P-ISSN: 2618-0723
E-ISSN: 2618-0731

NAAS Rating: 5.04
www.extensionjournal.com

International Journal of Agriculture Extension and Social Development

Volume 7; Issue 1; Jan 2024; Page No. 01-10

Received: 02-11-2023
Accepted: 04-12-2023

Indexed Journal
Peer Reviewed Journal

Dimensions of Berseem clover (*Trifolium alexandrinum* L.) seed production in Nepal: Exploring socio-economic perspectives

[1]Ram Prasad Ghimire, [2]Naba Raj Devkota, [2]Durga Devkota, [2]Mohan Prasad Sharma and [3]Rita Amgain

[1]National Fodder and Pasture Research Program, Nepal Agricultural Research Council, Khumaltar, Lalitpur, Nepal

[2]Agriculture and Forestry University, Rampur, Chitwan, Nepal

[3]National Soil Science Research Center, Khumaltar, Lalitpur, Nepal

DOI: https://doi.org/10.33545/26180723.2024.v7.i1a.195

Corresponding Author: Ram Prasad Ghimire

Abstract

Berseem clover stands as a prevalent choice among farmers in Nepal's dairy-pocket areas, functioning as a crucial winter fodder legume for both small-scale subsistence farmers and commercial counterparts. Despite its popularity for lush greenery, there is limited enthusiasm among farmers for seed production. This study, employing social surveys, focus group discussions, and key informant interviews, investigates this phenomenon. Conducted immediately after the Berseem clover cropping season, the household survey targets seed production pockets in Banke and Bardiya districts. Results indicate a higher involvement of female farmers in Berseem clover seed production compared to males, with respondents generally possessing a favorable educational background. Families cultivating Berseem clover seeds are predominantly engaged in agriculture, often combining it with remittances. Most farmers own Bari and Khet lands dedicated to Berseem clover cultivation, with the prevalent cropping pattern being paddy-Berseem clover (86.67%). Despite a notable reduction in cultivated land area per household for seed production, the study reveals Berseem clover seed production's greater economic viability compared to wheat and chickpea cultivation. Notably, 95% of farmers rely on seeds from formal sources, including government farms, research stations, government agencies, local agro-vets, and cooperatives. The marketing of Berseem clover seeds is extensively facilitated by both government agencies and private institutions. Challenges identified encompass lower productivity, unstable seed yield and quality, inadequate production packages for the region, storage facility challenges, cash-flow issues, mechanization concerns, marketing complexities, pricing challenges, seed quality, insect/caterpillar problems, *Cascutta* spp. infestations, other weed-related issues, and susceptibility to adverse climate and weather conditions.

Keywords: Economics, institutions, landholdings, marketing, occupation, problems and challenges

Introduction

Berseem clover, a native landrace in Egypt, has become one of the most popular annual fodder legumes globally. Widely cultivated as a winter legume, it finds a place in regions such as South East Asia, North America, Southern Africa, Southern Europe, and Australia (Muhammad *et al.*, 2014; Vijay *et al.*, 2017) [1, 2], as well as the Mid-west USA (Oushy, 2008) [3]. In the Terai and lower hills of Nepal, Berseem clover has played a crucial role in winter feeding strategies for ruminants for over four decades. With qualities like high digestibility (65%), excellent palatability, extended availability (November-May), and remarkable persistence, it stands out as a widely adopted fodder option (Tiwari & Yadav, 2014; Sharma, 2015; Vijaya *et al.*, 2017) [4, 5, 2].

Likewise, Berseem clover is a common choice among farmers in dairy pockets of Nepal for green fodder, catering to both small-scale subsistence farmers and commercial ones. However, in recent times, the production of Berseem clover seeds has dwindled among farmers in the Western Terai districts, in contrast to its prior cultivation by a larger number of farmers across 11 districts in Nepal (Ghimire, 2013; Pande, 2014) [6, 7]. Despite the immense potential for Berseem clover seed production of more than 200,000 hectares of paddy fields in various districts (Pande, 1995; TLDP, 2002; Pande, 2014) [8, 9, 7], the national production has declined significantly over the past two decades (Pande, 2014; NAFLQML, 2019) [7, 10]. This decline is particularly alarming as the demand for Berseem clover seeds continues to rise annually (Pande, 2014; Singh & Singh, 2019; NAFLQML, 2019) [7, 11, 10]. Farmers' preference has shifted away from seed production in recent years, focusing more on the cultivation of Berseem clover for its green lushes. Consequently, Nepal has been importing substantial quantities of Berseem clover seeds from other countries (NAFLQML, 2019) [10].

Understanding the constraints faced by farmers and identifying potential technical interventions are critical in addressing the challenges associated with Berseem clover seed production in the current scenario. The study aims to investigate the socioeconomic aspects of Berseem clover seed production in its production pockets in Nepal.

Materials and Methods

A social survey with semi-structured questionnaires, which involved focus group discussions and key informant

interviews, was carried out.

Household survey

The household survey was carried out between June and August 2017, right after the Berseem clover cropping season, focusing on its seed production hubs in Banke and Bardiya districts. The survey concentrated on two clusters located in Basantapur and Dallahipur villages within the Khajura Rural Municipalities of Banke district, as well as Guleriya Municipality in Bardiya district. These regions have a longstanding history of Berseem clover seed production. Employing a semi-structured questionnaire, the study encompassed 60 farmers with a consistent track record of Berseem clover seed production.

Focus group discussion and key informants' interview

Conducting a Focus Group Discussion (FGD), one in each district, proved instrumental in uncovering issues, constraints, and potentialities related to Berseem clover seed production, along with collecting supplementary insights on various facets of seed production. Facilitators and moderators oversaw the FGDs in Banke and Bardiya districts, each involving 10 to 12 participants representing diverse cross-sections of gender, age, and social hierarchy. Commencing with general questions, participants engaged in extensive discussions to share insights and opinions, fostering consensus. Checklists comprising probe-questions and exit questions guided the proceedings. Subsequent to the FGDs, farmers employed a two-way matrix ranking to highlight and prioritize the top five problems and constraints associated with Berseem clover seed production in their respective villages.

