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# Using Chemical Fertilizer to Major Cereal Crops in Baijnath Tole, Bhimdutta Municipality-19, Kanchanpur

**Bir Bahadur Singh Thakuri**
University Central Campus, Far Western University, Nepal
Email: hellobir789@gmail.com

## Abstract

The study, conducted in Baijnath tole, Bhimdatta municipality-19, Kanchanpur, Nepal, focuses on evaluating the impact of a chemical fertilizer pattern on major cereal crops, specifically paddy and wheat. Employing an empirical research with census survey method, the research investigates macronutrients, fertilizer sources, application rates, nutrient supply, and crop productivity. Data collected from 65 households using a semi structured questionnaire. By combining qualitative and quantitative data sources, it becomes evident that there has been a steady annual growth rate of around 12% in the utilization of chemical fertilizers for both paddy and wheat crops since the year 2075. This rise correlates with increased crop production, showing an average annual growth of 6% in paddy yields and a reversal of a 1% initial decrease in wheat, leading to a subsequent 4% annual increase over four years.

This research study contributes by providing insights into specific agronomic techniques connected to the use of chemical fertilizers on important grain crops in the area. If the research tackles unique difficulties or opportunities in the study area, it could provide useful information to local farmers and others. This could include soil types, climate conditions, and socioeconomic aspects. The study investigates the economic elements of chemical fertilizer use, taking into account issues such as input costs, farmer return on investment, and the overall economic impact on Nepalese agriculture. This study examines the impacts of chemical fertilizer use on soil health and the environment, taking into account factors such as soil fertility, nutrient runoff, and any environmental sustainability concerns. The study presents findings on how the use of chemical fertilizers affects the productivity of main cereal crops, as well as data on yield improvements, crop quality, and potential obstacles or constraints.

***Keywords*:** Agriculture, crops, chemical fertilizer, production, wheat and paddy

## Introduction

Agriculture serves as the cornerstone for Nepal's economy. A substantial majority of Nepal's population, around 78.88%, lives in rural areas, with 62.41% actively engaged in agriculture (CBS, 2021), contributing 23.95% to GDP (MOAD, 2022). The transition from subsistence to commercial agriculture is ongoing and progressing gradually. The country is separated into three main agroecological zones: Terai, mid-hills, and mountains, each with its own unique rural livelihoods. These zones play a crucial role in shaping agricultural crop cultivation and input utilization. Nepal cultivates a diverse array of agricultural commodities, including paddy, wheat, maize, buckwheat, millet, rice, tobacco, sugarcane, jute, cotton, lentil, chickpea, arhar, black gram, khichari, kidney pea, soybean, various fruits, vegetables, tea, coffee, chili, cardamom, zinger, garlic, turmeric, sericulture, beekeeping, fish culture, mushrooms, and more (MOAD, 2022).

The FAO recommends utilizing Climate Smart Agriculture (CSA) to address these three challenges. In three domains, CSA has proven to be a useful technique. It focuses on three objectives, or pillars: (1) increase production in a sustainable manner to encourage development, a fair rise in farm incomes, and food security; (2) improve resilience (adaptation); and (3) reduce or eliminate greenhouse gas emissions (mitigation) (de Nijs et al., 2014; FAO, 2010; Lipper et al., 2014). The goal is to mobilize funding and stimulate on-the-ground activities at the intersection of scientific and public policymaking (Saj et al., 2017).

Current worldwide crop yield variability related to climate change ranges from 32% to 39%, resulting in annual production fluctuations of 2 to 22 million tons for commodities like soybeans, rice, wheat, and corn (Ray et al., 2015). According to Vermeulen et al. (2012), agriculture and livestock contribute 19% to 29% of global greenhouse gas emissions. Furthermore, the Food and Agriculture Organization (FAO) predicts that by 2050, 60% more food will be required to sustain a growing worldwide population that is changing its consumption habits by consuming more protein (Alexandratos and Bruinsma, 2012). Agriculture faces three challenges: improving agricultural systems' ability to adapt to climate change, reducing their environmental effect, and ensuring food security both locally and worldwide (FAO, 2013).

