International Journal of Plant & Soil Science

Volume 38, Issue 4, Page 194-209, 2026; Article no.IJPSS.155575
ISSN: 2320-7035

Assessment of Farmers Knowledge and Adoption of Pea Cultivation Aspects in Ten Panchayats Seraj Valley, Mandi District, Himachal Pradesh, India

Rajeev Kumar [a*], Aanchal Chauhan [b], Reena Kumari [b], Priyanka Thakur [b] and Neha Thakur [a]

[a] College of Horticulture and Forestry, Thunag at Gohar (Gudhari) Mandi H.P. 175028, India.
[b] College of Horticulture, Nauni, Solan H.P. 173230, India.

Authors' contributions

This work was carried out in collaboration among all authors. Author RK designed the study and wrote the first draft of the manuscript. Authors AC and RK managed the analyses of the study. Authors PT and NT managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/ijpss/2026/v38i46041

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://pr.sdiarticle5.com/review-history/155575

Original Research Article

Received: 02/02/2026
Published: 11/04/2026

Abstract

Assessing the knowledge level of farmers and identifying their specific training needs are essential steps for designing effective agricultural extension programs. A needs-based approach not only to ensures relevance and responsiveness but also enhances farmer participation and technology adoption. A comprehensive field survey was conducted across ten selected panchayats in the Seraj Valley of Mandi District, Himachal Pradesh, to assess farmers' knowledge, practices and challenges related to pea cultivation and associated agricultural components. The study focused on various parameters, including farmer categories, field preparation methods, varietal usage, seed rate, seed treatment, fertilizer and irrigation practices, weed and

**Corresponding author: E-mail: rajeev8226@gmail.com;*

Cite as: *Kumar, R., Chauhan, A., Kumari, R., Thakur, P., & Thakur, N. (2026). Assessment of Farmers Knowledge and Adoption of Pea Cultivation Aspects in Ten Panchayats Seraj Valley, Mandi District, Himachal Pradesh, India. International Journal of Plant & Soil Science, 38(4), 194–209. https://doi.org/10.9734/ijpss/2026/v38i46041*

disease management, spacing knowledge, yield, income levels, crop rotation and perceptions of climate change. Results revealed a predominance of marginal farmers in all locations, with Thunag and Shilli Baggi comprising entirely of marginal landholders, reflecting the fragmented hill farming system. Traditional field preparation methods still dominate in remote areas, while modern mechanization was observed in more accessible regions like Thunag and Chatri. Varietal adoption showed wide variation; Dhim Kataru recorded the highest usage of recommended varieties (48%), whereas Shilli Baggi and Thunag lagged. Encouragingly, many panchayats reported medium to high compliance with recommended seed rates. However, seed treatment remained notably low across villages, indicating major gaps in awareness or access to inputs. Fertilizer knowledge was high in some villages but alarmingly low in others, like Thana and Bagra Thach, pointing to uneven extension coverage. Spacing and weed management also reflected similar disparities, while disease management knowledge was generally limited, except in a few panchayats. Yield and income levels were closely linked, with low productivity corresponding to low earnings in most villages. Crop rotation was widely adopted, except in Chiuni, while irrigation access remained a significant limiting factor for productivity. Awareness of climate change was highest in Thunag and Dhim Kataru, but remained poor or unacknowledged in others. These findings highlight the need for location-specific interventions, targeted extension services, and improved access to resources to enhance the productivity and resilience of hill agriculture in the region. The findings call for a comprehensive and location-specific approach focusing on capacity building, improved input delivery, demonstration of best practices, and climate-resilient technologies. Strengthening local extension systems and ensuring equitable resource access can significantly enhance the livelihoods and resilience of small and marginal farmers in the Seraj Valley.

Keywords: Socio-Economic Survey; panchayats; climate change; disease management; Pea Cultivation.

1. Introduction

The spread of modern agricultural practices has not been uniform across different regions of India. A larger adoption gap leads to lower utilisation of research-based recommendations, which in turn results in reduced agricultural productivity. The issue of low productivity remains a major concern for extension agencies. Among the various factors contributing to low yields, the adoption gap stands out as one of the most critical (Imoro et al., 2026). Pea (*Pisum sativum* L.) is an important leguminous vegetable crop widely cultivated in temperate and sub-temperate regions of India, especially in the hill states like Himachal Pradesh. It plays a crucial role in the agrarian economy by contributing to both nutritional security and farm income. In the high-hill areas such as the Seraj Valley in Mandi district, peas are a preferred crop due to favorable agro-climatic conditions, relatively short growing duration, and high market value. Peas continue to play an essential role in current agriculture as a nitrogen-fixing crop alongside grains. Peas play an essential part in both human nutrition and the Indian national economy. Peas have been farmed in India for decades and are well-adapted to the climate. There are several different local and exotic kinds available. The majority of the exotic types were introduced to India and employed as market varieties. Genetic diversity within the genus Pisum has resulted in a wide range of crop applications. Dry peas are used to feed animals as well as for humans to consume in soups and processed foods (Anurag et al., 2024).

However, despite the region's natural advantages, productivity remains below potential due to multiple constraints. These include traditional farming practices, limited awareness of improved agronomic techniques, poor pest and disease management and lack of scientific knowledge on input use and post-harvest handling. Poor knowledge as well as a reluctant attitude of farmers in adopting the new technology, could be another cause of low productivity (Tiwari and Tiwari, 2013). The situation is further compounded by inadequate access to extension services and training opportunities tailored to local needs (Rawal and Ansari, 2019).

Assessing the knowledge level of farmers and identifying their specific training needs are essential steps for designing effective agricultural extension programs. A needs-based approach not only ensures relevance and responsiveness but also enhances farmer participation and technology adoption. In this context, the present study was undertaken to assess the knowledge and training needs related to pea cultivation among farmers across ten selected panchayats of the Seraj Valley. The findings aim to inform extension functionaries,

policymakers, and researchers for targeted capacity building, ultimately contributing to increased productivity and sustainable agricultural development in the region.

2. Methodology

A structured questionnaire was designed to assess the socio-economic status, knowledge level on production practices, and their experiences linked to climate change by the farmers in the Seraj valley of Mandi district, Himachal Pradesh.

The study was conducted in Two consecutive years i.e., 2021-2022, five panchayats viz. Bagga Chanogi, Chatri, Shikawri, Thana, and Tunga Dhar were selected. In 2022, five additional panchayats viz. Bagra Thach, Chiuni, Dhim Kataru, Thunag, and Shilli Baggi were Studied. A total of 25 farmers from each panchayat were selected using a random sampling technique, resulting in a sample size of 250 respondents for the entire study.

The questionnaire covered various aspects of the socioeconomic survey, pea production technology aspect survey, climate change experience survey. The details of head wise survey is given below.

2.1 Socio-economic Survey

Under this category, a survey was conducted on farmers' land holding and preparatory cultivation practices. The details of the socio-economic survey is given in Table 1

Table 1. Details of Socio-economic Survey

Sr. No.	Socio-economic Aspect	Categorization
1	Farmers Categorization	Farmers were categorized into four categories marginal (less than 1 ha.) small (1-2 ha.), large (more than 2 ha.) and did not respond to question.
2	Preparatory cultivation	It was indirect assessment of farmers economic status and their assess to Government subsidy on power tiller. It is categorized into four categories viz. traditional method of cultivation with bullocks, modern method with power tillers, both traditional as well as modern and did not respond to question.

2.2 Pea Production Technology Aspect Survey

The survey is based on the aspects like knowledge level on recommended varieties/ use of recommended varieties, seed rate, seed treatment, fertilizer application, irrigation practices, weed management, disease management, yield and income level and crop rotation. The details of pea production aspect survey is given in Table 2.

