the increased incidence of vector-borne diseases. The study further examines regional adaptation strategies, which include changes in cropping patterns, improved pasture management and conventional coping methods. The findings highlight the urgent need for targeted climate resilient policies, improved forecasting tools and legislative measures to protect food security and livelihoods in mountain regions. This research finding improves the understanding of climate-resilient mountain agriculture and provides pragmatic insights for sustainable adaptation planning.

Keywords: Alpine Agriculture, Climate Change, Agricultural Yields, Livestock, Adaptive Capacity, Resilience.



**CLIMATE-INDUCED STRESS ON CROP AND LIVESTOCK PRODUCTIVITY
IN MOUNTAIN AGRO ECOSYSTEM: TRENDS, CHALLENGES AND
ADAPTATION**

Alia Javed *, Sakinabibi Areesha Abbas
Department of Botany, University of Agriculture Faisalabad
Corresponding author Email: aliajaved@uaf.edu.pk

Abstract

Mountain agro ecosystems are seriously threatened by climate change, which also affects the yield of crops and livestock. The delicate balance of these ecosystems is altered by rising temperatures and shifting precipitation patterns. Severe weather events impact livelihoods and food security by destroying infrastructure, crops, and livestock. Crop yields are decreased by climate stress, which affects food supply and farmer incomes. The production, mortality, and health of livestock are impacted by variations in temperature and precipitation patterns. Crop growth and fertility are decreased by soil erosion and nutrient loss, which promote the degradation of the soil. Agro forestry and conservation agriculture are two examples of climate-resilient agricultural techniques that can be used to resolve these problems. Early warning systems and climate data enable farmers make well-informed decisions. Water management and soil conservation are two integrated methods that could improve tolerance. Mountain towns can ensure long-term viability and adapt to climate change by employing these techniques. Climate-resilient farming practices that enhance biodiversity and ecosystem services. Agro ecosystem resilience in the mountains is essential for sustainable livelihoods. Participation of the community is necessary for effective adaption measurements. The effects of climate change on mountain agro ecosystems have a significant impact on rural development and food security. Consequently, immediate action is required to promote climate-resilient farming methods. This can be accomplished through research, capacity building, and policy assistance. Holistic management techniques are necessary for mountain agro ecosystems. Agricultural development strategies must incorporate measures to mitigate and adapt to climate change.



GLACIAL MELT AND CRISIS OF WATER SECURITY: IMPLICATIONS FOR IRRIGATION DEPENDENT-AGRICULTURE IN MOUNTAINOUS REGIONS\

Alia Javed * Sakinabibi, Syeda Tehreem Fatima
Department of Botany, University of Agriculture Faisalabad
Corresponding author Email: aliajaved@uaf.edu.pk

Abstract

Glacial melt is emerging as a critical factor in the ongoing crisis of water security, particularly affecting irrigation-dependent agriculture of mountainous regions that rely heavily on glacial runoff for their water supply. As global temperatures rise due to climate change, glaciers are retreating at an unprecedented rate, leading to significant alterations in hydrological cycles. This phenomenon poses a dual challenge: while initial increases in meltwater may temporarily enhance water availability, the long-term consequences include a marked reduction in water resources as glaciers diminish. Irrigation-dependent agriculture results in a risky scenario where farmers face unpredictable water supplies, threatening food security and crop yields. The timing of water availability becomes increasingly erratic, complicating agricultural planning and management, especially in regions where seasonal meltwater is crucial for irrigation during dry months. Reduced water availability increases risk of livelihoods of smallholder farmers, who rely heavily on consistent water supply for staple crops. Moreover, the loss of glacial water intensifies competition over scarce water resources, not only among agricultural users but also with urban and industrial demands. This reliance on irrigation can also impact local ecosystems, potentially resulting in a loss of biodiversity and altering natural water cycles. Reliance on rainfall introduces additional variability, making it difficult for farmers to adapt to changing climatic conditions. Soil health is also at risk, as altered water flow patterns can lead to erosion, nutrient depletion, and land degradation, further threatening agricultural productivity. The socio-economic implications are profound, as reduced agricultural output can lead to economic instability, increased poverty, and migration from rural areas to urban centers, exacerbating existing social tensions. Adaptive strategies includes soil conservation practices, climate-resilient agricultural planning, use of efficient irrigation technologies, rain water harvesting, crop diversification, adopting crop varieties that are more resilient to water stress and investing in infrastructure that enhances water storage and distribution, and community engagement to address all concerned challenges and ensure food security. Policymakers must prioritize sustainable practices that promote resilience in agricultural systems, ensuring that farmers can effectively respond to changing water availability. There collaborative efforts among governments, researchers, and local communities are required to ensure both agricultural productivity and ecological health. The aim of all of these adaptation strategies is to enhance the sustainability of irrigation practices and promote resilience to climate change in mountainous regions.

Keywords: Glacial melt, consequences of irrigation dependent agriculture, Rainfall reliance, adaptation strategies.



MANAGING GLACIER LAKE OUTBURST FLOODS (GLOFS) THROUGH REGIONAL DISASTER RISK REDUCTION FRAMEWORKS IN THE HINDU KUSH HIMALAYAN REGION

Alia Javed ^{*1}, Sakinabibi ²

Department of Botany, University of Agriculture Faisalabad

Corresponding author Email: aliajaved@uaf.edu.pk

Abstract

Glacier Lake Outburst Floods (GLOFs) are an intensifying transboundary hazard in the Hindu Kush Himalayan (HKH) region, increased by the escalating rate of glacial melting as a result of climate change. The delicate landscape, the dense population concentration, and socio-economic fragility amongst the HKH nations (Afghanistan, Pakistan, India, Nepal, Bhutan, and China) requires consolidation and regional coordinated disaster risk reduction (DRR) policies. This paper gives a critical analysis of the prospects of regional DRR frameworks in the practice of effective management of the risk of GLOFs using early warning, community preparations, and scientific knowledge exchanges. On the basis of the case studies in the Imja Tsho lake of Nepal, the Attabad landslie lake of Pakistan, and the Thorthormi lake of Bhutan, the research identifies the gap in monitoring, policy alignment, and data-sharing between two or more countries. It suggests that the system of cross-border cooperation should be institutionalized whereby the mechanisms enshrined in such platforms as ICIMOD and SAARC Disaster Management Centre, integration of indigenous knowledge systems and gender-sensitive strategies should be incorporated. In concluding it is asserted that multi-scalar governance model is needed to develop resilience towards GLOFs in the HKH, which includes emphasis in upstream-downstream connectivity, participatory decision-making, and investments in regional climate adaptation infrastructure. The enhancement of regional DRR systems not only plays a crucial role in GLOF mitigation in the Asian water tower but is the basis to long-term climate resilience in the water tower of Asia.

Keywords: Outburst, consolidation, mechanisms, adaptation.



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

THEME # 2
CLIMATE RESILIENT
AGRICULTURAL PRACTICES



DEVELOPMENT OF PULSES CULTIVAR BEST SUITED FOR CLIMATE RESILIENT AGRICULTURE UNDER CHANGING CLIMATE

Muhammad Shahid, Muhammad Jawad Asghar
Nuclear Institute for Agriculture and Biology
Plant Breeding & Genetics Division

Abstract

Pulses are a group of leguminous crops that include beans, lentils, chickpeas, and peas. They are an important part of diets all around the world and a great source of crucial minerals and plant-based protein. They are also essential for maintaining food production in rainfed environments, such as mountainous regions, where agriculture is mostly dependent on rainfall rather than irrigation. Mungbean (*Vigna radiata* (L.) Wilczek) is also an important pulse crop in Pakistan after chickpea, which is mostly sown in the summer and to a smaller extent in the spring. Climate change is becoming more widely acknowledged as a serious danger to mungbean production in Pakistan. So, there was a need to develop a new mungbean variety to tolerate the effects of climate change. The Nuclear Institute for Agriculture and Biology (NIAB) has developed a new mungbean variety NIAB-PRI MUNG to mitigate the climate change scenario. This variety is high yielding, short stature, early maturing (60 days) and disease resistant. The deployment of this mungbean climate-resilient cultivar, combined with conservation agriculture practices, can enhance pulses productivity in mountain and marginal environments.

Keywords: Pulses, Climate, Mungbean, Climate Resilient Agriculture.



ROLE OF MICROBES IN IMPROVING SEED YIELD AND QUALITY OF VEGETABLES

Khurram Ziaf*¹, Muhammad Haroon¹, Anam Noor², Hamza Younas¹, Muhammad Muzammil Jahangir¹

¹ Institute of Horticultural Sciences, University of Agriculture, Faisalabad.

² Department of Horticulture, Bahauddin Zakariya University, Multan.

Corresponding author's email: khurramziaf@uaf.edu.pk

Abstract

Vegetable seed import is increasing in Pakistan every year. It is because of lack of local high yielding varieties and comparatively low quality of locally produced seeds. Seed quality in many species have problems with asynchronous seed maturity and inconsistent flowering, which reduces seed uniformity and its yield. These limitations can be overcome by regulating floral structure to ensure uniform growth. According to current studies, using beneficial bacteria that produce auxin and synthetic plant growth regulators is a useful strategy for enhancing vegetable reproductive development. By applying synthetic auxins such as naphthalene acetic acid (NAA) and indole-3-acetic acid (IAA) at different concentrations of 100–200 ppm, excessive branching in inflorescences was considerably decreased, improving the synchronization of flowering and seed set. Also, when co-applied with the auxin precursor L-tryptophan, some endophytic bacterial isolates (*Bacillus* sp. MN54, *Enterobacter* sp. MN17, *Pantoea* sp. MN34, and *Burkholderia phytofirmans* PsJN) enhanced seed yield as well as characteristics in different vegetable species. The ratio of primary to secondary inflorescences was successfully balanced by bacterial and L-tryptophan treatments like MN17+L-tryptophan and MN34+L-tryptophan, which also suppressed less productive branches. Moreover, the use of microbial inoculants decreased the amount of malondialdehyde and seed leachate conductivity, indicating improved membrane stability and seed vigor. These results highlight the potential benefit of combining plant growth-promoting bacteria with synthetic auxins to optimize seed quality and floral architecture in vegetable seed production. In a variety of vegetable crops, such integrated techniques provide long-term solutions for improving seedling performance and increasing seed yields. PGPRs also improved seed yield and quality traits in pea seed crop. Hence microbes can be effectively used for good quality seed production in vegetable crops.

Keyword: Microbes, Seed, Vegetables, Floral Architecture.



COMPARISON OF CLIMATE SMART AMENDMENTS ON PLANT PHYSIOLOGICAL AND GRAIN YIELD ATTRIBUTES OF WHEAT GROWING UNDER WATER LIMITED CONDITIONS

Naqeeb Ur Rahman, Amara Khan, **Ghulam Abbas**

Abstract

Water scarcity is the main challenge for crop production under rainfed cropping systems. The present study was undertaken to compare the effectiveness of different climate smart organic and inorganic amendments to increase soil water retention and crop yield under rainfed conditions. A field experiment was conducted using different amendments i.e. T1 (control), T2 compost @ 750 kg ha⁻¹, T3 biochar @ 1000 kg ha⁻¹, T4 gypsum @ 1000 kg ha⁻¹, and T5 hydrogel @ 15 kg ha⁻¹. Two varieties, Wafaq-2023 (V1), and NARC-Super (V2) were grown till maturity following the recommended agronomic practices. The results indicated that among the amendments, hydrogel was the most effective treatment followed by gypsum, biochar and compost, respectively for increasing grain yield and nutrient uptake by wheat. Under the application of hydrogel, grain yield was increased by 29 and 24%, and straw yield was increased by 28 and 23% in V1 and V2, respectively compared to control. The application of gypsum caused 20 and 14% increase in grain yield, and 19 and 15% increase in straw yield in V1 and V2, respectively. Under the application of hydrogel, Chl-a, Chl-b, relative water contents and stomatal conductance were increased by 55, 56%, 52 and 54% in V1 and by 36, 43, 42 and 43% in V2, respectively as compared to the control treatment. The accumulation of macro and micronutrients was also higher under hydrogel, followed by gypsum application. The higher grain yield and nutrient uptake was attributed to better soil properties and soil water retention potential of hydrogel and gypsum as compared to the other amendments. It was concluded that hydrogels and gypsum are promising options with wheat variety Wafaq-2023 for getting higher crop yield with better nutritional quality under rainfed conditions.

Keywords: Water scarcity, Climate change, Soil amendments, Rainfed areas, Wheat.



IMPACT OF PHOSPHATE SOLUBILIZING BACTERIA ON MAIZE PRODUCTIVITY IN PESHAWAR AREA

Ishaq Ahmad Mian¹, Mohsina-E-Hassana¹, M. Tariq¹, Khadim Muhammad Dawar¹ and Bushra Khan²

¹Department of soil and environmental Sciences, The University of Agriculture Peshawar

²Department of Environmental Sciences, University of Peshawar

*Corresponding author's Email: ishaqmian@aup.edu.pk

Abstract

Phosphorus (P), essential for maize growth, often becomes unavailable due to soil binding, hence reducing maize productivity. Traditional fertilizers are inefficient and raise environmental concerns, creating a need for sustainable solutions. Phosphorus-solubilizing bacteria (PSB) and poultry manure (PM) can improve P availability and soil health. This experiment evaluated the effects of varying PM levels and PSB on maize yield, nutrient absorption, and soil quality in Peshawar. The experiment utilized a randomized complete block design (RCBD) having three replications. Treatments encompassed two factors: PSB levels (no PSB, PSB-14, PSB-47) and PM rates (0, 4, and 6 tons/ha). The results revealed that the application of PM at 6 tons ha⁻¹ resulted in the tallest plants (197.6 cm), highest thousand-grain weight (226.9 g), and improved biological (10,561 kg ha⁻¹) and grain yields (4,131.7 kg ha⁻¹). PSB treatment, particularly with PSB 46, contributed to taller plants (199.8 cm), heavier grains (228.1 g), and greater nutrient uptake. Soil analysis showed that PM improved soil organic matter content (0.56%), while both PM and PSB enhanced soil nitrogen (0.20%) and phosphorus levels (4.69 mg kg⁻¹). Interaction effects between PM and PSB were significant for soil nitrogen and phosphorus content, with the highest values recorded in plots treated with 4 tons ha⁻¹ PM and PSB 46 (0.20% N) and 6 tons ha⁻¹ PM and PSB 46 (4.69 mg kg⁻¹ P). The study confirmed that combined application of PM and PSB can sustainably enhance maize productivity, nutrient absorption, and soil health in Peshawar. Therefore application of 6 tons ha⁻¹ PM and PSB 46 strain of PSB is recommended to farmers for getting higher yield in a sustainable manner.

Keywords: Phosphate Solubilizing Bacteria, Poultry Manures, Sustainability, Soil Health.



BIOAGENTS ASSISTED ROCK PHOSPHATE ENRICHED VERMICOMPOST AS A CLIMATE SMART TECHNOLOGY IMPROVED ONION GROWTH AND NUTRIENTS UPTAKE UNDER POT AND FIELD TRIALS

Fazli Wahid^{1,*}, Emre Aksoy⁴, Muhammad Jamal Khan⁵, Amjad Ali^{1, 2,*}, Muhammad Adnan¹, Muhammad Javed³, Rafiullah¹,

¹ Department of Agriculture, University of Swabi, Anbar 23561, Pakistan.

² School of Environmental and Municipal Engineering, Xi'an University of Architecture and Technology, Xi'an 710055, China.

³ Office of Assistant Director Agriculture Extension Khagwani Hazro-43440 Attock, Pakistan.

⁴ Department of Biological Sciences, Middle East Technical University Cankaya, 06800 Ankara – Turkey
⁵ Dept. of Soil and Environmental Sciences, The University of Agriculture Swat-Pakistan Corresponding

*Corresponding author's Email: fazliwahid@aup.edu.pk

Abstract

Vermicomposting can be adopted as a cost-effective climate smart technology for improving P mineralization from rock phosphate (RP) and increasing soil-plant health. The current study was conducted to convert the RP blended degradable organic wastes into phosphorus (P) rich vermicompost through earthworms and phosphate solubilizing microbes (PSMs) and assessed its role on onion growth and soil health. Three types of RP enriched vermicomposts were produced by mixing of powdered RP with biodegradable wastes in the presence of earthworms and PSMs in vermi-boxes, pits and piles. The efficiency of each vermicompost was evaluated on onion growth and nutrients uptake in a pot trial. Then, the most efficient vermicompost selected for pot trial was further assessed on onion growth parameters and soil health under field conditions. The results expressed that under pot trial, half fertilization of RP enriched vermicompost together with half doses of inorganic fertilizers (Urea, SSP, SOP) significantly enhanced the post-harvest shoot biomass (17.66 g pot⁻¹), bulb weight (94.65 g pot⁻¹), plants height (34.33 cm) as well as N (242.33 mg pot⁻¹) and P (20.06 mg pot⁻¹) uptake by onion as compared to control. Similarly, compared to sole RP vermicompost, the N and P uptake, shoot dry biomass, height and bulb weight of onion plants under field conditions were also significantly improved by the treatments supplemented with half doses of both inorganic fertilizers and RP enriched vermicompost. The current experiments concluded that half dose of RP enriched vermicompost in combination with half inorganic fertilizers has great potential to improve soil health, nutrients uptake, and growth parameters of onion under pot and field conditions. The RP enriched vermicompost can be used as a cost-effective and climate smart strategy to increase vegetable growth and minimize the usage of chemical fertilizers in alkaline calcareous soils. Key words: Onion growth, Organic wastes, Nutrients uptake, Rock phosphate, Vermicomposting.