Numerous projects to make CSA operational have surfaced in the last few years on a variety of spatial scales (national, regional, local), incorporating various forms of innovation (technical, institutional, and collaborative) (Brandt et al., 2017; Neufeldt et al., 2015) Numerous assessment techniques have been developed as a result of these in order to prioritize and apply CSA.

In Nepal, maize is cultivated on 9,56,447 hectares of land with an average productivity of 2.84 t/ha, making it the second most major cereal crop after rice (MOALD 2020). According to the ABPSD 2020, maize accounts for approximately 3.15% of the national GDP and 9.5% of agricultural GDP. Maize is an important component of animal feed; therefore demand is increasing as more animal husbandry enterprises expand. Maize is largely used for feeding reasons in the Terai and as a staple food in Nepal's hills (Pokharel et al., 2016).

According to MOALD 2020, Nepal imported more than 5,000 tons of maize grain in 2018-19. Thus, to meet domestic demand, Nepal's maize output must be dramatically expanded. Some of the simple and practical strategies to increase maize yield in Nepal include using superior varieties or hybrids, as well as timely irrigation, fertilizers, and manure. However, maize yield varies from variation to variation and location to location, and is reliant on the availability of important factors such as the quantity of nutrients in the soil and the usage of fertilizers (Kogbe and Adediran 2003). In Nepal, ordinary maize farming is advised to use a dosage of 120:60:40 kg N, P2O5, and K2O plus 10 tons FYM/ha (NMRP 2018). Adhikari (2014) suggests that a comprehensive suggestion might not include all soil types and features, growth circumstances, combinations, domains, and farmers' social and economic standing. Being a mountainous nation, Nepal has varied soil in several areas, and during the rainy season, landslides and soil erosion cause a massive loss of soil minerals (KC et al 2013).

As per MOAD (2019), the cultivation of potatoes spans 195,173 hectares in Nepal, yielding 2,881,829 metric tons. Potatoes hold the fifth position in terms of area coverage, second in both production and consumption, and claim the top spot in productivity. The cultivation of potatoes occurs at altitudes ranging from 100m to 4400m (Joshi, 1997). In the Rasuwa district of Nepal, major potato varieties include Gatlang-Local, Khumal-Ujjwal, Khumal, Seto-1, Janak-Dev, and Kufri-Jyoti. Fertilizer application significantly impacts yield (Wastermann, 2005), and varietal selection also plays a crucial role in potato production. High-quality, healthy seeds can result in a yield increase of up to 40% (Khairgoli, 1987). Due to its poorly developed shallow root system, potatoes demand a substantial amount of nutrients compared to cereals. Potato plants produce a considerable amount of dry matter in contrast to cereals (Singh and Trehan, 1998), depleting large amounts of soil nutrients, which is a cause for concern.

Therefore, the application of essential inputs such as Nitrogen, Phosphorus, and Potassium is crucial, as these major macronutrients have demonstrated improvements in both yield and quality (Wastermann, 2005). During the bulking stage, the daily requirements for potato tuber growth are 4.5 kg ha-1 N, 0.3 kg ha-1 P, and 6.0 kg ha-1 K (Haifa, 2014). Nitrogen is vital for increasing plant height, leaf area index, shoot dry matter, and tuber yield (Zelalem et al., 2009), while phosphorus is essential for early growth and tuber maturity (UIES, 2010). Potassium is necessary for carbohydrate translocation and enhances plant resistance to diseases and abiotic stresses such as drought and heat (Pandey, 2020).

Integrating diverse conservation approaches is imperative, as underscored by Article 9 of the Convention on Biological Diversity (CBD), which emphasizes the synergy between ex situ and in situ species conservation by facilitating the exchange of plant genetic resources between farmers and genebanks (Thormann et al., 2006). Consequently, a multidisciplinary conservation strategy that amalgamates in situ and ex situ management processes is essential when appropriate (Conway, 2007; Byers et al., 2013; Schwartz et al., 2017), requiring an adaptive management process and robust collaboration at all levels of conservation action, including planning, implementation, monitoring, and assessment (Schwartz et al., 2017). This necessitates the engagement of multiple actors with diverse complementary skills. Community seed banks and community field genebanks have been established to bridge the gap between genebanks and farmers, serving as facilitators and platforms for knowledge exchange (Chaudhary, 2013). In the context of plant breeding, ex-situ conservation typically involves the collection, classification, evaluation, and utilization of agrobiodiversity, with community seed banks supporting genebanks in the collection, regeneration, and exchange of genetic materials (Vernooy, 2018; Joshi et al., 2018).