Table 2. Details of Pea Production Technology Aspect Survey

Sr. No.	Socio-economic Aspect	Categorization
1	Knowledge level on recommended varieties/use of recommended varieties	Farmers were categorized into four categories viz. use of recommended varieties (high level of knowledge) use of non-recommended varieties (low level of knowledge) and use of both recommended and non-recommended varieties (medium level of knowledge) and did not respond to question.
2	Seed Rate	Knowledge level of farmers were categorized into four categories viz. low (wide variation from recommended) medium (close to recommended dose), high (exactly recommended dose) and did not respond to question.
3	Seed Treatment	It was categorized under three categories either farmers practice, do not practice or did not respond to the question.
4	Fertilizer Application	Knowledge level on fertilizer application was categorized under four categories low (no knowledge on fertilizer application), medium (partial knowledge on fertilizer application), high (complete knowledge on fertilizer application) and did not respond to question.

Sr. No.	Socio-economic Aspect	Categorization
5	Irrigation Practices	Irrigation practices followed in the region were categorized into three categories rather rainfed, irrigated or did not respond to question.
6	Weed management	Knowledge level on weed management was categorized into four categories low (following manual weed management practice), medium (management with herbicides only), high (use of herbicide as well as manual practice) and did not respond to question.
7	Disease and Pest Management	Knowledge level on disease and pest management were categorized into four categories low (no knowledge on disease/pest and their control), medium (partial knowledge on disease/pest and their control), high (complete knowledge on disease/pest and their control) and did not respond to question.
8	Yield and Income Level	Both the yield and income levels were categorized into four categories Low (Yield: 5-7 q/bigha Income: < Rs. 25,000), Medium (Yield: 7-10 q/ha Income: Rs. 25,000-40,000), High (Yield: > 10 q/ha Income: >Rs.40,000) and did not respond for both yield and income.
9	Crop Rotation	Farmers were categorized under three categories viz. practice, do not practice and did not respond to the question. It was based on the question earlier or after crop in the same field of Pea

2.3 Climate Change Experience Survey

Following the needs assessment, targeted training programs and demonstrations were planned in the selected panchayats to address the identified knowledge gaps.

Table 3. Detail of Climate Change Experience Survey

Sr. No.	Socio-economic Aspect	Categorization
1	Climate Change	Farmers were categorized under three categories rather they experienced, not experienced and did not respond to the question. It was an indirect question on sowing time ten years back and at the time of survey. Same sowing time lead to conclusion not experienced climate change and change in sowing time lead to conclusion experienced climate change.

3. Results and Discussion

The data presented in Figs. (1-10 & 12-13) and Fig. 11 reveals considerable variation in socio-economic survey, pea production technology aspect survey and climate change experience survey across different Panchayats. The headwise detail description is given below.

3.1 Socio-economic Survey

Under socio-economic survey, two aspects were covered viz. categorization of farmers based on the land holding and field preparationary practices.

3.1.1 Farmers Category

The Fig. 1 illustrates the randomly selected respondents, farmers across ten selected panchayats in the Seraj Valley of Mandi district, Himachal Pradesh and were categorized under marginal farmers, small farmers, large farmers and non-respondents depending upon their land holding and response to the question. The data highlights a clear predominance of marginal farmers in all panchayats, with the highest numbers observed in Thunag and Shilli Baggi (100%), followed closely by Dhim Kataru and Bagra Thach.

Small farmers were present in very limited numbers, with minor representation in Shikawri, Tunga Dhar, Chiuni, and Dhim Kataru. No large farmers were recorded in any of the surveyed panchayats, indicating the

prevalence of small landholdings in the region. This aligns with the agricultural census data of GOI, 2016, which shows that the highest percentage share in the marginal category (68.5%) followed by small (17.6%), semi-medium (9.6%), medium (3.8%) and large category (0.6%).

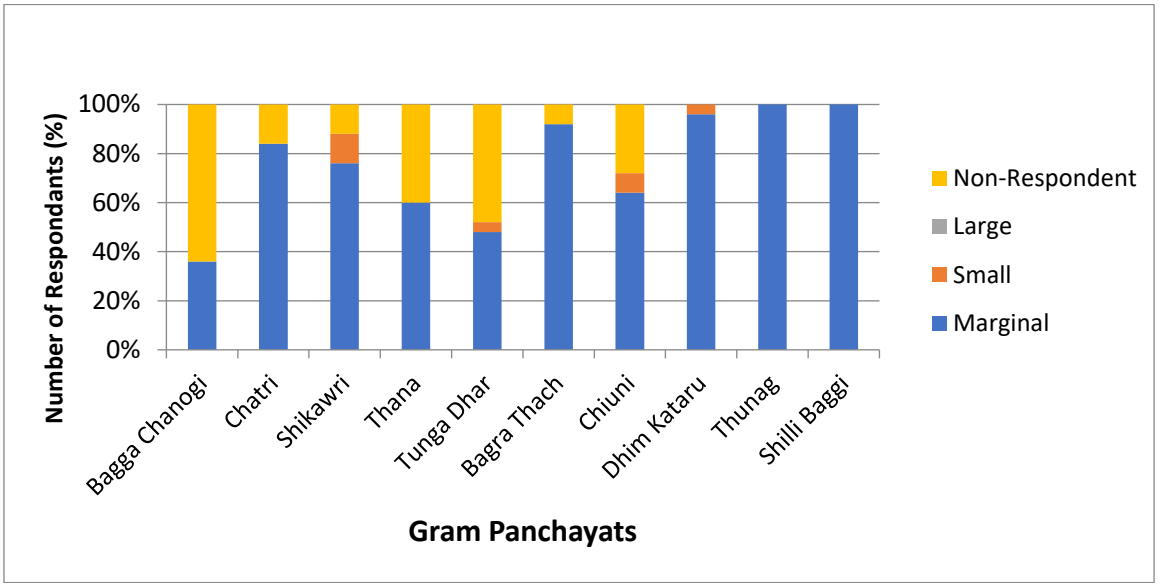

Fig. 1. Respondent Farmer Category (%) in Different Panchayats

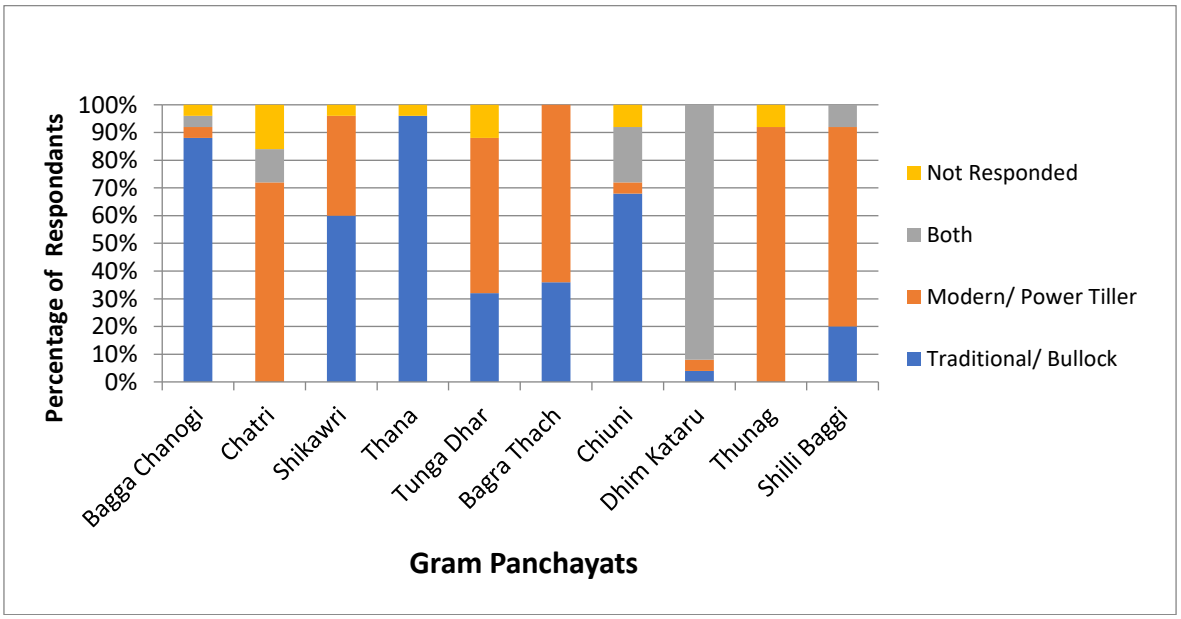

Fig. 2. Field Preparation Methods Used by Farmers in Different Panchayats

The "Not Responded" category was significantly higher in Bagga Chanogi, where 64% of the selected farmers did not participate, followed by Thana, Tunga Dhar, and Chiuni, which may reflect barriers such as migration, low awareness, or hesitation to participate in formal assessments. Some panchayats, such as Dhim Kataru, Thunag and Shilli Baggi had full participation with no non-respondents.