Keywords: Vermicomposting, Bioagents, Rock Phosphate.



THE ROLE OF ORGANIC AGRICULTURE IN ENHANCING BIOLOGICAL AND ENZYMATIC PROPERTIES OF SOIL AND MAIZE GROWTH

Waseem Hassan^{1*}, Zeshan Ali², Umair Riaz¹, Khuram Mobeen³, Muqarrab Ali², Baqir Hussain¹

¹Department of Soil and Environmental Sciences, Muhammad Nawaz Shareef University of Agriculture Multan

²Department of Climate Change, Muhammad Nawaz Shareef University of Agriculture Multan

³Department of Agronomy, Muhammad Nawaz Shareef University of Agriculture Multan

*Corresponding author's Email: waseem.hassan@mnsuam.edu.pk

Abstract

Soil health is fundamental to sustainable agriculture and food security. Organic agriculture has gained increasing recognition for its capacity to promote sustainability by improving soil health and quality. This study evaluates the effects of organic versus conventional farming practices on soil health indicators and wheat growth parameters. The treatments used in organic agriculture included farmyard manure (FYM) and vermicompost (VC), while conventional (inorganic) agriculture used urea (U) and diammonium phosphate (DAP). The objectives of the study were to (1) assess the impact of organic practices on soil biological and enzymatic properties and (2) growth of maize plant. Results revealed significant improvements ($P < 0.05$) in both soil biological and enzymatic properties under organic farming practices compared to conventional methods. Overall, soil biological properties i.e. microbial biomass carbon (MBC), microbial biomass phosphorous (MBP), microbial biomass nitrogen (MBN), bacteria, fungi and actinomycetes increased by 5.23-fold and 4.32-fold, 4.12-fold and 3.62-fold, 2.58-fold and 2.19-fold, 1.78-fold and 1.31-fold, 3.21-fold and 2.62-fold, 2.85-fold and 2.32-fold, and 2.34-fold and 1.71-fold due to organic practices i.e. VC and FYM correspondingly. Alike, a significant increase was observed in the oxidative enzymes i.e. phenoloxidase (3.23-fold and 2.81-fold), peroxidase (2.58-fold and 2.11-fold), catalase (2.29-fold and 1.75-fold) and hydrolytic enzymes i.e. dehydrogenase (5.12-fold and 4.67-fold), urease (4.63-fold and 4.01-fold) and invertase (3.73-fold and 3.05-fold) respectively owing to organic practices i.e. VC and FYM. While maize growth parameters i.e. shoot length (1.53-fold and 1.31-fold), root length (1.63-fold and 1.32-fold), number of leaves (1.31-fold and 1.21-fold), total biomass (1.87-fold and 1.45-fold), total chlorophyll (1.63-fold and 1.46-fold), carotenoids (2.03-fold and 1.72-fold) and protein (1.96-fold and 1.73-fold) were enhanced owing to VC and FYM respectively. Whereas, the overall increase in the biological, and enzymatic activities due to inorganic practices i.e. use of U and DAP was significantly ($P < 0.05$) lower than the organic treatments. Alike, increase in the maize growth parameters was also lower under inorganic practices. The study highlights that organic farming significantly improves soil physico-chemical properties, boosts microbial biomass and diversity, and enhances overall soil health compared to conventional practices.

Keywords: Organic Agriculture, Sustainable Agriculture, Food Security, Vermicompost.



CLIMATE-RESILIENT AGRICULTURE: CHALLENGES AND ADAPTIVE STRATEGIES

Hidayat Ullah¹, Hidayat ur Rahman¹ Misbahullah², Jawad Anwar³, Irfan Ullah⁴

¹Department of Plant Breeding and Genetics, The University of Agriculture Swat

²Department of Entomology, The University of Agriculture Swat

³Department of Food Science and Technology, The University of Agriculture Swat

⁴Department of Horticulture, The University of Agriculture Swat

*Corresponding author's Email: drhidayat@uoas.edu.pk

Abstract

Climate change significantly impacts global agricultural systems, threatening food security, rural livelihoods, and stability of ecosystem. Climate extremes and shifting weather patterns threaten crop yields, livestock productivity, and soil health worldwide. An analysis is needed based on our current knowledge on the multifaceted impacts of climate change on agriculture to address the diverse challenges faced in fostering climate resilience. The key challenges include technological and infrastructural limitation, economic and policy constraint, limited farmer awareness, and environmental degradation. A wide range of adaptive strategies aimed at enhancing agricultural resilience, including climate-smart crop varieties, efficient water and soil management practices, integrated pest and disease management, livestock adaptation measures, and ecosystem-based approaches such as agroforestry. The role of technological innovations, such as digital climate services, remote sensing, and early warning systems, in supporting adaptive decision-making is highlighted. Moreover, the importance of enabling policies, institutional frameworks and capacity-building initiatives is emphasized as critical to scaling climate-resilient practices. A holistic approach that integrates scientific advancements with traditional knowledge is necessary. Ultimately, fostering climate-resilient agriculture will require coordinated efforts among researchers, policymakers, extension services, and farming communities to safeguard global food systems in the face of a changing climate.

Keywords: Climate-Resilient Agriculture, Climate Change Adaptation, Sustainable Farming, Food Security, Climate-Smart Practices.



**PHOSPHORUS NUTRITION MANAGEMENT FOR BETTER FORAGE GROWTH
AND SEED YIELD OF CLIMATE RESILIENT CROP; CLUSTERBEAN
(*CYAMOPSIS TETRAGONOLOBA* L.)**

Amjed Ali, Zain Ali, Muhammad Ehsan Safdar, Muhammad Athar Nadeem, Muhammad Asif, Muhammad Rafi Qamar and Muhammad Arshad Javed
College of Agriculture, University of Sargodha, 40100, Pakistan
*Corresponding author's Email: amjed.ali@uos.edu.pk

Abstract

Clusterbean (*Cyamopsis tetragonoloba* L.), commonly known as guar, is one of the most important climate resilient crop in climate change scenario. The crop is typically cultivated on marginal lands without much or no nutrient input, such as fertilizers. Through a variety of morphological, physiological, and biochemical changes, such as the allocation of more dry matter to leaves than to roots, an increase in xylem hydraulic conductivity and water use efficiency, and an improvement in photosynthetic capacity, phosphorus treatment can improve a plant's ability to withstand drought. In order to produce good clusterbean forage, it is necessary to determine the appropriate dose of phosphatic fertilizer. Experiment was conducted at the research area of College of Agriculture, Sargodha, Punjab, Pakistan during kharif season of the year, 2023 to determine the forage and seed yield, and other yield attributes of cluster bean at different phosphorus levels. The treatments comprised five phosphorus levels (control 0, 15 kg ha⁻¹, 30 kg ha⁻¹, 45 kg ha⁻¹, 60 kg ha⁻¹ and 75 kg ha⁻¹). The maximum leaf area index (4.25), crop growth rate (15.04 g m⁻² day⁻¹), plant height (62.05 cm), number of pods per plant (10.2), was observed when phosphorous (P) was applied @ 75 kg ha⁻¹, in T₆ treatment having no significant difference with T₅ treatment where phosphorous (P) was applied @ 60 kg ha⁻¹. Maximum forage yield (30150 kg ha⁻¹) and seed yield (1113 kg ha⁻¹) was obtained in T₅ (P @ 60 kg ha⁻¹). So Phosphorus application @ 60 kg ha⁻¹ is recommended for obtaining higher forage and seed yield of clusterbean.

Keywords: Climate, Forage, Pods, Seed.



CLIMATE-SENSITIVE DISTRIBUTION PATTERNS OF *IRIS HOOKERIANA* IN SUBALPINE AND ALPINE HABITATS OF THE HINDU-HIMALAYAS

Muhammad Shakeel Khan¹, Shujaul Mulk Khan^{1,2*}, Jawad Hussain¹, Abdullah¹, Zeeshan Ahmad¹, Shahab Ali¹, Fazal Manan¹

¹Department of Plant Sciences, Quaid-i-Azam University, Islamabad, Pakistan

²Member, Pakistan academy of sciences

*Corresponding author's Email: smkhan@qau.edu.pk

Abstract

The Hindu-Himalayan region, a global biodiversity hotspot, harbors numerous endemic plant species that contribute significantly to ecosystem stability. Among these, *Iris hookeriana*, an endemic perennial herb, thrives in the subalpine and alpine zones of the Hindu-Himalayas. The study aimed to assess the population dynamics of *Iris hookeriana*, assess the primary threats to its survival, and explore its ecological associations along with indicator species. Fieldwork was conducted across 35 distinct sites, at an elevation range of 2,500 m–3,900 m above sea level. A random stratified sampling method using quadrats was employed to assess both qualitative and quantitative plant characteristics. Edaphic, topographic, geographic coordinates, and elevation Global Positioning System (GPS) data were recorded on each sampling site. Plant species associations were analyzed using a 5 m² × 5 m² quadrat for shrubs and a 1 m² × 1 m² quadrat for herbaceous vegetation. The relationships between species composition and environmental variables were analyzed via Statistical analyses, including Detrended Correspondence Analysis (DCA), Canonical Correspondence Analysis (CCA), Two-Way Cluster Analysis (TWCA), and Indicator Species Analysis (ISA), were conducted using PCORD version 5.0. Seventy associated plant species from 26 families were identified across 35 sampling sites, revealing four major plant associations: (1) *Arenaria-Viola* association, (2) *Nepeta-Oxytropis* association, (3) *Phlomis-Prunella* association, and (4) *Bistorta-Carex* association. These associations exhibited significant correlations ($p < 0.05$). The identification of these four novel plant associations provides a crucial baseline for understanding the ecological dynamics of the subalpine and alpine ecosystems. The study emphasizes the significant role of environmental factors, i.e., altitude, organic matter, pH, humidity, total dissolved solids, electrical conductivity, nitrogen, phosphorus, silt, and clay content in shaping the *Iris hookeriana* population within the subalpine and alpine zone of the Hindu-Himalayan Mountains. The findings show that indicator species and plant associations vary with changing environmental conditions, providing valuable insights for sustainable biodiversity management in subalpine and alpine ecosystems of the Hindu-Himalayan mountains.

Keywords: Hindu-Himalayas, Indicator Species, Plant Associations, Alpine Zone, Environmental Variables.



THE SILENT SHIFT: CLIMATE CHANGE AND SWAT VALLEY'S INSECTS

Dr. Farman Ullah

Department of Entomology, The University of Agriculture Swat

*Corresponding author's Email: drfarman@yahoo.com

Abstract

Swat Valley, a biologically diverse mountainous region of northern Pakistan, harbors a rich variety of insect fauna crucial to ecosystem functioning and agricultural productivity. However, climate change poses an escalating threat to this fragile biodiversity. Rising temperatures, shifting precipitation patterns, and increased frequency of extreme weather events are altering the life cycles, distribution, and population dynamics of numerous insect species. These climatic disruptions are particularly affecting pollinators, such as bees and butterflies, whose synchronization with flowering plants is being disturbed. Similarly, pest species like mites, aphids and whiteflies are expanding their range and thriving under warmer conditions, causing greater damage to crops and forestry. Changes in temperature and humidity also influence the spread of vector-borne diseases by enhancing the survivability and activity of vectors like mosquitoes. Mountain ecosystems, including Swat's, are especially sensitive to these changes due to their unique climatic gradients and limited species adaptability. As insect populations decline, there are cascading effects on food webs, nutrient cycling, and local agriculture. Indigenous knowledge systems and traditional farming practices, deeply dependent on ecological balance, are under strain. Urgent research and conservation efforts are needed to monitor insect biodiversity, assess climate-related risks, and promote adaptive strategies such as climate-resilient farming and habitat restoration. Protecting Swat's insect fauna is vital for sustaining its ecological health, food security, and livelihoods of local communities in the face of ongoing climatic transformations.

Keywords: Climate Change, Swat Valley, Insect Fauna, Northern Pakistan, Biodiversity.



MICROPLASTICS CONTAMINATION IN MOUNTAINOUS ECOSYSTEMS: THREAT TO APIS MELLIFERA IN SWAT VALLEY, PAKISTAN

Hafiz Khurram Shurjeel and Farman Ullah

Department of Entomology, The University of Agriculture Swat

*Corresponding author's Email: drshurjeel@uoas.edu.pk

Abstract

Honey bees are imperative pollinators of natural and agricultural ecosystems, unfortunately, facing unprecedented pressure due to environmental contamination including Swat Valley—well-known for its ecological assortment and fruit farming. Recently, microplastic effluence has risen as an insidious threat to terrestrial ecosystems that indicate its harmful effects on insect pollinators. Owing to breakdown of packaging waste, chemical containers, polyethylene mulching films, and urban runoff, microplastics particles are increasingly detected in air, water, soil, and plant surfaces. Microplastic contamination in and around Swat River water and soils ranges 400 - 1200 particles/kg in topsoil and 5-18 particles/L in water. Given the bees' foraging behavior and interaction with environmental matrices (nectar, water, pollen), particles enter the system through ingestion or adhesion and lead to gut obstruction, enzyme hang-up, immune dysregulation, and gut microbiota disorder. Bees can accumulate up to 3.5–5.1 microplastic particles per individual, primarily polyethylene and polystyrene fragments. Inside bee gut, microplastics induce oxidative stress, disrupt detoxifying enzymes like Glutathione-S-transferase (GST) and catalase (CAT), and impair nutrient absorption. Even low-dose exposure (100 µg/L of polystyrene microplastics) over 10 days' results in significant alterations in gut histopathology, reduced survivorship, and suppressed immune gene expression in worker bees. Furthermore, they disrupt gut microbiota homeostasis, failing bee resistance to pathogens. In Swat Valley, where fruit-based monocultures and excessive use of chemical (neonicotinoid, organophosphates) are rising, microplastics act synergistically with pesticides and heavy metals, multiply their toxicity. Heavy metals like Cd, Pb, and Zn—detected in river sediments due to natural erosion, vehicle expulsions, and poor waste processing, restrict the bee neurophysiology and detoxification process, increasing susceptibility to stressors. Being in pollen and nectar further pollute hive stuffs, raising ecological and food safety concerns. Swat' cold climate reduces microbial degradation of plastic, allow microplastic accumulation over time in soils and plant surfaces visited by bees. Despite these risks, no monitoring of microplastics in bees has been conducted in Swat. This gap underscores need to quantify microplastic levels in bees and assess sub-lethal and chronic effects. Applying sustainable plastic waste management, restricting plastic use, and upholding organic apiculture are important to protect pollinator health in this fragile mountain ecosystem.

Keywords: Honey Bees, Microplastic, Mountains, Ecosystem, Agrochemical.



**DISTRIBUTIONAL NOTES AND SPECIES DIVERSITY OF DUNG BEETLES
(SCARABAEIDAE) FROM DISTRICT MALAKAND KHYBER PAKHTUNKHWA,
PAKISTAN**

**Toheed Iqbal¹, Sohail Khan¹, Muhammad Abbas², Maqsood Shah¹, Muhammad Nawas¹,
Siraj Ahmad Khan¹**

¹Department of Entomology, Faculty of Plant Protection Sciences, The University of
Agriculture Peshawar, Pakistan-25000

²Zoological Science Division, Pakistan Museum of Natural History, Shakarparian, Garden
Avenue, Islamabad-44000.

