Reviving Rural Economies: Building Climate-Resilient Livelihoods for Apple Farmers in Indian Himalayas

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Abstract

Apple farming serves as the socioeconomic backbone of Himalayan communities, providing income, employment and regional identity. However, climate variability, erratic precipitation and rising temperatures have disrupted productivity and quality posing severe livelihood challenges. Despite their economic significance, apple farmers in Himachal Pradesh often face financial exclusion, limited institutional access and inadequate financial and climate literacy, factors that weaken their resilience against environmental and market shocks.

This research aims to promote sustainable livelihoods among high-altitude apple farmers through an integrated approach encompassing financial inclusion, financial literacy and climate-aware literacy. Drawing upon mixed-method research, the study employs a multi-stage sampling framework across selected districts of Himachal Pradesh to collect primary and secondary data. Analytical techniques such as descriptive statistics, logistic regression and PLS-SEM will be used to examine linkages among financial empowerment, literacy levels and adaptive capacity. A key innovation lies in designing a targeted intervention model that enhances both financial and climate literacy while facilitating inclusive access to institutional credit and risk management tools.

Keywords: Sustainable livelihood, Apple farming, Climatic changes, Resilience

JEl Code: Q12, Q54

1. Introduction

1.1. Apple Farming as the Socioeconomic Backbone of Himalayan Communities

Tucked within the snow-covered Himalayan ranges and given the name of “Fruit Basket of India” Himachal Pradesh has found its identity by its thriving apple orchards. Apple farming has influenced both the geographical landscape and livelihood of Himachal Pradesh rural economy **(Kumar and Mukherjee, 2024)**; (**Yasmin et al., 2023); (Sahu et al., 2020); (Kaur, 2019)**. In Himachal Pradesh around 70% of communities depend upon agriculture as there primary source of livelihood where apple farming serves as corner stone of its rural economy **(Kumar and Parmar, 2023)**. In 2024, Agriculture and allied activities contributed around 14.5% in states GVA **(Economic Survey Himachal Pradesh, 2023-2024)** whereas Apple industry contributed around 5.50 crores to state’s GDP **(Indian Express, 2025)** while covering 40% of total area under fruit cultivation **(Manjul and Nishupal, 2024).** Wherein districts Shimla and Kinnaur home to many small and marginal farmers serves as major contributor i.e. 75% of total state output **(Kaur, 2020)**. In Himachal Pradesh Apple accounts for 88% of total production among all fruits and extends to 1,15,680 hectare empowering around 2 lakh farming families **(Chandra, 2024); (World Bank Group, 2023)**

However significant changes have emerged in recent years with erratic climatic changes in form of frequent hailstorms, cloudburst and unseasonal snowfall severely affecting apple production and reducing overall yields. **(Larue and Ker, 2024); (Arundhati and Bhagat, 2020); (Singh et al ., 2016).**

1.2. Shifting Climate Patterns and Its Impact on Apple Productivity

The shifting climate patterns have led to unprecedented losses for apple farmers during recent times affecting yield of apples in Himachal Pradesh.

According to **(Economic Survey of Himachal Pradesh, 2023-2024)**, with increasing climate uncertainty the state witnessed a loss of ₹1,061 crore which lead small and marginal farmers into debt burden. Further, monsoon failure and shifting climate patterns resulted in decline of 28% in crop production.The output fell from 672,000 tonnes in 2022 to just 484,000 tonnes in 2023. In past

years state has experienced deficiency in rainfall in both monsoon and post monsoon season affecting crop productivity and yields **(Himachal Pradesh Economic Survey, 2023-2024).**
As reported by **World Bank (2024)** Marginal and small farmers who constitute the pillar of apple economy have not only faced climatic shocks but also lack of financial access due to which they are being pushed to either abandon there land or face losses and sell there lands. Therefore vulnerability does not stem from climate uncertainty alone but also from limited access to formal financial tools and services also play a pivot role.

