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Farmer's Knowledge on Maize Pests, Their Management, and Cultivation Practices in Baitadi

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Abstract

The primary objective of this research was to assess farmer's knowledge on pests, their management practices adopted, and maize cultivation practices in Baitadi, Nepal. Four research locations were selected purposively, Dashrath Chand Municipality-2, Pancheswar-6, Patan-4 and Dashrath Chand Municipality-9, as they were hot region for maize production in the district. 75 Household interviews along with Focused Group Discussion and Key Informants Interview were performed. Statistical operations included; Mean, standard deviation, Chi-square test, ordinal logistic regression model. The study found that education status of the farmers was associated with Seed storage structures used, Chemical fertilizer usage, and Insect pest management knowledge. Agri-professionals' visit was associated with Modern seed storage structures used, Chemical fertilizer usage, Insect identification capacity, and Integrated Pest Management awareness among farmers. Access to cooperatives membership was associated with training experience. Fall Army Worm were the most severe insect pest followed by cutworms and White grubs in the study area. Education level, agriculture profession, Fall Army Worm identification capacity, and Insect pest management knowledge in a respondent increased the chances of perceiving Fall Army Worm attacks as "Highly severe". In the initial growth stages, Cutworm was more severe, but in the later stages Fall Army Worm was the most severe. Wild boar was the most severe animal pest followed by Porcupine, Monkey, Birds and Rodents. Maize weevil was the only prevalent post-harvest insect pest. 59.3%, 60.4%, and 73.9% of the respondents correctly identified Fall Army Worm, Cutworms and, White grubs, respectively from their Mark of identification. However, 96.4%, 93.8% and 56.4% of the respondents correctly identified the on-field symptoms caused by Fall Army Worm, Cutworm and White grubs, respectively. Thus, the study concluded that improving agriculture education through training, easier access to membership, and cultural practices are encouraged for policy makers to consider.

Introduction

Maize (Zea mays L.) is considered the second most important crop in terms of area and production in Nepal. Maize is being cultivated in 979,650 ha of land and the production of maize in the fiscal year 2076/77 was 2,997,733 m. tons with a productivity of 2.5 t /ha (ABPSD, 2021). Although there has been a rise in Maize production in the recent years, the increase in maize production is only due to an increase in the cultivation area of maize rather than an increase in yield (ABPSD, 2020/21). Sudurpaschim province, although contributing to only 4.1% of total maize production in Nepal, is heavily dependent on Maize as a staple crop. This situation exists majorly because of the uneven cultivable land along with dry and cold climate in most of 7 out of 9 districts in this province which is not suitable for Rice cultivation as a staple crop. Baitadi district lies in the Sudurpashim hills of Nepal with suitable climatic conditions for growing maize cultivated in 11,031 ha with a total production of 26,939 Mt, having a productivity of 2.44 Mt/ha in the year 2020/21 (ABPSD, 2020/21). Although 73.78% of the maize production area lies in the hilly belt (2.52) the productivity lags behind the Terai (2.87). (MOALD, 2021).

One of the major factors that limit maize cultivation is insects and pests, which can infest maize at any stage of crop development and storage (Ortega, 1987). In the current scenario, insect pests are contributing to a loss of about 40 Mega tonnes of Maize yield per year. This status does only seem to increase with time with increasing global temperatures in the following years. (Dunne, 2018). Among the insect pests, the moth group (which includes cutworms, armyworms, borers, and grain moths) is the most damaging to maize worldwide, followed by the beetles (rootworms, wireworms, grubs, grain borers, and weevils) followed by the sap-sucking bugs (hoppers and aphids) (Ortega, 1987). FAW, which was previously considered a minor pest, has seen unexpected global rise in number. The similar rise was expected in Nepal because it hosts favorable climatic condition for FAW growth and development. After the incidence of FAW in Nepal, this pest has been reported to have infested almost all maize-producing districts. Prior to the incidence of FAW, cutworms and maize borers were considered the major insect pests throughout the country. (PQPMC, 2019)

Initially, being a minor pest under the agroecological system of America, FAW didn't pose much of a threat to the global community. However, after being first reported in 2016 in Africa, it turned out to very destructive pest in sub-Saharan Africa and the whole of Africa. (Goergen G, 2016)

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Fall Armyworm (FAW) was first identified in India in July 2018, followed by Sri Lanka, Bangladesh, Myanmar, Thailand and China in the year 2020 (FAO, 2020). The invasion of this pest was officially declared in Nepal in August 12 2019 by NPPO Nepal (MoALD, 2019). FAW was reported first time in Nawalpur district on May 9, 2019. After the first incidence, the pest has been reported in different districts, including Chitwan, Sindhupalchowk, Sindhuli, Ramechhap, Udayapur, Khotang, Okhaldhunga, Dolakha, Kavrepalanchowk, Lalitpur, Bhaktapur, Banke, Rolpa, Pyuthan, Salyan, Dailekh . (MoALD, 2019). The fecundity of this pest is high (more than 1000 eggs/moth); thus, there can be multiple pest generations per cropping season or year. (CABI, 2019) Its major impact is on maize crops. It affects the crop at different stages of growth, from early vegetative to physiological maturity. Almost every maize-producing district has been infested by FAW except eastern high hills. More severe cases are seen in western Terai and hill areas for maize production.