Furthermore, four Key Informant Interviews (KIIs) were conducted with seed entrepreneurs and traders, featuring two interviews in each district. These interviews aimed to gather detailed information on aspects such as the demand and supply dynamics of Berseem clover seeds, sources and systems of seed collection, storage practices, existing marketing channels both domestically and abroad, as well as challenges, constraints, and technological advancements. Prior to the KIIs, a concise interview guide containing pertinent questions was prepared. Key informants, with over a decade of experience in trading Berseem clover seeds, included two traders from Nepalgunj market and two traders from Guleriya market. Two of the four key informants represented the private sector, one from each district, while the others were associated with cooperatives. Adequate notes were diligently taken during the interviews to capture both quantitative and qualitative data.

Data analysis

The household survey data was processed and analysed by using software programs; Jamovi™ (The jamovi project, 2020) [12] and IBM SPSS Statistics™ 25 (IBM Corp. Released, 2017) [13]. Economic parameters for each household were manually calculated and analysed as part of the study.

Results and Discussion

Involvement in activities by gender

In comparison to male farmers, female farmers demonstrated a greater level of involvement in the production of Berseem clover seeds. Women assumed more prominent roles throughout the seed production process, spanning from sowing to harvesting (cutting). Tasks related to post-harvest activities, such as threshing and seed selling were primarily undertaken by men. Notably, in the realm of seed production and marketing, approximately half of the respondents indicated that men played a significant role in decision-making processes. Moreover, about one-sixth of respondents reported women taking decisive actions, while around two-fifths stated that decisions were made jointly.

Recognizing the importance of involving women in capacity building and economic activities is seen as a more effective strategy in both fodder and livestock production, as highlighted by Afzal (2010) [14]. Similar findings were observed in other South Asian countries too. For instance, in Punjab, Pakistan, Tufail (2016) [15] reported that the most senior male member of the family held the decision-making and responsibility role. A study conducted in the Lalitpur district of the Bundelkhand region of Uttar Pradesh found that, among smallholder farmers producing Berseem clover, 53% of families had male decision-makers (Satyapriya *et al.*, 2013) [16].

Education status of the respondents

In this investigation, approximately three-quarters of the farmers had completed secondary and higher secondary education, with less than 3.33% being illiterate. The educational attainment of the farmers in this study surpassed the levels reported by other researchers. Tufail (2016) [15] documented an 88% literacy rate among Berseem clover farmers in Punjab, Pakistan. In a separate study in India, Nanda *et al.* (2014) [17] found that 38.75% of respondents had education up to middle school, while 20% had completed primary and high school. A study on Berseem clover farmers in the Lalitpur district of the Bundelkhand region of Uttar Pradesh revealed that 26% had finished primary education, and the remaining 27% had not received any formal education (Satyapriya *et al.*, 2013) [16]. The literacy or education level emerges as a critical factor for the success of agricultural enterprises among smallholder farmers. Education facilitates and plays crucial roles in the adoption of technologies, development interventions, and decision-making processes (UL-Allah *et al.*, 2014) [18]. A significant proportion of the farmers in this study were educated at the secondary or higher secondary level. This elevated education level is indicative of the potential benefits, as it facilitates the easier adoption of improved technologies, practices, and interventions for the enhancement of Berseem clover seed production in the region.

Major occupations of the farmers

Approximately three-quarters of the farmers exclusively engaged in agriculture, whereas approximately one-fifth combined agricultural activities with remittances. The percentage of respondents simultaneously involved in agriculture and trading, as well as agriculture and service-related occupations, was below 6.67%.

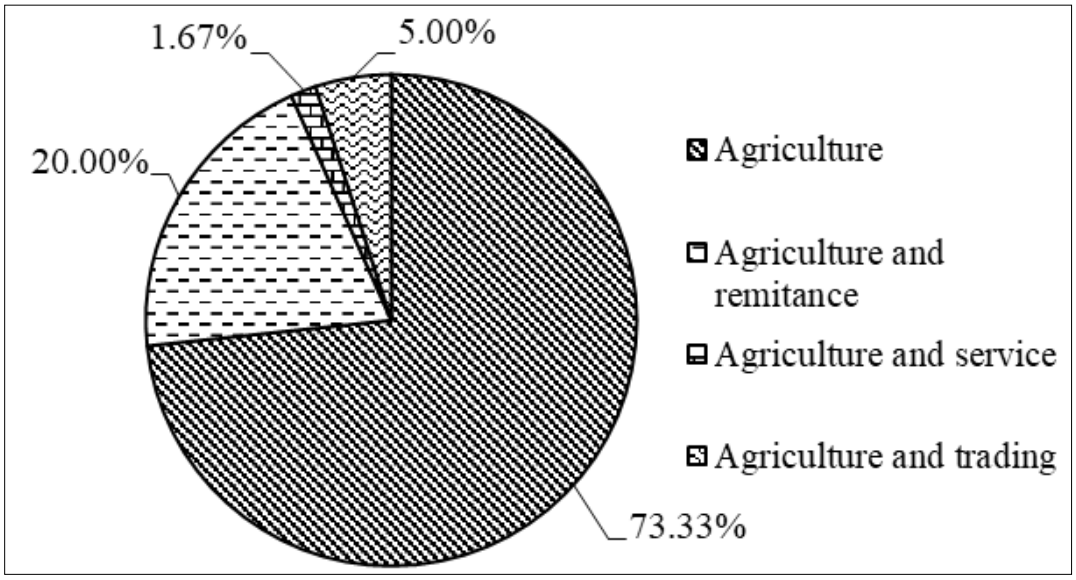

Fig 1: Major occupations of the respondents involved in the seed production of Berseem clover in Banke and Bardiya of Nepal.

The majority of families cultivating Berseem clover seeds were primarily engaged in agriculture or combine agricultural activities with remittances. This reliance and commitment to agriculture suggest a favorable environment for emphasizing the promotion of Berseem clover seed production in the region.

Type and size of land holdings of the respondents: In this research, most farmers possessed *Bari* and *Khet* lands for Berseem clover cultivation. Approximately three-fifths of the participants owned both *Bari* and *Khet* lands, while one-third exclusively had *Khet* lands.

The percentage of respondents who owned alternative land types, such as marginal lands, roadside areas, and riverside lands, was below 6.67% (Figure 2).

