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Research Article

Farmers' perception on the performance of different rice varieties in Kapilvastu district, Nepal

Sundar Sapkota[1*] and Sanjib Sapkota[2]

[1]Department of Biology, Eastern New Mexico University, Portales, NM 88130, USA.

[2]Department of Biological Sciences, Simon Fraser University, Burnaby, V5A 1S6, Canada.

*Correspondence: sundar.sapkota@enmu.edu

ORCID: https://orcid.org/0000-0001-5948-9523

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ABSTRACT

Rice is the major staple food crop in Nepal. To date, several rice varieties have been developed and released in Nepal. However, rice production is far below in comparison with its production potential. A household survey was conducted in Bangaganga municipality of Kapilvastu district in 2018 to assess farmers' perception on performance of four different rice varieties (Radha-4, Ramdhan, Gorakhnath, and Sawa). The data were collected from a total of 120 rice farmers (randomly selected) using the interview schedule and analyzed using descriptive statistics, Likert scale, and indexing technique. Statistical analysis showed that the Ramdhan variety had the highest yield (4.95 t/ha), whereas Radha-4 had the lowest yield (3.15 t/ha). The most disease and drought-tolerant variety, as perceived by the farmers, was Radha-4. Smut and Khaira were perceived as the primary diseases whereas Brown planthopper and Rice Gundhi bug were the most important insects of all studied rice varieties. The study recommended that the plant breeders should focus on developing site-specific rice varieties to meet the multiple concerns of the farmers, such as higher yield and stress-tolerant. The farmers should be made aware of varietal selection and crop pest management techniques via training programs, which further helps to reduce the yield gap between farmers' field and research field.

Keywords: *Oryza sativa*, perception, varieties, indexing, farmer

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INTRODUCTION

Rice (*Oryza sativa* L., Poaceae family) is the primary food crop to more than half of the world's population. It provides diet to millions of Asians, Africans, and Latin Americans in tropics and subtropics regions (Yoshida, 1981). In Nepal, rice ranks first food crop, provides more than 50% calories to the Nepalese diet (Basnet, 2008; Gauchan et al., 2014; Kharel et al., 2018: Gadal et al., 2019; Devkota et al., 2019). Rice contributed 31.4% and 21% to GDP and AGDP respectively (MoF, 2017; Bhusal et al., 2018). Rice can be grown in diverse elevations ranging from 50 to 3,000 meters. Modern rice varieties were developed and released in Nepal since 1960s. Kapilvastu district, because of its climate and environment, reported as one of the major rice-producing regions of Nepal. Most rice farmers in Kapilvastu district grow a few popular varieties such as Sawa, Ramdhan, Radha-4, and Gorakhnath. In addition, other cultivars such as Golden Mansuli, Loknath, Hybrid (6444), Hardinath, Sukha-3, Sabitri, Kala namak, Mayur, Motisabha, Mahima, Sindhur, Sawa Saba-1, and Swarna Sawa-1 were grown in the district (DADO, 2016; Sapkota & Sapkota, 2019).

It is essential to understand what farmers know about plant varieties, their perceptions about the crop yield, stress incidence, and yield loss. Farmers' pest and disease perception and damage quantification might be quite different and less accurate than biological research in the field. However, farmers' knowledge provides crucial information as farmers decide on a course of action based on what they think the problem is, not on the actual problem. If farmers have better knowledge about plant varieties, pest's infestation, and drought effect, yield loss could be reduced substantially (Adam et al., 2015).

Farmers benefits from cultivating a specific crop variety. The decision to grow particular crop variety is determined by the household's perception of its ability to fulfill the household's requirement and relative to other alternative options (Brush and Meng, 1998). Improved rice varieties can change in farmer's status. Changes are associated with selection and seed management practices, which are, in turn, affected by economic, social, and cultural conditions. Farmer's understanding of diseases is reported for millet in Ghana, (Tanzubil & Yankubu, 1997), cotton in Africa (Ochou et al., 1998), and vegetables in Botswana (Obopile et al., 2008). Furthermore, Rubia et al. (1996) reported farmers' perception of white stem borer of rice in Indonesia. However, in Nepal, farmers' perception on crop performance has not been reported yet. Building knowledge among farmers is, therefore, a meaningful way to enhance crop production. Thus, this study aims to assess farmers' perception on the performance of four different rice varieties in Banganga municipality of Kapilvastu district.

