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SOIL-BORNE VEGETABLE DISEASES IN SHIVALAYA, JAJARKOT: FARMER PERCEPTIONS, MANAGEMENT PRACTICES AND CONSTRAINTS

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ABSTRACT

Soil-borne diseases are a serious threat to vegetable crops. This study aimed to investigate farmers' perception regarding soil-borne diseases of vegetables and their management practices in Shivalaya Rural Municipality, Jajarkot. A semi-structured interview was conducted with 60 vegetable-growing farmers to collect data. The study found that 91.7% of respondent farmers encountered plant diseases in their fields; however, only 73.3% were acquainted with soil-borne diseases. Respondents indicated damping-off as the most important soil-borne disease (index value: 0.90) based on a ranking study, followed by wilt (0.78) and root and collar rot (0.59). Among the respondents, 63.3% practiced non-chemical methods, and of these, 97.9% applied bio-pesticides prepared by themselves, while the rest used commercially manufactured *Trichoderma*. A total of 71.7% of farmers had received support from governmental and non-governmental organizations; however, most were highly unsatisfied with the support received. The majority of farmers (78.3%) indicated the influence of climate change on soil-borne diseases, based on their perception of increased frequency and severity in recent years. Besides, the majority of the respondents also perceived that the incidence of soil-borne diseases was affected by season as well as the type of vegetable crops. Barriers to effective disease management included a lack of knowledge, costlier inputs, and limited resource availability. The study highlights the importance of accessible extension services, awareness programs, and policy support for capacity building to manage soil-borne diseases. By considering farmers' perceptions, this study provides valuable information for developing effective disease management strategies, enhancing agricultural sustainability and productivity.

Key words: *Chemical methods, Damping off, Karnali, Trichoderma*

INTRODUCTION

Nepal is an agricultural country where 60.4% of the economically active population depends on farming for their livelihood. Growing awareness of health benefits from vegetables has boosted commercial vegetable cultivation. In 2023/24, vegetables were grown on 3,11,885 ha, producing 44,40,116 MT at a productivity of 14.24 MT/ha- an increase of 4.01% from the previous year (MoALD, 2025). Vegetable production contributes 11.92% to Nepal's Agricultural GDP, and the per capita consumption rose to 134.6 kg in 2021, up from 133.07 kg in 2020 (FAOSTAT, 2021).

Jajarkot district, situated in the subtropical to temperate region of Karnali province, which was declared an organic province in 2018 (Government of Karnali Province, 2018), is a key vegetable-growing area. Major crops include cauliflower, cucumber, pumpkin, squash, onion, beans, tomato, radish, and broadleaf mustard, which contribute to 6.95% of Karnali's total vegetable production (MoALD, 2025). Despite this potential, farmers struggle with soil-borne diseases that threaten productivity and food security (H. Adhikari, personal communication, May 5, 2024).

Soil-borne diseases are caused by pathogens such as fungi, bacteria, and nematodes that persist in the soil for a long period of time and can infect crops, posing a significant threat to crop production (Lamichhane & Venturi, 2015). Some common soil-residing pathogens, including *Fusarium*, *Rhizoctonia*, *Pythium*, *Plasmodiophora brassicae*, *Verticillium*, *Ralstonia, Xanthomonas*, and *Meloidogyne*, are responsible for significant economic losses (Lewis & Papavizas, 1991; Mihajlovic et al., 2017). Due to the lack of research-based extension services, sufficient inputs, and awareness regarding soil-borne diseases, they are difficult to manage (Subedi et al., 2024). Multiple factors, like susceptible planting materials, environmental suitability, favorable cultivation practices, poor awareness, and lack of effective disease management strategies, are highly responsible for increased vulnerability to soil-borne diseases (Longjam et al., 2024; Veena et al., 2014).

Since the farmers are the role models and backbone of farming, understanding their perceptions of diseases is crucial for developing effective and sustainable management practices. Farmers' knowledge, attitude, and practices significantly influence their decision-making processes and their willingness to adopt new technologies or interventions (Ngoya et al., 2023). Additionally, these perceptions are also important among policy formulators, planners, and organizations to deliver efficient and acceptable support to the farmers. However, there is a notable gap in research regarding how farmers in Jajarkot perceive soil-borne diseases and their current management practices.

A multifaceted strategy that combines knowledge of local farming methods and attitudes with scientific research is needed to combat soil-borne diseases. Therefore, investigating farmers' perceptions is critical to designing appropriate extension programs and interventions.