This data suggests a need for focused extension efforts and training programs targeting marginal farmers, who form the backbone of vegetable cultivation in the region. The variation in response rates also indicates the need for improved farmer engagement strategies in certain panchayats. These findings support the need for

customized interventions to improve productivity and climate resilience among the primary farming population in the Seraj Valley.

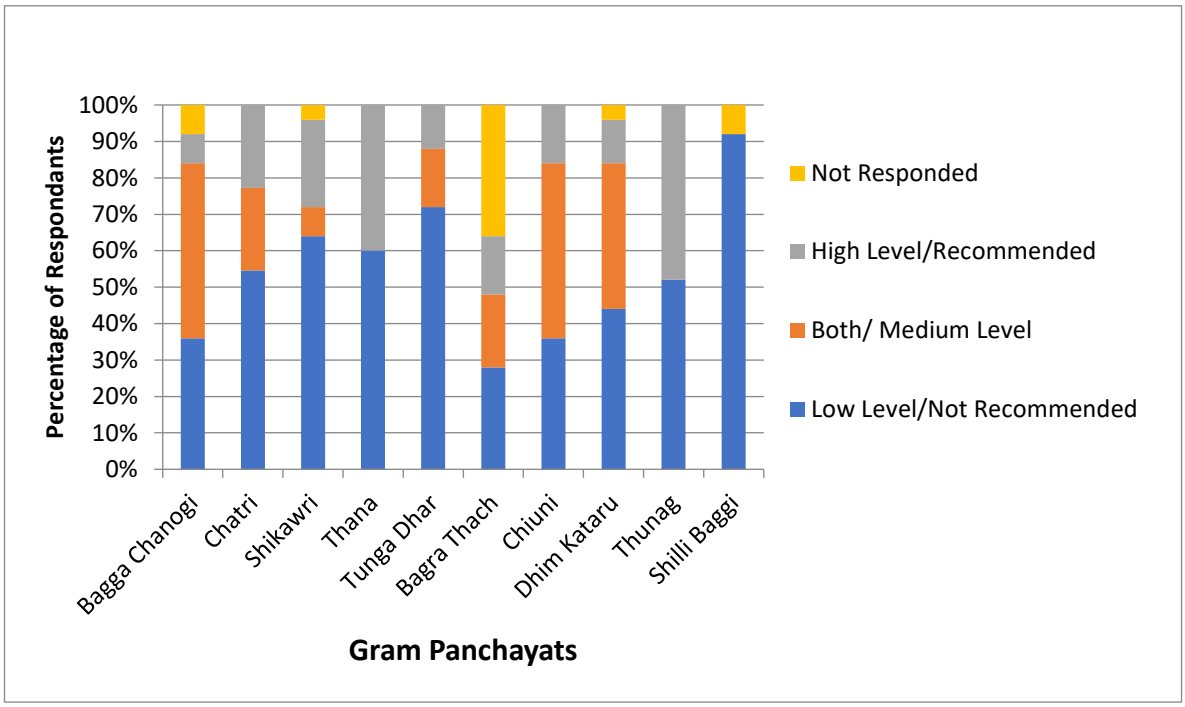

Fig. 3. Recommended Variety Use Knowledge Level %

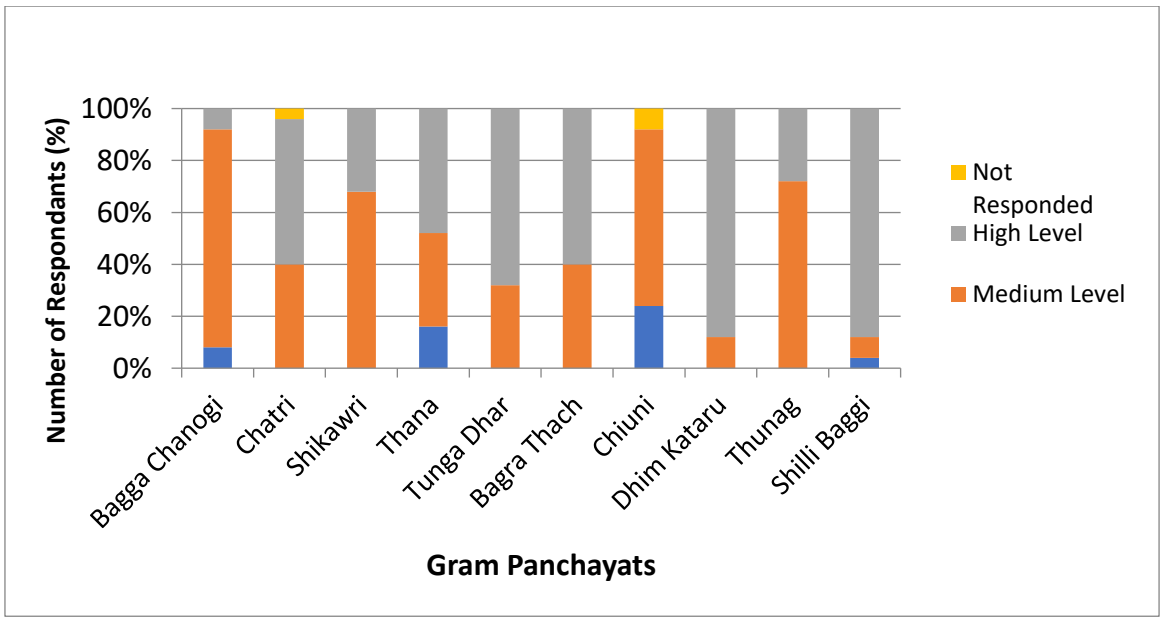

Fig. 4. Farmers Seed Rate Knowledge Level % in Different Panchayats

3.1.2 Field Preparationary Practices

The Fig. 2 illustrates the distribution of field preparation methods adopted by farmers across ten panchayats in the Seraj Valley of Mandi district, Himachal Pradesh. The methods include: Traditional Method (Bullock-

driven), Modern Method (Power Tillers), Both Traditional and Modern. Farmers reluctant to respond to the question were categorised as not responding.

A significant number of farmers in Bagga Chanogi (88%), Thana (96%) and Chiuni (68%) rely predominantly on traditional bullock-drawn field preparation. This reflects the continued dependence on animal-based agriculture in the hill regions, due to the limited accessibility and affordability of mechanization.

Use of modern methods is highest in Thunag (92%), Shilli Baggi (72%) and Chatri (72%), indicating growing adoption of mechanized tools. During the last five decades, India has made considerable progress in farm mechanization and it helped in saving of inputs, increased cropping intensity, and reduced the cost of operation (Mehta et al., 2023).

Farmers in Dhim Kataru (92%) and Chiuni (20%) report using both traditional and modern methods, suggesting a transitional phase in these areas where farmers are balancing traditional wisdom with new technologies.

Notable non-response rates were recorded in Bagga Chanogi (4%), Chatri (16%) and Tunga Dhar (12%), which may reflect communication gaps, disinterest, or lack of clarity among respondents.

The data suggests a gradual but significant shift towards mechanization, especially in accessible panchayats. However, traditional practices still dominate in less developed or remote areas. The dual-method usage in some panchayats reflects adaptability and openness to new practices. These insights underline the importance of targeted training and demonstration programs**,** tailored to the mechanization readiness of each panchayat.