METHODOLOGY

Study area

A survey study was conducted in Banganga municipality (latitude: 27°35″- 27°48″ N; longitude: 83°03″ E; altitude: 107 m) of Kapilvastu district in 2018. The area was selected purposively as it was noted for extensive rice production according to the rice implementation zone, Kapilvastu. The average annual minimum, maximum temperature, and precipitation of the study site were 6 °C, 38° C, and 130 cm, respectively.

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Selection of farmers

Rice farmers were selected based on the criteria that they had planted different varieties of rice. The total sampling population was five hundred rice farmers and was obtained from the rice implementation zone, Kapilvastu. One hundred twenty rice farmers (30 farmers for each four varieties: Gorakhnath**,** Radha-4, Ramdhan, and Sawa) were randomly chosen for the study.

Data collection and analysis

Data were collected from rice farmers using an interview schedule. The collected data were processed into Microsoft Excel. The yield of different rice varieties was analyzed using descriptive statistical tool such as mean. The importance and severity of biotic and abiotic stress were ranked to highlight farmers' perceptions. Likert scale and indexing technique were used to quantify farmer perception on different variables. The average of the index was determined, and values were compared to give an overall ranking for the variety. Following formula was used to determine the index of importance (Miah, 1993).

$$\text{Iimp} = \text{I} = \sum \frac{S_i f_i}{N}$$

Where,
Iimp = Index of importance
Si = Scale value
fi = frequency of importance given by the respondents
N = Total number of respondents

Different scale values such as 1, (1-1/n), (1-2/n), (1-3/n) …were used, where n denotes number of categories in ranking.

Subedi et al. (2019a) used this formula to identify the constraints associated with the potato production in Terai region of Nepal. This formula was applied by Shrestha and Shrestha (2017) to rank the problems associated with maize seed production. Subedi et al. (2019b) used this technique to explore the problems associated with wheat production.

RESULTS AND DISCUSSION

Rice yield

The greatest grain yield was produced from Ramdhan variety followed by Gorakhnath (Table 1). The final rice production depends on genetic makeup, crop adaptability to the environment, stress incidence, and cultivation practices. The higher yield of Ramdhan could, in part, be due to the presence of a better gene that can resist disease and weeds infestation. Chendge et al. (2017) reported that the genetic makeup of the crop is the primary factor determining its growth and production. The production potential of rice varieties: Radha-4, Ramdhan, and Sawa at the national level in Nepal are 3.2 t/ha, 4–7.2 t/ha, and 3.5– 4 t/ha, respectively (AICC, 2018). Efisue et al. (2008) reported that the significant yield gap between farmers' yield and the yield potential is probably due to: a) drought stress b) use of low-yielding varieties and c) lack of agricultural inputs such as fertilizers. Thus, emphasizes should be given in developing new varieties that are drought-tolerant, high yielding, and adaptable to environments.

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Table 1. Average yield of four different rice varieties perceived by the farmers' in Banganga, Kapilvastu

Rice Varieties	Grain Yield (t/ha)
Ramdhan	4.95
Radha-4	3.15
Gorakhnath	4.2
Sawa	3.75

Source: Field survey, 2018

Rice varieties and disease incidence

Farmers perceived Khaira as the most critical disease for Radha-4 and Ramdhan rice. In contrast, Smut ranks as the primary disease for Gorakhnath and Sawa varieties (Table 2). This finding corresponds to the reports of Khanal et al. (2017), who stated that Radha-4 was resistant against blast disease.