1.3. Financial Exclusion and Institutional Gaps in Apple Farming Ecosystem

While climate risks continue to disrupt apple farming limited access to formal financial tools has made recovery even harder for small and marginal farmers. Financial inclusion can be stated as making financial services available, accessible and affordable to all the citizens in a safe and transparent manner to support inclusive and resilient multi-stakeholder led growth **(National Strategy for Financial Inclusion, 2019-2024).**
Inaccessibility and unawareness of formal financial tools like crop insurance schemes, agri-credit, loans and savings have made these farmers vulnerable to income uncertainty **(Das and Maji, 2023); (Kumari et al., 2021).**
As per the (**Himachal Pradesh Economic survey, 2023-2024)** report it was found that in terms of population to bank ratio the State has an average population of 2,919 per bank branch which is significantly lower compared to national average of 11,000**.** Despite the existence of cooperative and RRB′s in the state the geographical spread has remained a concern specially in hilly and remote regions. As reported by **NABARD, Financial Inclusion Survey (2022)** more than 38% of rural households in hill states lack access to formal institutional credit and less than 1 in 5 were ever a part of financial literacy training program. All India Rural Financial Inclusion Survey **(NAFIS, 2021-22)** revealed that agricultural households availing loans from financial system just rose from 60.5% in 2016-17 to 75.5% in 2021-22 indicating households dependency on informal credit sources.
Yet linking farmers into financial systems alone does not ensure resilience as Financial Inclusion should be accompanied with Financial Literacy, in order to make Financial Inclusion meaningful.

1.4. Role of Financial Literacy in Apple Farming Communities

Financial literacy is stated as combination of financial skills, attitude, knowledge and behaviour important to take financial decisions **(RBI, 2024)**. Financial literacy becomes the bridge that transforms access into meaningful usage. Given these challenges it becomes evident that financial inclusion alone is not suffice without the support of Financial literacy, as both are mutually reinforcing **(Khandelwal et al., 2025)**; **(Alqam and Hamshari, 2024)**. Despite the efforts rural areas of HP still lacks financial literacy in terms of availing government schemes and banking therefore continuous awareness campaign regarding state and central government schemes will serve as one step solution for sustainable rural development **(Kumar and Abdi, 2021).**

1.5. Moving from Financial literacy to Climate-literacy.

In the wake of recent developments having ability to make climate informed decisions has become crucial for farmers, this is where climate literacy becomes essential as its more about enabling farmers to take climate-smart decisions and adapt their practices in line with evolving climate conditions **(Arundhati and Bhagat, 2023)**.

Apple farming once a Proud and dependable profession is increasingly becoming less preferred option due to unstable incomes hurting the rural economy. Farming has long been a generational occupation but the growing disconnect between the younger generation and this occupation now poses a serious threat to its continuity therefore investigating this social and economic problem will help not only generate long term sustainability but also help transfer this legacy of farming to next generation.

2. Research Objectives

1. To examine the current status and gaps in financial inclusion and financial literacy among small and marginal apple farmers in the districts of Shimla, Kinnaur and Kullu.
2. To investigate how improved climate literacy will influence farmers capacity to take climate-informed decisions and adopt sustainable livelihood strategies such as crop diversification, improved farm inputs and risk-mitigation practices.
3. To design a multi-phase intervention framework consisting of financial inclusion tools, targeted financial literacy programs and climate-smart planning modules to promote sustainable livelihood.

4. To explore and identify barriers and motivating factors influencing youth participation in apple farming.

3. Methodology

3.1. Research Design

The current study adopts an exploratory method of research involving both quantitive methods (survey, statical testing, constructing indexes) as well as qualitative methods (Participatory Rural Appraisal (PRA) - group discussions and interviews) so as to capture every detail related with Financial Inclusion, Financial and climate literacy, and to explore the reasons behind youth disengagement in farming. Given the basic multi-dimensional nature of our study this method is most suitable.