Maize stem borer (*Chilo partellus* Swinhoe) is also one of the major insect pests to maize production throughout the country. (Neupane, 1986). Dead hearts and not bearing fruits are the prominent symptoms of Maize stem borer. The attack of Maize stem borer lasts throughout the growth phase of maize, from the seedling to the harvest maturity stage. (Gyawali, 1978; Shivakoti & KC, 1978). Maize stem borer compromises both yield and quality of grain. (Pingali, 2001; James, 2003).

The oviposition of stem borer was observed 23 days after planting (Palikhe, 1982) and 27 days after planting (Shivakoti, 1978). Females lay eggs mostly on the upper surface of the leaves (61%), and the remaining 39% were laid under the lower surface at the mid-rib and margins of the leaves.

Larvae of scarab beetles (chafer beetles) are known as white grubs. These are soil insect pests. Both larvae and adult forms of scarab beetles may be destructive for the plant. (Mittal, 2000). These are usually recognized by their C- shaped body and white colour with a brown head. (Khanal et. al, 2018). White grubs feed on the root of almost all of the important crops in Nepal. The crops include maize, tomatoes, potatoes, capsicum, cauliflower, groundnut. However, these pests dislike legumes (Matheson, 1985). In Baitadi, White grubs are mostly encountered in vegetables (tomatoes, potatoes, capsicum, cauliflower, chilly etc.) followed by corn. The location in which white grubs prevail most is Dehimandu-1, Sideshor-7 and Sideshor-8 (Khanal et al., 2018). The same white grub from the season of vegetable production carries on to the next season of maize and incites damage to the roots of young to mature maize plants

In addition, post-harvest pests also inflict a significant damage to the crops. These are insect pests and animal pests (Bhandari et al., 2015). Maize weevil (*Sitophilus zeamais,* Motsch*)* is the most significant post-harvest insect pest in Maize cultivation in Nepal. This pest incites damage through quality degradation of grain by making porous holes inside and residing in them. (Trematerra, Ianiro, Athanassiou, & Kavallieratos, 2013). In store houses in Nepal, a significant grain weight and quality loss is observed. (Tiwari et al., 2018). The ground weevil (*Sitophilus zeamais* Motsch), also known as the large rice weevil, is a species of beetle in the family Curculionidae. The corn weevil is a small (2.5-4 mm long) reddish-brown weevil with a long snout and four reddish-brown spots on the forewing (2 spots on each elytra). The length of the head and thorax is approximately equal to the length of the wings. (Tiwari et al., 2018)

Moreover, the incidence of wild animals in rural Baitadi very high compared to that in urban maize cultivation areas. Some of the animal pests are: Wild boar (*Sus scrofa*), Rhesus monkey (*Macaca mullata), Porcupine (Erethizon dorsatum)*, Birds (*Aves)*, and Rodents (Field mouse *Mus musculus*). Due to their inquisitiveness, intelligence, and proximity to people, rhesus monkeys also caused the highest amount of crop damage in the surrounding Shivapuri National Park (Pandey et at., 2016) Langtang National Park (Regmi et at., 2013) and Chitwan National Park (Mishra, 1982) of Nepal. Primates are also the dominant pest for crop damage in Africa (Amador-Alcala, 2013). Wild Boar (*Sus scrofa*) is the most problematic animal pest in the regions near forest vegetation in Nepal. In shivapuri national park, the most problematic animal was regarded as Wild boar, followed by Monkey, Porcupine and Birds. (Pandey & Bajracharya, 2015). For management, Bio-fencing was practised by building a wall-like structure using *Euphorbia* and *Jatropa* in the areas near Shivapuri national park. (Pandey & Bajracharya, 2015).

In Baitadi, the major problems of pests in Maize arise due to similar cropping patterns every year leading to easy insect pest adaptation coupled with limited access to controlling mechanisms such as pheromone traps and scouting. Organic management methods, though easily accessible, the local farmers do not have any established knowledge-based system concerning the use of these methods. In addition, the controls to post-harvest animal pests have not yet been implemented in Baitadi. Similarly, the rudimentary cultivation practices only aggravate the problem in Maize production.

Despite all of these difficulties, the farmer’s knowledge and perception of pest-damage has been heavily under-studied in Baitadi leading to a lean understanding of insect pest management in this area. This study will attempt to assess farmer's knowledge of insects and pests, their damage, control measures and cultivation practices in the maize production areas in the Baitadi district. More specifically, the research will study the pest infestation patterns as perceived by farmers, cultural practices, and suggest possible solutions to the problems found.