*Corresponding author's Email: toheed.iqbal@aup.edu.pk

Abstract

The *Scarabaeidae* family was studied in the Malakand district of Khyber Pakhtunkhwa, Pakistan, in the year 2020. Handpicking, light traps, and pitfall traps were used to collect the specimens from various areas around District Malakand. A total of 950 specimens were found, of which 16 species belonged to the *Scarabainae* subfamily and two species belonged to the Aphodinae. In addition to *Onthophagus hindu* and *O. bicolor*, Khyber Pakhtunkhwa now has records for four additional species of *Aphodius* (*Calaphodius*) and *Aphodius* (*Paraphodius*). An optical microscope from Kyowa (Model SDZ-P) was used to analyse the specimen's morphology and identify it. The specimens were imaged and measured using a Trinocular Microscope SMZ 749T. Adobe Photoshop was used to create the image's white background. The Pakistan Museum of Natural History in Islamabad has received all of the donated items. In order to identify the wildlife in District Malakand, Khyber Pakhtunkhwa, the most noticeable characteristics were chosen.

Keywords: Species, Dung Beetle, Diversity, Malakand.



MEALWORM (*TENEBRIO MOLITOR*) REARING AND GROWTH OPTIMIZATION AS A SUSTAINABLE FOOD SOURCE USING VARIOUS LARVAL DIETS UNDER LABORATORY CONDITIONS

Aizaz Ali Shah, Amjad Usman, Toheed Iqbal

Department of Entomology

Faculty of Crop Protection Sciences

The University of Agriculture, Peshawar

Corresponding author's email: toheed.iqbal@aup.edu.pk

Abstract

A new approach to supplying foods and feeds that are high in protein has emerged in the form of insect farming. Insect- farmed food may also serve as part of a sustainable diet for humans. The mealworm *Tenebrio molitor* L. (Coleoptera: Tenebrionidae) is the most widely consumed insect worldwide. In this study, 10 larval diets were tested in the laboratory to determine their suitability for mass- feeding mealworms at 28 °C and 60–65% r.h., in a completely randomized design. Various larval diets had a significant impact on the biological features of *T. molitor*. The larvae, pupae, and adults were greater on diets containing wheat bran alone and wheat bran in combination with maize and porridge. Larval mortality was significantly higher (60.7%) on a diet with porridge alone, compared to a control diet, followed by diets with porridge in combination with barley (55.6%) or maize (50.6%). Sex ratio was also affected by the tested larval diets. Female hatch (65%) was higher than male hatch (35%) on diet containing wheat bran alone as compared to all other diets. The findings contribute to optimizing mealworm rearing practices for sustainable food production and promote the potential use of mealworms as a viable protein source especially livestock diets based on mealworm reared on wheat bran show promise.

Keywords: Barley, Insect Farming, Mealworm Rearing, Nutritional Composition, Tenebrionidae.



TARNAB GANDUM-I: A CLIMATE-RESILIENT, ZINC-ENRICHED, AND RUST-RESISTANT WHEAT VARIETY FOR RAINFED AND IRRIGATED SYSTEMS OF KHYBER PAKHTUNKHWA

Hidayat Ullah¹, Iltaf Ullah²

¹Department of Agriculture, Faculty of Sciences, The University of Swabi, Anbar-23561, Swabi, Khyber Pakhtunkhwa, Pakistan

² Agriculture Research Institute (ARI), Tarnab, Peshawar-Khyber Pakhtunkhwa, Pakistan

*Corresponding author's Email: drhidayat@uoswabi.edu.pk

Abstract

Climate change poses serious threats to agriculture in mountain and rainfed regions through increased disease pressure, erratic rainfall, and declining soil fertility. Tarnab Gandum-I is a newly released spring wheat variety developed by the Wheat Breeding Program at ARI Tarnab-Peshawar, aimed at improving food and nutritional security in Khyber Pakhtunkhwa (KP), Pakistan. The Variety Evaluation Committee (VEC) has recommended Tarnab Gandum-I for multiplication. It combines triple rust resistance (stripe, leaf, and stem rust), drought adaptability, and biofortification with zinc to address the multifaceted challenges of climate variability. Derived from CIMMYT genetic resources, Tarnab Gandum-I demonstrated a consistent yield advantage (4.1–10.1%) over standard checks under both irrigated and rainfed environments in multi-year, multi-location trials. It showed a superior nutritional profile, including 15.4% protein and 34–35 ppm zinc, supporting human health under nutrient-deficient diets. Its performance was validated in National Uniform Wheat Yield Trials (NUWYT), and DNA barcoding confirmed its distinct genetic identity. Tarnab Gandum-I exemplifies a climate-resilient, high-performing wheat variety suitable for mountain agriculture, and supports the thematic focus on sustainable seed innovation and climate-smart agriculture.

Keywords: Climate-Smart Agriculture, Biofortification, Rainfed Wheat, Rust Resistance, Sustainable Yields, Khyber Pakhtunkhwa.



PULSES PRODUCTION UNDER CLIMATE VARIABILITY IN THE DRYLAND ZONES OF SOUTHERN KHYBER PAKHTUNKHWA: EVIDENCE FROM PANEL DATA ANALYSIS

¹Khuram Nawaz Sadozai, ²Munawar Raza Kazmi, ³Rajendra Adhikari and ¹Awais Habib

¹Department of Agricultural & Applied Economics, The University of Agriculture, Peshawar, Pakistan

²Country Manager - Pakistan, Australian Centre for International Agricultural Research

³Senior Lecturer School of Agriculture and Food Sustainability (AGFS), The University of Queensland, Australia

*Corresponding author's Email: ksaddozai@aup.edu.pk

Abstract

The research study was undertaken under the aegis of ACIAR Project entitled “Developing Inclusive and Competitive Pulses Value Chains in Pakistan”. The central theme of the research was to analyze the impact of climate variability on pulses production in the southern districts of Khyber Pakhtunkhwa (KP), Pakistan. Two pulse crops, namely chickpea and mung bean, were selected for this study in the context of climate change. Key variables included climatic factors such as temperature, humidity, and precipitation, along with data on pulses production and area under cultivation. Secondary data covering a 36-year period (1986–2022) were obtained from the Pakistan Meteorological Department and the Agriculture Statistics of KP. Separate panel data sets were constructed for chickpea and mung bean. The Shapiro-Wilk test was applied to assess normality, yielding a p-value of 0.63, indicating insignificance and leading to the acceptance of the null hypothesis, thus confirming normal distribution of the data. The Wooldridge test produced an F-value of 6.39 and a p-value of 0.0717, which is also insignificant at the 5% level, suggesting no issue of serial correlation. The analysis confirmed that both data sets were balanced. The Hausman specification test, run separately for each crop, indicated that the fixed effects model was suitable for the chickpea data, while the random effects model was more appropriate for mung bean. Major findings show that maximum temperature is statistically significant for chickpea yield; an increase of 1°C in maximum temperature could enhance chickpea yield by 0.0463 units. However, precipitation had no significant effect. The R-squared value of 0.537 indicates that 53% of variation in chickpea yield is explained by the model. Humidity also had a statistically significant and positive association with chickpea yield. For mung bean, minimum temperature was found to significantly contribute to yield. Moreover, humidity was also significant for mung bean, suggesting that a 1% increase in humidity could enhance its yield by 0.023 units. The R-squared value for mung bean was 0.577, implying that 57% of the variation in yield is explained by the included variables. The study concludes that temperature and humidity significantly influence pulses yield. It is recommended to build the capacity of pulse growers to adopt climate change adaptation strategies, such as water harvesting techniques to ensure sustainable irrigation and mitigate the effects of erratic rainfall. Furthermore, the government should ensure the availability of heat- and drought-tolerant pulse varieties to promote climate-resilient pulse cultivation.

Keywords: Climate Change, Pulses, Chickpea, Mungbean, Panel Data, Pakistan, ACIAR.



SOCIOECONOMIC IMPACT OF INTRODUCING TEA AS A COMMERCIAL CROP IN HILLY REGIONS OF KHYBER PAKHTUNKHWA PROVINCE

Farukh Sayar Hameed
Food and Agriculture Organization

Abstract

Globally agricultural landscapes and food systems are experiencing multiple stresses including increased competition for land and water resources, legacies of sub-optimal agricultural practices, environmental degradation, population pressure, and climate change and variability. Therefore, there is an urgent need to manage agricultural landscapes and food systems appropriately to ensure food security, preserve environmental resources and promote sustainable livelihoods. International trade in tea is one of the largest in value among tropical and subtropical crops, yet little attention has been paid to the value of landscapes for livelihood security, or the impact of tea production to climatic variation in these regions. Tea Industry is not only the mainstay of the hilly people but also the backbone of the hill economy. The Khyber Pakhtunkhwa province of Pakistan has diverse landscape as it stretches from the Himalayas in the north to the deserts in the south. Mountains, which occupy major portion of the province's area, are bestowed with rich natural resources like forests, water etc. These areas encompass Abbottabad, Mansehra, Battagram, Kohistan, Swat, Shagla, Buner, Dir and Chitral, districts. Agriculture is the mainstay of the province economy. Farming in the mountains is always difficult. The agriculture in the province in general and in the mountains in particular, is mainly a small farm activity. The small farmers mostly conduct subsistence farming, using family labour. Lack of land use planning is one of many factors causing unsustainable development of the mountain communities. The mountain areas which are cultivated, suffer soil and water erosion as well as limited infrastructure and market facilities. Tea occupies an important place among plantation crops of the world and is known as one of the healthy beverages. Because of the long history and a large scale production, trade and consumption, tea occupies an important place in the world agriculture economy. Tea plantation is a wonderful agro-asset and does not cause any imbalance in the eco-system; rather it contributes a lot in maintaining ecological balance. Its plantation is spread over in 31 countries scattered from 45° north to 33° south of the equator. The lush green tea plantation retains the soil cover, checks soil erosion, conserves the soil moisture and provides shelter to wild life. Being a labour intensive crop, it provides employment opportunities to the locals and controls the population flow from rural to urban areas. Tea being a lucrative cash crop enables a qualitative boost in farm income and contributes to general uplift of backward, rural hilly areas. Tea crop with Chinese origin has already been successfully demonstrated in potential tea growing areas of above mentioned districts on the land of small holders in Khyber Pakhtunkhwa.

Keywords: Perennial shrub, Farmer income, land use changes, erosion control, employment opportunities in rural areas, rural development, indigenous tea production.



CLIMATE-RESILIENT FLORICULTURE AS A SUSTAINABLE LIVELIHOOD STRATEGY IN THE MOUNTAINOUS REGION OF SWAT VALLEY, NORTHERN PAKISTAN

Prof. Dr. Noor Ul Amin and Dr. Irfan Ullah

Department of Horticulture, The University of Agriculture Swat

Corresponding author Email: drnoorulamin@yahoo.com

Abstract

The Swat Valley located at Northern Pakistan and is a part of the fragile Hindu Kush mountain ecosystem, is experiencing increasing climate-related stresses that ranges from temperature fluctuations and erratic precipitation, glacial retreat and frequent extreme weather events such as flash flooding etc. These shifts have placed traditional farming systems under pressure, demanding innovative, adaptive, and economically viable livelihood alternatives. Floriculture, particularly the cultivation of climate-resilient ornamental crops, offers a promising pathway toward agricultural diversification in the region as well as helps enhance livelihoods of the farming community. A study needs to explore the potential of selected ornamental species *Gladiolus*, *Lilium*, *Tagetes* (Marigold), and indigenous wildflowers under the changing agro-climatic conditions of Swat. A combination of field-based trials and participatory rural approaches may be employed to assess agro-ecological adaptability, low-input production methods, and the socioeconomic feasibility of integrating floriculture into Local Mountain farming systems. Additionally, the initiative also emphasizes gender-inclusive practices, community involvement, and the application of nature-based solutions such as protected cultivation, organic inputs, and efficient irrigation systems. The study forms part of a broader effort to position floriculture as a component of climate-resilient mountain agriculture, aligned with sustainable development goals and regional adaptation strategies.

Keywords: Swat Valley, floriculture, climate adaptation, ornamental crops, mountain agriculture, sustainable livelihoods, Northern Pakistan



MOUNTAINS IN A TEST TUBE: CLIMATE-SMART CONSERVATION OF MEDICINAL FLORA IN SWAT VALLEY- A REVIEW

Dr. Irfan Ullah¹, Misbahullah¹, Hidayat Ullah², Jawad Anwar, Prof. Noor Ul Amin¹ and
Naveed Ahmad⁵

¹Department of Horticulture, The University of Agriculture Swat

²Department of Entomology, The University of Agriculture Swat

³Department of Plant Breeding and Genetics, The University of Agriculture Swat

⁴Department of Food Science and Technology, The University of Agriculture Swat

⁵Department of Horticulture, The University of Agriculture Peshawar

Corresponding author Email: drirfan@uoas.edu.pk

Abstract

The Swat Valley in Northern Pakistan is often referred to as the “Switzerland of the East.” It is home of a rich diversity of medicinal plants that play a pivotal role in traditional healthcare and rural livelihoods. However, impacts of climate change coupled with anthropogenic pressures, overharvesting and habitat degradation are threatening the survival of several high-values and endangered species, including *Swertia chirayita*, *Saussurea lappa*, *Berberis lycium*, *Valeriana jatamansi*, and *Picrorhiza kurroa*, leading to a potential risk to both ecosystem stability and traditional healthcare systems. In vitro conservation techniques offers a viable, climate-resilient strategy to safeguard these species, in addition to promoting sustainable mountain agriculture. This review explores the potential of tissue culture particularly micro-propagation, callus culture, and somatic embryogenesis to mass-produce genetically stable, pathogen-free plantlets under controlled conditions. Key in vitro technique such as micro-propagation, callus culture, and somatic embryogenesis are reviewed for their effectiveness in producing genetically uniform, disease-free plantlets under controlled conditions. Tissue culture enables rapid, year-round multiplication of rare species, reducing dependence on wild populations and ensuring availability for cultivation and research. The integration of such biotechnological tools into mountain agriculture presents a promising avenue to strengthen agro-biodiversity, support ecological restoration, and enhance resilience to climate-induced challenges. This approach bridges traditional knowledge with modern biotechnology, advocating for integrated conservation frameworks in mountainous regions vulnerable to climate change.

Keywords: Tissue culture, medicinal plants, Swat Valley, climate resilience, mountain agriculture, in vitro conservation, endangered species.



INTEGRATING CLIMATE RESILIENT PRACTICES FOR MANAGING PEST AND DISEASE OUTBREAKS IN HIGH-ALTITUDE AGRICULTURE

Alia Javed *, Sakinabibi Saman Khalil

Department of Botany, University of Agriculture Faisalabad

Corresponding author Email: aliajaved@uaf.edu.pk

Abstract

Climate change, one of the most critical issues, poses serious difficulties to world agriculture. Pest and disease outbreaks contribute an increasing hazard to high-altitude agriculture such as climate change temperature, precipitation, and ecosystem dynamics. Climate change has a wide range of effects on pest insects. They expand their geographic range, improve overwinter survival rates, produce more generations, alter plant-pest synchrony, alter interspecies interactions, increase the risk of migratory pest invasion, increase the number of plant diseases transmitted by insects, and reduce the effectiveness of biological pest control methods, particularly natural enemies. Pests consume up to 40% of the world's food supply; mitigating pest impact is more important than ever in ensuring global food security, reducing input consumption, and lowering carbon emissions. Pests and diseases have an impact on agricultural output and quality while also reducing resource efficiency. Improved crop protection measures that prevent such damage and loss can boost output and significantly contribute to food security. To lower weed competition, boosting production by lowering crop damage from insects and diseases, and minimizing environmental harm related to agricultural pesticide use, multidisciplinary methods to solve problems needed. There is an urgent need for climate resilience methods including Integrated pest and disease management (IPDM) designed for hilly areas integrate ecological, agronomic, and biological approaches. The integration of approaches intended to minimize chemical-induced health and environmental damage by using cultural, mechanical tools, and biological agents to manage a variety of biotic stressors. Despite this, the effectiveness of the control measures is influenced by their effective execution. Weather forecasts and data needed to figure out whether improved pest management methods, which include transgenic plants resistant to diseases and pests, new biological control agents, creative cultural controls, biological pesticides, and other information to improve the effectiveness of conventional chemicals, are suitable for use. Various agronomic practices, such as vegetative soil cover, intercropping, sacrificial crops, tillage practices, and planting time, help to reduce insect populations and severity of pathogenic attacks. Over the last two decades, evaluation of agricultural performance following major climate anomalies (hurricanes and droughts) have proven that farms with higher levels of biodiversity are more resilient to climate disasters. Agroecosystems are more resilient when incorporated in a diverse agro ecological landscape matrix including adaptive local germplasm used in varied cropping systems managed with soils high in organic content and water conservation-harvesting technologies. Crop diversification, protection of native gene pools, live-stock crop integration, soil organic management, water conservation and harvesting, and other agro ecological practices all contribute to reduced vulnerability to climate instability. Scaling adaptive solutions for climate-smart highland agriculture requires strong policy support and research investments.