The quantitive part will include standardised structured questionnaires. Whereas, construction of Financial inclusion and Literacy index scores will be guided by RBI Financial index (2024) and Organisation for Economic Co-operation and development (OCED, 2023) framework respectively to ensure consistency and comparability. On qualitative side Participatory Rural Appraisal tools such as interviews and discussion will be employed so as to analyse the lived experiences and behaviour of farmers, there perception on climatic uncertainty and declining livelihood in recent years.

3.2. Sampling Framework

The present study has opted for Multi-stage random sampling wherein Selection of districts, blocks and villages will be done on basis of maximum Apple production and Agro climatic conditions (High altitude regions).

The sampling stage will begin with selecting districts followed by selecting blocks out of those districts in second stage. Further identification of villages will take place in the third stage and finally selection of households on random basis. Present study will focus on small and marginal farmers. Marginal farmers are those who are cultivating less than 1 hectare of land and small farmers having landholding between 1 to 2 hectare of land **(Agricultural Census Division, 2019).**

Table 1: Selection of Districts

District	Apple Production-in Million Tones	Apple production from 1991-2024	Area Under Apple Cultivation	Elevation of Districts	Rural Population(2011 census)
Shimla**	281106	243042	42085	2,276m	612659
Kinnaur**	58299	9159	10911	2759m	84121
Kullu**	102860	70857	27258	1,279m	396512
Lahul-Spiti	705	27	1776	4270m	31564
Chamba	9980	2661	14205	1006m	482972
Mandi	47727	15359	16930	760m	937140
Sirmaur	5534	474	2580	932m	472690
Kangra	350	422	525	500-5000m	1423794

Note: ** represents selected districts

Source(s):

Department of Horticulture, Himachal Pradesh (2024); Census of India (2011) – Himachal Pradesh; State Statistical Abstract (2022); District Administration (Official Websites): Shimla – https://hpshimla.nic.in, Kinnaur- https://hpkinnaur.nic.in, Kullu – https://hpkullu.nic.in, Lahaul & Spiti – https://hplahaulspiti.nic.in, Mandi – https://hpmandi.nic.in, Sirmaur – https://hpsirmaur.nic.in, Kangra – https://hpkangra.nic.in; Agricultural Marketing Board – https://hpsamb.org/chamba_home

The basis for selecting these districts for the present study rests on their geographical elevation, agro-ecological suitability and prominence in area under apple and total production.

As shown in above table Shimla, Kullu and Kinnaur districts have fulfilled the selection criteria. Shimla has consistently remained largest producer of apples in recent years followed by Kullu and Kinnaur. **(Manjul and Nishupal, 2024); (Sarta and Kaur, 2023); (Kaur, 2020)**

All three districts share common landscape marked by high elevation and altitude which is highly conductive for apple cultivation. District Shimla elevation ranges between 500m to 6000m above the sea levels in comparison the elevation of Kullu district also ranges between 500m to 5000m **(Himachal Pradesh State Agricultural Marketing Board [HPSAMB])**. Kinnaur district known

for its steep terrain has the height elevation ranging between 1250m to 6755m above the sea level (**District survey report Kinnaur, 2024)**.

3.2.1. Selection of Blocks

Under Each selected district two blocks are identified and selected on basis of dominance in apple production and Agro-climate conditions as high altitude regions are more vulnerable to witness climate uncertainty **(Integrated Climate-Risk Assessment, 2024); (;Sahu et al., 2020); (Business Standard, 2017**) .

From District Shimla out of 10 blocks, selected blocks are Jubbal-Kothkai which has highest share in apple production **(Manjul and Nishupal, 2024)** and Chaupal

From district Kullu we have total of 6 blocks, selected two Blocks are Banjar and Naggar **(Ranta and Kumar 2021); (Sharma et al 2018)**

Lastly, from Kinnaur district out of 5 blocks, Pooh and Kalpa blocks are selected hence satisfying our selection criteria **(ESIA Report, Department of Horticulture HP, 2020)**

Table 2: Selection of Blocks

District	Blocks	Criteria
Shimla	Jubbal-Kothkai	Dominance in apple production and Agro-climate conditions
	Chopal	
Kullu	Banjar	
	Naggar	
Kinnaur	Pooh	
	Kalpa	

Source: Author’s Calculation

3.2.2 Selection of Villages

From each block two villages are selected again on basis of apple production and High altitude areas.