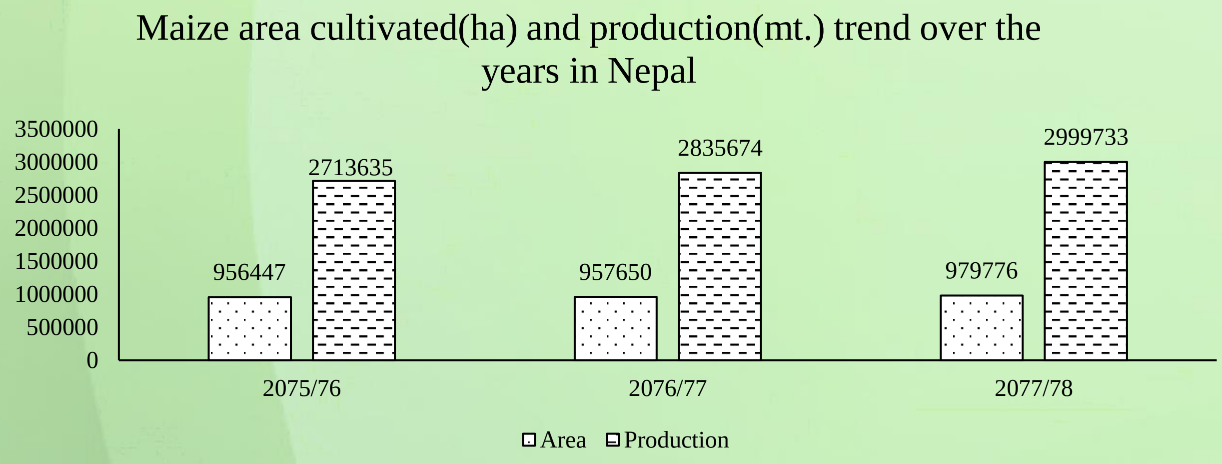

Figure 1: Maize area(ha) and production(mt.) in Nepal over the years
(Source: MOALD, 2077/78)

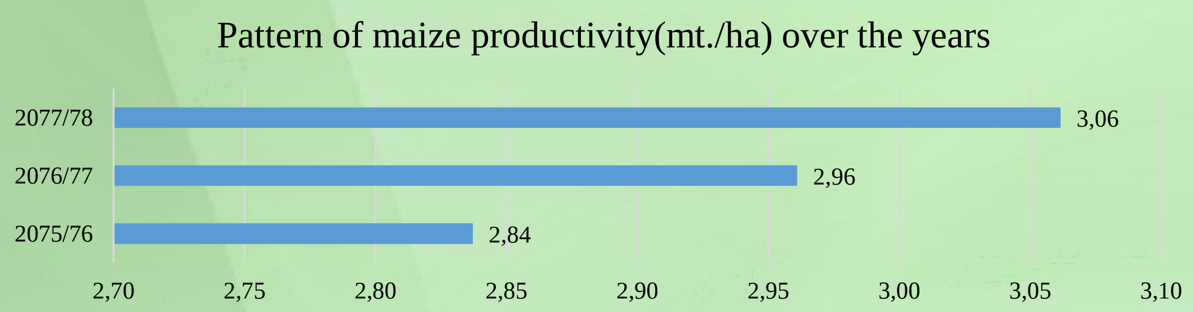

Figure 2. Pattern of maize productivity (mt./ha) over the years in Nepal

Materials and Methods

Learning through Entrepreneurial Experience (LEE) site and subsector

Learning through Entrepreneurial Experience is a program designed by the Agriculture and Forestry University, Chitwan, in collaboration with the Prime Minister Agriculture Modernization Project (PMAMP), Government of Nepal. Under this program, students enrolled in the university in the final semester are sent as interns to Super Zones and Zones in various districts of the country. The students were assigned a Terms of Reference (TOR) stating the work they were supposed to do in the office they get assigned. In addition, the students were also expected to carry out an action research/survey/case study during their tenure at the LEE site and present the results at the end of the semester. The commodity/sub-sector on which they carried out their study depended on which super zone or zone they got assigned. The site of my study is the Baitadi district. The assigned zone for the study of maize by PMAMP was Dashrathchand municipality-10, Dashrath Chand municipality-2, Pancheswar rural municipality-6, and Patan municipality-4, as peak maize-producing areas in the district.

Research site

The research was conducted in Dashrathchand municipality ward no. 2 Gurukhola, Patan municipality ward no. 6, Pancheswar rural municipality ward no. 6 . The field area was located at Latitude: 27.975700 / N 27° 58' 32.52" and Longitude: 83.755000 / E 83° 45' 17.999". The soil type was clay. The site was situated at 2000masl altitude.

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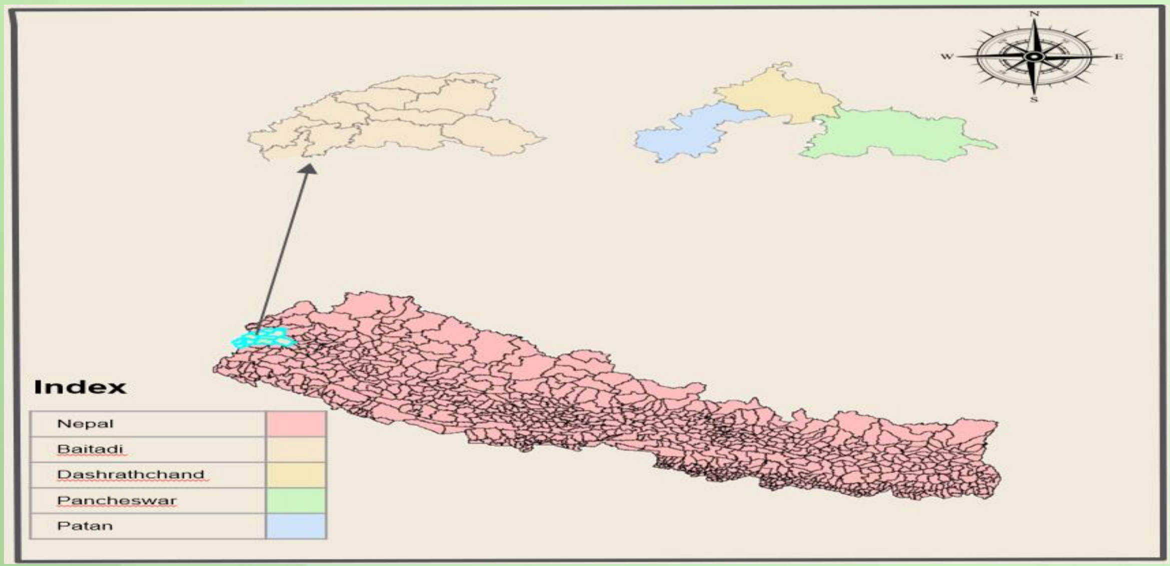