3.2 Pea Production Technology Aspect Survey:

Under this category survey on aspects like knowledge level on recommended varieties/ use of recommended varieties, seed rate, seed treatment, fertilizer application, irrigation practices, weed management, disease management, yield, income and crop rotation.

3.2.1 Knowledge Level on Recommended Varieties/ Use of Recommended Varieties

Dhim Kataru exhibits the highest adoption of recommended varieties, with 48% of respondents reported use of recommended varieties. This suggests the area has favorable awareness, access, and environmental compatibility for improved varieties, positioning it as a promising Panchayat for scaling up successful varietal interventions. Similarly, Shikawri (40%) and Chatri (24%) show moderate levels of high-use adoption, likely indicating moderate exposure to extension services and seed distribution systems.

On the other hand, Shilli Baggi presents a concerning scenario, with 92% of respondents using low-level or non-recommended varieties. This may reflect poor varietal suitability, environmental constraints or limited access to quality seeds (Ali & Gupta, 2012). The situation is comparable in Thunag (92%) and Thana (72%), where a high proportion of low-level usage points to significant gaps in varietal awareness, farmer training or local adaptability.

Additionally, Tunga Dhar has a 36% non-response rate, which could point to issues in data collection, lack of interest, or limited community engagement or knowledge regarding varietal practices.

3.2.2 Seed Rate

Most Panchayats Bagga Chanogi, Chatri, Shikawri, Bagra Thach and Thunag reported the highest values under the Medium Level category, indicating a considerable number of farmers in these locations are using seed rates that are close to the agronomically recommended dose. This suggests a positive trend toward informed decision-making and local adaptation.

In contrast, Tunga Dhar, Shilli Baggi, and Dhim Kataru have high values in the High Level category, representing exact adherence to recommended seed rates. This indicates effective knowledge dissemination and likely access to quality extension services.

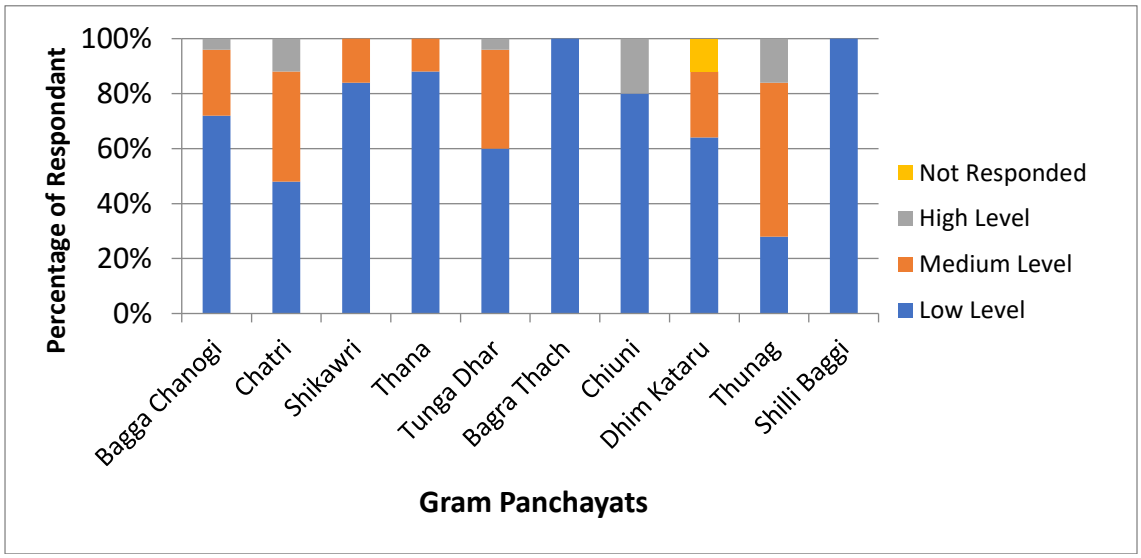

Fig. 5. Farmers Seed Treatment Knowledge Level % in Different Panchayats

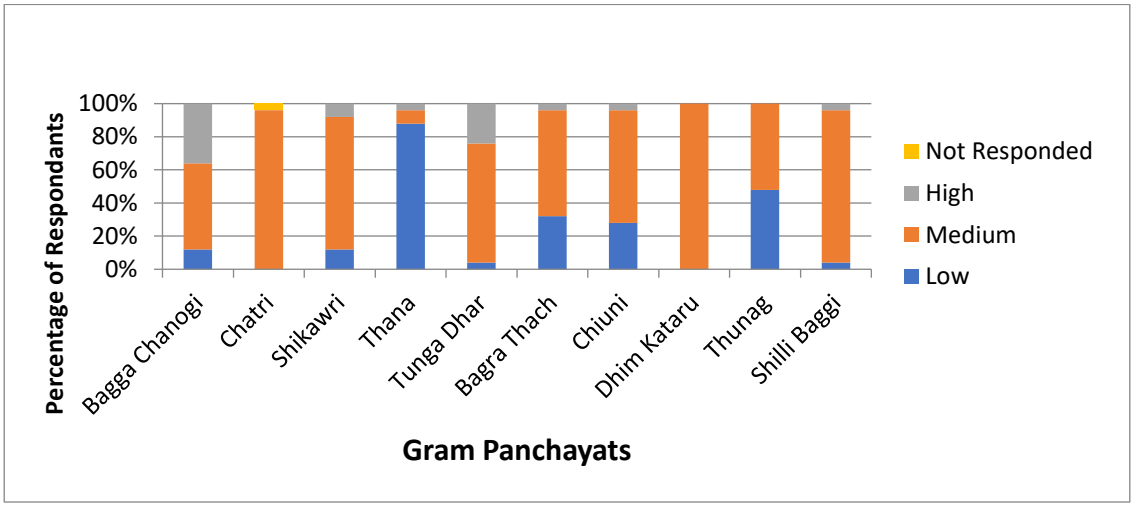

Fig. 6. Farmers Fertilizer Application Knowledge Level (%) in Different Panchayat

