Project Title

Reconstruction of climate pattern in Padder Valley using dendrochronology of *Pinus gerardiana* Wall. Ex D.Don

DETAILED PROGRESS REPORT
(RESEARCH GRANT 2022-23)

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RESULTS:

The study included sample collection from the field and its processing in the laboratory. Therefore, observations were taken both from field and laboratory after proper processing as per the standard operations and procedures in the laboratory. Within this set of samples, one sample, i.e., sample no. 3 was collected from locales exhibiting proximity to human habitation around the forest of the species, while the remaining three samples were acquired from areas distanced from human settlements. Samples 3 and 4 were situated in the eastern aspect whereas Samples 1 and 2 were situated in the western aspect, representing a geographical juxtaposition characterized by a spatial separation from human habitation.

Sample number 1 was obtained from the Gulabgarh, precisely situated at the geocoordinates of 33°13'06.27" N and 76°12'40.16" E. The elevation of the collection site was recorded at 2126 meters above sea level, while the terrain exhibited a slope of 20.97°.

Dendrochronology:

During investigation of the *Pinus gerardiana* tree core samples, each specimen unveils a captivating chronicle of its growth and existence. The first *Pinus gerardiana* tree, represented by Sample 1, has been around 210 years old. Originating in the year 1813, this venerable tree stands as a living witness to nearly two centuries of environmental changes, weather events, and the ever-shifting landscape. The second tree core sample discloses an age of 94 years. Germinated in the soil in 1929, this tree offers a window into the environmental conditions it experienced over the course of the 20th century. At 73 years old, the third sample tree started its growth in 1950, encapsulating a century's worth of environmental influences and weather patterns. Finally, the fourth tree core sample, aged 105 years, showcases the growth history of a tree that sprouted in 1918. Through the intricate patterns of its growth rings, we uncover a detailed account of the *Pinus gerardiana*'s resilience and adaptation to changing conditions across the decades. These wood core samples not only signify the longevity of these trees but also provide a valuable historical record of their interaction with the environment throughout their extended lives.

Dendrochronology of *Pinus gerardiana*: Environmental Insights:

1. **Sample 1 (1813–2023, 210 Rings):**
   o Light portions (1–7 mm): Indicate wet periods and favorable conditions, with 1817 and 1818 showing robust growth.

- o Dark portions (0.25–2 mm): Represent dry periods with slower growth, reflecting environmental stress.

2. **Sample 2 (1929–2023, 94 Rings):**
   - o Light portions (0.5–3 mm): Highlight years of favorable conditions, notably 1997 and 1998 with higher growth rates.
   - o Dark portions (0.25–1 mm): Indicate stress periods, with denser autumn wood suggesting limited resources.
   - o Stable growth observed during 1987–1989, 1991–1993, and 2004–2008 reflects a balanced ecosystem.

3. **Sample 3 (1950–2023, 73 Rings):**
   - o Light portions (1–6 mm): Reflect favorable conditions, especially during 1998–2007 with environmental stability.
   - o Dark portions (0.5–1 mm): Indicate dry periods, suggesting challenges such as limited water and nutrients.

4. **Sample 4 (1918–2023, 106 Rings):**
   - o Light portions (0.25–3.5 mm): Mark wet periods, with heightened growth during 1930–1934, 1940–1944, and 1995–1998.
   - o Dark portions (0.25–1 mm): Highlight dry periods, especially during 1917–1923 and 1926–1931.
   - o Post-1960 climate shows increased wet periods and reduced dry phases, suggesting more complex climatic patterns.

The growth rings of *Pinus gerardiana* reveal significant environmental shifts over time. Prior to 1960, balanced climatic conditions prevailed, but post-1960, a rise in wet periods points to changing climate dynamics in the region.