Figure 3: Map of Baitadi showing PMAMP zone

Sample and sampling technique

The sample of the study was drawn in two stages. First, four high maize producing locations in Baitadi district (Patan Municipality, Dashrathchand-2, Dashrathchand-9, and Pancheswor Municipality) and were selected on purpose as per the data available in PMAMP, Maize zone, Baitadi. The list of registered maize farmers from PMAMP Baitadi maize zone was then used to obtain a sample size of 81. The interview was carried out with 75 maize growing farmers with 6 being unable to attend the interview because of various reasons. The interviewees were informed of the fact that their personal information would not be disclosed in public and they were allowed to leave the interview at any time they felt being uncomfortable because of the questions.

To assist the data derived from the interviews, a detailed review of the following materials on the subject matter was done to obtain the necessary secondary data; Journals, Articles, Publications of DOA, NARC, AKC, VDC, PMAMP, Newspaper articles, Related references (textbooks, booklets, leaflets)

Key Informants' Interview: Key informants such as the village local leaders, DADO officer, and OVOT (One village, one technician) were asked a series of questions about the then-present scenario maize problem in the area, current yield statistics, number of people in the area involved in agriculture and maize cultivation.

Case studies: Detailed study about successful maize growers in and around the area, if any, was carried out to find out about methods that can be useful in overcoming the problems related on maize.

Research equipment/design

Data collection was done through a household survey. Based on the interview schedule and checklist, questions were asked with the selected respondents to gain the aimed information. Key Informant Interviews (KII) and Focus Group Discussions (FGD) were carried out primarily to generalize the data and information obtained from scheduled interviews and secondarily obtain additional qualitative information regarding our survey topic.

Household survey

A pre-tested questionnaire was used to collect information on the adoption of improved varieties of maize among maize growers in the the targeted site. The information collected from farmers included the socio-demographic factors, maize cultivation practices, knowledge and perception of farmers about improved variety maize, and extent of adoption of improved varieties in the proposed site.

Key informant interview

Key informants such as the village's local leaders, DADO officers, and OVOT (One village one technician) were asked a series of questions about the present scenario maize problem in the area, current yield statistics, and the number of people in the area involved in agriculture and the maize cultivation.

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Focus group discussion

One comprehensive Focus Group Discussion was conducted after completing the household survey to validate the collected data and information from the farmers. Participants in FGD included local farmers, all ethnic groups of the community and both male and female farmers.

Method of data collection

Both the primary and secondary sources of data collection was used. Maize growers were the major sources of primary data. Secondary information was collected from the document of the different institutions/organizations.

Data analysis technique

The collected data were arranged systematically and put forward for analysis. For data analysis, computer software like SPSS, Ms-Excel, and stata were used.

Descriptive analysis:

The demographic and economic characteristics of the sample were described using descriptive statistics in SPSS. Variables like gender, age, schooling, total farm size, economically active population, etc., were described using descriptive statistics like frequency, percentage, mean, standard deviation etc.

Association test:

Chi-square method was applied for association testing purposes among many dependent and independent variables.

$$\chi2 = \sum \frac{(Oij - Eij)^2}{Eij}$$

Where $\chi2$= chi-square

O_{ij} = observed frequency of each ijth term

E_{ij} = indicates the expected frequency of ijth term

i =1,2, 3..........r j =1,2,3.........K

This was tested at 0.05 or 0.01 level of probability for different degree of freedom.

Logit model

The ordinal logit model was built around a latent regression model represented as; $Y^{*}=\beta' X_i+\varepsilon$. The observed ordinal severity index *Y* is a function of Y^*, an underlying continuous unmeasured latent variable that indexes the level of contribution of selected variables to the respondents' decision-making on perception. β is the parameter vector to be estimated, *X* represents the demographics, farm, and ecological characteristics, and ε is the random error term

Model specification

Let the severity of FAW be an ordinal outcome with J(3) categories;

j {not severe (1), moderately severe (2) and very severe (3)}.