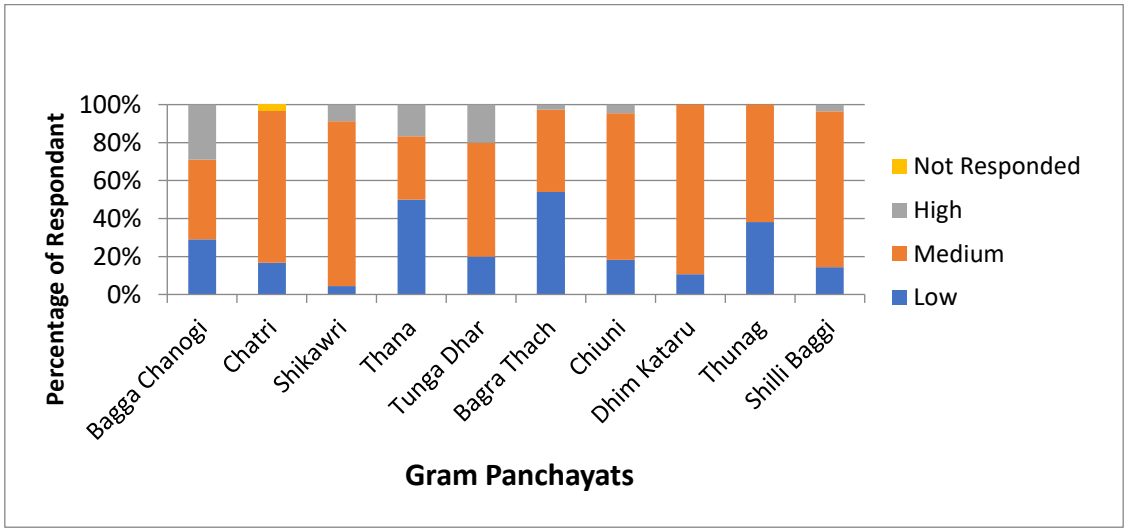

Fig. 7. Farmers knowledge Level on Spacing in Different Panchayats

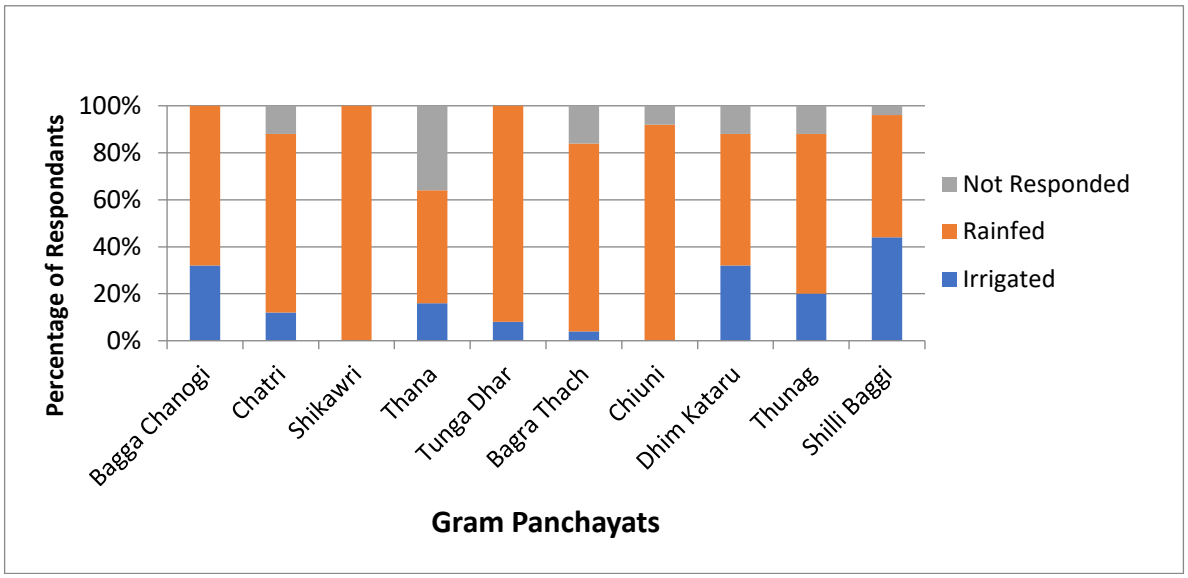

Fig. 8. Irrigation Practices in Different Panchayats

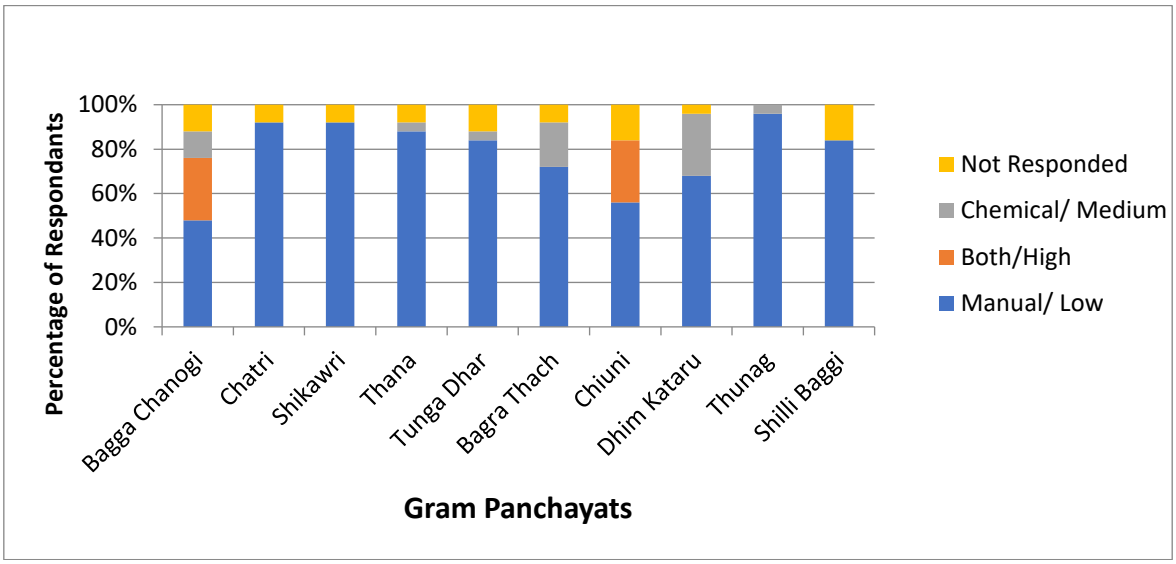

Fig. 9. Farmers Weed Management knowledge level in Different Panchayats

Shikawri, Bagra Thach, and Dhim Kataru showed zero values under the low level category, which is encouraging as it reflects that no farmers are applying seed rates that are far from the recommended dosage.

Not responded values are mostly negligible, highlighting high survey response reliability. However, Chatri (4.00%) and Dhim Kataru (8.00%) did record some non-responses, which might be attributed to seasonal migration, absence during the survey period, or hesitancy in sharing information issues often noted in participatory rural appraisals in hill regions.

3.2.3 Seed Treatment

Most Panchayats, especially Bagra Thach, Shilli Baggi, Thana, and Shikawri, report over 80% seed treatment under Low-Level. This suggests limited use of scientifically recommended seed treatment methods like fungicides, bio-agents, or micronutrient coating.