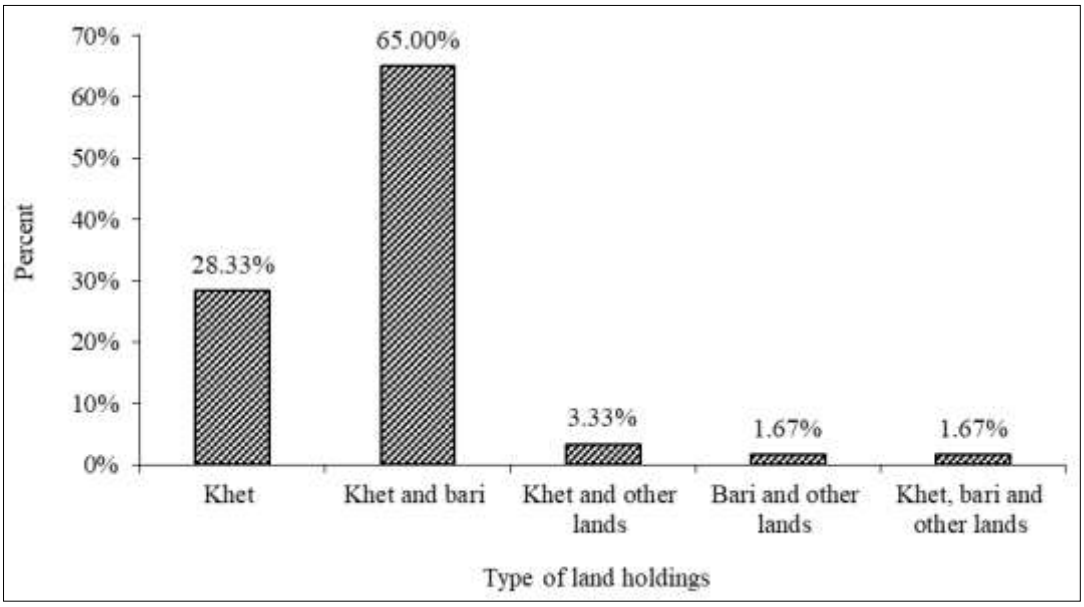

Fig 2: Respondents' status of land holdings in the study sites, Banke and Bardiya.

Mugerwa *et al.* (2012) [19], based on their research in Uganda, highlighted that the adoption of new fodder production technologies among smallholder farmers is influenced by factors such as age, education levels, and land ownership. The land holdings of farm families emerge as a crucial aspect in the realm of Berseem clover seed production enterprises. In the South Asian context, it is common for smaller farmers to be involved in the seed production of Berseem clover. A study in India revealed that 52.50% of respondent families had small farms with an average land size of 1.01 hectares (Nanda *et al.*, 2014) [17]. Similarly, Tufail (2016) [15] reported varied farm sizes among Berseem clover farmers in Pakistan, ranging from 0.40 hectares to 48 hectares. Within this range, 70% of respondents had less than 5 hectares of land, and 63% had less than 3 hectares. In the present study, the farm families were classified as medium farmers with an average landholding of 1.53 hectares, ranging from 0.4 hectares to 2.00 hectares. This is considered a substantial landholding in the Nepali context. The involvement of farmers with a moderate landholding (1.53 hectares) suggests promising potential for developing the areas as key pockets for

Berseem clover seed production.

Land areas under different cropping patterns

Various cropping patterns were observed involving Berseem clover seed production, with the paddy-Berseem clover pattern being the most prevalent (86.67%). A minority of respondents (less than 10%) reported other patterns, such as Teosinte-Berseem clover and patterns involving different crops alongside Berseem clover, such as paddy-wheat, paddy-chickpea, and paddy-oat. Among these, the paddy-Berseem clover cropping pattern stood out as the most popular. The maximum land area allocated to the paddy-Berseem clover pattern by farmers was 1.33 hectares, as detailed in Table 1.

Table 1: Average land holdings of the respondents' farm families under different cropping patterns in the study areas of Banke and Bardiya

Cropping pattern	Average land holding of each farmer (ha)	Maximum holdings of a single farmers (ha)
Paddy-Berseem clover	0.45	1.33
Maize-Berseem clover	0.01	0.33
Paddy-Oat	0.10	1.00
Paddy-Wheat	0.29	1.66
Paddy-Chick pea	0.11	1.00
Paddy-Lentil	0.07	0.93
Teosinte-Berseem clover	0.01	0.33
Teosinte-Oat	0.02	0.47
Teosinte-Wheat	0.08	1.07
Others	0.71	3.33

Duration of farmers' involvement in the cultivation of Berseem clover

Farm families in the study exhibited a diverse range of experience in Berseem clover production, spanning from 5 to 36 years. On an average, their tenure in Berseem clover seed production was 11.80 years, with a minimum of 3 years and a maximum of 25 years. Berseem clover cultivation was prevalent among almost all farmers in the villages, serving either as fodder or for seed production.

Sources of Berseem clover seed in the study areas

Utilizing both informal and formal seed sources is a prevalent practice, although informal sources contribute only minimally. The majority of farmers (95%) rely on seeds from formal sources, including government farms, research stations, and other government agencies (90%), local agrovets (3.33%), and cooperatives (1.67%), with the Green gold cultivar being the most commonly used in the study areas. A small proportion of farmers (5%) obtain seeds from informal sources.

Despite the formal seed system's history spanning around half a century in developing countries, both formal and informal seed supply systems are in practice. The formal system involves systematic plant breeding procedures, cultivar development, and seed production, followed by a formal certification process by the government or organized channels (Bishaw & Turner, 2008) [21]. This system addresses only 10-20% of the farmers' seed demand in developing countries, while the remaining seeds are supplied by the informal sector, utilizing seeds produced locally by farmers (Reddy *et al.*, 2006; Bishaw & Gastel, 2008) [21, 22]. This predominant reliance on the informal seed system poses challenges for quality seed production and marketing, leading to lower productivity in smallholder farmers (Almekinders *et al.*, 2007) [23]. Therefore, enhancing the income of Berseem clover farmers involves using higher quality seeds coupled with agronomic adjustments and aligning with appropriate weather conditions (Tufail, 2016) [15]. In Nepal, both formal and informal seed systems coexist. Major public sectors, such as research institutes, government farms, and cooperatives, play a significant role in producing and supplying fodder seeds (SQCC, 2013; Sharma, 2015) [24, 5]. Similar to other developing countries, the informal seed sector predominantly supplies most fodder seeds, although NARC has developed and released various cultivars for different ecological domains (SQCC, 2013). However, the scenario is distinct for Berseem clover seeds in the study areas, where the majority of seeds come from formal channels. This can be attributed to the facilitation and institutionalization of Berseem clover seed production and marketing by government farms/agencies, research organizations, and academic institutions. Addressing the conventional practices of smallholder farmers in seed production and their challenges in meeting formal seed system requirements can be achieved through the establishment of farmers' seed enterprises as an alternative and sustainable approach (David, 2004) [25]. Formal seed sources in the study areas were better obtained compared to findings in another study, where smallholder farmers in Punjab, Pakistan, primarily relied on their own seed or sourced seeds from neighboring or fellow farmers (74%), research stations (3%), and local agricultural markets (23%) (Tufail, 2016) [15].