Y be an ordinal outcome (Severity of FAW)

$$logit(P(Y \leq j)) = \beta_{j0} + \beta_{j1}x_1 + \beta_{j2}x_2 + \beta_{j3}x_3 + \beta_{j4}x_4 + \beta_{j5}x_5 + \beta_{j6}x_6 + \beta_{j7}x_7$$

x_1= Education status above secondary (dummy; No=0, Yes=1)

x_2= Education status above lower secondary (dummy; No=0, Yes=1)

x_3= Source of income (dummy; Other=0, Agriculture=1)

x_4= FAW correctly identified or not (dummy; No=0, Yes=1)

x_5= Insect identification capacity (dummy; No=0, Yes=1)

x_6= Frequency of agriculture officer's visits (dummy; Rare=0, Frequent=1)

x_7= Insect pest management knowledge (dummy; No=0, Yes=1)

x_8= Variety of cultivation (dummy; Local=0, Improved=1)

***Constraints ranking and indexing*:**

Constraints will be assessed by group discussion and other participatory approaches. Indexing will be used to rank the problems faced by the farmers in the specific site. The scaling technique provides the direction and extremity attitude of the respondents towards any proposition. The formula below was used to find the index for the intensity of production problems faced by producers.

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$$I_{prob} = \sum \frac{S_i f_i}{N}$$

Where,
I prob = Index value for intensity of problems
∑ = Summation
Si = Scale value of i^{th} intensity
fi = Frequency of i^{th} response
N= Total number of observations

Results

Socio-economic character of the respondents, and corn yield

In the study area, 63.99% of respondents were male. 32% of the total respondents were illiterate, meaning they didn't know how to read or write. 22.66% had only primary education and a meagre 1.33% people had education above bachelors. In the study area, economically active population (29-59) was 66.68% of the total population, followed by older dependent population (>59) which constituted 23.98% of the total population. The source of income for majority of the household (57.68%) was agriculture followed by public service (21.29%), Remittance (9.33%), and business with a paltry 1.34% of people depending on it for income. The average yield of for the improved variety maize growers (3.32mt/ha) was considerably higher than the local maize variety growers (1.98mt/ha) in the study site. Furthermore, the majority of farmers in the study area were small land holders with total cultivable land to be 1243 ropani with an average landholding of 16.57 ropani per household with a standard deviation of 36.24 ropani.

Table 1. Socio-economic character of the respondents, and corn yield

		Bijula	Gurukhola	Gwallek	Patan	Weighted Mean (SD)	X^2value	P value
Education status (%)	Illiterate	25.0	30.8	37.9	29.4	32 (5.85)	29.015^{*}	0.048
	Primary	50.0	0.0	20.7	17.6	22.66 (18.466)		
	L. Sec.	12.5	7.7	13.8	11.8	12.01(2.45)		
	Secondary	0.0	46.2	17.2	17.6	18.65(16.6)		
	Plus 2	0.0	7.7	10.3	0.0	5.31(5.54)		
	Bachelor	12.5	7.7	0.0	17.6	8(8.16)		
	Above bachelor	0.0	0.0	0.0	5.9	1.33(2.85)		
Age (%)	< 29	6.3	30.8	3.4	5.9	9.93(11.4)	10.348^{ns}	0.111
	29 - 59	68.8	38.5	72.4	76.5	66.68(15.2)		
	>59	25.0	30.8	24.1	17.6	23.98(4.83)		
Gender(%)	Female	31.3	23.1	41.4	41.2	36.03(8.24)	1.661^{ns}	0.646
	Male	68.8	76.9	58.6	58.8	63.99(8.25)		
Income source (%)	Agriculture	62.5	53.8	36	93.1	57.68	26.97	0.008***
	Remittance	12.5	15.38	0	17.64	9.33		
	Public Service	25	30.76	6.8	35.29	21.29		
	Business	0	0	0	5.9	1.34		
	Labour	0	0	0	11.77	2.67		
Yield(mt/ha)	Local Variety(mt/ha)	2.66	2.08	1.68	1.60	1.98(0.86)		
	Improved variety(mt/ha)	3.22	3.636	3.44	3.74	3.32(1.16)		

*, **and *** indicates level of significance at 10%, 5%, 1% respectively

Cultivation practices of Maize:

In the study area there was no irrigation facility available for cultivation practices of maize, and were completely dependent upon rain. On average, the sowing occurred on Jestha 7 (SD=3.37) throughout the study area, commensurate with the average monsoon arrival date. The earliest sowing date was found to be Jestha 1, and the latest sowing date was found to be Jestha 12. 98.6% cultivated Local maize seeds, 1.3% cultivated improved seed only, 38.7% households cultivated Local seeds only, 60% households cultivated both local and improved maize

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seeds and 61.3% cultivated improved maize seeds. 96% of households practiced intercropping in their maize fields. Among them 97.2% cultivated indigenous crop called *sotta*. Intercropping was done in the local maize variety fields only and not in improved maize variety cultivated fields.

Insect pest knowledge among farmers:

98.6% of farmers claimed that they could successfully identify the insect pests that infested their maize. However, upon interrogation about the pest's physical and symptomatic features, only 69.3% of farmers actually had the knowledge. 59.3%, 69.3%, and 73.9% of farmers could identify the FAW, Cutworms, and White Grubs, respectively, upon seeing it. And 89.3%, 93.8%, and 89.6% farmers could identify the symptoms correctly of FAW, Cutworms, and White Grubs, respectively, in their maize fields.