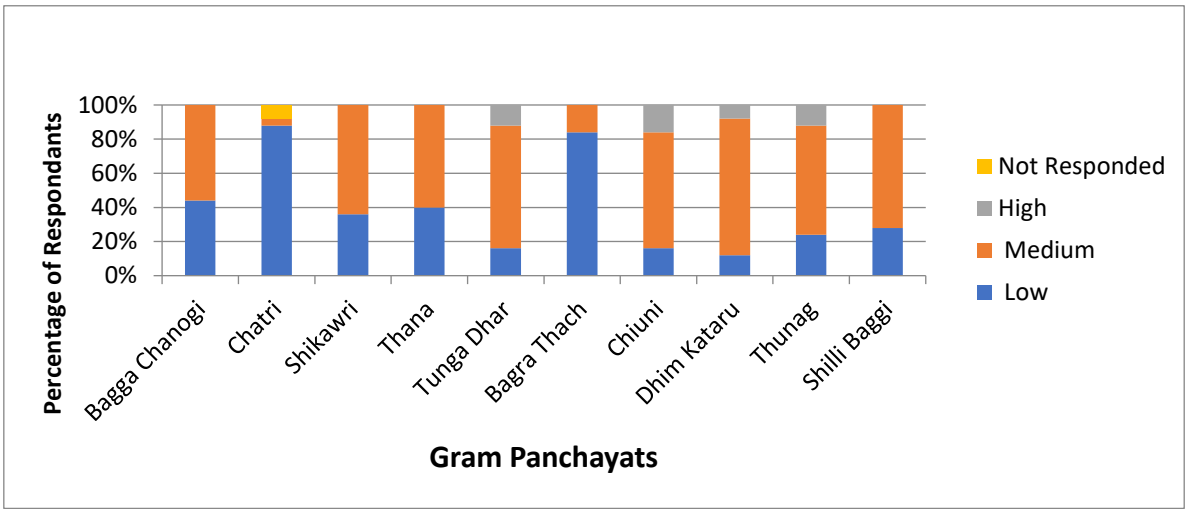

Fig. 10. Farmers Disease Management Knowledge Level in Different Panchayat

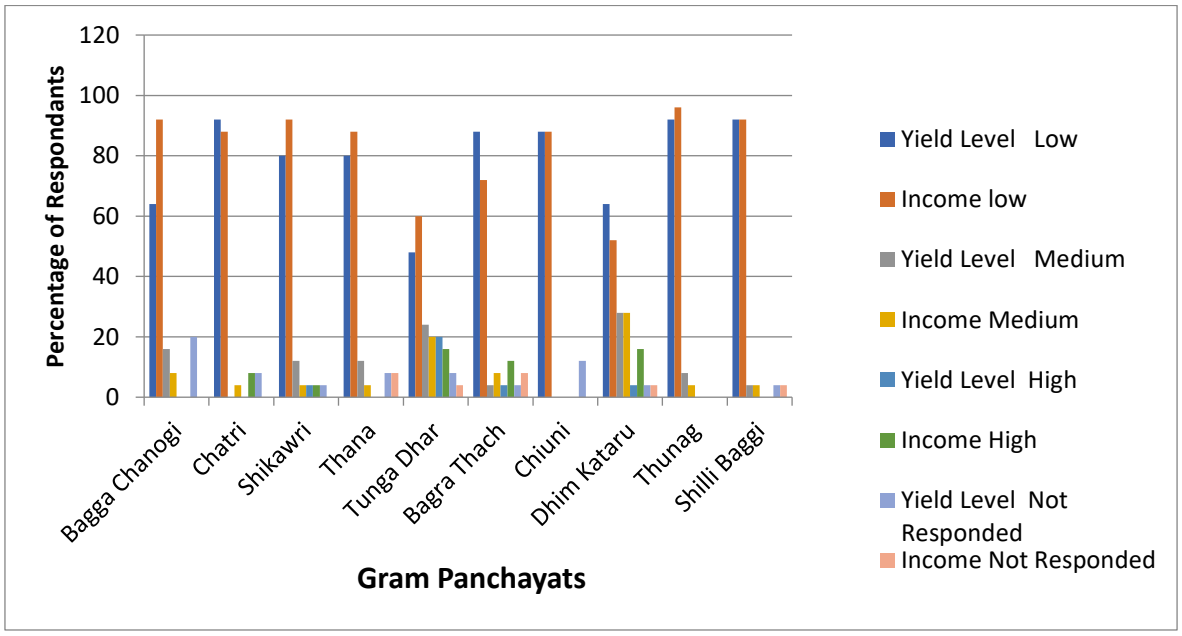

Fig. 11. Combined Yield and Income Levels in Different Panchayat

Seed treatment is absent in 6 of 10 villages and remains below 20% in all others, except Chiuni (20%). This could imply a gap in extension services or resistance to adoption of advanced techniques like polymer coating, inoculation with rhizobium or Trichoderma and Multi-step treatments with pesticides.

Villages like Chatri (40%), Thunag (56%) and Tunga Dhar (36%) showed a balanced share of Medium-Level treatment. These regions might be receiving partial support through government schemes, awareness programs, or access to cooperative societies that supply treated seeds.

Dhim Kataru is the only village where 12% of the respondents did not disclose their seed treatment practices. This might reflect uncertainty or lack of knowledge, reluctance to participate in surveys and possible data collection or classification issues.

3.2.4 Fertilizer Application

Knowledge level on fertilizer application is a critical indicator of the farmer's capacity to optimise nutrient use and ensure sustainable crop production.

Shilli Baggi (92%), Chatri (96%), Dhim Kataru (100%) and Shikawri (80%) show very high levels of knowledge. These locations likely benefit from higher literacy rates and proactive extension support.

Locations like Bagga Chanogi (52%), Thunag (52%), Tunga Dhar (72%), Chiuni (68%), Bagra Thach (64%) and Shikawri (80%) fall into the medium knowledge category. These regions may have partial awareness of fertilizer types, but lack of clarity on dosage or timing; reliance on traditional practices, with limited formal guidance; and influence of farmer-to-farmer communication rather than institutional recommendations. Medium knowledge groups often apply fertilizers without soil test-based recommendations, leading to suboptimal yields or soil degradation.

Thana (88%), Thunag (48%), Chiuni (28%), and Bagra Thach (32%) reflect substantially low-level knowledge. In such areas, farmers may face limited access to training or advisory support. In low knowledge zones, there is often misuse of nitrogen fertilizers and neglect of micronutrients, which exacerbates soil nutrient imbalance.

Only Chatri (4%) did not respond. This might suggest survey fatigue or ambiguity in understanding the question or gaps in enumerator communication or classification.

3.2.5 Spacing Knowledge Level

Proper spacing in crop planting is essential for optimizing plant population, nutrient use, light interception, and ultimately, crop yield and resource efficiency. The current dataset highlights substantial variation in spacing knowledge among farmers across different Panchayats.

Panchayats like Shilli Baggi (92%), Chatri (96%), Shikawri (80%), Dhim Kataru (100%) and Tunga Dhar (24%) demonstrated high levels of spacing knowledge, indicating high extension support likely through Krishi Vigyan Kendras (KVKs) or demonstration programs.

Bagga Chanogi (52%), Thunag (52%), Tunga Dhar (72%), Chiuni (68%), Shikawri (80%) and Bagra Thach (64%) reflect moderate awareness. Farmers here may understand general spacing guidelines, but lack specificity for crop or variety.

Notably, Bagra Thach (80%), Bagga Chanogi (36%), Thunag (32%), Tunga Dhar (24%), Chatri (20%), Chiuni (16%) and Shilli Baggi (16%) showed a substantial segment of farmers with low spacing knowledge. Improper spacing not only affects plant architecture but also contributes to increased pest and disease incidence due to poor aeration.

Only Chatri (4%) recorded non-response. Possible explanations include the farmer hesitation due to survey fatigue or confusion.

3.2.6 Irrigation Practices

This dataset categorizes farmer responses into irrigated, rainfed, and non-responders. Irrigation is critical for improving crop productivity, especially in rainfed zones, and its adoption is linked to infrastructure availability, water source reliability, and policy support.

Irrigated farming prevalence above 30% was reported in panchayats Shilli Baggi (44%), Bagga Chanogi (32%) and Dhim Kataru (32%). These areas show moderate irrigation infrastructure or practices, possibly due to proximity to water sources like springs, tanks, or streams and awareness of micro-irrigation or farm pond use.

Predominantly Rainfed above 75 % was reported in panchayats Shikawri (100%), Chiuni (92%), Tunga Dhar (92%), Bagra Thach (80%) and Chatri (76%).

These Panchayats depend heavily on rainfall, reflecting the absence of perennial irrigation sources, fragmented landholding patterns, making irrigation infrastructure uneconomical and limited uptake of rainwater harvesting or watershed development projects. Rainfed agriculture dominates in Himalayan and tribal regions due to topographic constraints and limited irrigation investment.

Highest non response on the question was from Panchayat Thana (36%) followed by Chatri (12%), Dhim Kataru (12%), Thunag (12%), Chiuni (8%) and Shilli Baggi (4%).

3.2.7 Weed Management Knowledge Levels

The data reflects farmer preferences and knowledge levels regarding weed management, categorized as manual/low knowledge, chemical/medium knowledge, both/high knowledge and not responded.

Most Panchayats viz. Chatri (92%), Shikawri (92%), Thunag (96%), Thana (88%), Shilli Baggi (84%) and Tungadhar (84%) still rely heavily on manual which indicates traditional knowledge dependence, limited herbicide access, or cultural preferences. Manual weeding is labor-intensive and may lead to reduced efficiency during peak season. Most hill-region farmers rely on manual weed control due to terrain, labor availability, and poor chemical access.

Only Bagga Chanogi (28%) and Chiuni (28%) show significant use of both methods, reflecting higher awareness or exposure to training. These may be priority sites for piloting integrated weed management (IWM) approaches.

Moderate use of chemical methods reported only in Bagga Chanogi (12%), Bagra Thach (20%), Dhim Kataru (28%), Thana (4%), Tunga Dhar (4%) and Thunag (4%). Chemical use is relatively rare which is due to cost concerns, fear of side effects, or lack of knowledge.