Cultivated land area under Berseem clover and productivity in different years

Figure 6 illustrates the productivity of Berseem clover seed and the average land area for various years. Notably, there has been a substantial reduction in the average area per household dedicated to Berseem clover seed production from 2009/10 to 2017/18. The productivity, while also experiencing a decline, exhibited a less pronounced decrease (Figure 3).

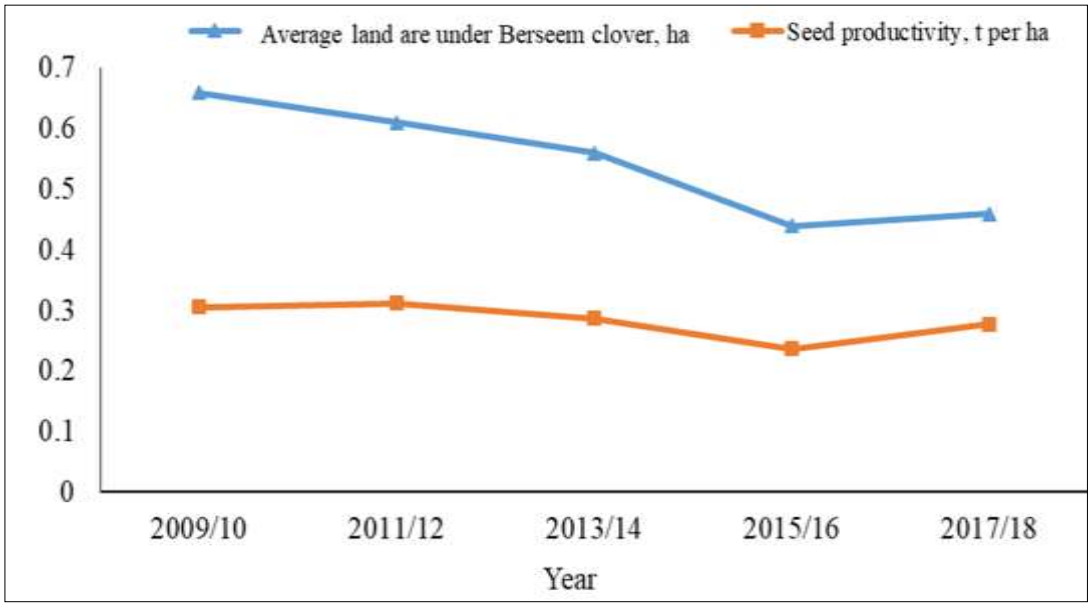

Fig 3: The average land area under the seed production and status of productivity of Berseem clover seed in different years in the study areas of Banke and Bardiya.

Support and involvement of different institutions

In the study areas, different institutions were involved and provided support to Berseem clover seed growers. Approximately three-fourths of the farmers received assistance from government farms, which included technical guidance, capacity enhancement, seed quality maintenance, and market facilitation. The District Livestock Services Office (DLSO) in Banke and Bardiya financially supported one-tenth of the farmers, while another one-tenth did not receive any direct support. Various institutions conducted training sessions on Berseem clover seed production to enhance farmers' capacities. Around half of the respondents reported receiving training from their DLSOs and government farms. One-tenth of the respondents underwent training at Nepal Agricultural Research Council (NARC) research stations. Similarly, a proportionate number of respondents received repeated training from different institutions, such as NARC, DLSOs, and private organizations. In about one-fifth of the cases, respondents did not undergo any formal training but acquired knowledge from their neighbors.

In the study areas, the majority of Berseem clover seed producers received support from public institutions, similar to other parts of the country. Approximately 86.67% of seed growers were backed by public sectors for technical assistance, market facilitation, and input management.

The establishment and growth of village fodder seed enterprises in collaboration with farmers, utilizing participatory approaches to develop technologies and research-based seed production systems for Berseem clover, emerge as promising options for smallholder farmers (Stur *et al.*, 2000; Devendra & Thomas, 2002; David, 2004; Bishaw & Turner, 2008) [26, 27, 25, 20]. In the present study, farmers engaged in producing Berseem clover seeds in groups or cooperatives, aligning with a similar strategy reported in Pakistan. The growth of efficient small-scale seed producers, involving farmers and guided by research organizations with niche-specific technologies, is an excellent strategy for addressing seed deficiency in developing countries (Anwar *et al.*, 2012; Tufail, 2016) [28, 15]. The development and dissemination of high-yielding cultivars, along with improved technologies and training for farmers, contribute to sustainable development in smallholder farming systems (Kamanji & Mapiye, 2012) [29]. This enhances farmers' knowledge and skills in technical and managerial aspects of Berseem clover seed production, providing a valuable avenue for promoting seed production in the areas, although region-specific technologies are essential.

Sources of other inputs

Farmers participating in the study areas successfully acquired the required inputs from diverse institutions. Around 40% of respondents exclusively procured their inputs from local agro-vets and government farms, while another third had access solely to local agro-vets and government farms. Approximately 10% of respondents sourced their inputs from government farms and Indian markets (Figure 4).