Fall army worm was the most problematic pest by far with a total rank index of 0.84 followed by Cutworms (0.78), White grubs (0.58), and Borers (0.30). FAW was the most severe pest in Vegetative growth stage, Tasseling stage, and physiological maturity stage of maize development among all the pests. While Cutworms were the most severe during Seedling and Knee-high stage, White grub severity was considerably low in comparison to other pests. Maize Borer, although seen occasionally, no damage was reported by farmers.

Furthermore, the study observed that the respondents with; an education level above lower secondary, agriculture as the primary source of income, the capacity of identifying FAW mark of identification, and insect pest knowledge had significant odds of 4.52, 5.55, 16.88, and 5.02, respectively, of perceiving FAW attacks as highly severe as compared to the odds of perceiving FAW attacks as not severe and moderately severe both combined. In contrast, respondents with insect identification capacity had significantly lesser odds of selecting High severity as compared to odds of perceiving FAW attacks as not severe and moderately severe.

While insect pests were the major nuisance, due to proximity of rural Baitadi to forests, animal pests were also significant in their impact. Among the animal pests, Wild boar (Sus scrofa) was ranked highest on the basis of damage severity followed by Porcupine, Monkey, Birds, and Rodents.

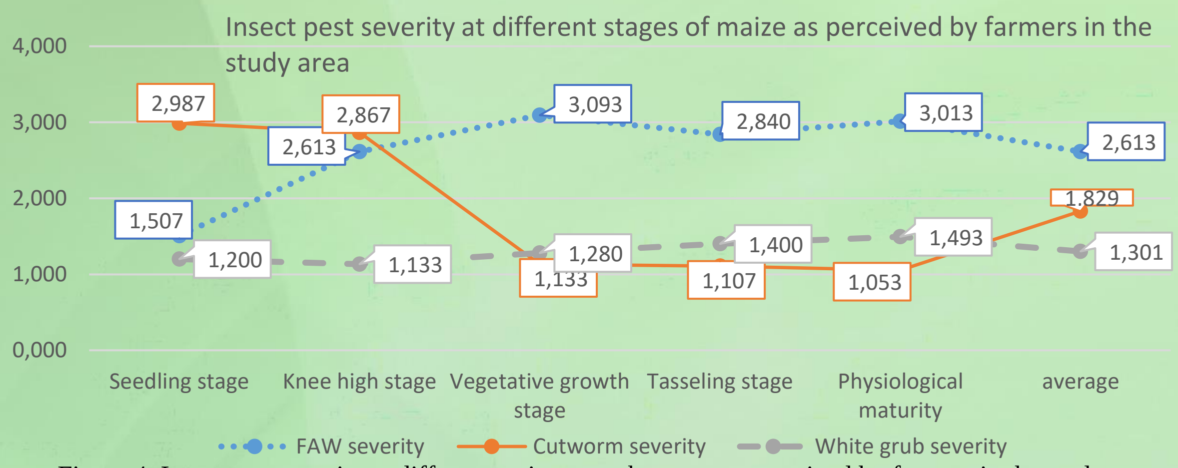

Figure 4. Insect pest severity at different maize growth stages as perceived by farmers in the study area

Table 2. Determinants of perception of farmers on the severity of FAW in the study site

FAW severity order	Coefficient	Std. err.	Odds ratio	Std. err.	P value
Above lower secondary education (above Lower Secondary =1, below Secondary = 0)	1.510	0.733	4.528**	3.317	0.039
Above Secondary education (above Secondary = 1, below Higher Secondary = 0)	-1.161	0.928	0.313	0.290	0.211
Sources of income (0=other, 1= Agriculture)	1.715	0.636	5.556***	3.532	0.007
FAW correctly identified or not (0=no, 1=yes)	2.827	0.766	16.900***	12.941	0.000
Insect identification capacity (0=no, 1=yes)	-2.106	0.762	0.122***	0.093	0.006
Frequency of agriculture officers' visits (1=frequent, 0=rare)	0.583	0.676	1.793	1.212	0.388
Insect pest management knowledge (0=no, 1=yes)	1.615	0.741	5.028**	3.725	0.029
Variety of cultivation (1=improved, 0=local)	-1.046	0.552	0.351*	0.194	0.058
/cut1	-0.322	0.841	-0.322	0.840	
/cut2	2.925	0.915	2.925	0.915	

*,**and *** indicates level of significance at 10%, 5%, 1% respectively

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Table 3. Ranking of animal pests prevailing in the study area based on their damage severity in maize production

	1	2	3	4	5		Rank index	Rank
Wild boar	44	18	1	12	0		0.85	I
Porcupine	0	52	23	0	0		0.73	II
Monkey	31	0	27	9	8		0.69	III
Birds	0	0	17	40	18		0.39	IV
Rodents	0	5	7	14	49		0.31	V

Ins
ect pest management knowledge among respondents:

77.33% of the farmers had the know how of insect pest management in the study area. When asked about what form of pest management strategy would they prefer if the resources were at their disposal, usage of chemical pesticides was ranked first for the highest number of times with a rank index of 0.73 followed by Physical management (0.63) and Biological management (0.61). For FAW, only 46.67% of the farmers reporting FAW infestation in their field tried to manage them culturally. The most popular cultural method was early plantation (62%) followed by application of ash (42.9%). On the contrary, 88% of the farmers didn't use any chemical management method at all.