MATERIALS AND METHODS

Site selection

Six different wards of Shivalaya Rural Municipality, where the Group of Helping Hands (SAHAS) Nepal had been working closely with farmers, were selected for the study. Shivalaya Rural Municipality is located in Jajarkot district in Karnali province of Nepal. It covers an area of 134.3 sq. km, with a total population of 14,776, including 7,478 females and 7,298 males (CBS, 2021). It lies between 28.66°N latitude and 81.95°E longitude.

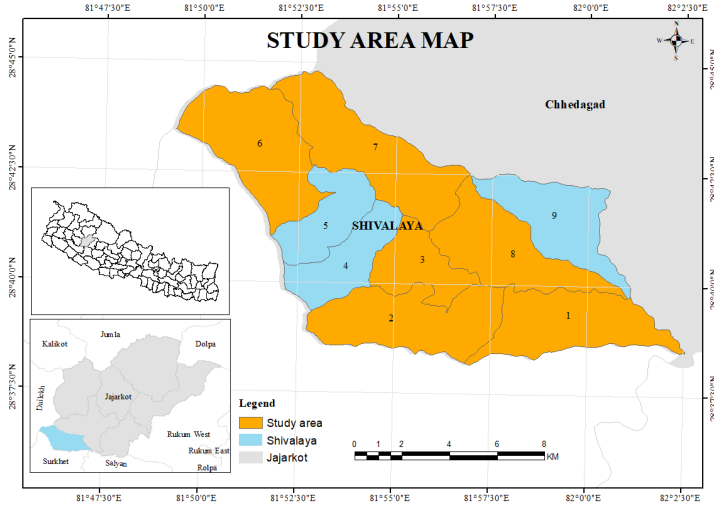

Figure 1. Map of the study area

Research design

The household survey was conducted with the help of a semi-structured interview schedule. A total of 60 farmers from selected wards of Shivalaya Rural Municipality were surveyed through the simple random sampling technique.

Data collection

The study collected both primary and secondary data. The primary data were collected through household surveys in different wards of Shivalaya Rural Municipality. Multiple-response questions were asked to assess the types of support received from various organizations and the level of satisfaction. Disease symptoms and signs were explained along with photographs to rank the diseases perceived by farmers. Similarly, secondary data were taken from the published reports, journal articles, and government bulletins.

Data analysis

MS Excel 2013 was used for data entry. The stored data in the Excel file were analyzed using IBM SPSS 25, and a descriptive analysis of the study was conducted.

RESULTS AND DISCUSSION

Socio-demographic and land holding characteristics

The socio-demographic and land holding profile of respondents is presented in Table 1 as well as Figures 2, 3, and 4. Most households relied on farming as their primary source of income, and respondents were predominantly middle-aged and female. Education levels were generally low, with a large proportion being illiterate. A high number of illiterate farmers in Shivalaya may have resulted in difficulty in understanding the technical methods of disease management. Most households were found to own a larger amount of land (more than 5 ropani); however, they allocated only a small portion for vegetable cultivation. In contrast, households owning 1-5 ropani of land used a larger portion for vegetable cultivation (Figure 4).

Table 1: Socio-demographic characteristics of respondents

Variables	Mean	Standard Deviation
Age	43.72	12.44
Gender (male=0, female=1)	0.58	0.50
Economically active members	2.98	1.36
Experience in vegetable farming	8.12	6.75
Involvement in farmers' groups or cooperatives (Yes=1, No=2)	1.08	0.28