Non-Response Rates were high in Chiuni (16%), Shilli Baggi (16%), Bagga Chanogi (12%) & Tunga Dhar (12%) which suggests knowledge gaps or hesitance in reporting herbicide use, potentially due to regulatory concerns or community norms.

3.2.8 Disease Management Knowledge Levels

The dataset given in Fig. 10 presents self-reported levels of knowledge about disease management among farmers in ten panchayats of the Seraj Valley, divided into Low, Medium, and High levels, with a small percentage of Not Responded.

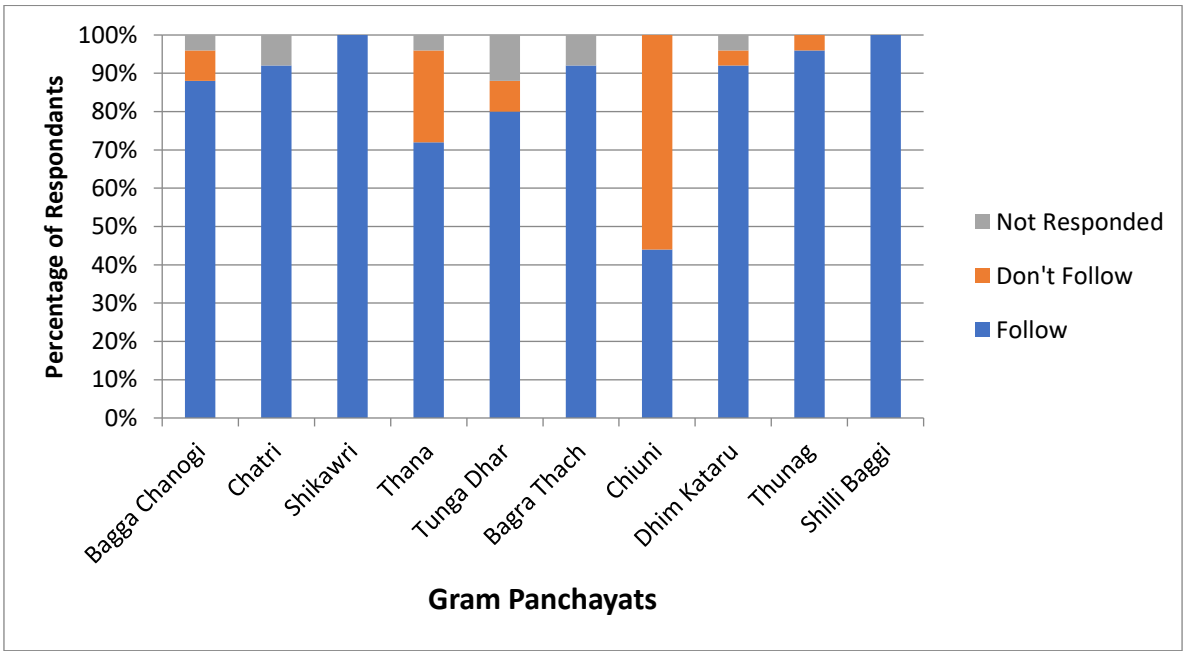

Fig. 12. Crop Rotation Practiced in Different Panchayats

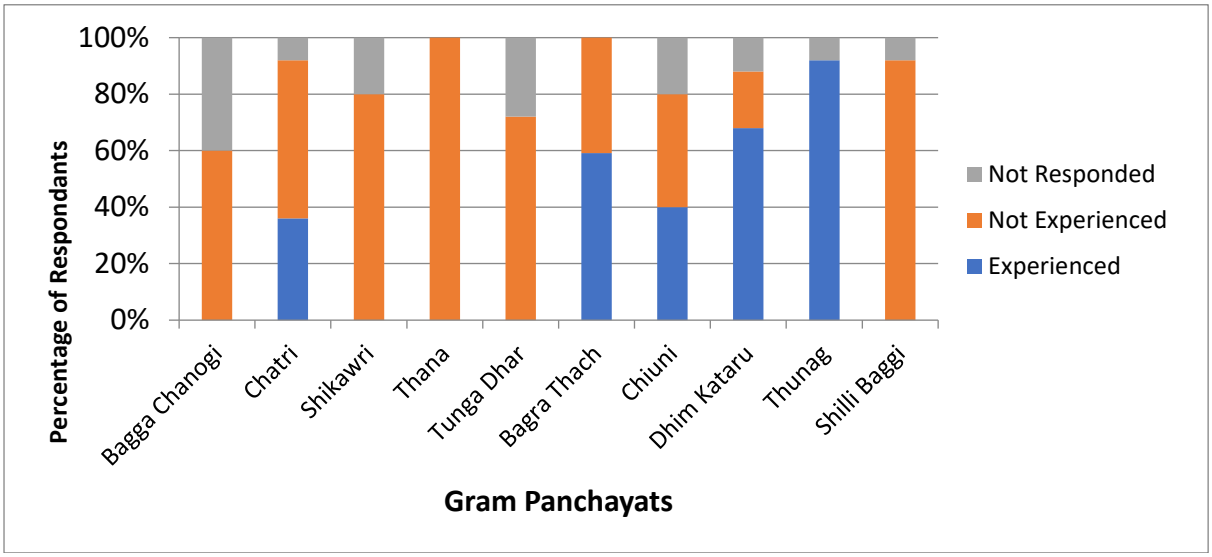

Fig. 13. Climate Change Experienced by Farmers in Different Panchayats

Chatri (88%), Bagra Thach (84%), and Bagga Chanogi (44%) report low levels of knowledge indicating limited access to training, extension services, or possibly the presence of traditional or outdated practices. Bagra Thach and Chatri may require targeted training programs, considering their extremely low "High Knowledge" percentages (0%). Sahu and Mishra, (2013) concluded that disease knowledge improves where farmers receive personalized climate and crop advisories.

Medium knowledge is most prevalent is most common level in many panchayats viz. Shikawri (64%)**,** Thana (60%)**,** Tunga Dhar (72%)**,** Shilli Baggi (72%)**,** and Dhim Kataru (80%)**,** suggests some awareness or exposure to disease management, likely via informal sources or NGO/government campaigns. Hill farmers often have medium awareness but lack practical training, leading to misdiagnosis or delayed action in disease control.

Chiuni (16%)**,** Tunga Dhar (12%)**,** Thunag (12%), and Dhim Kataru (8%) show relatively higher levels of knowledge. These could be linked to active agricultural extension**,** demonstration plots**,** or personal farming experience with disease outbreaks**.**

Chiuni stands out with 0% low knowledge and 16% high**,** reflecting potential early adopter behavior or better access to advisory services.

Minimal non-response except Chatri (8%) and Dhim Kataru (8%) indicative of either uncertainty or hesitance in self-assessment**.**

3.2.9 Yield and Income Level

The Fig. 11 presents data on pea yield and income levels across ten panchayats of the Seraj Valley. It classifies the percentage of respondents under four categories: Low, Medium, High, and Not Responded for both yield and income.

Bagga Chanogi, Chatri, Shikawri, Thana, Chiuni, Bagra Thach, Shilli Baggi exhibit over 80% of farmers reporting low yield and low income. These findings suggest a strong positive correlation between poor yield and low income—consistent with empirical evidence from Indian hill farming contexts.

Chiuni (88% low yield and low income) is one of the most critical locations, indicating lack of diversification, irrigation access, or market integration. Low-input farming in hill areas often yields poor returns unless supported by sustainable intensification practices.

Tunga Dhar (24%-20%), Dhim Kataru (28%-28%) show a more balanced productivity pattern. These areas possibly benefit from better agro-techniques, soil health, or community-level extension services.

Only Tunga Dhar (20% yield, 16% income) and Dhim Kataru (4% yield, 16% income) indicate respondents achieving high returns. Production expansion results higher household income was also reported by Li Fan et al., (2025).

High non-response in Bagga Chanogi (20% yield), Chiuni (12%), Thana (8%-8%) likely reflects data collection challenges, marginal farmer hesitation, or poor record-keeping.