Among post-harvest insect pests, to manage Maize weevil 65.3% of the farmers used "Celphos" even though it was partially banned in the study area. 56% of the farmers used sun curing and 38.7% of them used indigenous biological control methods such as Neem leaves, Walnut leaves, and Sichuan pepper.

Table 4. Fall Armyworm cultural management methods used in the study site

		Responses		Percent of Cases
		N	Percent	
Cultural method	Early Plantation	22	51.2%	62.9%
	Ash	15	34.9%	42.9%
	Deep Ploughing	6	14.0%	17.1%
Total		43	100.0%	122.9%

a. Responses percent denotes percentage out of total responses recorded
b. Cases percent denotes the percentage out of the total respondents involved.

Test of association between different independent and dependent variables

The study shows that education status is significantly associated with seed storage structures, chemical fertilizer usage, and insect pest management knowledge at 10%, 10%, and 5% of significance, respectively. Moreover, the study elucidates that the frequency of extension agent visits was significantly associated with Seed storage structures used, Chemical fertilizer usage, Insect identification capacity, and IPM awareness among the farmers at 1%, 1%, 5%, and 1% level of significance respectively. Furthermore, access to membership was significantly associated with Insect pest management knowledge at 10% levels of significance, respectively. In addition, provision of training to farmers was significantly associated with IPM awareness among them. (Table: 5)

Table 5. Association between dependent and independent variables

		LPDS	STS	SSS	CFU	III	IMK	MPU	PPE	IMP
Gender	X^2	1.339	2.365	6.234	.033	2.014	1.484	.412	1.432	1.140
	P(value)	.512	.500	.398	.856	.156	.223	.521	.231	.286
Education status	X^2	15.396	24.904	50.462	11.048	8.445	12.605	8.880	10.152	8.606
	P(value)	.220	.128	.055*	.087*	.207	.050**	.180	.118	.197
Frequency of Agri-visit	X^2	.651	1.464	52.045	8.042	6.351	1.491	2.366	.111	19.452
	P(value)	.722	.691	.000***	.005***	.012**	.222	.124	.739	.000***
Access to membership	X^2	8.937	2.127	5.386	.324	1.766	3.490	.289	.350	.744
	P(value)	.011**	.546	.495	.569	.184	.062*	.591	.554	.389
Provision of training	X^2	.571	4.327	5.866	.054	.232	.410	.182	.044	3.914
	P(value)	.752	.228	.438	.816	.630	.522	.669	.834	.048**

LPDS: Land preparation, days prior to sowing; STS: Sowing techniques; SSS: Seed storage structures; CFU: Chemical fertilizer usage; III: Insect identification; IMK: Insect pest management knowledge; MPU: Method of pesticide use; PPE: Possession of pesticide equipment; IMP: IPM awareness; *, **and *** indicates level of significance at 10%, 5%, 1% respectively

Discussion

There were no prior research efforts concerning the pest problem in Baitadi, although being a burning issue among the maize farmers. Several findings, associations, and determinants were observed and inferred throughout the study. The majority of the respondents were male. This calls for the fact that in most households, decisions taken are male-dominated, whereas women task force is more perpetuated towards indoor activities. This pattern follows the common suit of male being decision dominant in agriculture and women's decision being dominant in household tasks in the Nepalese context. The majority of the respondents, with limited access to transportation, consequently devoid of education (1/5th of the surveyed population was still illiterate, and 44% of people with a secondary or above level of education.) and business schooling, it is no surprise that they were reliant on agriculture for their livelihood. The local variety of maize was largely more cultivated than improved varieties because of a lack of availability, knowledge etc. (Chete, 2021). The date of sowing was similar every year, with the average date of Jestha 7 varying from Jestha 1 to Jestha 12, barring some inconsistencies. 96% of the respondents would plant maize early because of Early rainfall. If late planted, 90% and 80% of the respondent would late plant if the dry weather spell was longer than usual and there was a lack of irrigation facilities, respectively. This portrays the insidious problem of lack of irrigation during the dry period in Baitadi.

Even though 99% thought they could identify the insect pests encountered in their fields, only 69% could actually identify them. The fall armyworm was the most severe insect pest, followed by Cutworms, White grubs, and borers. Fall armyworms being voracious feeders and the most recent insect pests in the area, are the most severe of the insect pests as farmers perceive. The novelty of the pest is one of the many factors that have increased its perceived severity.

59.3% and 96.4% of respondents correctly identified FAW from their Mark of identification and their infested symptoms. Symptoms were readily identified rather than a typical mark of identification of FAW as farmers tend to notice the damage caused by insects rather than the actual insect. This basic psychological tendency explains their insect pest identification pattern. Similarly, 60.4% and 93.8% correctly identified Cutworms from their Mark of identification and infested symptoms, respectively. However, 73.9% and 56.4% correctly identified White grubs from their Mark of identification and symptoms, respectively. This aberration is explained by the fact that most farmers could not distinguish if the damage in their plants was caused by white grub. The damage symptoms of White grubs are wilting and root damage of the maize plant. These symptoms are not clearly associated with White grub for the farmers as many other factors may cause wilting and root damage because White grub symptoms were less often identified than their Mark of identification. This provides new insight into how farmers perceive damage from White grubs.