EVALUATING THE EFFECTIVENESS OF CLIMATE SMART AGRICULTURE (CSA) TECHNOLOGIES IN ENHANCING SOIL HEALTH AND WATER USE EFFICIENCY UNDER CHANGING CLIMATE

Sakina Bibi^{*1}, Alia Javed², Isha Ashraf³

Department of botany, University of Agriculture Faisalabad

Corresponding author Email: *1sakinabibi@uaf.edu.pk

Abstract

Climate change is having a major impact on our environment, especially in farming. Farmers are now dealing with unpredictable rainfall, higher temperatures, and frequent droughts. These changes are harming soil quality and making water harder to manage, leading to lower crop yields and food insecurity. Additionally, rising temperatures and shifting weather patterns are causing the spread of new plant diseases and pests, which further damage crops and reduce productivity. Warmer climates create favorable conditions for pests to multiply quickly and spread, making it harder for farmers to control them using traditional methods. To handle these challenges, there is a need for smarter and more sustainable farming practices. Climate Smart Agriculture (CSA) offers a helpful solution by promoting methods that protect natural resources and improve productivity. Techniques like drip irrigation, cover cropping, mulching, and reduced tillage play a major role in this. They help the soil stay healthy and reduce water loss during irrigation. Healthier soils can hold more nutrients and moisture, supporting better crop growth even during dry periods. CSA practices also help lower greenhouse gas emissions and reduce environmental damage from farming. By using CSA, farmers can become more resilient to climate related risks. This approach supports long term sustainability while improving efficiency. The focus of this study is to understand how CSA methods improve soil health and water use under changing climate conditions. Adopting these methods is essential to protect farmland and ensure food production continues. With smart techniques, farmers can reduce losses, use resources wisely, and prepare for extreme weather.

Keywords: Climate-smart Agriculture, Yield, Plant diseases, Food insecurity.



CLIMATE-RESILIENT FLORICULTURE AS A SUSTAINABLE LIVELIHOOD STRATEGY IN THE MOUNTAINOUS REGION OF SWAT, NORTHERN PAKISTAN

Abstract

The Swat Valley in Northern Pakistan, part of the fragile Hindu Kush mountain ecosystem, is experiencing increasing climate-related stresses—ranging from temperature fluctuations and erratic precipitation to glacial retreat and frequent extreme weather events. These shifts have placed traditional farming systems under pressure, demanding innovative, adaptive, and economically viable livelihood alternatives. Floriculture, particularly the cultivation of climate-resilient ornamental crops, offers a promising pathway toward agricultural diversification in the region. This study aims to explore the potential of selected ornamental species—*Gladiolus*, *Lilium*, *Tagetes* (Marigold), and indigenous wildflowers—under the changing agro-climatic conditions of Swat. A combination of field-based trials and participatory rural approaches were employed to assess agro-ecological adaptability, low-input production methods, and the socioeconomic feasibility of integrating floriculture into local mountain farming systems. This initiative also emphasizes gender-inclusive practices, community involvement, and the application of nature-based solutions such as protected cultivation, organic inputs, and efficient irrigation systems. The study forms part of a broader effort to position floriculture as a component of climate-resilient mountain agriculture, aligned with sustainable development goals and regional adaptation strategies.

Keywords: Swat Valley, floriculture, climate adaptation, ornamental crops, mountain agriculture, sustainable livelihoods, Northern Pakistan.



INTEGRATING CLIMATE- RESILIENT CROPS AND IMPROVED SEED SYSTEMS INTO NATIONAL AGRICULTURE POLICY: A CASE STUDY FROM A CLIMATE HOTSPOT REGION.

Sakina bibi*¹, Alia Javed Uzma Naseer

Department of botany, University of Agriculture Faisalabad

Corresponding author Email: sakinabibi@uaf.edu.pk

Abstract

Agriculture is among the sectors likely to face direct impacts from climate change in the coming years. Pakistan one of the most climate-vulnerable countries globally, faces increasing challenges in its agricultural sector due to warmer temperatures, changes in rainfall distribution, and a rise in extreme weather occurrences. The integration of climate-resilient crops and improved seed systems into Pakistan's national agricultural policy focuses on a climate hotspot region within the country. Through analysis of policy documents, field data, and interviews with key stakeholders including farmers, researchers, and policymakers, the study evaluates the adoption and impact of drought-tolerant and heat-resilient crop varieties. It also explores the effectiveness of improved seed distribution systems, emphasizing the importance of localized research, institutional collaboration, and public-private partnerships. To accelerate the development of resilient crop varieties, plant breeding programs should extensively incorporate modern molecular technologies, supported by advanced field phenotyping techniques. This approach requires close cooperation between plant breeders and scientists from multiple disciplines. The findings suggest that embedding climate-smart approaches into policy not only enhances food and livelihood security but also strengthens the adaptive capacity of smallholder farmers. This case underscores the need for integrated policy reforms, investment in resilient seed systems, and farmer-oriented extension services to ensure sustainable agricultural development under changing climate conditions in Pakistan.

Keywords: climate vulnerability, climate-resilient crops, public-private partnership, phenotypic techniques.



CLIMATE CHANGE AND THE EMERGENCE OF PESTS AND DISEASES IN MOUNTAIN AGRICULTURE, ASSESSING RISKS AND DEVELOPING CLIMATE-RESILIENT MANAGEMENT STRATEGIES

Sakina Bibi*, Alia Javed, Amna Sarwar
Department of Botany, University of Agriculture Faisalabad
Corresponding author's email: sakinabibi@uaf.edu.pk

Abstract

Climate change and global warming pose significant threats to agriculture across the globe. Key climatic factors including rising temperatures, elevated atmospheric CO₂ concentrations, and shifts in rainfall patterns directly influence both crop production and the behavior of agricultural insect pests. These environmental changes can impact insect pests in multiple ways, such as broadening their habitat range, enhancing survival rates during winter, increasing the number of life cycles per season, disrupting the timing between pest emergence and crop development, modifying species interactions, and raising the likelihood of infestations by migratory species. Consequently, these effects can lead to substantial crop losses and present a growing concern for global food security. 1°C rise in temperature can result in an altitudinal shift of pest populations by approximately 150 meters, exposing previously unaffected highland crops to biotic stress. This study aims to evaluate the spatial and temporal patterns of pest and pathogen emergence under projected climate variability through the application of geospatial analytics and hazard zonation techniques. Furthermore, the research will investigate adaptive, climate-resilient control frameworks such as integrated pest management (IPM), incorporation of genetically resistant genotypes, and deployment of eco-friendly biological control organisms. A strong focus will be placed on participatory methodologies involving indigenous mountain agro-communities to enhance the contextual relevance and scalability of proposed adaptation strategies. The outcomes are anticipated to contribute to agro-ecosystem sustainability and guide the formulation of evidence-based policy interventions targeting climate-induced biotic threats in high-altitude farming systems.

Keywords: climate change, global warming, pest population, agro communities.



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

THEME # 3
INNOVATION AND TECHNOLOGY IN
MOUNTAIN AGRICULTURE



THE EFFECT OF BIOCHAR ON NITRATE LEACHING NITROGEN UPTAKE AND YIELD OF WHEAT

Ishaq Ahmad Mian¹, Mauz Ul Haq¹, M. Tariq¹, Khadim Muhammad Dawar¹ and Bushra Khan²

¹Department of soil and environmental Sciences, The University of Agriculture Peshawar

²Department of Environmental Sciences, University of Peshawar

*Corresponding author's Email: ishaqmian@aup.edu.pk

Abstract

A pot experiment was conducted to examine the “Effect of biochar on nitrate leaching, nitrogen uptake and yield of wheat” in glass house of the University of Agriculture Peshawar, Khyber Pakhtunkhwa during Rabi season 2022-2023. There were two factors studied in experiment, to check the leachate from the pots that was treated with Nitrogen (with and without biochar) where 2% biochar was treated with soil. The parameters were significantly influenced by biochar. Four leachate were collected on different stages and pots were equally irrigated. First leachate was collected after 2 weeks from sowing and the remaining were collected from each pot after every 10 day. The pots which were treated with biochar produced maximum plant height (65.7 cm), spike length (9.07 cm), hundred grains weight (3.39 g), biological yield (68.34 g pot⁻¹), grain yield (22.76 g pot⁻¹), Nitrogen concentration in plant (1.22%), Nitrogen in soil (28.12 mg kg⁻¹) Nitrogen uptake (832.63 mg kg⁻¹). The leachate of biochar treated pots contained less nitrate nitrogen which were collected after every 10 days (34.18 ppm, 29.07ppm, 24.13ppm, 19.23ppm) while those pots which was treated with same doses of nitrogen without biochar contained high nitrate nitrogen (41.78ppm, 34.42ppm, 33.14ppm, 24.39ppm). Finally our results concluded that biochar has the ability to enhance plant growth, increase the availability of nitrogen, adsorb and retain nutrients including nitrate. Biochar provides habitat and substrate for beneficial microbes. This can enhance nutrient availability, including nitrogen, also influence nitrogen transformation processes, reducing nitrogen losses through volatilization. This can potentially increase the efficiency of nitrogen uptake by plants.

Keywords: Biochar, Nitrate Leaching, Nitrogen Uptake.



SELENIUM NANOPARTICLES ENHANCE SESAME'S BIOTIC STRESS TOLERANCE AND OIL BIOACTIVES IN A CHANGING CLIMATE

Ilyas Ahmad, Zohaib Younas, Naveed Iqbal Raja, **Zia-ur-Rehman Mashwani***

Department of Botany, PMAS Arid Agriculture University, Rawalpindi

*Corresponding author's Email: mashwani@uaar.edu.pk

Abstract

Vegetable oil consumption is expected to reach almost 200 billion kilograms by 2030 in the world and almost 2.97 million tons in Pakistan. A large quantity of edible oil is imported annually from other countries to fill the gap between local production and consumption. Compared to other edible oil crops such as soybean, rapeseed, peanut and olive, sesame has innately higher (55%) oil content, which makes it an excellent candidate to be considered to meet local edible oil production. Oil seed crops, especially sesame, are affected by various pathogens, which results in decreased oil production with low quality oil. Selenium nanoparticles (SeNPs) work synergistically, as it has antifungal activity along with improving plant growth. Different concentrations of SeNPs were used, on three different varieties of sesame (TS-5, TH-6, and Till-18). Plant growth and development were accelerated by SeNPs, which ultimately led to an increase in crop yield. Morphological parameters revealed that SeNPs resulted in a growth increase of 55.7% in root length, 48% increase in leaf number/plant, and 38% in stem diameter. Out of three sesame varieties, TS-5 seedlings treated with 40 mg/L SeNPs showed 96.7% germination and 53% SVI at 40 mg/L. Sesame varieties dramatically increased antioxidant capability using SeNPs, resulting in 147% increase in SOD and 140% increase in POD enzyme units in TH-6 and 76% elevation in CAT enzymes in TS-5 (mean $\pm$ S.E). GCMS analysis revealed that bioactive compound I, sesamin, sesamol, and tocopherol contents were increased along with enhanced production of different unsaturated fatty acids. Kegg pathway analysis and MSEA revealed that these compounds were mainly involved in biosynthesis of unsaturated fatty acids, suggesting that SeNPs have elicited the biosynthesis of unsaturated fatty acids such as oleic acid, linoleic acid, and α -linoleic acid. This study concluded that SeNPs (40 mg/L) have an excellent capability to be used for crop improvement along with better oil quality.

Keywords: Selenium Nanoparticle, Sesame, Edible Oil, Crop Improvement, Biotic Stress.



EFFECT OF SEED PRIMING WITH ZINC NANOPARTICLES AND SALINE IRRIGATION WATER ON YIELD AND NUTRIENT UPTAKE BY WHEAT PLANTS

Ishaq Ahmad Mian¹, M.Tariq¹, Mauz Ul Haq¹, Bushra Khan² and Khadim Muhammad Dawar¹,

¹Department of soil and environmental Sciences, The University of Agriculture Peshawar

²Department pf Environmental Sciences, University of Peshawar
Peshawar-Pakistan

*Corresponding author's Email: ishaqmian@aup.edu.pk

Abstract

The decrease of salinity in wheat is a critical strategy. This study investigated the zinc (Zn) seed priming effect on saline soil. The soil (0 to 20 cm) was collected from Research Farm, The University of Agriculture Peshawar and brought to the glass house. The soil was air dried and sieved through 2 mm mesh. Ten kg soil was placed in each pot. Wheat seed were soaked in Zn solution having different Zn concentration and 15 seeds were sown in normal soil in pots. The experimental treatments consisted of T1: dry seed, T2: 0.1%, T3: 0.2%, T4: 0.4%, T5: 0.6% Zn. The basal dose of nitrogen, phosphorus and potassium were applied at 120, 90 and 60 kg ha⁻¹. Thinning of plants was done and 10 plants were maintained till harvesting. Wheat crop was harvested after 125 days and agronomic data such as plant height, spike length, grain per spike, 100 grain weight, grain yield and biological yield were recorded. Both soil and plant samples were collected from each pot for laboratory analysis after harvesting. The result indicated that wheat seed treated with Zn solution at different concentration (0.1%, 0.2%, 0.4%, 0.6%) before sowing significantly enhanced plant growth, grain per spike, biological yield as compare to dry seed under salinity. The seed primed with 0.1%, 0.2%, 0.4%, 0.6% increased plant height from 66 to 83 cm. spike length 6 to 8 cm, 100 grain weight 3 g to 3.8 gm, biological yield 46 g to 67g, grain yield 18 g to 22 g. The nitrogen in straw was increased from 0.65% to 0.8% and N in grain increased from 1.0% to 2.1%. The phosphorous in straw were increased from 0.11% to 0.20 % and in grain increased from 0.12% to 0.20%. The potassium in straw was increased from 2.1% to 2.4%, and in grain increased from 0.55% to 0.80%. The Zn was increased in straw from 1.13 mg to 20.17 mg and in grain increased from 1.3 mg to 24.1 mg. The Zn uptake was increased from 0.12mg kg⁻¹ to 3.0mg kg⁻¹ It is concluded from the present study that Zn seed priming levels significantly decrease salinity. Seed priming of wheat with Zn at 0.4% is recommend for reducing salinity. Also enhancing wheat yield and Zn nutrition in saline soil, Zn seed priming would be a win-win strategy. However, field experiments on different crops are needed for confirmation of Zn seed priming levels and widespread application of research.

Keywords: Zinc Nanoparticles, Saline Irrigation, Nutrient Uptake.



BIOFORTIFICATION OF CROPS: A WAY TO ENGINEERING CLIMATE RESILIENCE IN MOUNTAIN AGRICULTURE

Merit. Prof. Dr. Hidayat ur Rahman¹, Hidayat Ullah¹ and Zabihullah²

Department of Plant Breeding and Genetics, The University of Agriculture Swat
Director Office of the Director General Agriculture Research Khyber Pakhtunkhwa

*Corresponding author's email: drhidayat@uoas.edu.pk

Abstract

Plant breeding is an industrial endeavor where raw material in the form of genetic recombinations are synthesized to develop crop cultivars with desirable attributes. The ever increasing population of Pakistan mostly with surging malnutrition and confounded with the changing climate impact necessitates development of crop varieties with enhanced yield potential accompanied with increased level of tolerance to changing environment and improved level of essential food nutrients and minerals. The task of feeding the growing population with sufficient food and enriched with micronutrients such as iron and zinc as well as proteins and essential vitamins is the need of the day and is of critical importance. Micronutrients malnutrition often refers to as hidden hunger is a wide-spread disorder that affects approximately one third of the global population. WHO reports reveal that counts of hidden hunger affectees worldwide surged to 828 million in 2021 since the onset of covid-19 pandemic. According to global hunger index, Pakistan ranks 102nd out of 125 countries and is grappling with alarming malnutrition. Micronutrients deficiency is also becoming a worldwide crop production and human health constraint. As people in the 3rd world countries mostly rely on staple crops such as wheat maize and rice for food which are micro nutrients deficit, therefore due to hidden hunger stunted physical development, hindered cognitive abilities, weekend immunity and increased vulnerability to degenerative and chronic illnesses are becoming more common in the 3rd world countries. Biofortification is genetically incorporation of one or more essential nutrients into the crop cultivars which are otherwise deficient for these essential nutrients. It is thus a natural approach to enhancing the nutrient profile of a crop through conventional or molecular breeding thus ultimately enhancing its nutritional value. Globally 22 zinc bio fortified wheat varieties have been developed of which five are developed in Pakistan. Pro-vitamin-A enriched transgenic Rice (Golden Rice) latest version contains 37 µg/ g carotenes. Super basmati is the only iron and zinc bio fortified Rice variety of Pakistan. In maize biofortification comprises development of OPV/Hybrids with higher Pro vitamin A and kernel zinc content along with production of Quality Protein Maize (QPM) OPVS/Hybrids.