Further from Jubbal-Kothkai block two selected villages are: Hatkoti and Kot.

From Chaupal Block two selected villages are: Madavag, and Bamta.

Hatkoti-Jubbal-Kotkhai belt is also popularly known as the Apple Valley or Golden Valley in the state.**(Town and Country Planning Department, 2035).**

Under Banjar block: Bandrol and Dobhi are selected.

From Naggar block: we have selected Nagar and Shaheen.

From Kalpa block selected villages are: Ribba and Kalpa.

From Pooh block selected villages are: Chango and Nako

Table 3: Selection of Villages

District	Blocks	Villages	Criteria
Shimla	Jubbal-Kothkai	Hatkoti and Kot	Dominance in apple production and Agro-climate conditions
	Chopal	Madavag and Bamta	
Kullu	Banjar	Bandrol and Dobhi	
	Naggar	Nagar and Shaheen	
Kinnaur	Pooh	Chango and Nako	
	Kalpa	Ribba and Kalpa	

Source: Author's Calculation

3.2.3 Selection of Households

Finally in last stage households will be targeted on basis of simple random sampling for further investigation.

Table 4: Selection of Households

Distri	Block	Village	Criteri	Household	Criteri
Shiml	Jubbal-Kothkai	Hatkoti and Kot	Dominance in apple production and Agro-climate conditions	50 households will be selected from each village. 12*6=600	Simple Random sampling
	Chopal	Madavag and Bamta			
Kull	Banja	Bandrol and Dobhi			
	Nagga	Nagar and Shaheen			
Kinnau	Pooh	Chango and Nako			
	Kalp				

Source: Author's Calculation

Thereby total of 12 villages are selected wherein 50 households from each village will be selected on random basis making total sample size of 600.

3.3. Data Collection and Sources

To ensure comprehensive understanding present study will rely on both Primary and secondary methods for data collection. Primary data will be collected first hand by doing field surveys and employing structured tools in form of standardised pre-coded schedules or questionnaires **(Kumar, 2022)**. The schedules/questionnaires will be designed in consultation with stakeholders and experts in particular field. To ensure reliability and consistency it will undergo a pre-testing stage with small sample of farmers selected from each village.

Study will also engage in focussed interviews and group discussions with farmers and key stakeholder's in all three districts. Whereas secondary sources will include government reports and data from India Meteorological Department (IMD) and Horticulture department, published surveys, academic literature and news archives.

3.4. Analytical techniques and Data Analysis

For quantitive data analysis we will be employing both descriptive and inferential statistical techniques using SPSS. Descriptive tools like mean, frequencies and cross tabulation will help us summarise and interpret data collected by means of primary method from farmers **(Shah et al., 2022) (Atakli and Agbenyo, 2020)**. Frequencies and percentages will help us categorise farmers on basis of there responses in terms of FI, FL and climate literacy. Whereas cross-tabulation will help us analyse relation between categorical variables.

whereas inferential tools like logistic regression and hypothesis testing will help us derive empirical results and conclusions **(Doda et al., (2025)**; (**Xing et al., 2023); (Shah et al., 2022)**.

To get a comprehensive understanding and examine the interlinkages between FI, FL and climate literacy we will employ PLS-SEM **(Divyanshu et al., 2025); (Sohail, 2022); (Maji and Lana, 2022)**. The modelling will be done by using SmartPLS. Conversely, data gathered through Participatory Rural Appraisal (PRA) tools like interviews and discussions will be analysed by employing thematic analysis so as to generate patterns in farmers perceptions and opinions **(Behl and Cardey, 2024); (Thakur and Pandey, 2023).**

Lastly to ensure robustness we will perform sensitivity and validity checks to promote accuracy and reliability.