For the initial seedling and knee-high stages, cutworm had the highest severity, closely followed by FAW, but at and after the Knee-high stages Severity of FAW peaked, and the severity of cutworm dropped significantly. In the initial stages of maize development, Cut worms are known for their behavior of cutting down seedlings, so their perceived severity is high than fall armyworms that only start to infest when the maize development reaches the phase of vegetative growth. As FAW larvae are voracious feeders, they affect most severely at the vegetative stage and later. This explains the perceived severity pattern observed among farmers. White grubs did not look threatening at any growth stage of maize in the area.

A respondent with an education level above lower secondary, a major source of income as agriculture, who correctly identified FAW from their mark of identification, who have insect pest management knowledge had significantly high odds of choosing FAW as highly severe in comparison to odds of choosing not severe or moderately severe. An educated farmer can better comply with the information provided to him/her, thus having a conscience of stating FAW as very severe. Those who had a major source of income in agriculture are more invested in the factors that may degrade their productivity than the farmers who did not have agriculture as their major profession. FAW infestation was a peril, so they were expected and found to perceive FAW attacks as highly severe. Those who could correctly identify FAW naturally perceived FAW as severe. Furthermore, those with better knowledge of insect pest management knew about the life cycle of FAW. AThus, they would know how severe the attacks can be at certain life cycle stages of FAW.

Wild boar was the most severe animal pest, followed by Porcupine, Monkey, Birds and
Rodents. (Field survey, 2022) Most villages were near forest areas; the wild animals were major perils from which the grains had to be preserved. Animal pests were one of the significant reasons behind farmers' focus not shifting towards damage caused by insect pests and the adoption reluctance of improved maize varieties. (Field survey, 2022). Most farmers prefer chemical methods for insect pest management if available abundantly. This can be directly linked to a lack of IPM awareness among farmers in the study area. 46.67% used cultural methods for FAW control. 88% did not use any chemical pesticides. Chemical pesticides were simply unavailable. 20% used Deep plowing as a cultural method for White grub control. Most did not use any method for Whitegrub control because symptoms were not seen as often as those of Cutworm and FAW.

For weevil control majority used celphos (65.3%). The majority of those who used biological methods (58.4%) used "Both Sichuan pepper and walnut leaves." The pungency of Sichuan pepper and Walnut leaves worked as repellents for Maize Weevils.

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The association test results portrayed the relationship between Education status and; Seed storage structures used, Chemical fertilizer usage, and Insect pest management knowledge. Traditional seed storage structures were incapable of conserving grains, resulting in post-harvest losses. It can be inferences from the result above that those people with good education did know the consequences of traditional seed storage structures; thus, they moved on to modern seed storage structures. People with good education knew the importance of chemical fertilizers and were more equipped with insect pest management knowledge. Though having rare visits, the "Frequency of agri-professionals visits" was associated with Seed storage structures used, Chemical fertilizer usage, Insect identification capability, and IPM awareness among farmers. "Access to membership of cooperatives" was associated with "Insect pest management knowledge" among farmers. "Provision of training" was found to be associated.

Conclusion

Even though maize is the second most popular staple crop in this region and inherently etched in people's daily lives, lack of availability and implications of available technology and information has ensured that the level of maize cultivation does not improve from the one that is prevailing traditionally. Furthermore, the scale of urgency among farmers regarding pest damage is even more alarming. Most farmers have considered insect pest damage as normal and a factor that cannot be controlled, leading to consequence that they are not interested in insect pest management for anything other than FAW, because of its more visible symptoms and its alarming feeding rate. This has kept the practice of insect pest management confined to only FAW to a large extent. FAW being the most recent pest, a keen insight may be drawn from the results of the factors affecting farmers' perception concerning its severity. Education, their major source of income, Insect identification capacity, Insect pest management knowledge, and Improved variety cultivation positively affected the chances of FAW attacks being called severe, which they must be.

FAW was the most severe insect pest according to farmers, and cutworm was accepted as normality despite being detrimental at the initial stages as no management practices would be deployed against it. For white grubs, no insect pest management practices were adopted. Agriculture education is lacking in the community. This can be testified by the fact that 99% of farmers, although sure that they could identify the insect pests, only 69% could actually identify them.

Cultural practices are popular in the area, but without any systematic mechanism governing the practices. Among the cultural methods Deep ploughing, usage of ash and early plantation are the popular ones. The application is entirely informally spoken without any written or formal publications.

Management of animal pests was not considered possible and the infestation was inevitable. Although animal pests are causing damage in a similar intensity as insect pests and post-harvest pests, no management practices were observed. Without government-aided fencing, the locals were not able to follow through with any action.

This study suggests that farmers reach out for agricultural education opportunities. They should increase the usage of cultural methods for insect pest management which are the most applicable & readily available methods. Emphasis should be given to participating in agriculture cooperatives and participating in training. The adoption of improved variety is recommended for traditional local farmers. Likewise, for the future researchers the study suggests further explorations of the possibilities of study on the efficacy of locally accessible cultural practices FAW management in the region, and further study on reason behind certain pockets of maize cultivation area being FAW free.

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