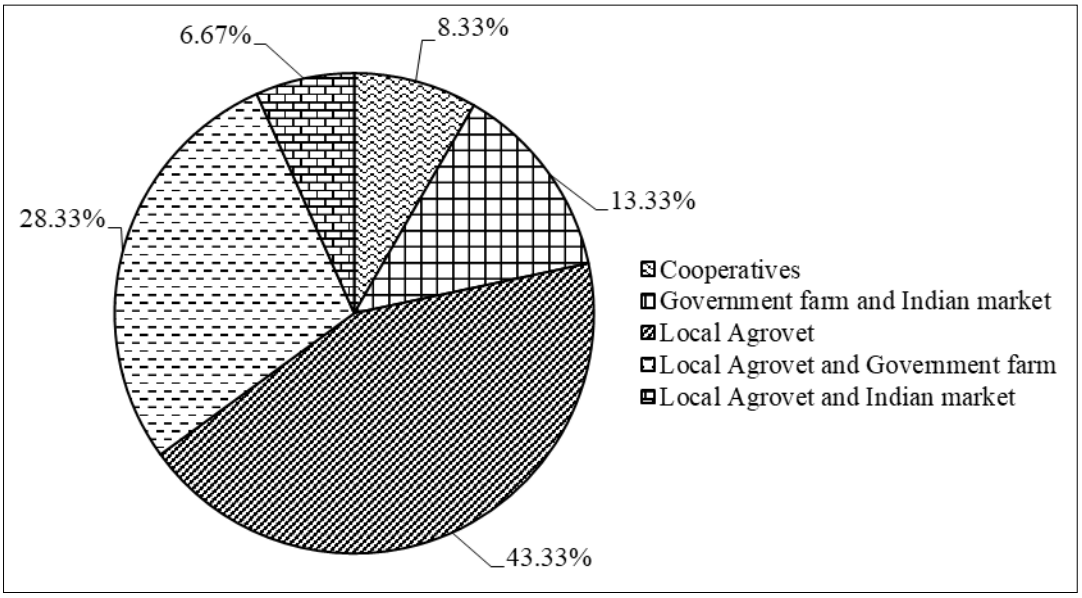

Fig 4: The sources of input accessed by the farmers involved in the study sites of Banke and Bardiya.

Marketing network of Berseem clover seeds

Figure (5) illustrates the Berseem clover seed marketing network in the study areas. The seed marketing of Berseem clover is extensively and collaboratively facilitated by government agencies (Government farms and DLSOs) and private institutions (cooperatives, agro-vets).

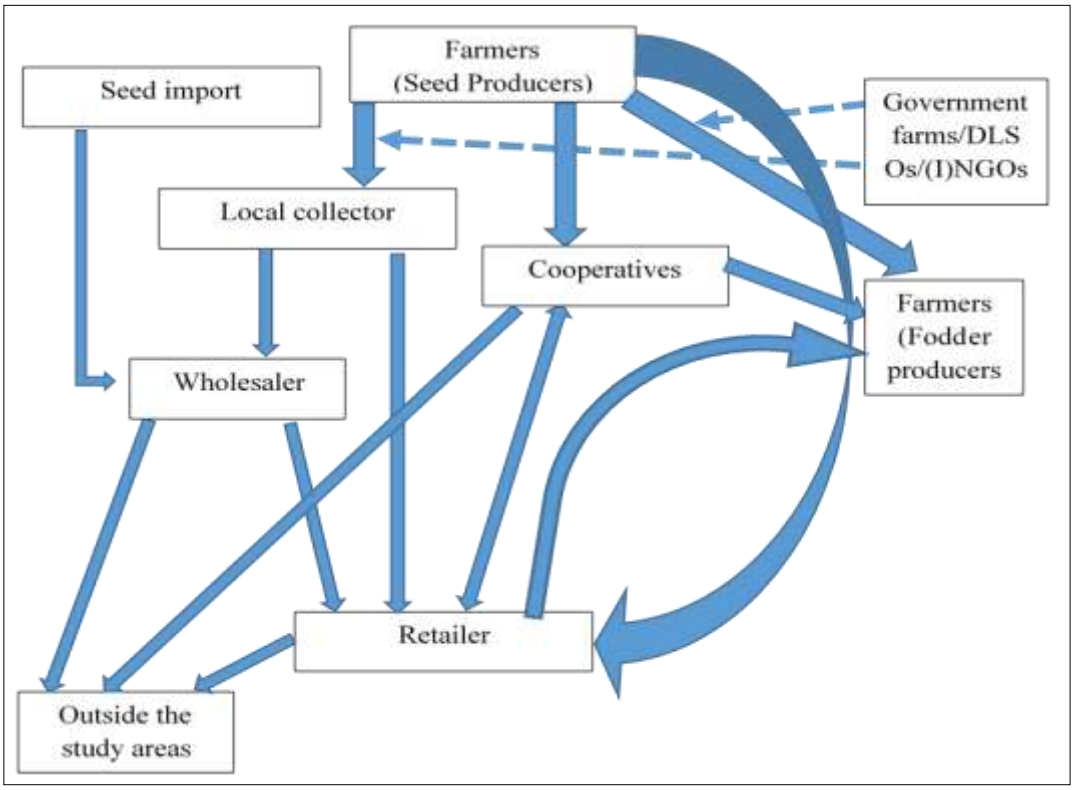

Fig 5: The marketing network of seed of Berseem clover in the study areas of Banke and Bardiya

Typically, seeds are either individually sold to local traders or, in certain instances, gathered collectively by groups or cooperatives and dispatched to merchants or local traders. Farmers occasionally directly sell their seeds to agro-vets (retailers) or to fodder producers in their regions. Seeds, either locally collected or imported from abroad or within the country, are sold to retailers through wholesalers. Notably, farmers commonly market their seeds under the cultivar name 'Green gold' without accurate labeling.

The potential options for addressing the demand for fodder seeds involve commercializing seed production in both governmental and non-governmental farms and establishing connections with larger companies and industries to ensure quality seed production and effective marketing, as proposed by Tufail (2016) [15]. This requires well-functioning marketing channels, which was found in the study areas, an established and functional marketing channel was identified. Major stakeholders in the seed marketing of

Berseem clover included seed producers, cooperatives, wholesalers, retailers and government farms. The facilitation of marketing networks was predominantly carried out by public and private institutions such as government farms, DLSOs, cooperatives and agro-vets. Similarly, in Pakistan, the seed distribution systems were primarily governed by local vendors (Tufail, 2016) [15]. Public-private entrepreneurship is recommended as a favorable economic strategy for informal and decentralized seed production of Berseem clover among smallholders (Tufail, 2016) [15]. In India, the lack of active involvement from both public and private seed production firms was attributed to the absence of organized marketing channels, leading to an unorganized production and marketing channel for Berseem clover seed (Vijay *et al.*, 2017) [2].