Keywords: Biofortification, Climate Resilience, Micronutrients, Malnutrition.



ADDITIONS TO THE PAKISTANI FAUNA: NEWLY REPORTED GENERA IN THE PLANTHOPPER TRIBE DELPHACINI

Kamran Sohail^{1*}, Muhammad Usman¹, Misbahullah², Amjad Usman¹, Syed Fahad Shah¹,
Bashir Ahmad³ & Yalin Zhang⁴

¹ Department of Entomology, The University of Agriculture Peshawar, Khyber
Pakhtunkhwa, 25100, Pakistan

²Department of Entomology, The University of Agriculture Swat, Khyber Pakhtunkhwa

³ Dean, Faculty of Crop Protection Sciences, The University of Agriculture Peshawar,
Khyber Pakhtunkhwa, 25100, Pakistan

⁴ Key Laboratory of Plant Protection Resources and Pest Management of the Ministry of
Education, Entomological Museum, Northwest A&F University, Yangling, Shaanxi
712100, China

Corresponding author's email: kamran.sohail@aup.edu.pk

Abstract

The delphacid fauna of Pakistan remains insufficiently explored, with only 15 species across 9 genera reported to date (Bourgoin, 2021). This figure, representing merely 0.6% of the globally described species, this number likely falls far short of the true delphacid diversity present in the country. Specimens were collected from the Khyber Pakhtunkhwa Province of Pakistan and are deposited at the Entomological Museum of Northwest A&F University (NWAUFU) Yangling, Shaanxi, China. The genera *Rhombotoya* Fennah (1975) and *Queenslandicesa* Koçak & Kemal (2010) in the subfamily Delphacinae are here reported from a 2018-2019 survey of delphacids from the Khyber Pakhtunkhwa Province of Pakistan. Both genera are represented by a single species *Rhombotoya pseudonegripennis* (Muir, 1918) and *Queenslandicesa fennahi* Bellis & Donaldson (2016). Two genera i.e. *Rhombotoya* and *Queenslandicesa* are reported for the first time from Khyber Pakhtunkhwa Province as new country record. Identification keys to the tribe and all known genera from Pakistan are provided. Habitus photographs of these newly recorded genera are also provided.

Keywords: Fulgoroidea, Taxonomy, Morphology, Distribution, Pakistan.



ON MATHEMATICAL MODEL FOR PINE WILT DISEASE USING FRACTIONAL ORDER DERIVATIVE

Fazal Haq

The University of Agriculture Swat

Corresponding author's email: dr.fazalhaq@uoas.edu.pk

Abstract

The most important computational technique, the Laplace Adomian Decomposition Method (LADM), which plays an important role in the solution of non-linear models, is used. This work investigates some results for the existence and uniqueness of a solution to the Pine Wilt disease (PWD). Numerical results are presented to verify the established analysis. Naturally the existence of man is dependent, and this existence can be affected by natural disasters or by man-made destructions. As a universal phenomenon in nature, existence theory has attracted the attention of most scholars. The study of existence theory is insights into chemistry, physics, biology, and mathematics. This work also presents existence and uniqueness results of PWD.

Keywords: PWD Model, Fractional Derivatives, LADM, Existence Theory, Approximate Solution.



EFFECT OF PHOSPHOROUS APPLIED WITH BIOCHAR AND POULTRY MANURE ON YIELD AND NUTRIENT UPTAKE IN MAIZE CROP

Ishaq Ahmad Mian¹, Asif-Ur-Rehman¹, M. Tariq¹, Khadim Muhammad Dawar¹ and Bushra Khan²

¹Department of soil and environmental Sciences, The University of Agriculture Peshawar

²Department of Environmental Sciences, University of Peshawar

*Corresponding author's Email: ishaqmian@aup.edu.pk

Abstract

The response of Phosphorous, Biochar and Poultry manure alone and in combination was assessed on the yield and nutrient uptake by using the maize variety Jalal under field conditions at the Agriculture Research Farm, The University of Agriculture Peshawar. The experiment was carried out in RCBD with three replications having 12 treatments with 3×3 m² plot size. Organic manures including the above sources were used for source of P. Synthetic fertilizer SSP was also applied @ 120 kg ha⁻¹ into two splits. The results showed that SSP, Biochar and Poultry manure have beneficial effect on all the parameters under studied. Maximum plant height (195 cm), cob weight 119 g, cob length 14.7 cm was recorded for (100 kg SSP) followed by (50 kg SSP+5t BC+5t PM) (193cm), 118 g cob weight and 13.93 cm cob length. Moreover, the maximum grains cob⁻¹ 370.7 was observed in (50 kg SSP+5t BC+5t PM) followed by (100 kg SSP) and (50 kg SSP + 5t PM) (369 and 363, respectively) while the minimum was recorded for control. 1000 grain yield (321.7 kg ha⁻¹), Grain yield. (4638 kg ha⁻¹), Stover yield. (9854 kg ha⁻¹) and biological yield. (14493 kg ha⁻¹) were observed in (50 kg SSP+5t BC+5t PM) while the lowest 1000 grain weight (298 kg ha⁻¹), grain yield (2410 kg ha⁻¹), stover yield (7825 kg ha⁻¹) and biological yield (10235 kg ha⁻¹) were recorded for control. The plant N concentration was recorded maximum in (100kg ha⁻¹ SSP + 10 t ha⁻¹ BC) (1.36%), followed by (50 kg ha⁻¹ SSP + 5 t ha⁻¹ BC + 5 t ha⁻¹ PM) (1.34%) and the lowest was recorded for control (1.2%) while there was a nonsignificant change in soil N concentration. The maximum plant phosphorous concentration was recorded in (100kg ha⁻¹ SSP) (0.32%), followed by (100kg ha⁻¹ SSP + 10 t ha⁻¹ BC) (0.29%) and the lowest was recorded for control (0.15%) while the maximum soil K was recorded for (100kg ha⁻¹ SSP) (8.21 mg kg⁻¹), followed by (100kg ha⁻¹ SSP + 10 t ha⁻¹ BC) (7.95 mg kg⁻¹) while the lowest was recorded for control (3.64 mg kg⁻¹). It is concluded the both synthetic fertilizers and organic based fertilizers showed the best results for maize crop enhancing their yields, nutrient concentration and soil properties.

Keywords: Poultry Manure, Synthetic Fertilizer, Biochar, Organic Best Fertilizer.



**FRUITS OF MICROPROPAGATED STRAWBERRY (*FRAGARIA ANANASSA*)
PLANTS EXHIBITED HIGHER ANTIOXIDANT METABOLITES AS
COMPARED TO *IN VIVO* GROWN PLANTS**

Muhammad Irshad

Department of Horticulture, Amir Muhammad Khan Campus Mardan, The University of
Agriculture Peshawar 25120 Pakistan

Abstract

Berry crops have the highest concentrations of antioxidant metabolites, which have a considerable potential to reduce the risk of a variety of degenerative diseases. This work aimed to provide a standardized protocol for micropropagation of *Fragaria ananassa* from stem segment explants and to compare the antioxidant metabolites of aqueous extracts of fruits from *In vitro* and *In vivo* derived plants. Earliest callus induction (7.33 days) with maximum response (93.33%) was observed on MS medium containing 0.5 mg L^{-1} 2,4-D + 0.5 mg L^{-1} NAA. The earliest shoot induction (within 13.33 days from callus masses), maximum shooting frequency (80.33%) and highest number of shoots (a mean of 5.67 shoots per callus) was obtained on MS media supplemented with 1.5 mg L^{-1} TDZ. Earliest rooting (8.67 days), maximum rooting response (66.33%) and highest number of roots (6.33 per individual shoots) was noted on MS half strength media containing 1 mg L^{-1} IBA. Number of fruits and yield per plant was higher *In vivo* as compared to micropropagated plants. In contrast, total anthocyanin, total phenolic and ascorbic acid content were found higher in micropropagated plants as compared to *In vivo* plants. High performance liquid chromatography (HPLC) showed that the anthocyanins pigments from fruits of micro propagated plants were identical with field grown plants, and appeared on the ODS-column HPLC with higher retention time than the main pigments of field grown crop. These findings suggest that the fruits of micropropagated strawberry plants could be utilized as a source of bioactive substances with antioxidant properties in industrial applications.

Keywords: Strawberry, Micropropagation, Plant growth regulators, Bioactive compounds.



PLANT BASED BIOGENIC NANOPARTICLES AS AN EFFECTIVE TOOL FOR BIOTIC AND ABIOTIC STRESS TOLERANCE IN PLANTS: A REVIEW

Nazish Khan ^{1*}, Azmat Ali Khan ²

¹ The University of Agriculture Swat, P.O. Box 19040, Pakistan.

² Chemical and Petroleum Engineering Department, UAE University, P.O. Box 15551, Al Ain, United Arab Emirates.

*Corresponding author's Email: Nazishpbg@uoas.edu.pk

Abstract

In the changing climate scenario, biotic and abiotic stress around the world has been a key problem that has resulted in the reduction of plants development and productivity. Abiotic stresses comprise salinity, drought and excessive high and low temperatures while biotic stresses include viruses, bacteria, fungi, nematodes, insects, and weeds that are negatively affecting plant development and productivity. In this scenario, nanotechnology has arisen as robust technique to address the problems induced by biotic abiotic stresses that reduce the production of crops worldwide. Among the numerous biogenic synthesis routes for nanomaterials, the biogenic method which utilizes plant extracts provides a green, sustainable, and eco-friendly substitute to conventional techniques. Therefore, this review provides a comprehensive overview of the biogenic approaches for synthesis of nanoparticles and their applications to improve biotic and abiotic stress tolerance in plants. The review addresses with an overview to the nanoparticles synthesis approaches utilized through biogenic techniques. The review discusses numerous types of nanoparticles, metals, noble metals, metal oxides and carbon based materials synthesized through biogenic approaches. The review analyzes the mechanisms by which biogenically synthesized nanoparticles mitigate stresses such as drought, salinity, heavy metal toxicity, and temperature extremes. The review discusses the role of these nanoparticles in improving plant properties such as physiological processes, antioxidant defense systems, and gene expression related to stress resilience, low toxicity, biodegradability. In addition, the review identifies challenges faced during the synthesis through biogenic approach that are related to scalability, environmental impact, and proposes directions for future research aimed at integrating biogenic nanomaterials into sustainable agricultural practices. Finally, the perspectives are put forward for possible improvement of the plant biological process.

Keywords: Climate, Biogenic, Nano Particles, Antioxidant.



SMART GRID TESTBED FOR LAUNCHING DOS ATTACKS AND IMPACT OF DOS ATTACKS ON ENERGY MANAGEMENT SYSTEM

Tahir Ullah¹, Waseem Ullah Khan², Safdar Nawaz Khan Marwat³

¹ Dept. of Computer Systems Engg University of Engineering & Technology Peshawar,
Pakistan

² Faculty of Computer Science and Engg GIK Institute of Engineering Sciences &
Technology Swabi, Pakistan

³ Institute of Computer Sciences & Information Technology University of Agriculture
Peshawar, Pakistan

Corresponding author's email: engrtahir@uetpeshawar.edu.pk

Abstract

Smart Grid is digitally enabled power grid that is equipped with variety of embedded devices that can communicate, compute, sense, and control. Smart grid is the concept which integrates information and communication (ICT) technologies with the traditional power grid. Due to this feature, the smart grids introduces new cyber security challenges that are at the cost of a greater risk of data loss, security breaches and high power consumption. In a Smart Grid, we can bifurcate the cyber domain and power system domain. The attack happens in cyber domain which in turn affects the power systems domain. In this paper, the software test bed for launching Denial of Service (DoS) attacks and the impact of DoS attacks on Smart Grid is proposed. In a software testbed, DoS attacks is executed on Smart Grid. The simulated software test bed consists of smart meters, power plant and utility servers. The simulation is performed using SCORE emulator. The performance is evaluated in terms of network throughput. The results show that execution of DoS attacks reduces the network throughput, makes the power station inaccessible for its authorized nodes.

Keywords: Cyber Security; Cyber Attacks; DoS Attacks, Encryption; Smart Grid.



METABOLOMICS AND BIOCHEMICAL ANALYSIS OF TWO POTATO (*SOLANUM TUBEROSUM* L.) CULTIVARS EXPOSED TO IN-VITRO OSMOTIC AND SALINITY STRESSES

Bahget Talat Hamooh¹, Farooq Abdul Sattar^{1*}, Gordon Wellman², Magdi Ali Ahmed Mousa^{1,3*}

¹ Department of Arid Land Agriculture, Faculty of Meteorology, Environment and Arid Land Agriculture, King Abdulaziz University, Jeddah, 21589, Kingdom of Saudi Arabia

² Division of Biological and Environmental Sciences and Engineering, King Abdullah University of Science and Technology, Thuwal, 23955-6900, Kingdom of Saudi Arabia

³ Department of Vegetables, Faculty of Agriculture, Assiut University, Assiut 71526, Egypt

*Corresponding Author Email: bhamooh@kau.edu.sa

Abstract

Globally, many crops production areas are threatened by drought and salinity. Potato (*Solanum tuberosum* L.) is susceptible to these challenging environmental conditions. In this study, an *in vitro* approach was employed to compare the tolerance of potato cultivars 'BARI-401' (red skin) and 'Spunta' (yellow skin). To simulate ionic- and osmotic stress, MS media was supplemented with lithium chloride (LiCl 20 mM) and mannitol (150 mM). GC-MS and spectrophotometry techniques were used to determine metabolite accumulation. Other biochemical properties, such as total phenols concentration (TPC), Total flavonoids concentration (TFC), antioxidant capacity (DPPH free radical scavenging capacity), polyphenol oxidase (PPO), and peroxidase (POD) activities, were also measured. The two cultivars respond differently to ionic and osmotic stress treatments, with 'Spunta' accumulating more defensive metabolites in response, indicating a higher level of tolerance. While further investigation of the physiological and biochemical responses of these varieties to drought and salinity is required, the approach taken in this paper provides useful information prior to open field evaluation.

Keywords: Drought, Ionic, Antioxidant, Tissue Culture, Screening.



APPLICATION OF AI TOOLS FOR DEVELOPING NUTRACEUTICALS IN MOUNTAINOUS REGION

Asif Ahmad^{*1}, Zain Ul Iman² and Muhammad Saad Asif³

^{*1} Institute of Food and Nutritional Sciences, PMAS-Arid Agriculture University
Rawalpindi, Pakistan

² University Institute of Information Technology, PMAS-Arid Agriculture University
Rawalpindi, Pakistan

Corresponding author Email: asifahmad@uaar.edu.pk

Abstract

The use of artificial intelligence (AI) tools is opening up new avenues for the development of nutraceuticals, especially within geographically regions with distinct climate such as mountainous regions. These are home to wide range of endemic medicinal plants and biodiversity and host a variety of endemic medicinal plants and natural resources with untapped nutraceutical potential. Integrating AI-driven methodologies—such as machine learning, deep learning, natural language processing, and predictive analytics—enables efficient screening, analysis, and classification of bioactive compounds derived from these high-altitude ecosystems. By harnessing local genomic, chemical composition, metabolomic, bioactives and ethnobotanical data, AI can identify promising functional ingredients, optimize their formulations, and assess potential therapeutic effects that may have industrial application for product development. Moreover, intelligent algorithms support knowledge extraction from regional scientific literature and traditional health practices, creating a bridge between ancestral wisdom and modern science. AI tools also facilitate targeted product development that accounts for ecological constraints like seasonal variability and limited infrastructure, enhancing sustainable sourcing and processing. The personalization capabilities of AI enable recommendations tailored to populations living in mountainous areas, considering altitude-related physiology, lifestyle, and nutrition patterns. Supply chain analytics improve distribution strategies by predicting demand and managing logistical challenges unique to mountainous terrains. Ultimately, this synergy between AI and mountainous biodiversity offers an innovative pathway for developing effective, localized, and resilient nutraceutical solutions that align with both environmental sustainability and global health priorities.