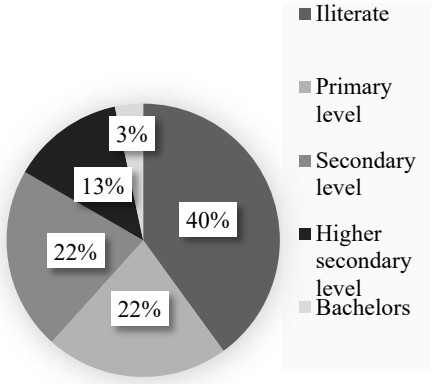

Figure 2: Education status of respondents

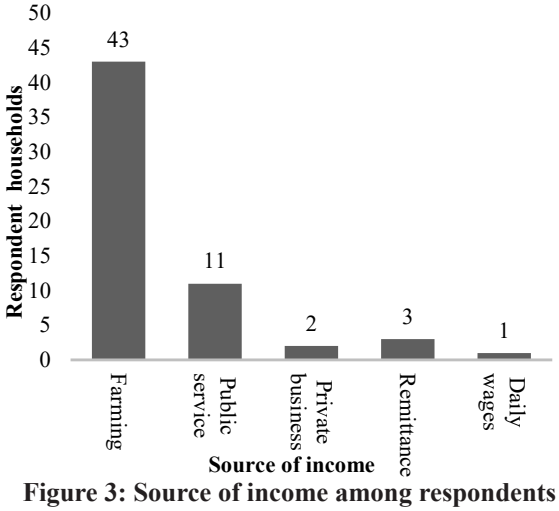

Figure 3: Source of income among respondents

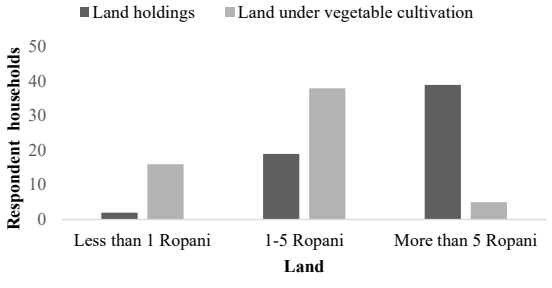

Figure 4: Land holdings and land under vegetable cultivation

General perception of respondents on disease prevalence and management

Table 2 shows that most farmers constantly monitored their fields and were well-informed about soil-borne diseases and plant diseases as a whole, showing an active approach to disease control. However, a notable portion of the farmers were unfamiliar with these issues, which may limit the early identification of diseases and their effective management. Bio-control measures were widely known, but only a few farmers adopted them, which may indicate acceptance hurdles from application expertise or preparation nuisance. Additionally, most farmers avoided chemical pesticides, but those who used them had a poor understanding of the pesticide labels, underscoring the need for more information on safe pesticide usage. It was found that farmers have not used hybrid varieties for a long time. But, in this short time frame, they noticed differences in local and hybrid varieties in the context of soil-borne disease susceptibility. Of the total respondents, 96 % stated that hybrid varieties are more susceptible to soil-borne diseases (Table 2).

The observation that disease incidence was higher in hybrid varieties and under repeated monocropping aligns with Garrett et al. (2006), who emphasized the vulnerability of genetically uniform hybrids in monoculture systems.

Table 2: Knowledge, practices, and experiences of respondents

Aspect	Response	Frequency	Percentage
1. Plant disease experience	Yes	55	91.7
	No	5	8.3
2. Acquaintance with soil-borne diseases	Yes	44	73.3
	No	16	26.7
3. Field monitoring	Yes	43	71.7
	No	17	28.3
4. Knowledge of bio-control methods	Yes	51	85
	No	9	15
5. Use of bio-control measures	Yes	46	76.7
	No	14	23.3
6. Use of chemical pesticides	Yes	22	36.7
	No	38	63.3
6.1 Knowledge of pesticide labels	Yes	4	18.2
	No	18	81.8
7. Soil-borne disease susceptibility difference in hybrid and local varieties	Yes	49	81.7
	No	11	18.3
7.1 Variety's higher susceptibility to soil-borne diseases	Hybrid	47	96
	Local	2	4

Studies in Nepal have consistently identified damping-off, Fusarium wilt, and root rot as major soil-borne diseases of vegetables, causing considerable yield losses (Adhikari et al., 2024; Dahal & Shrestha, 2018; Subedi et al., 2020). Our findings similarly support these reports, with vegetable-growing farmers in Shivalaya, Jajarkot, ranking damping-off and wilt as the most important diseases (Table 3).

Table 3: Major soil-borne vegetable diseases experienced

Disease	Index value	Rank
Damping off	0.90	I
Fungal and bacterial wilt	0.78	II
Root and collar rot	0.59	III
Powdery scab	0.41	IV
Nematodal root-knot	0.32	V

Farmers also identified crucifers as the most vulnerable crop group, followed by solanaceous and cucurbitaceous crops (Table 4), which is consistent with earlier studies highlighting the susceptibility of crucifers to soil-borne pathogens (Arie et al., 1998; Sumner, 1974), solanaceous crops to Fusarium wilt (Agrios, 2005), and cucurbits to damping-off caused by *Pythium* spp. and *Rhizoctonia* spp.