Price fixation mechanisms for Berseem clover seeds

In the study areas, various methods were employed for fixing the price of Berseem clover seed. A considerable portion (53.33%) relied on government-set prices, while around one-third determined prices through local negotiations between seed producers and collectors or other buyers. Additionally, one-fifth of respondents mentioned that cooperatives determined prices by considering both local production trends and overall market demand. The coordination of price fixing and the marketing of Berseem clover seed were generally overseen by government institutions. The government-set price for a kilogram of seeds stood at Nepalese Rupees (NRs) 250. Negotiations between local agro-vets and farmers, especially during the production and sowing seasons (April, May, October, November), could result in a slight variation in prices, potentially increasing to NRs 350 to 400 per kg during the sowing season. Similarly, in Pakistan, there is no formal fodder seed marketing channel, and the fixation of fodder seed prices depends on negotiations between producers or farmers and traders, referencing the prevailing market price (Cain *et al.*, 2007) [30]. The seed prices during harvesting and sowing times may experience fluctuations in the market in India too (Kumar *et al.*, 2017) [31].

Economics of seed production of Berseem clover

In comparison to wheat and chickpea seed production, Berseem clover seed is more lucrative but falls short of the profitability seen in oat seed production. Detailed economic parameters for these crops are presented in Tables (2 and 3).

Table 2: Average cost of production of Berseem clover and other crops seeds in the study sites of Banke and Bardiya on the basis of partial budgeting (Variable Costs).

Crop inputs	Berseem clover, NRs ha^{-1}	Wheat, NRs ha^{-1}	Oat, NRs ha^{-1}	Chick pea, NRs ha^{-1}
Land rent	20000	20000	20000	20000
Land preparation and sowing cost	14538	12260	12260	8640
Seed cost	7557	7700	9600	6000
Fertilizers cost	6046	9680	6820	2360
Labor cost	20800	18635	19540	14745
Irrigation water cost	4327	2365	2365	1010
Insecticide, Pesticides, Herbicide's cost	1282	450	235	1830
Harvesting and threshing cost	12600	14800	15660	11975
Total Variable Cost	87150	85890	86480	66560

The economic viability of Berseem clover seed production was evident during the study, proving to be more economical than some other crops cultivated during the same season in the study sites. Although it was economically superior to wheat and chickpea, it fell slightly short of oat seed production. Farmers continued to prefer cultivating Berseem clover over wheat and chickpea due to its numerous advantages. Despite the oat seed production having a better estimated benefit-to-cost ratio, farmers favored Berseem clover due to factors such as its contribution to providing leguminous green fodder during dry winters, challenges associated with marketing oat seed, and the need for larger storage areas for voluminous oat seeds during the period from harvesting to sowing. The ease of cultivation of Berseem clover was another influential factor. Berseem clover seed production was economically more beneficial than wheat and rice in India (Vijay *et al.*, 2017) [2] and outperformed wheat in Pakistan (Leghari *et al.*, 2018) [32]. Additionally, it was recognized as an economical and successful crop for agricultural development in desert lands of North Sinai Governorate, Egypt (Mohamed *et al.*, 2014) [33].

Comparing economic parameters through partial budgeting in the study, the MRR (Marginal Rate of Return) and B:C (Benefit-to-Cost) ratio on a variable cost basis for Berseem clover were 14.38 and 1.14 respectively, surpassing those of wheat and chickpea. Similar results were reported by Kumar *et al.* (2017) [31] in Jhansi, India, where net returns from Berseem clover cultivation for quality seed production were INR 26,262.14 per hectare with a benefit-to-cost ratio of 1.57 and a benefit-to-cost ratio on a variable cost basis of 2.00. Vijay *et al.* (2017) [2] also reported favorable benefit-to-cost ratios of 1.85 and 2.32 on variable cost basis at Jhansi, India. These ratios indicated the superior profitability of Berseem clover seed production compared to cereal crop production. In another study in Peshawar, Pakistan, Khan *et al.* (2012) [34] found that Berseem clover cultivation was economically more beneficial than wheat, with better input: output ratios and increased net revenue by 32.7%. Gross income and average net revenue for Berseem clover were Rs 111,238 and Rs 54,419 respectively, whereas for wheat, they were Rs 109,366 and Rs 41,014. Studies in Kasur and Okara districts of Punjab, Pakistan, reported that Berseem clover cultivation for seed production had gross income of Rs 259,292, net income of Rs 155,031, a marginal rate of return of 149%, and a benefit-to-cost ratio of 2.49:1, outperforming other crops such as potato, wheat, oat, and canola (Tufail, 2016) [15].

The study results revealed that Berseem clover seed production in Nepal operates in a pseudo-commercial

setting, generating income with good profitability in a sustainable manner. This enterprise is considered of lower risk due to its existence in a mixed farming system and the less variability of market seed prices. Variability in market seed prices and crop inputs poses a risk to agricultural enterprises (Devendra & Thomas, 2002; Cain *et al.*, 2007; Shah *et al.*, 2011) [27, 30, 35].

Farmers are attracted to Berseem clover not only due to its direct benefits but also because of its contributions to improving the productivity of successive crops or associated crops, as noted by Valiki *et al.*, (2015) [37]. It enhances the yield of successive crops and reduces production costs by lowering fertilizer expenses (Naveed *et al.*, 2015) [36].

Berseem clover serves as a high biological nitrogen accumulator in the soil through its biological nitrogen fixation process. The fixed biological nitrogen, released through its mineralized roots and nodule nitrogen, is partly available to associated crops (Valiki *et al.*, 2015) [37]. Similar findings were observed in the present study, with farmers recognizing several benefits of cultivating Berseem clover, including its higher nutritive profile with good palatability. Farmers preferred this fodder due to its low maintenance requirements, reduced risks of damage from diseases and insects, income-generating potential, the ability to harvest both fodder and seed from a single crop, improvement of soil fertility, and increased milk yield in livestock. Berseem clover also saved farmers time and labor, as they no longer needed to travel long distances to gather fodder for their livestock.

Table 3: Average revenue, net income, MRR and B:C ratio of the production of Berseem clover and other crops seed in the study sites of Banke and Bardiya.