Table 2. Farmers' perception on disease incidence for different rice varieties in Banganga, Kapilvastu

Varieties/	Radha-4		Ramdhan		Sawa		Gorakhnath	
Diseases	Index	Rank	Index	Rank	Index	Rank	Index	Rank
Smut	0.69	II	0.71	III	1	I	0.95	I
Blast	0.51	IV	0.60	IV	0.51	IV	0.67	III
Khaira	0.88	I	0.86	I	0.78	II	0.76	II
Sheath Blight	0.52	III	0.43	V	0.43	V	0.56	IV
Brown Spot	0.31	VI	0.80	II	0.63	III	0.56	IV
Bacterial Blight	0.34	V	0.33	VII	0.34	VII	0.35	VI
Foot Rot	0.22	VII	0.34	VI	0.40	VI	0.21	VII

Source: Field survey, 2018

Rice varieties and insect incidence

Notably, farmers were able to differentiate various insects and their intensity in the rice field. Three rice varieties: Radha-4, Sawa, and Gorakhnath, were infected by one remarkable insect, Brown planthopper. For Ramdhan rice, farmers perceived Rice Gundhi Bug as the major insect (Table 3).

Table 3. Farmers' perception on insect incidence for different rice varieties in Banganga, Kapilvastu

Varieties/	Radha-4		Ramdhan		Sawa		Gorakhnath	
Insects	Index	Rank	Index	Rank	Index	Rank	Index	Rank
Grasshopper	0.58	III	0.58	IV	0.42	IV	0.54	IV
Rice Gundhi bug	0.79	II	0.83	I	0.86	II	0.79	II
Leaf Roller	0.38	VI	0.48	V	0.35	VI	0.37	VI
Brown planthopper	0.89	I	0.75	II	0.90	I	0.80	I
Armyworm	0.54	IV	0.64	III	0.69	III	0.76	III
Stem borer	0.42	V	0.37	VI	0.36	V	0.40	V

Source: Field survey, 2018

Rice varieties and weed incidence

Farmers were asked to prioritize different weeds that they observed the most in their rice field. Farmers reported *Echinochloa* as the major weed in Sawa and Gorakhnath rice, whereas *Cynodon* as the least growing weed for those rice varieties (Table 4). Dry tillage, alternate wetting and drying practices favor germination and growth of highly competitive

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weeds, causing yield loss of 50–91% (Elliot et al., 1984). Thus, timely weed control is vital to enhance rice production.

Table 4. Farmers' perception on weed infestation for different rice varieties in Banganga, Kapilvastu

Varieties/	Radha-4		Ramdhan		Sawa		Gorakhnath	
Weeds	Index	Rank	Index	Rank	Index	Rank	Index	Rank
Cynodon	0.75	I	0.73	I	0.38	IV	0.44	IV
Echinocloa	0.55	IV	0.59	II	0.94	I	0.961	I
Digitaria	0.71	II	0.47	IV	0.67	III	0.59	III
Fimbrysylis	0.37	V	0.51	III	0.68	II	0.61	II

Source: Field survey, 2018

Overall ranking of biotic stress incidence in different rice varieties

The overall biotic stress was determined based on the index of priority value, which was calculated taking the average of individual stress incidence rank. The highest disease incidence was found in Sawa rice, followed by Ramdhan and Gorakhnath. Similarly, farmers perceived the most top insect and weed incidence in Gorakhnath and Radha-4 rice respectively (Table 5).