Keywords: Artificial Intelligence, Nutraceuticals, Machine Learning; Deep Learning



SECURING IOT ARCHITECTURES FOR CLIMATE CHANGE MONITORING: A CYBERSECURITY-DRIVEN APPROACH

Khwaja Jawad ¹ and Kiramatullah ²

^{*} ¹The University of Agriculture Swat

^{**}INJE University, Gimhae, South Korea

Corresponding author Email: kiramatullah541@gmail.com

Abstract

In the wake of accelerating global climate change, the integration of Internet of Things (IoT) and cybersecurity within the realm of Information Technology (IT) has emerged as a critical enabler of sustainable environmental monitoring and adaptive response systems. This research proposes a novel framework that leverages secure IoT architectures to collect, analyze, and transmit real-time climate data across decentralized ecosystems. While IoT-based sensing platforms provide unprecedented granularity in capturing environmental variables—such as greenhouse gas concentrations, temperature anomalies, and deforestation metrics—their exposure to cyber vulnerabilities poses significant risks to data integrity and reliability. We introduce a lightweight, AI-assisted security layer that ensures end-to-end encryption, anomaly detection, and automated threat response, designed specifically for resource-constrained IoT devices in climate-sensitive regions. The proposed model was validated through simulations involving smart agricultural systems and coastal flood alert networks. Results demonstrate a 32% improvement in data accuracy and a 48% reduction in network-level threats, highlighting the dual imperative of secure digital infrastructure in mitigating the effects of climate change. This interdisciplinary effort bridges IT, environmental science, and cybersecurity, providing a resilient blueprint for future smart climate monitoring frameworks.

Keywords: IoT, Climate Change, Cybersecurity, Environmental Monitoring, Smart Agriculture, Sustainable Technology Tools



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

THEME # 4
POLICY, INSTITUTIONS,
AND FINANCING CLIMATE RESILIENCE



IMPACT OF CLIMATE-SMART AGRICULTURE ON CROP PRODUCTION AND MITIGATION OF GREENHOUSE GAS EMISSION

Abdul Shakoor ^{1*}, Maqsood Qamar ¹, Zahid Mehmood ¹, Syed Haider Abbas ¹, Samman Gul Vaseer ¹, Sundus Waqar ¹, Imtiaz Hussain ², Humaira Iqbal ¹ and Taj Naseeb Khan ³

¹Wheat Program, National Agricultural Research Centre, Islamabad, Pakistan

²Pakistan Agricultural Research Council, Islamabad, Pakistan

³Crop Sciences Institute, National Agricultural Research Centre, Islamabad, Pakistan

*Corresponding author's Email: shakoor2914@gmail.com

Abstract

Worldwide climate changes has posed serious threats to agricultural production. Long-term changes in climate variability, vulnerability, a rise in average temperature, and changes in precipitation patterns including sea level rise, floods, droughts, and extreme weather events threaten crop productivity, food security and the livelihoods of people across the globe. One of the main contributors to climate change is the release of greenhouse gases (GHGs) into the atmosphere. Lower crop yields with higher dependence on food imports, global economic shocks and climate change exacerbate more challenges to food security, specifically in developing countries. Pakistan has an agro-based economy with a high dependency on the sector, contributing 19.2% to the country's GDP. Therefore, adaptation to climate change is necessary to promote farmers' sustainable livelihoods and mitigate carbon emissions. A technologically sophisticated solution to the problems facing agriculture due to climate change is called Climate-Smart Agriculture (CSA). Crop rotation, crop residue management, and soil and water conservation are called Climate-Smart Agriculture practices. It is reported that Climate-Smart Agriculture practices increased water use efficiency and total water storage by 9-68% and 1-13%, respectively. Furthermore, implementation of Climate-Smart Agriculture practices increased wheat yield by 30-45%. The adoption of Climate-Smart Agriculture practices can potentially help reduce greenhouse gas emissions without compromising agricultural production. Using advanced internet technology to ensure agricultural information security, improvement of cropping patterns and management techniques, carrying out “internet + weather” service and improving the agricultural service are considered as the main direction of future development of Climate-Smart Agriculture. Researchers, extension workers and policymakers can benefit from synthesizing all this information as it may help provide favorable plans to boost crop production by selecting and using relevant CSA practices in Pakistan.

Keywords: Climate-Smart Agriculture, Crop Yield, Adaptation, Greenhouse Gases.



UNLOCKING CLIMATE RESILIENCE: A STUDY OF INSTITUTIONAL BARRIERS REGARDING COMPETENCIES ENHANCEMENT IN ADAPTATION STRATEGIES OF EXTENSION WORKERS IN PAKISTAN

Raheel Saqib^{1*}, Syed Mufeed Hadi Naqvi¹, Badar Naseem Siddiqui², Muhammad Zafarullah Khan¹, Hammad Raza³, Ikramul Haq¹ and Karim Ullah¹

¹Department of Agricultural Extension Education and Communication, The University of Agriculture Peshawar, Pakistan

²Department of Agriculture Extension, PMAS Arid Agriculture University Rawalpindi, Pakistan

³Department of Agricultural Extension and Education, Ghazi University Dera Ghazi Khan

*Corresponding author's Email: raheel.saqib@aup.edu.pk

Abstract

Agriculture is considered the backbone of economic development, particularly in developing countries, as it provides significant employment to rural communities. However, rising population pressure and climate variability scenarios pose serious challenges to agriculture sector. For addressing these problems, it is essential to enhance the crop productivity by adapting latest, climate resilient strategies. In Pakistan, efforts have been made since independence to achieve self-sufficiency in major crops however progress has remained fragile, mainly due to communication gaps between research, extension and farmers. The present study aimed to assess the institutional barriers faced by extension field staff (EFS) in enhancing competencies regarding climate-resilient strategies. Five districts (Multan, Rajanpur, Rahimyar Khan, Bahawalpur, and Bahawalnagar) representing various agro-ecological zones were purposely selected. Using a multistage sampling technique, a sample of 359 respondents were drawn from a population of 540 farmers. For equal representation from each district, respondents were selected by proportionate sampling technique. Demographically, 43.37% of respondents were aged between 20–35, while 18.56% were above 50 years. A majority (82.1%) held an agricultural diploma, only a small portion of respondents had higher degrees (B.Sc. Hons. 2.8%, Ph.D. 2.6%). Mostly (61.71%) had up to 15 years of experience in extension activities, and additionally 73.7% had personal farming experience. By calculating weighted score, Lack of incentives for enhancing competencies ranked highest (1219), followed by lack of funding (1212), inadequate transport facilities (1157), Political influence (1157), assignment of non-departmental work (1136) and weak linkages between extension and research (1063) were found barriers in enhancing competencies regarding climate resilient strategies. Furthermore, based on weighted scores the study revealed that efficient water usage (1479), irrigation water storage expansion (1389), changing cropping intensity (1287), adjust timing of farm operation to reduce risk of damage (1246) and mechanization of farm (1241) may support as adaptation strategies to cope the climate variability. The study concluded that field staff had various organizational barriers but with a diverse knowledge of extension activities, personal experience of farming and focusing on adaptation strategies like efficient water usage, changing cropping intensity, adjust timing of farm activities may help the farming community to cope the climate variability effects. Based on the conclusions it is recommended that provision of incentives, funding support for acquiring climate resilient competencies and transport facilities may enhance the capability of extension field staff to work efficiently in supporting farming community. Moreover, it is suggested that government should introduce and implement policies to halt the assigning activities other than their professional work.

Keywords: Climate Resilient Adaptation Strategies, Institutional Barriers, Cross-Sectional Study.



INTEGRATED SOIL NUTRIENTS (NP) MANAGEMENT; TRAILS OVERVIEW

Muhammad Adnan

Department of Agriculture, University of Swabi, KPK, Pakistan

Abstract

Integrated Soil Nutrient Management (ISNM) aims to optimize the use of organic, inorganic, and biological sources of nutrients to enhance soil fertility and crop productivity in a sustainable manner. This overview highlights a series of field trials focused on the efficient management of nitrogen (N) and phosphorus (P) in various agro-ecological zones. The trials evaluated the combined application of synthetic fertilizers, compost, green manures, and biofertilizers, biochar and rock phosphate to assess their synergistic effects on crop yield, nutrient use efficiency, and soil health. Results consistently demonstrated that integrated approaches outperformed sole fertilizer applications by improving nutrient availability, reducing losses, and maintaining soil organic matter. The findings reinforce the potential of ISNM in achieving balanced fertilization, minimizing environmental risks, and supporting resilient farming systems. This synthesis provides practical insights for refining nutrient management strategies and guiding policy frameworks toward sustainable agriculture.

Keywords: ISNM, Soil Health, Synergetic Effects, Biochar, Biofertilizer.



FROM STRESS TO STRATEGY: MAPPING CLIMATE RISK AND FARMER RESPONSE IN MOUNTAIN CROPPING SYSTEMS

Hassnain Shah¹, Christian Siderious², Petra Hellegeres³

¹ Social Sciences Division, Pakistan Agricultural Research Council, Islamabad, Pakistan;

² Uncha Uncharted Waters Ltd. Sydney, Australia

³ Water Resources Management Group, Environmental Sciences, Wageningen University and Research Centre, Wageningen, The Netherlands

Abstract

Mountain agriculture in Pakistan's Indus Basin—particularly in the mid-hills and high mountain zones—is increasingly vulnerable to climate variability. This study employs a cause-effect-response-impact chain analysis to examine how single climate stresses, such as unexpected frost or unseasonal rainfall, can trigger multiple loss-causing pathways in crop production. Based on the primary data we analyze the in-season climate hazards, impacts on crops, farmer responses, limitations, and the effectiveness of coping strategies in these regions. The analysis of different stress by crop stage revealed that the yield losses ranged from 10–30% in 43% of cases and 31–50% in 39%, particularly when multiple hazards occurred within a single season or affected both crops in a rotation. In-season coping strategies—such as replanting, supplemental irrigation, or input adjustments—have shown variable effectiveness. In-season coping strategies avoid 50–90% of yield loss and cost 4–34% of the recovered value. In the high mountains, warming trends have extended the summer growing period by 10 (± 6) days and the winter period by 13 (± 5) days, offering potential yield benefits. Conversely, in the mid-hills, the winter growing period has shortened by 15 (± 6) days, leading to yield declines. Farmers have attempted to adjust sowing dates; however, these changes often could not be aligned with shifting seasonal patterns, and are constrained by risk aversion or some other technical or management limitations. The timing of farmer responses is critical; delays can exacerbate losses, underscoring the need for timely interventions. This research highlights the importance of identifying specific loss-causing pathways to develop targeted coping and adaptation strategies. It emphasizes that a single climate stress may generate multiple loss-causing pathways, that necessitates multiple, context-specific solutions. Mapping these pathways allows us to identify where and when losses occur, guiding more localized, resilient interventions. The findings provide real-time evidence on emerging challenges, offering actionable insights for sustaining mountain livelihoods under the theme “Innovative Together for Sustainable Livelihoods.”

Keywords: Climate Risk, Stress, Management, Cropping Pattern.



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

THEME # 5
COMMUNITY ENGAGEMENT
AND GENDER



DETERMINANTS OF INCOME INEQUALITY IN URBAN AND RURAL AREAS OF DISTRICT PESHAWAR, KHYBER PAKHTUNKHWA

¹Tajala Ahmad*, ¹Syed Attaullah Shah and ¹Dr. Khuram Nawaz Sadozai
Agricultural & Applied Economic, The University of Agriculture Peshawar

*Corresponding author's Email: tajallakhan2019@gmail.com

Abstract

The study was carried with the objective to identify the determinants of household's income in rural and urban areas of district Peshawar, measure inequality in income distribution and identify its determinants. A random sample of 200 households were randomly selected from urban and rural areas and a well-structured questionnaire was used to collect data from selected households. Regression based income estimation and decomposition analyses were conducted to identify determinants of income, measure income inequality and investigate its determinants. Both Lorenz curve and Gini coefficient were constructed/ estimated to measure income inequality. The estimated coefficient for Gini coefficient is 0.33395 which indicates 33.39 percent concentration of inequality in income distribution. Regression results show that a household's per capita income is directly related to head's age, education level, number of working individuals and their special skills, land holding and location in rural area. Results from regression based decomposition analysis for income inequality reveal that important factors affecting the inequality in income are land holding, head's education and age, household location, individual special skills and number of working individuals. Based on these findings, the study recommends the provision of free education upto matric level, arrangement of special training programs for young adults, jobs creation and financial support in terms of microcredit to poor households and raise their income and narrowing the income inequality in the study area.

Keywords: Rural Areas, Inequality, Income, Household.



EFFECT OF DIGITAL FINANCIAL LITERACY ON FINANCIAL INCLUSION OF WOMEN ENTREPRENEURS IN PUNJAB, PAKISTAN

Tahira Sadaf¹ Asghar Ali, nazia Tabasam, Komal Azharand Ayesha Rouf⁴

¹ Associate Professor, Institute of Agricultural and Resource Economics, University of Agriculture, Faisalabad

² Professor/Director, Institute of Agricultural and Resource Economics, University of Agriculture, Faisalabad

³ Assistant Professor, Institute of Agricultural and Resource Economics, University of Agriculture, Faisalabad

⁴ PhD candidates, Institute of Agricultural and Resource Economics, University of Agriculture, Faisalabad

Abstract

This study aims to estimate the degree of financial literacy in men and women in Pakistan; analyse gender gap in financial literacy and digital financial literacy among entrepreneurs in Punjab; evaluate the gender gap in financial inclusion among entrepreneurs in Punjab; and assess the effect of digital financial literacy on financial inclusion in female entrepreneurs in Punjab by using a mixed method approach. The first objective has been addressed using secondary data from the World Bank's Global Findex database, revealing a significant gender gap in financial literacy. Results show that only 21% of individuals in Pakistan have a bank account, with a mere 13% of women having access to formal banking services, highlighting a substantial gender disparity in financial inclusion. Furthermore, Pakistan ranks among the lowest in account ownership among low-middle-income countries, with a significant gap between men and women. Primary data has been collected through a structured questionnaire for addressing the remaining objectives. Sampling was done in two steps using PSLM microdata 2019-20. As a first step, target district was selected from Punjab based on its high proportion of female entrepreneurs as evident from analysis of PSLM microdata 2019-20 and as a second step, number of respondents for data collection were selected. The district of Faisalabad was randomly selected for data collection. Total sample size was 237, where number of women was 100 (42 percent) and those of men was 137 (round 58 percent) male and 42 percent female entrepreneurs indicating a slightly higher proportion of male respondents. There was a statistically significant gender gap in financial literacy, digital financial literacy as well as in financial inclusion among entrepreneurs in Punjab. Women had lower levels of financial literacy, digital financial literacy and financial inclusion compared to men. The study revealed that digital financial literacy has a positive impact on financial inclusion for entrepreneurs. The study recommends targeted interventions for female entrepreneurs for promoting their financial literacy, and digital financial literacy so that they may have better financial inclusion for getting financial benefits from formal financial institutions. By doing so policymakers can contribute significantly by doing to the economic empowerment of women entrepreneurs in Punjab.

Keywords: Women, Entrepreneur, Literacy, Policymakers.



CLIMATE RESILIENCE IN AGRICULTURE EXTENSION: AN ASSESSMENT OF AGRICULTURE OFFICERS CAPABILITIES IN KHYBER PAKHTUNKHWA PAKISTAN

Shah Saud¹ and Muhammad Zafar Ullah Khan¹,

¹ Department of Agricultural Extension Education and Communication, The University of Agriculture Peshawar, Pakistan 19120

² Department of Agricultural Extension Education and Communication, The University of Agriculture Peshawar, Pakistan 19120

*Corresponding author's Email: shah.saud1991@aup.edu.pk

Abstract

Keeping in view the role of extension services in uplifting the socio-economic condition of the farming community is very important and crucial. The study was steered to assess the professional capabilities of Agriculture Officers (AOs) working in the Agriculture Extension Department Khyber Pakhtunkhwa to prioritize the training needs capabilities of the respondents in the study area. All the AOs (79) were interviewed from all districts of Khyber Pakhtunkhwa. The respondents were interviewed through a validated and pre-tested interview schedule and the outcomes presented in the form of graphs, tables and percentages. To get the desired objectives Linear Regression Model, Standard Deviation (SD), Mean, and Paired Sample t-test were used. Outcomes disclosed that maximum (49.4%) respondents were recorded in the age category of 31-40 years. Educational level of AOs showed that mainstream (79.7%) of the respondents had master qualifications. The results regarding In-Service and Pre -Service Training availed by the AOs showed that majority (81.0%) claimed that they didn't avail any In-Service training. The possessed mean in climate change capabilities of AOs was recorded 2.74 against the mean required of 4.57. Based on the mean difference, AOs ranked, know-how of climate change, understanding & communicating weather forecast and communicate climate information effectively at higher ranks of training needs highlighting a mean difference of -1.39, -1.46 and -1.62 respectively. Similarly, practicing cultural approaches in mitigating climate change effects and familiarity with soil and water conservation techniques were ranked at 4th and 5th order of training needs with a mean difference of -1.64 and -1.67 respectively. The statistical data measured from the regression analysis revealed that age had a positive and statistically significant effect on climate change capabilities of the AOs. It means that with the increase in age, the ability in climate change capabilities would increase. So, it is recommended that more in-service training courses need to be conducted that will add skilled manpower to the system. AOs need to be equipped and trained with required technology tools so they can perform their duty efficiently. Moreover, they should spend specified day in the field instead of offices and farmer should know these days for their easy access to solve the farmer problems effectively and efficiently.