Crop	Green forage, straw yield, kg ha^{-1}	Seed yield, kg ha^{-1}	Total variable cost, NRs ha^{-1}	Gross income, NRs ha^{-1}	Net Income, NRs ha^{-1}	MRR%	B:C Ratio
Berseem clover	10285	275	87150	99,683	12,533	14.38	1.14
Wheat	3740	2768	85890	86,780	890	1.04	1.01
Oat	4370	2645	86480	133,200	46,720	54.02	1.54
Chick Pea	890	1035	66560	58,705	-7855	-11.80	0.88

Problems and Challenges

The table (Table 4) outlines the six primary problems and constraints identified and prioritized by farmers and traders in Berseem clover seed production. The foremost challenge reported was a decline in seed yield attributed to lower seed setting and insufficient production packages for the entire region. Ranked second among the top issues were inadequate storage facilities from the harvesting season (April/May) to the sowing season (October/November), along with cash flow challenges during the extended period between harvesting and sowing, and difficulties in receiving payments for sold products. The third most significant problem, as ranked by Berseem clover seed producers and traders, was the diminished quality of harvested seeds, including concerns about seed size and low germination rates. The lack of timely availability of seeds and fertilizers during the crop season, as well as challenges in the harvesting and threshing of seeds, secured the fourth and fifth positions in the rankings.

Table 4: Ranking of the major problems and challenges faced by the Berseem clover seed producers at study sites of Banke and Bardiya

Rank	Problems
I	Production-related - Decreased seed yield attributed to lower seed setting and absence of a comprehensive package of practices (Including optimal sowing time and irrigation)
II	Marketing-related - Challenges in seed storage (For 7 months), cash flow, and receiving timely payments for sold seeds
III	Production-related - Decreased seed quality, characterized by smaller-sized seeds and a low germination percentage
IV	Marketing-related - Unavailability of desired cultivar seeds and fertilizers at the right time
V	Production-related - Challenges associated with manual seed harvesting and threshing
VI	Other - Issues such as insect damage (caterpillars), the presence of *Cascutta* spp. weed, and low soil fertility in paddy relay cropping

Various production-related, marketing-related, and other problems and challenges were identified and ranked by farmers in the study (Table 4). The production-related issues identified require further field research, while marketing-related problems involve both managerial and researchable aspects. Key problems and challenges in Berseem clover production and marketing include lower productivity and unstable seed yield, insufficient production packages tailored to the region, storage facilities for the produced seed and cash-flow issues, mechanization in operations, marketing of inputs and outputs, pricing concerns, seed quality, insects/caterpillar issues, *Cascutta* spp. and other weed problems, adverse climate and weather conditions and more.

The study underscored the significance of region or location-specific approaches in understanding and addressing the socio-economic challenges faced by small-holder farmers, emphasizing the need for technological interventions that align with the realities of local agricultural practices and constraints.

Conclusion

In the study, a noteworthy gender disparity was observed in the involvement of farmers in Berseem clover seed production, with female farmers demonstrating a higher level of engagement compared to their male counterparts. The majority of the Berseem clover farmers were educated, primarily deriving their livelihood from agriculture or a

combination of agriculture and remittance. Typically, these farmers fell into the smallholder or medium farmer categories, and the prevalent cropping pattern in the areas was Paddy-Berseem clover. Despite a reduction in the area dedicated to Berseem clover seed production in recent years, farmers possessed extensive experience in seed production. Governmental, non-governmental, and private sectors actively participated in supporting and promoting Berseem clover seed production and marketing, with a well-functional marketing channel established in the study areas. The economic viability of Berseem clover seed production was established in the study, surpassing the economic returns of wheat and chickpea, although slightly trailing behind oat seed production. The challenges faced by the Berseem clover seed producers, ranging from lower productivity to storage and cash-flow issues, highlight the need for collaborative efforts among policymakers, researchers, and industry players to develop and implement comprehensive strategies. Addressing these challenges collectively will not only help the Berseem clover seed producers overcome obstacles but also thrive, ultimately contributing to the sustainable livelihoods of smallholder farmers and the overall enhancement of agricultural productivity.

Acknowledgement
The study works of this manuscript was done under the PhD dissertation in AFU. So authors are highly acknowledged to Agriculture and Forestry University, Rampur, Chitwan, Nepal and Nepal Agricultural Research Council.

References

1. Muhammad D, Misri B, EL-Nahrawy M, Khan S, Serkan A. Egyptian clover (*Trifolium alexandrinum*), King of forage crops. Food and Agriculture Organization of the United Nations, Regional Office for the Near East and North Africa; c2014.
2. Vijay DN, Manjunatha N, Maity A, Kumar S, Wasnik VK, Gupta CK, *et al.* BERSEEM-Intricacies of seed production in India. Technical Bulletin. ICAR-Indian Grassland and Fodder Research Institute, Jhansi, India; c2017.
3. Oushy H. Fact Sheet: Egyptian clover. Afghanistan Water, Agriculture and Technology Transfer (AWATT) Program; c2008.
4. Tiwari SP, Yadav JP. Consequences of number of irrigations and their interval on seed yield and biomass production of Berseem in Nepal. Egyptian clover (*Trifolium alexandrinum*) King of forage crops, edited by D Muhammod, B Misri, EL-Nahrawy M, Khan S, Serkan A. Food and Agriculture Organization of the United Nations, Regional Office for the Near East and North Africa, 2014, 95-97.
5. Sharma B. Present status and future strategy of forage development in Nepal. J Agric. Environ. 2015;16:170-79.
6. Ghimire RP. Fodder management strategies and their challenges for commercial goat production in Nepal. The Proceedings of the National Research and Development Strategies for Goat Enterprises in Nepal, edited by TB Gurung, BR Joshi, UM Singh, BS Shrestha, KP Rijal, and DR Khanal. Nepal Agricultural Research Council, Department of Livestock Services, Kathmandu, Nepal: Heifer Project International-Nepal, 2013, 24-41.
7. Pande RS. Berseem (*Trifolium alexandrinum*) seed production in Nepal. Egyptian clover (*Trifolium alexandrinum*) King of forage crops, edited by D Muhammod, B Misri, EL-Nahrawy M, Khan S, Serkan A. Food and Agriculture Organization of the United Nations, Regional Office for the Near East and North Africa, 2014, 91-94.
8. Pande RS. Potential for Berseem (*Trifolium alexandrinum* L.) seed production in Nepal. Proceedings workshop on Stylo and Berseem Seed Production and Marketing in Nepal. Dairy Enterprises Support Component/ATSP, Chemonics International Consulting Division, USA and DOAD, Division of Livestock Services, Nepal; c1995.
9. TLDP. Forage seed production and area mapping. Third Livestock Development Project, Kathmandu, Nepal; c2002.
10. NAFLQML. Balance sheet of animal feed and forage seed of Nepal and impact study of forage mission program. National Animal Feed and Livestock Quality Management Laboratory, Hariharbhawan, Lalitpur; c2019.
11. Singh SB, Singh N. Nepal livestock feed balance and strategies to address the feed deficit. J Agric. For. Univ. 2019;3:59-71.
12. The Jamovi Project. Jamovi, 2020. https://www.jamovi.org/, 25 December 2021.
13. IBM Corp. Released. 2016. IBM SPSS Statistics for Windows, Version 24.0. IBM Corp., Armonk, NY; c2016.
14. Afzal M. Re-Designing smallholder dairy production in Pakistan. Pakistan Vet. J 2010;30:187-90.
15. Tufail MS. Development of Berseem clover (*Trifolium alexandrinum* L.), village-based forage seed enterprises for the profitability and sustainability of smallholder farmers of Pakistan in mixed farming systems. Charles Sturt University, New South Wales, Australia; c2016.
16. Satyapriya, Agrawal RK, Sharma P, Singh M, Kumar S. Knowledge level of fodder cultivating farmers about Berseem production technology. Range Manag. Agrofor. 2013;34(1):73-76.
17. Nanda R, Gupta V, Rai PK. Evaluation of the performance of frontline demonstration of Berseem in district Jammu. Egyptian Clover (*Trifolium alexandrinum*), King of forage crops, edited by D Muhammod, B Misri, EL-Nahrawy M, Khan S, Serkan A. Food and Agriculture Organization of the United Nations, Regional Office for the Near East and North Africa, 2014, 72-76.
18. Allah US, Khan AA, Fricke T, Buerkert A, Wachendorf M. Fertilizer and irrigation effects on forage protein and energy production under semi-arid conditions of Pakistan. Field Crops Res. 2014;159:62-69.
19. Mugerwa S, Kabirizi BM, Njarui MD, Mpairwe D. Utilization of introduced forages by smallholder dairy farmers in Uganda. Int. J Biosci. 2012;2(1):36-45.
20. Bishaw Z, Turner M. Linking participatory plant breeding to the seed supply system. Euphytica. 2008;163:31-41.