Table 5. Farmers' perception on incidence of biotic stress for different rice varieties in Banganga, Kapilvastu

Biotic stress/	Disease incidence			Insect incidence			Weed incidence		
Varieties	Weightage	Index	Rank	Weightage	Index	Rank	Weightage	Index	Rank
Gorakhnath	17.4	0.58	II	18.34	0.61	I	18	0.60	III
Radha-4	14.854	0.50	III	18	0.60	III	18.52	0.62	I
Ramdhan	17.4	0.58	II	18.26	0.608	II	18.25	0.61	II
Sawa	17.56	0.59	I	17.92	0.59	IV	17.96	0.59	IV

Source: Field survey, 2018

Performance of rice varieties in drought condition

According to the Likert scale, farmers were asked to indicate the performance of rice varieties under drought condition on a different scale; -1 (drought susceptible or poor performance), 0 (slight drought resistant or average performance), 1 (drought resistant or good performance). Farmers in Banganga mentioned Radha-4 as the most drought-tolerant variety followed by Ramdhan. In contrast, farmers perceived Sawa as the most drought susceptible variety (Table 6). Efisue et al. (2008) reported drought stress hampers both vegetative and reproductive stages of rice. The genotypic variation existing among rice varieties cause the plant to respond differently under drought condition. Drought at the vegetative stage: a) delays flowering time b) reduces tiller numbers and c) lowers biomass (Lilley and Fukai, 1994). Furthermore, Villegas et al. (2007) reported that spike length and weight were negatively associated with the drought susceptibility index.

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Table 6. Farmers' perception on performance of rice varieties in drought condition in Banganga, Kapilvastu

Varieties	Scales					
	Good (1)	Average (0)	Poor (-1)	Weightage	Index	Rank
Gorakhnath	0	16	14	-14	-0.47	III
Radha-4	30	0	0	30	1	I
Ramdhan	10	17	3	7	0.23	II
Sawa	0	8	22	-22	-0.73	IV

Source: Field survey, 2018

Yield loss due to biotic stress

Farmers were asked to indicate grain yield loss due to biotic stress for four rice varieties on different scales: -1 (negligible), 0 (slight), and 1 (severe). The scale values were further used to determine index value and provide the final rank. Farmers perceived a severe yield loss in Radha- 4 variety, followed by Gorakhnath and Sawa due to disease. Farmers mentioned insects as the primary cause for yield reduction in Gorakhnath rice, and second biotic cause to Radha-4 and Sawa. Farmers ranked weed as the major biotic stress responsible for the significant yield reduction in Ramdhan rice (Table 7). Additionally, the net benefit obtained from rice cultivation depends on production cost and market price. Sapkota and Sapkota, (2019) reported that Sawa variety had highest benefit cost ratio in Banganga municipality of Kapilvastu district in Nepal.

Table 7. Farmers' perception on yield loss due to biotic stress for different rice varieties in Banganga, Kapilvastu

Biotic stress/	Disease			Insect			Weed		
Varieties	Weightage	Index	Rank	Weightage	Index	Rank	Weightage	Index	Rank
Gorakhnath	-4	-0.13	II	4	0.13	I	4	-0.13	III
Radha-4	2	0.06	I	-1	-0.03	II	-1	-0.03	II
Ramdhan	-6	-0.2	IV	-5	-0.17	III	4	0.13	I
Sawa	-5	0.16	III	-1	-0.03	II	-9	-0.30	IV

Source: Field survey, 2018

CONCLUSION

In summary, the farmers in the Banganga municipality cultivated different varieties of rice. The farmers in the study area had a good understanding of crop production, stress incidence, and damaged yield and were concerned about crop performance. It is essential to incorporate farmers' opinion about the crop performance in breeding programs to encourage farmers for the adoption of right varieties which in turn enhance crop yield and quality. Furthermore, crop improvement programs should emphasize the development of ecologies specific crop varieties to increase impact. The farmers should be made aware of varietal selection and crop pest management techniques via training programs, which further helps to reduce the yield gap between farmers' field and research field.

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Author contributions

Conceptualization, S.S. (Sundar Sapkota) and S.S. (Sanjib Sapkota); Methodology, S.S. (Sundar Sapkota), data collection and analysis, S.S. (Sundar Sapkota); original draft, S.S. (Sundar Sapkota); Writing- review and editing, S.S. (Sundar Sapkota) and S.S. (Sanjib Sapkota).

Conflict of interest

Authors declare no conflict of interest.

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