Keywords: Climate resilience, Linear Regression Model, Paired Sample Test, Climate Change Mitigation.



UNRAVELLING THE LINK BETWEEN WOMEN'S EMPOWERMENT AND HUMAN DEVELOPMENT IN DEVELOPING COUNTRIES

Sada Wahab

Abdul Wali Khan University, Mardan

*Corresponding Author's Email: Sadawahab22@gmail.com

Abstract

Women's empowerment is indispensable for sustainable growth and socio-economic advancement, promoting individual freedom and societal progress. Goal number five of the SDGs highlights gender equality and empowerment as key to international development. However, many developing nations struggle to turn this concept into actionable outcomes. The process of allowing women to actively engage in social, political, and economic domains is known as women's empowerment. It entails establishing an atmosphere in which women can have an impact on organizational policies and government initiatives that impact their lives. Women's empowerment and gender equality are given top priority in the Sustainable Development Goals, yet there are still obstacles to implementation, especially in developing countries. Studies have historically frequently identified political women's empowerment as a key factor affecting human development. However, this study has broadened the focus to include social and economic dimensions of progress, alongside the political. This study explored the impact of women's social, political, and economics empowerment on HDI for 105 world developing countries over the period 2000-2023. The study used panel data econometrics techniques for estimating the impact of different women's empowerment dimensions on HDI. The cross-sectional dependency tests show that all countries are independent from each other. The first-generation panel unit root tests identified all variables stationary at level except internet users, fertility rate, and population growth. Since the dependent variable is stationary at level, the study used conventional panel data econometrics techniques such as Fixed effect and Random effect. Based on the results of the Housman test, Random effect model is chosen to estimate the unknown parameters. The estimated results show that both women's political and economic empowerment have positive and statistically significant impact on HDI. While the impact of social empowerment is positive but statistically insignificant. Rules of law and health expenditure also have positive and significant impact on HDI while population growth and fertility rate both have negative and significant impact on HDI. Contrary to the fact, per capita GDP has negative and insignificant impact on HDI. Based on the findings, the study recommends that developing countries foster and facilitate women's meaningful involvement in social, political, and economic domains as a means to advance their overall development.



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

THEME # 6
CROSS-BORDER AND REGIONAL
COOPERATION



CLIMATE CHANGE MITIGATION THROUGH SOIL ORGANIC CARBON SEQUESTRATION UNDER LONG-TERM FERTILIZATION IN A PROFILE OF CHINESE LOESS PLATEAU SOIL

Syed Atizaz Ali Shah ^{1*,2}, Minggang Xu ¹, Mohammad Jamal Khan ², Muhammad Mohsin Abrar ¹, Adnan Mustafa ¹, Tufail Shah ³, Syed Aizaz Ali Shah ⁴, Wei Zhou ¹, Sun Nan ¹
¹ National Engineering Laboratory for Improving Quality of Arable Land, Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing, 100081, China

² Department of Soil and Environmental Sciences the University of Agriculture Swat, 25000, KPK, Pakistan

³ College of Land Science and Technology, China Agricultural University, Beijing, 100093, PR China

⁴ College of Horticulture, Department of Vegetable Sciences, China Agricultural University, Beijing, 100093, PR China

Corresponding author's email: syedatizaz@uoas.edu.pk

Abstract

Soil organic carbon is indispensable for soil health and, in the context of climate change, is considered a significant CO₂ sink. Improving agricultural management to increase long-term soil organic carbon (SOC) stocks for mitigating climate change requires tools that estimate short and long-cycling SOC pools, crop productivity and soil health are limited by organic carbon (OC), however, the variations in the mechanisms of SOC in a complete soil profile subjected to long-term fertilization remains unclear. The objective of the study was to examine the content and profile distribution of the distinctive SOC protection mechanisms on a complete profile (0-100 cm) of Eumorphic Anthrosols in Northwest China after 23 years of chemical and manure fertilization. The soil was fractionated by combined physical-chemical and density floatation techniques. Throughout the profile, significant variations were observed among fractions. In the topsoil (0-20 and 20-40 cm), mineral coupling with the fertilization of manure (MNPK) enhanced total SOC content and recorded for 29% of SOC in the 0-20 and 20-40 cm layers. Moreover, MNPK increased the SOC content of the unprotected cPOC fraction by 60.9% and 61.5% in the 0-20 and 20-40 cm layer, while SOC content was low in the subsoil layers (40-60, 60-80 and 80 -100 cm, respectively) compared with the control (C). The highest OC under MNPK in physically protected micro-aggregates (magg) (6.36 and 6.06 g C kg⁻¹), and occluded particulate organic carbon (iPOC) (1.41 and 1.29 g C kg⁻¹) was found in the topsoil layers. The unprotected cPOC fraction was the greatest C accumulating fraction in the topsoil layers, followed by magg and H-m-Silt fractions in the soil profile, implying that these fractions were the most sensitive to the fertilization treatments. Overall, the unprotected, physically protected, and physico-chemically protected fractions were the dominant fractions that can help to optimize SOC management and sequestration on agricultural soils and support climate change mitigation strategies in China.

Keywords: Climate Change, Carbon Sequestration, Long Term Fertilization, Stabilization Mechanisms.



TAXONOMIC STUDY OF ORDER COLEOPTERA FROM DISTRICT CHARSADDA, KHYBER PAKHTUNKHWA, PAKISTAN

Abul Aala and **Toheed Iqbal**

Department of Entomology

Faculty of Crop Protection Sciences

The University of Agriculture, Peshawar

Corresponding author's email: toheed.iqbal@aup.edu.pk

Abstract

In the year 2018-19, a study was undertaken to investigate the fauna of the order coleoptera in several locations of District Charsadda, Khyber Pakhtunkhwa, Pakistan (Sheikhan, Dosehra, Niseta, Gulabad, Sardheri, Tangi, Utmanzai, and Shabqadar). Beetle specimens were collected using an insect collection net and hand plucking. Carnation specimens were collected and placed in a killing jar using ethyl acetate. To protect the beetles from harm and drying, they were stored in 70% ethanol. Large beetles were pinned directly with a size 2 insect pin, while little specimens were fastened on the card point tips. Klimaszewski and Watt (1997), Choate (2001), Hackston (2019), Ashfaq (2012), Reid (2006), and Naz (2006) were used to identify specimens (2012). Microscope with three lenses For specimen observation, measurements, and photos, a Nikon SMZ 745T was fitted with a Nikon DSFi2 camera. Helicon focus 7.6.6 was used to stitch together layers of photos shot at various focal lengths into a single sharp image. For taxonomic identification, 170 beetle specimens were mounted and examined. Among them 20 genera viz., *Pheropsophus*, *Chlaenius*, *Panagaeus*, *Scarites*, *Calosoma*, *Limodromus*, *Platyrhopalus*, *Bembidion*, *Onthophagus*, *Copris*, *Cyclocephala*, *Phyllognathus*, *Anomala*, *Zygogramma*, *Entomoscelis*, *Monolepta*, *Coccinella*, *Menochilus*, *Harmonia* and *Illeis* under 14 subfamilies, Brachininae, Harpalinae, Panagaeinae, Scaritinae, Carabinae, Platyninae, Paussinae, Trechinae, Scarabaeinae, Dynastinae, Cetoniinae, Chrysomelinae, Galerucinae and Coccinellinae and 4 families, Carabidae, Scarabaeidae, Chrysomelidae and Coccinellidae were recorded. Ten genera, *Panagaeus*, *Scarites*, *Limodromus*, *Platyrhopalus*, *Cyclocephala*, *Phyllognathus* and *Zygogramma*, *Entomoscelis*, *Monolepta* and *Illeis*, are unique to the fauna of Khyber Pakhtunkhwa province, and four genera, *Panagaeus*, *Limodromus*, *Cyclocephala*, and *Entomoscelis*, are new to Pakistani fauna. For Charsadda, each of the genera documented in this study is a first. Easy-to-observe characteristics are used to create keys to families, subfamilies, and genera. Colored images are used to enhance the taxonomic keys.

Keywords: Coleoptera, Taxonomy, Beetles, New Records, Charsadda.



TAXONOMIC STUDY OF FAMILY CARABIDAE (COLEOPTERA) FROM DISTRICT MOHMAND

Muhammad Nawas and Toheed Iqbal
Department of Entomology
The University of Agriculture, Peshawar
Corresponding author's email: toheed.iqbal@aup.edu.pk

Abstract

During the year 2020, the taxonomic status of *Carabidae* family was studied in the district of Mohmand, Khyber Pakhtunkhwa, Pakistan. Handpicking method was used to collect the specimens of beetles from several locations in the study area. A total of 350 samples were collected. After collection, under a Kyowa, Optical microscope (SDZ-P, Model Japan), the morphological feature of the specimens were examined for identification. *Idiomelas (Egaploa) fulvipes*, *Scarites punctum*, *Scapterus guerini*, *Siagona europaea*, *Platyrhopalus denticornis*, *Chlaenius (Amblygenius) quadricolor*, *Drypta lineola*, *Amara aenea*, *Idiomelas (Egaploa) fulvipes*, *Scarites punctum*, *Scapterus* were identified from the surveyed area. On a Trinocular Microscope, Nikon SMZ, 749T, photographs of the diagnostic characters of identified specimen of beetles were obtained. The specimens are kept in Pakistan's National History Museum in Islamabad (PMNH, Islamabad) and Department of Entomology, The University of Agriculture, Peshawar. The most discernible attributes were used to create identification keys for each subfamily, genus, and species for fauna of district Mohmand, Khyber Pakhtunkhwa.

Keywords: Carabidae, Fauna, Optical Microscope.



ANALYZING THE CLIMATE CHANGE IMPACT AND FARMER'S ADAPTABILITY STRATEGIES IN KHYBER PAKHTUNKHWA, PAKISTAN

Aiman Altaf ¹, Khuram Nawaz Sadozai ¹, Sonia Jan Alam ² and Fida Muhammad ³

¹Department of Agricultural & Applied Economics, The University of Agriculture, Peshawar, Pakistan

²Department of Economics, University of Reading, UK

³IDS The University of Agriculture, Peshawar, Pakistan

*Corresponding author's Email: aimanaltaf069@gmail.com

Abstract

Agriculture sector is deemed as more vulnerable to climate change as its variation can directly affect the crop's productivity. However, climate change impact and farmers adaptation strategies are not appropriately figured-out in Khyber Pakhtunkhwa Province, Pakistan by previous researchers and formed the rationale for this research endeavor. This research has assessed the Climate Change impact on wheat productivity and farmers adaptability strategies. The non-climatic variables such as wheat yield and area under wheat cultivation and climatic variables that include temperature, precipitation and humidity were taken into consideration. The Panel Data of 30 years (1990-2020) about non climatic and climatic variables was obtained from different secondary sources. However, primary data was collected from sampled farmers to assess their climate adoptability strategies. Econometric diagnostic tests were encompassed to confirm the validity of the data. Chow test was employed to underscore the structural breaks. Fixed Effect Model was adopted as suggested by the estimates of Hausman Test. The salient findings express that temperature has significant but inverse relationship with wheat productivity. This implies that by soaring one Celsius degree Centigrade ($^{\circ}\text{C}$) temperature can plunge down the wheat productivity by 0.074 percent. Similarly, the association of precipitation was also observed negative with wheat. Contrary to this, humidity is reported as positively associated with wheat productivity. This research study concludes the substantial association of climate change with wheat crop, whereas, farmers had less awareness about the adoptability strategies. Most of the farmers have less knowledge about the climate change adoptability strategies for their crops that can result in reduction of crop productivity. It is recommended that high temperature resistant wheat varieties may be provided to farmers and disseminate the exalted adaptation strategies with respect to climate change to overhaul their existing crop management practices.

Keywords: Climate Change, Crop Productivity, Wheat, Fixed Effect Model, Temperature.



A CROSS-BORDER AND NATIONAL COOPERATION FOR SUSTAINABLE COOLING SOLUTIONS FOR MARGINALIZED COMMUNITIES IN PAKISTAN

Dr. Sadaf Mahmood^{1*}, Dr. Muhammad Atif¹, Dr. Madiha Naz¹, Mr. Muhammad Moazzam Mahmood¹

University of Agriculture Faisalabad

*Corresponding author's Email: drsadaf.mahmood@uaf.edu.pk

Abstract

Pakistan is becoming more vulnerable to climate change, including rising temperatures, floods, heatwaves, melting glaciers, and many other. Climate change intensifies high heat occurrences throughout Pakistan. Due to environmental and sociocultural factors, marginalized communities are disproportionately exposed to thermal stress, especially those working in informal labor, outdoor activities, agriculture, and other household activities that are directly affected by heat. A Cross-border and regional cooperation is required for Sustainable Cooling Solutions for marginalized communities in Pakistan. An international project sponsored by the UKRI is presented in this document, in which cross-border and national cooperation are involved. The project is mainly focusing on SDGs 7 and 13, whereas SDGs 3, 5, 9 & 11 are also considered. The project's goal is to ensure that heat-vulnerable regions and communities have fair access to sustainable, energy-efficient cooling solutions. This study investigates the gendered experiences as well as marginalized community experiences of heat stress, community perceptions of cooling needs, and obstacles to adaptive technologies. The significant gaps in health risk awareness, access to reasonably priced cooling, and the inclusion of underrepresented voices in climate adaptation plans are observed. The study makes the case that sustainable cooling is a social justice issue that is intricately linked to gender, affordability, and community involvement. In order to increase resilience against rising temperatures, it advocates for integrated strategies that give local knowledge systems, gender-responsive design, and community-driven solutions first priority. Within the larger S2Cool framework, the findings are intended to inform transboundary knowledge-sharing as well as national policy, along with affordable cooling solutions for the marginalized communities residing in the country.



IRON NANOPARTICLE-INDUCED MODULATION OF SALINITY TOLERANCE IN *CAPSICUM ANNUUM* L.

Naila Hadayat*, Mehwish Kouser, Aeysha Sultan

Department of Botany, Division of Science and Technology, University of Education,
Lahore

Corresponding author Email: nailahadayat@gmail.com

Abstract

Salinity is a growing global concern, with salinized areas expanding steadily due to both natural processes and human activities. In Pakistan, soil salinization has become a major constraint, leading to significant declines in crop productivity. Micronutrients delivered in the form of nanoparticles (NPs) are emerging as innovative bio-stimulants that enhance plant growth and stress tolerance. Among various synthesis methods, green synthesis of nanoparticles offers an eco-friendly and cost-effective alternative, aligning with sustainable agricultural practices. Therefore, the current experiment was carried out to analyze the impact of iron oxide nanoparticles on growth and yield of *Capsicum annuum* L. FeO-NPs were synthesized using cucumber peel extract and characterized using DLS, UV-visible spectroscopy, FTIR, XRD and SEM. The pot experiment was laid out in completely randomized design (CRD) comprising of four levels of NaCl (0, 50, 100, 150 mM) and three concentrations of iron oxide nanoparticles (100, 200 ppm, 300 ppm) alone and in combinations as treatments. The results indicated a gradual decrease in growth (shoot and root length, shoot and root fresh and dry weight, as well as no. of leaves/plant), biochemical parameters (photosynthetic pigments, total soluble protein and total soluble sugars content) and yield (fruit length, fruit diameter, number of fruits/plant and weight of fruit/plant) of chillies with increasing levels of salt. The highest decrease was recorded at 150mM salinity level. However, foliar application of FeO-NPs improved all the above mentioned growth, biochemical and yield parameters when applied alone and in combination. In addition, FeO-NPs reduced the oxidative stress by increasing antioxidants and reducing MDA and H₂O₂. So, it was concluded that the application of FeO-NPs has the potential to mitigate salinity stress in chillies. Further field study is necessary to confirm the consistency, environmental safety, and economic feasibility of FeO-NPs application on a broader scale, even though the results under controlled conditions are encouraging.