21. Reddy RC, Tonapi VA, Prasad VL, Bezkorowajny P. Innovative seed systems and seed delivery models for food-feed-fodder security in semi-arid tropics of Andhra Pradesh. Proceedings of XII National Seed Conference, Indian Society of Seed Technology, Hyderabad, 2006, 57-72
22. Bishaw Z, Gastel AJGV. ICARDA's seed-delivery approach in less favorable areas through village-based seed enterprises: Conceptual and organizational issues. J New Seeds. 2008;9:68-88.
23. Almekinders CJM, Thiele G, Danial D. Can cultivars from participatory plant breeding improve seed provision to small-scale farmers? Euphytica. 2007;153:363-372.
24. SQCC. National Seed Vision 2013-2025. Ministry of Agriculture and Livestock Development, 2013. http://www.moald.gov.np. 16 May, 2021.
25. David S. Farmer seed enterprises: A sustainable approach to seed delivery? Agric. Human Values. 2004;21:387-97.
26. Stur WW, Ibrahim T, Tuhulele M, Binh LH, Gabunada F, Nakamanee IG, *et al.* Adaptation of forages to climate, soils and use in smallholder farming systems in Southeast Asia. Working with Farmers: The key to adoption of forage technologies, australian centre for International Agricultural Research (ACIAR), Mandanao, Philippines, 2000, 112-119.
27. Devendra C, Thomas D. Crop-animal interactions in mixed farming systems in Asia. Agric. Syst. 2002;71:27-40.
28. Anwar MZ, Khan MA, Ikram S, Akhtar A, Shafique Z, Abdul M. Small farmers perceptions regarding improved fodder and forage varieties: results of participatory on-farm research Pakistan J Agric. Res. 2012;25(4):295-306.
29. Kamanji M, Mapiye C. Feed inventory and smallholder farmers perceived causes of feed shortage for dairy cattle in Gisagara District, Rwanda. Trop. Anim. Health Prod. 2012;44:1459-1468.
30. Cain P, Anwar M, Rowlinson P. Assessing the critical factors affecting the viability of small-scale dairy farms in the Punjab region of Pakistan to inform agricultural extension programmes. Agric. Syst. 2007;94(2):320-330.
31. Kumar V, Satyapriya, Maharaj S, Bahukhandi D. Economics for quality seed production of Berseem (*Trifolium alexandrinum* Linn.). Progress. Agric. 2017;17(2):221-26. DOI: 10.5958/0976-4615.2017.00039.4.
32. Leghari SJ, Soomro AA, Laghari GM, Talpur KH, Soomro FA, Mangi MH, *et al.* Effect of NPK rates and irrigation frequencies on the growth and yield performance of *Trifolium Alexandrium* L. AIMS Agric. and Food. 2018;3(4):397-405.
33. Mohamed MM, El-Nahrawy MA, Abdu MA, Shams SA. The Role of Egyptian clover (*Trifolium alexandrinum* L.) in agriculture development in desert lands, North Sinai-Governorate, Egypt. Egyptian clover (*Trifolium alexandrinum*) King of forage crops, edited by D Muhammod, B Misri, EL-Nahrawy M, Khan S, Serkan A. Food and Agriculture Organization of the United Nations, Regional Office for the Near East and North Africa, 2014, 28-31.
34. Khan I, Jan AU, Khan I, Ali K, Jan D, Ali S, *et al.* Wheat and berseem cultivation: A comparison of profitability in district Peshawar. Sarhad J Agric. 2012;28(1):83-88.
35. Shah H, Hussain K, Akhtar W, Sharif M, Majid A. Returns from agricultural interventions under changing price scenario: A case of gypsum application for moisture conservation for wheat production under rainfed conditions in Pakistan. World Appl. Sci. J 2011;14(2):363-368.
36. Naveed M, Mehboob I, Shaker MA, Hussain MB, Farooq M. Biofertilizers in Pakistan: initiatives and limitations. Int. J Agric. Biol. 2015;2(17):411-420.
37. Valiki SRH, Ghanbari S, Golmohammadzadeh S, Alaeiyan Y. Yield and quality of Berseem (*Trifolium alexandrinum* L.) in response to nitrogen fertilization and plant density. Int. Res. J Appl. Basic Sci. 2015;9(6):873-877.