3.2.10 Crop Rotation Practices

Crop rotation is a key agroecological practice that enhances soil fertility, prevents pest buildup, and contributes to sustainable agriculture. Majority (86%) of farmers across locations reportedly follow crop rotation—indicating a high level of adoption. Shikawri, Shilli Baggi, Thunag, Chatri, Bagra Thach and Dhim Kataru have high adoption rate. Crop rotation may be practiced in these regions due to its diverse advantages. Beillouin et al., 2019 reported global evidence showing that crop rotation improves yields, soil health, reduces pests and adoption varies by region depending on awareness and support.

Bagga Chanogi, Thana, Tunga Dhar have moderate adoption. These may have partial coverage or transitional adoption—further support could help achieve universal practice.

Only one location Chiuni shows a significantly low adoption rate of 44%, with 56% not following crop rotation. Smaller landholders sometimes avoid crop rotation due to short-term yield focus.

Tunga Dhar (12%) and Bagra Thach (8%) and Chatri (8%) have moderate non-response, possibly reflecting survey fatigue, misunderstanding, or lack of decision-making autonomy among respondents.

Zero non-response in Shikawri, Chiuni, Thunag and Shilli Baggi, indicating strong clarity or participation in these villages.

3.3 Climate Change Experience

Fig. 13 data reflects the heterogeneity of climate change perception across Seraj Valley's rural landscape. It suggests that exposure, education, traditional knowledge, and vulnerability shape how rural communities perceive climate change. The dataset reflects perception-based responses on climate change experience across ten rural locations. It was based on the indirect question of sowing time of today and ten years back. If answer was same time of sowing then categorized under not experienced climate change otherwise experienced. The key trends were 50% of locations reported no climate change in past ten years. Only 3 locations viz. Thunag, Dhim Kataru and Bagra Thach had more than 50% of respondents acknowledging climate change in past ten years. High non-response rates up to 40% suggest data uncertainty or possibly limited understanding or engagement or survey design limitation or cognitive dissonance or fear in acknowledging climate change and lack of perceived link between climate and local effects.

Low Awareness and High Non-Response were reported in Bagga Chanogi (40%), Shikawri (20%) and Tunga Dhar Panchayat (28%). Studies show that rural populations in developing countries often under-report climate change experiences due to lack of meteorological information access, reliance on traditional knowledge systems, and perceiving climate variability as normal weather patterns.

High awareness in vulnerable areas was Thunag – 92% and Dhim Kataru – 68%. These areas may be more vulnerable to climate anomalies, such as irregular snowfall/rainfall, increased incidence of crop failure and seasonal shifts. The mountain regions in South Asia are particularly climate-sensitive, and residents are more likely to observe impacts firsthand.

Locations like Chatri (36% experienced, 56% not experienced) and Chiuni (40%-40%) show balanced awarenss—possibly due to access to agricultural advisories, education, and farming experience which influenced perception among farmers. Banerjee, 2015 also highlighted rural India's climate awareness heterogeneity, influenced by education, exposure, and vulnerability.

4. Conclusion

The survey of ten panchayats in the Seraj Valley of Mandi District, Himachal Pradesh, provides critical insights into the socio-agricultural dynamics, adoption of pea production technologies, and farmer perceptions. The overwhelming dominance of marginal farmers reflects the structural constraints of hilly agriculture, necessitating tailored interventions that address their specific needs. While there are encouraging trends in seed rate and crop rotation adoption, major gaps remain in seed treatment, disease management, and irrigation access. The uneven distribution of knowledge and technology adoption across panchayats underscores the need for decentralized, panchayat-specific extension strategies.

High-performing panchayats such as Dhim Kataru and Thunag demonstrate the potential impact of effective awareness, input access, and extension linkages. Conversely, areas like Chiuni and Thana exhibit significant constraints due to poor infrastructure, knowledge gaps, and non-responsiveness. The limited mechanization and continued reliance on traditional practices in remote areas further highlight the challenges of accessibility and affordability.

Moreover, while some farmers recognize shifting climatic patterns, widespread low perception or non-responsiveness to climate change indicates a need for climate education and integration of adaptive practices. The direct relationship observed between low yield and low income highlights the urgent need for interventions that improve productivity through better agronomic practices, input use, and market linkages.

In conclusion, the findings call for a comprehensive and location-specific approach focusing on capacity building, improved input delivery, demonstration of best practices, and climate-resilient technologies. Strengthening local extension systems and ensuring equitable resource access can significantly enhance the livelihoods and resilience of small and marginal farmers in the Seraj Valley.

Disclaimer (Artificial Intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Acknowledgement

The authors gratefully acknowledge the NABARD, Regional Office, Shimla for their generous financial support and encouragement in conducting the survey across ten panchayats of the Seraj Valley in Mandi District, Himachal Pradesh. This study would not have been possible without their timely funding and institutional backing. We sincerely appreciate their commitment to promoting region-specific agricultural research and rural development. Their support has been instrumental in facilitating fieldwork, data collection, and analysis aimed at understanding the ground realities of hill agriculture and enhancing the livelihoods of small and marginal farmers in the region.

Competing Interests

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

References

Ali, M., & Gupta, S. (2012). Carrying capacity of Indian agriculture: Pulse crops. *Current Science, 102*(6), 874–881.

Banerjee, R. R. (2015). Farmers' perception of climate change, impact and adaptation strategies: A case study of four villages in the semi-arid regions of India. *Natural Hazards, 75*(3), 2829–2845. https://doi.org/10.1007/s11069-014-1466-z

Beillouin, D., Ben-Ari, T., & Makowski, D. (2019). Evidence map of crop diversification strategies at the global scale. *Environmental Research Letters, 14*(12), 123001. https://doi.org/10.1088/1748-9326/ab4449

Government of India. (2016). *Agricultural census 2015–16*. Department of Agriculture, Cooperation & Farmers Welfare.

Imoro, B. S., Koasi, B. E., Addae-Frimpomaah, F., Ahiakpa, J. K., & Karikari, B. (2026). Pigeon pea production in northern Ghana: Farmer perspectives on cropping practices, trait prioritisation, and constraints for guiding breeding programs. *BMC Agriculture*, *2*(1), 1.

Li, F., Pan, X., Liu, Y., & Wu, J. (2025). Agricultural technology extension and farmers' income: Evidence from China. *Economies*, *13*(11), 331. https://doi.org/10.3390/economies13110331

Mehta, C. R., Bangale, R., Chandel, N. S., & Kumar, M. (2023). Farm mechanization in India: Status and way forward. *Agricultural Mechanisation in Asia, Africa and Latin America, 54*(2), 75–88.

Rawal, J., & Ansari, M. A. (2019). Extension needs of vegetable growers: A study in Kumaon region of Uttarakhand. *Asian Journal of Agricultural Extension, Economics and Sociology*, *36*(4), 1–10. https://doi.org/10.9734/AJAEES/2019/v36i430248

Sahu, & Mishra. (2013). Analysis of perception and adaptation to climate change among farmers in Odisha. *APCBEE Procedia, 13*(6), 123–127. https://doi.org/10.1016/j.apcbee.2013.05.022

Singh, A. S., Meena, N. R., Doharey, R. K., Tripathi, U., Warshini, A., Kumar, G., & Singh, R. (2024). Constraints faced by the pea growers in adoption of pea production technology and possibilities of future prospects for promotion of pea production technology. *International Journal of Research in Agronomy*, *7*(6), 163–168. https://doi.org/10.33545/2618060X.2024.v7.i6c.827

Tiwari, A. K., & Tiwari, J. K. (2013). Constraints in adoption of modern vegetable cultivation in Bastar Plateau. *International Journal of Current Microbiology and Applied Sciences*, *7*(1), 820–826. https://doi.org/10.20546/ijcmas.2018.701.100

Peer-review history:
The peer review history for this paper can be accessed here:
https://pr.sdiarticle5.com/review-history/155575