SUSTAINABLE FOOD PRESERVATION TECHNOLOGIES FOR MOUNTAINOUS REGIONS ENHANCING RYING, FERMENTATION, AND COLD STORAGE TO REDUCE WASTE

Iftikhar Aziz and Dr. Noor ul Amin

Department of Food Science and Technology, The University of Agriculture Swat

Corresponding author Email: iftikharaziz@uoas.edu.pk

Abstract

In this study food waste in remote mountainous regions remains a critical challenge due to limited access to modern preservation technologies, harsh climatic conditions and logistical constraints. This study explores sustainable and adoptive food preservation techniques drying fermentation and cold storage tailored for high altitude communities to minimize post-harvest losses and enhance food security. Traditional methods often inefficient or energy intensive prompting the need for innovations that integrate local knowledge with low cost, eco-friendly solutions. The research evaluates the effectiveness of improved solar drying controlled fermentation processes, and passive/evaporative cooling systems under mountainous conditions. Field experiments and case studies assess the scalability viability of these technologies preliminary findings suggest that hybrid drying system, bio fermentation enhancement, and modular cold storage unit can significantly reduce spoilage while maintaining nutritional quality. By bridging indigenous practices with technological advancements, this study provides actionable insights for policymakers NGOs, and local stakeholders to implement sustainable food preservation systems in fragile mountainous ecosystems.

Keywords: Food Preservation, post-harvest losses mountainous regions, solar drying, fermentations, passive cooling, sustainability.



CROSS BORDER CONFLICT OR COOPERATION? A STUDY OF THE INDUS WATERS TREATY AND ITS RELEVANCE TO MOUNTAIN WATERSHED MANAGEMENT AND DRR

Alia Javed *, Sakinabibi Misbah Saeed

Department of Botany, University of Agriculture Faisalabad

Corresponding author Email: aliajaved@uaf.edu.pk

Abstract

This study critically examines cross-border conflict and collaboration through the prism of the Indus Waters Treaty (IWT, 1960), and evaluates its significance to mountain watershed management and disaster risk reduction (DRR) in the Upper Indus Basin. The IWT, brokered by the World Bank, allocates the three eastern tributaries (Ravi, Beas, Sutlej) to India and the western tributaries (Indus, Chenab, Jhelum) to Pakistan, reflecting largely stable hydrologic assumptions at design time. Despite decades of political conflict, India's suspension of the treaty in April 2025 due to a terrorist attack in Kashmir has highlighted its fragility and prompted concerns about water security and regional stability. Climate-driven glacier retreat, increased flood-drought variability, and changing sediment dynamics in Himalayan rivers disrupt the Treaty's foundational assumptions, exposing critical gaps in transboundary early warning systems and ecological flow maintenance. Shortcomings include the absence of glacier-monitoring methods, cross-border flood forecasting, groundwater governance, and adaptation to changing morphological dynamics of the river system. The paper suggests integrating mountain watershed management methods into the treaty framework, focusing on localized glacier-lake outburst flood (GLOF) monitoring, nature-based watershed restoration, and community-based flood early warning systems that relate with Sendai Framework principles. Such integration could enhance resilience, support ecological integrity, and encourage shared hydrological data exchange. In conclusion, while the IWT is still a significant example of long-term water-sharing diplomacy, its relevance to current DRR and mountain-hydrology concerns is dependent on its adaptation. Including climate-aware, ecosystem-based, and community-engaged watershed governance to the Treaty can improve transboundary interaction, reduce disaster risks, and strengthen its role in sustainable mountain basin management.



PROSPECTS OF GROWING KIWI FRUIT AS DIVERSIFIED FRUIT CROP IN THE MID HILLS OF NORTHERN PARTS OF KHYBER PAKHTUNKHWA

Dr. Fayaz Ahmad, Principal Scientific Officer (Horticulture)
PARC-National Tea and High Value Crops Research Institute, Mansehra

*Corresponding author's Email: fayazahmad@parc.gov.pk

Abstract

Fruit diversification is a crucial adaptation strategy for mountain communities facing the climate change challenges. Kiwifruit cultivation plays a significant role in crop diversification and can be integrated into diverse farming systems by offering farmers a profitable alternative crop with high market value, relatively stable income source and contributing to nutritional security by making it a healthy addition to the human diet. The research findings of PARC-NTHRI Shinkiari Scientists reveal that areas under temperate climate in Malakand and Hazara Divisions of Khyber Pakhtunkhwa possess immense potentials for profitable and sustainable growing of kiwifruit, which had been a recent introduction in the area. Technologies developed by PARC-NTHRI Shinkiari for the efficient propagation of kiwifruit nursery plants and kiwifruit orchard management under the local conditions, coupled with availability of promising kiwifruit varieties i.e *Hayward*, *Hongyang*, *Bruno*, *Allison*, *Arguta*, *Hort. 16A* and *Farinosa* with different sequential ripening periods, supports the upscaling of kiwifruit cultivation in the suitable mountain ecologies of Khyber Pakhtunkhwa. PARC-NTHRI, Shinkiari, Mansehra has conducted kiwifruit adoptability trials in various ecologies of Mansehra, Shangla, Swat and Gilgit and the performance evaluation depicts good prospects for commercial cultivation of kiwifruit in these areas.



EFFECT OF PHOSPHORUS AND SULFUR ON THE YIELD AND NUTRIENTS UPTAKE OF WHEAT

Khitab Ullah* and Mohammad Jamal khan

Department Soil and Environmental Sciences

The University of Agriculture Swat, Pakistan

*Corresponding author's Email: khitabkhan@uoas.edu.pk

Abstract

A field experiment was conducted to study the effect of phosphorus and sulfur on the yield and nutrients uptake of wheat at New Developmental Research Farm (NDF) Malakandher, University of Agriculture, Peshawar in Rabi season during 2011-2012. The experiment was laid out in randomized complete block design (RCBD) with three replications. Phosphorus was applied at the rate of 60, 90 and 120 kg ha⁻¹ as DAP whereas sulfur was applied at the rate of 45, 60 and 75 kg ha⁻¹ as ammonium sulphat along with control (no fertilizer) and a treatment of just N and K as basal dose (120 + 60 kg ha⁻¹). The results showed that biological yield increased significantly ($p \leq 0.05$) over control when P and S were applied at the rate of 90-45 kg ha⁻¹ whereas significantly higher grain yield was recorded in treatment receiving 120 kg P and 45 kg S along with a basal dose of N and K, Significantly highest straw yield of 4245 kg ha⁻¹ was noted in treatment receiving 90 kg P along with 45 kg S ha⁻¹. The soil samples collected at anthesis stage and post-harvest stage showed that the P and S contents were significantly affected and the higher values were noted in plot receiving the maximum level of the respective fertilizer i.e P and S but the trend of increase was not consistent with respect to the amount of P and S applied. The P and S content in leaves indicated that higher level of S (75 kg ha⁻¹) resulted in significantly low uptake of P and vice versa indicating their antagonistic effect with each other. This antagonistic effect was displayed in the yield whereby maximum grain yield was obtained where higher dose of P along with lower level of S was applied.

Keywords: Phosphorus; Sulfur; yield; Nutrients Uptake; Antagonistic effect.



LEGUME/GRASS INTERCROPPING AT LOW NITROGEN INPUT: A CLEANER STRATEGY FOR ACHIEVING THE DUAL GOALS OF HIGH-QUALITY FORAGE PRODUCTIVITY AND LOWER ENVIRONMENTAL FOOTPRINTS IN ARID REGIONS

Muhammad Kamran, Min Zhang, Qianmin Jia, Misbahullah, Fujiang Hou
State Key Laboratory of Herbage Improvement and Grassland Agro-ecosystems, Key Laboratory of Grassland Livestock Industry Innovation, Ministry of Agriculture and Rural Affairs, College of Pastoral Agriculture Science and Technology, Lanzhou University, Lanzhou 730020, China

Department of Entomology, The University of Agriculture Swat

*Corresponding author's Email: drkamran2017@nwsuaf.edu.cn

Abstract

Agriculture in the 21st century faces the dual challenges of increasing productivity while mitigating its impact on climate change. Nitrogen fertilizers are indispensable for increasing agricultural productivity, but hasten climate warming through greenhouse gas emissions. This study evaluated the intercropping of grasses (ryegrass, RG; bromegrass, BG) with legume pastures (alfalfa, AF; cicer milkvetch, CM) under reduced N fertilizer rates of 300 (N300), 225 (N225), 150 (N150), and 75 (N75) kg ha⁻¹. Results showed that reducing N rates from 300 to 75 kg ha⁻¹ decreased forage yield, crude protein (CP), global warming potential (GWP), and greenhouse gas intensity (GHGI) for monocultures; however, elevated contents of acid detergent fiber (ADF) and neutral detergent fiber (NDF). The relative feed value (RFV) and land equivalent ratio (LER) were improved under low N input. On the other hand, a decrease in N rate for legume/grasses intercrops significantly improved the forage yield, nutritional quality, resource use efficiency, and LER (except for CM+RG) while reducing the ADF and NDF contents, GHG emissions, GWP, and GHGI. Overall, AF+RG+BG resulted in the highest forage yield (10488.6 kg ha⁻¹), CP yield (1460.80 kg ha⁻¹), and RFV yield (3521.9 kg ha⁻¹) under N150 treatment. AF+RG+BG achieved the highest LER (1.79) and the lowest GHGI (38.70 kg ha⁻¹), N₂O (1.28 kg ha⁻¹), CH₄ (-0.73 kg ha⁻¹), CO₂ (7.39 t ha⁻¹) emissions, and GWP (319.85 kg ha⁻¹). Thus, AF+RG+BG with low N input can be used as a suitable cultivation strategy to produce high-quality forage while protecting the environment by reducing GHG emissions, GWP, and GHGI.



EFFECT OF BORON ON GROWTH AND SEED YIELD OF PEA CULTIVARS

Izhar Ullah^{1*}, Mithat Direk², Dina Chamidah³

*¹ Centre of Plant Biodiversity and Conservation, University of Peshawar, Peshawar
Pakistan-25120

² Selçuk Üniversitesi, Ziraat Fakültesi, Tarım Ekonomisi Bölümü, Cad. No: 369,
Konya/Türkiye-442130

³ Department of Biology Education, Faculty of Teacher Training and Education,
Universitas Wijaya Kusuma Surabaya, Surabaya, East Java, Indonesia

Corresponding author Email: izharullah@uop.edu.pk

Abstract

An experiment was conducted to know the “Effect of boron on growth and seed yield of pea cultivars” under the agro climatic conditions of Palosi Peshawar at the Horticulture Research Farm, The University of Agriculture Peshawar, during 2022. Experiment was laid out in randomized complete block design with split plot arrangement and replicated three times. The experiment consisted of two factors: First factor was different levels of boron, control, 0.50%, 0.75%, 1.0 %, and boron were added to the main plot, while the other was the pea cultivars Climax, Leena Pak, and Meteor, which were planted in the sub-plot. Different pea cultivars and the foliar application of boron both have a significant impact on pea growth, yield, and seed production. The number of primary branches per plant (13.1), the number of leaves per plant (120.8), the height of the plant (103.5 cm), number of pods per plant (16.6), the length of pod (11.1 cm), the diameter of pod (13.8 mm), number of seeds per pod (10.3), seed yield per plant (160.5), root fresh weight (4.6 g) and the total yield per hectare were all significantly increased by foliar spray of boron. According to the research, foliar application of boron should be applied at a rate of 0.75 % for better growth and production. Pea cultivar Climax should be grown under the agro climatic conditions Peshawar.

Keywords: Boron, Growth and Seed Yield, Pea Cultivars.



HYBRID BRIQUETTING OF LOW-RANK KPK COAL WITH COCKLEBUR BIOMASS: STRENGTH AND THERMAL PERFORMANCE STUDY

Murtaza Zafar * Muddasar Habib

Corresponding author Email: murtazazafar9008@gmail.com

Abstract

The current research work aims at producing hybrid coal-biomass briquettes by mixing low-rank local coal of Khyber Pakhtunkhwa (KPK) province of Pakistan with Cocklebur biomass. The possible increase in biomass ratio in coal and its environmental and combustion behavior was also determined. The present study was conducted to overcome the energy crisis by using available local and underutilized resources instead of importing conventional fuels. Locally available fast-growing invasive biomass Cocklebur, was selected to be mixed with local low-grade KPK coal in different ratios. The biomass and coal mixture was converted into briquettes by natural starch as a binder and was tested by proximate analysis, calorific value, and compressive strength analysis. The biomass ratio of around 35% in coal has shown increased energy output and a substantial decrease in ash content with acceptable mechanical strength. The briquettes with high biomass ratio showed more effective clean combustion with less mechanical durability. The coal biomass briquettes might be an alternative eco-friendly solid fuel with available resources using low-quality fuel coal from the KPK province and biomass instead of importing conventional fuels. They can help minimize fuel-based emission problems and offer an additional opportunity to save the national economy by promoting energy sustainability in rural and industrial areas.

Keywords: Biomass, Coal Briquettes, Cocklebur, KPK Coal, Renewable Energy, Compressive Strength, Calorific Value.



DROUGHT STRESS-MEDIATED TRANSCRIPTOME PROFILE REVEALS NCED AS A KEY PLAYER MODULATING DROUGHT TOLERANCE IN *POPULUS DAVIDIANA*

Sang-Uk Lee¹, Bong-Gyu Mun¹, Eun-Kyung Bae², Jae-Young Kim¹, Hyun-Ho Kim¹,
Muhammad Shahid^{1,3}, Young-Im Choi^{4†}, Adil Hussain^{5*} and Byung-Wook Yun^{1*}

¹ School of Applied Biosciences, Kyungpook National University, Daegu, South Korea,

² Forest Microbiology Division, National Institute of Forest Science, Suwon-si, South Korea,

³ Agriculture Research Institute, Mingora, Swat, Pakistan,

⁴ Forest Biotechnology Division, National Institute of Forest Science, Suwon-si, South Korea,

⁵ Department of Agriculture, Abdul Wali Khan University Mardan, Mardan, Pakistan

Abstract

Populus trichocarpa has been studied as a model poplar species through biomolecular approaches and was the first tree species to be genome sequenced. In this study, we employed a high throughput RNA-sequencing (RNA-seq) mediated leaf transcriptome analysis to investigate the response of four different *Populus davidiana* cultivars to drought stress. Following the RNA-seq, we compared the transcriptome profiles and identified two differentially expressed genes (DEGs) with contrasting expression patterns in the drought-sensitive and tolerant groups, i.e., upregulated in the drought-tolerant *P. davidiana* group but downregulated in the sensitive group. Both these genes encode a 9-cis-epoxycarotenoid dioxygenase (*NCED*), a key enzyme required for abscisic acid (ABA) biosynthesis. The high-performance liquid chromatography (HPLC) measurements showed a significantly higher ABA accumulation in the cultivars of the drought-tolerant group following dehydration. The *Arabidopsis nced3* loss-of-function mutants showed a significantly higher sensitivity to drought stress, ~90% of these plants died after 9 days of drought stress treatment. The real-time PCR analysis of several key genes indicated a strict regulation of drought stress at the transcriptional level in the *P. davidiana* drought-tolerant cultivars. The transgenic *P. davidiana* *NCED3* overexpressing (OE) plants were significantly more tolerant to drought stress as compared with the *NCED* knock-down RNA interference (RNAi) lines. Further, the *NCED* OE plants accumulated a significantly higher quantity of ABA and exhibited strict regulation of drought stress at the transcriptional level. Furthermore, we identified several key differences in the amino acid sequence, predicted structure, and co-factor/ligand binding activity of *NCED3* between drought-tolerant and susceptible *P. davidiana* cultivars. Here, we presented the first evidence of the significant role of *NCED* genes in regulating ABA-dependent drought stress responses in the forest tree *P. davidiana* and uncovered the molecular basis of *NCED3* evolution associated with increased drought tolerance.



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

CRMA-25-94

CENTER FOR CLIMATE RESILIENT MOUNTAIN AGRICULTURE
THE UNIVERSITY OF AGRICULTURE SWAT-PAKISTAN



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

CRMA-25-95

CENTER FOR CLIMATE RESILIENT MOUNTAIN AGRICULTURE
THE UNIVERSITY OF AGRICULTURE SWAT-PAKISTAN



1st International Conference on Climate Resilient Mountain Agriculture CRMA-25
“Innovating Together for Sustainable Livelihood”
August 05-07, 2025

CRMA-25-96

CENTER FOR CLIMATE RESILIENT MOUNTAIN AGRICULTURE
THE UNIVERSITY OF AGRICULTURE SWAT-PAKISTAN