SUMMARY:

Dendroclimatology is a highly significant study with respect to its applicability in studying climate change. Therefore, it serves unique opportunity to us to study the interconnectedness of trees and climate by the meticulous analysis of tree rings. *Pinus gerardiana* which is commonly known as the Chilgoza pine, holds significant economic importance in the regions where it is found. Exploration of *Pinus gerardiana* growth histories provide a valuable snapshot of the species. A computer program for interactive scientific graphing and data analysis, visual representations in the form of stack column bar graphs were generated. These

graphs served as dynamic depictions of the ring measurements in millimetres across varying time intervals in years. Stack column bar graphs generated not only provided a visually accessible representation of the tree's growth but also facilitated the identification of significant trends and anomalies in past climate.

Examination of past climatic conditions provides critical insights into the species' historical responses to environmental dynamics. This dynamic characteristic highlights the tree's adaptability to changing environmental conditions whereas fluctuations indicate its responses to other factors (climatic variations, resource availability, or other ecological influences) that impact the tree's growth trajectory.

Additionally, this analysis reveals wavering growth rates in different years within each sample. Years with comparatively higher growth rates correspond to favourable conditions and vice versa. Comparative approach offers advantage of identification of common trends as well as unique responses within the samples, contributing to a more comprehensive study. Therefore, this study contributes to the scientific understanding of *Pinus gerardiana* and gives broader perspective on the resilience and adaptability of trees in response vacillating ecological surroundings.
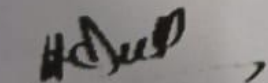
This study significantly contributes to the scientific understanding of *Pinus gerardiana*, offering a broader perspective on the resilience and adaptability of trees in the face of ever-changing ecological surroundings. By unravelling the historical responses of these trees to environmental dynamics, the research provides valuable insights that can enhance our understanding of the intricate interplay between trees and climate. During the current study the oldest tree of about 210 years' age and the youngest of about 73-year-old is sampled from the study area. Since 1950 onwards, wet and dry periods of the year are reduced than before 1950 in the region which indicates the less season variations are prevailing in the current years in the study area. Therefore, it is summarized that the temperate climates are rapidly changing to the tropical conditions wherein the season variation are less profound.
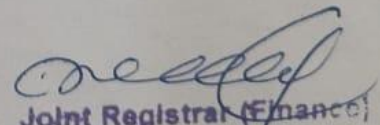
Utilization Certificate

1. **Title of the project:** "Reconstruction of of climate pattern in Padder Valley using dendrochronology of Pinus gerardiana Wall. ex. D. Don".
2. **Sanction Order no.:** RA/23/7244-51dated 23-01-2023.
3. **Name of the PI:** Dr. Harish Chander
4. **Department:** Department of Botany, University of Jammu
5. **Total Project Cost:** Rs. 2,00,000.00
6. **Statement of Expenditure:**

Head	Total grant released	Total expenditure incurred (INR)	Unspent Balance (INR)
Purchase of Minor Equipment	1,10,000.00	1,09,000.00	1,000.00 ✓
Equipment Repair	10,000.00	10,000.00	0.00 ✓
Contingency	10,000.00	10,000.00	0.00 ✓
Field Work	60,000.00	60,000.00	0.00 ✓
Any other item	10,000.00	10,000.00	0.00 ✓
Total	2,00,000.00	1,99,000.00	1,000.00 ✓

Certified that out of **Rs. 2,00,000.00 (Two lakhs only)** of Grant-in-aid, sanctioned vide order no. **RA/23/7244-51dated 23-01-2023** during the year 2023 in favour of Dr. Harish Chander, a sum of **Rs. 1,99,000.00** has been utilized for the purpose of research for which it was sanctioned and that balance of **Rs. 1,000.00** remained unutilised.

Signature
Assistant Prof.
PI Dept. of Botany
University of Jammu
JAMMU

Deputy Registrar (Grants)
University of Jammu
Signature
Deputy Registrar

Joint Registrar (Finance)
University of Jammu
Signature
Joint Registrar