Table 4: Perceived susceptibility of vegetable crop groups to soil-borne diseases

Disease-susceptible crop groups	Index value	Rank
Cruciferous	0.73	I
Solanaceous	0.62	II
Cucurbitaceous	0.62	III
Leguminous	0.54	IV
Others	0.50	V

Management of soil-borne diseases and challenges associated

Table 5 shows the ranking of different management practices against soil-borne vegetable diseases. Sanitation was the most preferred method for managing soil-borne diseases. Although sanitation can't completely eradicate pathogens, removing debris and stubble can effectively reduce primary inoculum from the field (Lin & Peduto Hand, 2019). Following sanitation, the use of biopesticides was very popular among farmers.

Of the total respondents, 85% (n=51) were found to be acquainted with bio-control methods, however only 76.7% (n=46) of the total respondents practiced the use of bio-control measures in their fields. Among the respondents using bio-control measures, only 2.1% (n=1) were found using *Trichoderma*. The remaining 97.9% (n=45) were found to use Jholmal, prepared from locally available plants. Jholmal has antimicrobial properties and can suppress soil-borne pathogens (Bhusal et al., 2022). This method is an environmentally friendly and sustainable alternative to chemical pesticides.

Although bio-control concepts are promoted, Pretty et al. (2018) noted that many farmers may not adopt them without adequate training. In the present study, the lower use of microbial biocontrol agents, such as *Trichoderma*, even after a majority of farmers being aware of their benefits, could be due to the least prioritization in adoption, suggesting the possibility of a gap between knowledge and confidence in application. Although *Trichoderma* is a broad-spectrum antagonist, the number of farmers practicing it was negligible. NGOs in Jajarkot are more focused on promoting general bio-pesticide preparation, and commercial *Trichoderma* has not yet been widely introduced at the farmer level (H.P. Adhikari, personal communication, May 7, 2024).

The use of chemical pesticides was the least practiced management strategy against soil-borne vegetable diseases in Shivalaya (Table 5). Places with easy access to chemical pesticides and technical assistance are more likely to use chemical pesticides (Shrestha & Neupane, 2002). Karnali province, being declared an organic province, could limit the availability of chemical pesticides. Knowledge about pesticide labels was very low among the practitioners of chemical pesticides. Khanal et al. (2022) also found a significant percentage of vegetable farmers in Rupandehi who used chemical pesticides were unaware of label instructions, with only 16.7% of the respondent farmers reading and understanding the pesticide labels and handling procedures. Due to a lack of such knowledge, pesticides are often handled and applied improperly, increasing health hazards.

Neem cake is considered effective in controlling soil-borne diseases (Meena et al., 2014), but farmers in the study area ranked it as the least practiced soil amendment (Table 5), likely due to its unavailability. The preference for *Asuro* (*Justicia adhatoda*) as the best soil amendment could be due to its abundance and habitual usage. Among the different barriers for managing soil-borne diseases, the primary one to be reported by respondents was the lack of education. This includes a lack of knowledge about the cause of disease, a lack of training, and limited dissemination of best practices. Environmental factors such as unpredictable rainfall, long droughts, and emerging pests are also creating obstacles. Limited resources, referring to the financial constraints and hard access to required materials, costly conventional control methods, and pesticide resistance among pathogens, were the other barriers to managing soil-borne diseases (Table 5).

Table 5: Disease management practices and barriers

Category	Practice/Item	Index Value	Rank
Management practices	Sanitation	0.88	I
	Biopesticide	0.62	II
	Soil amendment	0.56	III
	Intercropping	0.40	IV
	Chemical pesticide	0.28	V
Soil amendments	Asuro	0.48	I
	Ketuke	0.47	II
	Mustard cake	0.47	III
	Cow urine	0.44	IV
	Neem cake	0.35	V
Barriers to management	Lack of knowledge	1.00	I
	Environmental issues	0.65	II
	Limited resources	0.62	III
	Costly plant protection measures	0.50	IV
	Pesticide resistance issues	0.27	V

Table 6 presents the respondents' perceptions regarding the benefits of using bio-control agents for managing vegetable soil-borne diseases. According to the respondents, being health-friendly was the most widely acknowledged benefit of using bio-control measures, followed by its environment-friendly nature and broad application (Table 6).