4. Intervention strategy

In order to promote sustainable livelihood among rural farmers in selected districts of HP. The study relies on strategic intervention approach to assess the Financial Inclusion, Financial and Climate Literacy and to explore the reasons for growing disconnect between apple farming and new generation. Present study will focus on designing intervention strategy tailored to farmers need and requirement. The strategy will follow four phases as mentioned below:

Phase 1: Mapping and Profiling of Farmers (2 months)

The first step will involve visiting to identified villages and selecting households on random basis for data collection. This phase will involve collecting information related to our research objections from pre coded standardised schedules and Participatory Rural Appraisal (PRA) like group discussions and focussed interviews.

Phase 2: Intervention Strategy and Module Designing (2 months)

Building on the insights gathered during the profiling phase. We move forward to designing intervention strategies, a crucial phase where designing training modules will shape the effectiveness of our intervention.

Consultations and discussions will be held with experts and stakeholders like financial institutions, SHG's to get surface level information so that training modules align to our objectives. Special attention will be paid to address the growing generational disconnect from agriculture by involving youth in sessions and including modules that showcase farming as a viable and sustainable livelihood.

Further detailed intervention plan has been discussed under section (2.1).

Phase 2.1. Module structure

The sampling has been conducted in a District- block-village wise phased manner. From each Block we have selected two villages and from every village we intend to select 50 Farmers on random basis. Therefore from every block we will have total of 100 respondents. Farmers will be shortlisted on basis of their FI, FL and CL index scores, only those farmers who require capacity-building will be trained.

The actual intervention strategy will follow a village wise structure. Each village will have two batches of 25 farmers each and each batch will undergo 4 days training program. Therefore each block will have 16 days training period. The same structure will be followed for every district.

Table 5: Block-wise Training Flow

District	Block	Villages	No of Households	No of Batches	Farmers per Batch	Training	Total Training days per block
Shimla	Jubbal-Kothkhai	Hatkoti	50	B1 B2	25 25	4 days 4 days	16
		Kot	50	B1 B2	25 25	4 days 4 days	

Source: author’s calculation

With training models designed, the next phase (3) will witness direct engagement and interaction with farmers. This phase will provide farmers with learning and feedback platform enabling them to gain practical exposure.

Phase 3: Implementation and Training (1 Months)

The core of intervention strategy lies in its implementation. This phase will ensure maximum participation of farmers to enhance there engagement and learning.

This will be carried out in two parts the first is dissemination of information related with financial systems and climate awareness by experts and other stake holders. Second part will include hands on training and demonstration, so as to provide exposure and lived experience to farmers with regard to crop diversification, digital tools and financial awareness.

Phase 4: Feedback, Reassessment and Re-Training (2 Months)

No Intervention is complete until desired outcomes are achieved. So this phase will not only incorporate feedback mechanism but will re-assess weather training sessions were effective or not. It will be conducted after the harvest season so that every real- time scenario are taken into account.

5. **Relevance of the proposed study for Policy making, Society and achievement of Sustainable Development Goals**

The main purpose of any research is to uplift the society and help government frame policies. The present study will act as a guiding framework for policy makers in rural and hilly regions. The most crucial aspect of this study is evidence based results that will be derived from field investigations**.** It will help policy makers to get even granular data that is often seen to be missing in large scale studies. The major drawback that society faces is government policies are often generic in nature, they are not designed with an understanding of the unique risk profiles and problems faced by high-altitude blocks or small and marginal farmers. This study will contribute by showcasing ground level insights to policy makers both in terms of empirical evidence as well as behavioural insights. Present need of farmers is not to have standalone schemes but integrated schemes (FI, FL,Climate aware literacy) that are tested on field and which actually serve the purpose of providing empowerment and support. Study will be helpful in framing long term policies and will serve as a replicable model that can be adopted by other states facing similar challenges.

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