The application of biological control agents is both safe and sustainable, as it fosters a healthier and environmentally responsible agricultural system. Moreover, BCAs tend to provide widespread antimicrobial effects, showing broad-spectrum activity against plant pathogenic fungi, viruses, and bacteria (Villavicencio-Vásquez et al., 2025).

Table 6: Benefits of using bio-control agents

Benefits	Frequency	Percentage	Percentage of cases
Environment friendly	27	34.2	58.7
Health friendly	44	55.7	95.7
Broad spectrum	8	10.1	17.4

Support received by farmers and their satisfaction level

Out of the total respondents, 71.7% received support from organizations related to agriculture. Governmental Organizations and Non-Governmental Organizations were the main and most significant sources of support (Table 7). To a larger extent, the Agriculture Development Section of Rural Municipality (ADS) also supported farmers with training, seeds, pesticides, and equipment, whilst Agrovets made just a little contribution.

Table 7: Support services among respondents

Organizations	Frequency	Percentage	Percentage of Cases
ADS	25	37.3	58.1
NGO/INGOs	37	55.2	86
Agrovets	5	7.5	11.6

Different organizations and institutions were found to assist in their related field to support the farmers. The data shows that seed and training were the most frequently received forms of support in the vast majority of cases (Table 8), whereas the support for pesticidal and equipment procurement was minimal.

Table 8: Agricultural support received from different organizations

Support received	Frequency	Percentage	Percentage of Cases
Training	30	37.0	71.4
Seeds	33	40.7	78.6
Pesticides	13	16.0	31
Equipment	5	6.2	11.9

Table 9 shows the farmers' satisfaction to the services from different GOs and NGOs. In this study, a high level of farmer dissatisfaction was observed towards Governmental Organizations, with a majority of respondents (41.7%) being highly unsatisfied. Around 22% of the respondents (21.7%) remained neutral about the services, while a significant proportion reported being satisfied (Table 9). In contrast, a good proportion of respondents (18.3%) were highly satisfied with the services from Non-Governmental Organizations, though dissatisfaction was prevalent among the sizable population. This implies that although NGOs outperform GOs in terms of satisfaction, there remains room for improvement in both sectors.

Table 9: Satisfaction with services of GOs and NGOs

Satisfaction level	GOs (n, %)	NGOs (n, %)
Highly satisfied	3 (5%)	11 (18.3%)
Satisfied	15 (25%)	18 (30%)
Neutral	13 (21.7%)	11 (18.3%)
Unsatisfied	4 (6.7%)	1 (1.7%)
Highly unsatisfied	25 (41.7%)	19 (31.7%)

Relationship between climatic factors and the occurrence of soil-borne vegetable diseases

In this study, 78.3% of respondents stated that climatic factors influenced the occurrence of soil-borne diseases, whereas 16.7% were uncertain about the influence of climatic factors on soil-borne diseases. A minority (5%) believed that the occurrence of soil-borne diseases is not influenced by changing climatic factors. Based on the collected responses, the most significant climatic factor contributing to soil-borne disease was increased or erratic precipitation, followed by rising temperatures and drought conditions. In contrast, the lower index values for wind and humidity suggest a lesser impact (Table 10).

Table 10: Climatic factors favoring soil-borne diseases

Climatic factors	Index value	Rank
Increased or erratic precipitation	0.57	I
Rising temperature	0.54	II
Drought	0.51	III
Humidity	0.4	IV
Wind	0.37	V

The occurrence of soil-borne diseases may differ with time and season. It is reported that the prevalence and severity of soil-borne diseases have been perceived by the respondents to be increasing in recent years (Figure 5). Similarly, Figure 6 illustrates that a majority of the respondents perceived soil-borne diseases to be more prevalent in the summer season, followed by spring and winter. The summer season, receiving more rainfall, increases soil moisture and favors the virulence and spread of plant pathogenic fungi (Teo et al., 1988).

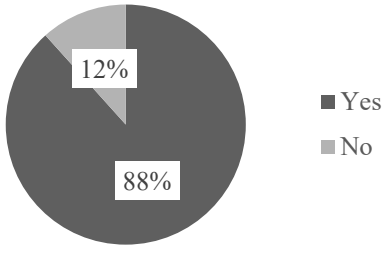

Figure 5: Increase in soil-borne disease incidence and severity in recent times

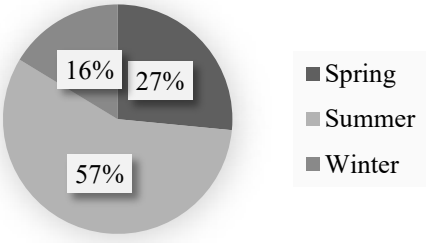

Figure 6: Relative soil-borne disease prevalence across seasons

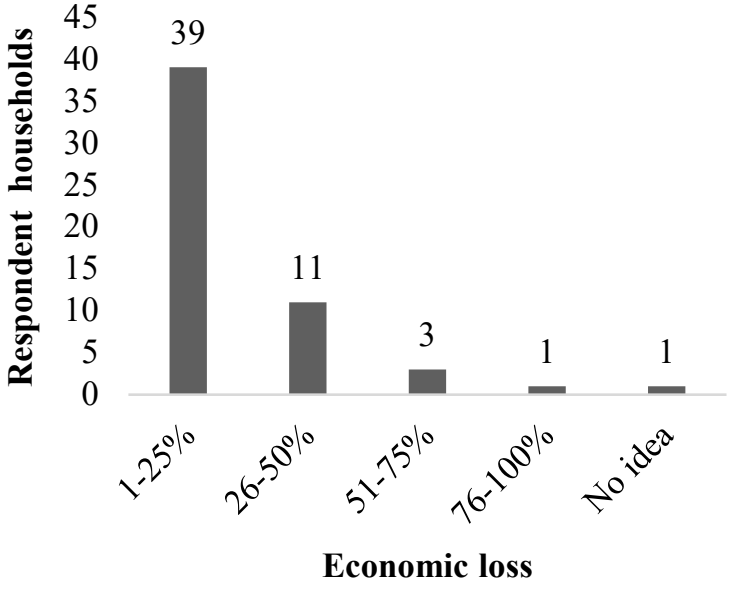

Figure 7: Economic loss due to soil-borne diseases

Farmers' perception of economic losses due to soil-borne diseases

The majority of the farmers believed to have reported minimal economic loss (1-25%) due to soil-borne diseases. However, a few believed to had experienced severe losses exceeding 50% (Figure 7).

During heavy infestations, soil-borne diseases cause severe economic losses. According to McGovern (2015), yield losses from Fusarium wilt in tomatoes can vary from 10% to 80%, depending on soil type, environmental factors, and the amount of pathogen inoculum. Damping-off can affect 5-80% of seedlings, causing significant economic losses (Lamichhane et al., 2017). Root-knot nematodes reduce tomato production by 26.5% to

73.3%, causing global losses of over $125 billion annually (Rawal, 2020). Farmers in this study area similarly reported substantial seedling and crop losses, especially during the early growing season.

Expectations of Farmers

This study also highlighted the expectations of farmers in Shivalaya Rural Municipality from different supporting organizations. Respondents ranked training as the most crucial support with a ranking index of 0.70, followed by regular monitoring by technicians (0.64), subsidies for biological pesticides (0.59), subsidies for chemical pesticides (0.57), and the availability of resistant varieties (0.50), respectively (Table 11). Though farmers were reported to receive training from various agriculture-based organizations, they still prioritized it as their most needed support. They may be referring to quality, practical, and demonstration-based training, rather than just general awareness programs. Rogers et al. (2019) also recommended the training events for farmers to prevent and manage soil-borne diseases.

Table 11: Expectations of farmers from different agencies

Variables	Index value	Rank
Training	0.70	I
Regular monitoring by technicians	0.64	II
Subsidies for biological pesticides	0.59	III
Subsidies on chemical pesticides	0.57	IV
Availability of resistant varieties	0.50	V

CONCLUSION

Agricultural practices in Shivalaya Rural Municipality reveal both challenges and opportunities for sustainable soil-borne disease management. The present study found that farmers of Shivalaya, Jajarkot, are still lacking detailed knowledge and information about plant diseases, especially caused by soil-borne pathogens. Among the soil-borne diseases, damping off was most problematic in the study area. Most of the farmers preferred non-chemical control methods for the disease management, but due to an increase in the incidence and severity of the disease, some farmers have adopted chemical means of disease management despite Karnali Province's organic goals. Support from public and private organizations working on agriculture-related issues was unsatisfactory. Therefore, to promote sustainable organic vegetable farming, coordinated efforts from all stakeholders are essential to manage soil-borne diseases effectively.

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