A sustainable food system would see variety kept in gene banks, in situ, or on farms as not supporting and promoting optimal conservation without their sustainable usage in food and nutrition security and the livelihood of the world's growing population. The conservation of main staple crops has dominated gene banks, with just 2% of materials held being non-staple crops, and crop wild relatives are similarly underrepresented. As a result, ex situ facilities are merely the tip of the iceberg (Dulloet al., 2019). Furthermore, due to deficient management techniques brought on by a lack of funding, staff with the necessary training, and sometimes overburdened and underfunded conservation initiatives, even diversity maintained in ex situ facilities may be genetically eroded. Through raising yields, managing marginal lands, and boosting family income, value chain development of underused nutrient-dense food crops can directly enhance the livelihoods and nutrition security of impoverished farmers in marginal contexts (Gauchanet al., 2019).

A study on "Fertilizer use Trend of far-western region in Nepal" by RAD Dipayal (2064-65) found that the average chemical fertilizer used annually on Paddy and Wheat of the FWDR was 109 kg/ha with 48.03kg/ha on Paddy and 60.9kg/ha on Wheat. Highest amount of chemical fertilizer annually used on major cereal crops Paddy and Wheat under Kailali district i.e. 316.9 kg/ha with 111.65kg/ha on Paddy and 205.2kg/ha on Wheat crop followed by Bajhang District with 146.3kg/ha, Kanchanpur with 139.6kg/ha, Doti with 123.9kg/ha, Dadeldhura 73.21kg/ha, Darchula 68.88kg/ha, Achham 39.76kg/ha, Bajura 37.18kg/ha and lowest amount of chemical fertilizer annually used under Baitadi district i.e. 37.48 kg/ha with 26.48kg/ha on Paddy and 8.3kg on Wheat crop (Heffer, 2016) .

## Methodology

The researcher wishes to undertake an in-depth inquiry in Baijnath tole of Bhimdatta municipality, where the majority of the people is engaged in agricultural activities. As a result, the Baijnath tole, one of ten in Bhimdatta municipality Ward 19, was chosen as the census method's research area. According to a census study, there are 65 dwellings and 275 people residing in Baijnath tole, which is part of Bhimdatta Municipality 19. This study was carried out using the census method/ approach, with respondents chosen from 65 agricultural households in Baijnath tole. The questionnaire focused on gathering information about the agricultural land in Katta, including details on land size, types, frequency, and quantity of manures used. To standardize land size measurements, the information collected on Katha (local unit) was converted to hectares, with 1 Katha equaling 0.00668903 hectares.

The research design of this study employed a combination of empirical research methods utilizing both qualitative and quantitative data. A semi-structured questionnaire served as the primary tool for data collection. The study focused on exploring the status of chemical fertilizer use and its impact on the production of major cereals in the specified area, which had not been previously investigated. This approach was exploratory in nature, seeking to uncover insights into the macro plant nutrient scenario, sources of macro-nutrient-rich chemical fertilizers, quantities of chemical fertilizers used per unit area, and the supplied quantity of macro-nutrients. The research aimed to provide a comprehensive and accurate description of the study by employing descriptive methods, facilitating fact-finding investigations with adequate interpretation.

Overall, this research aimed to fill the gap in understanding the relationship between chemical fertilizer use and cereal production in the specified area, employing a robust methodology combining both quantitative and qualitative data collection techniques

## Results and Discussion

### Area, Production and Productivity of Major Cereal Crops (Paddy and Wheat of Last 5 Years)

The farmed area has stayed quite steady over the last five years. Paddy cultivation spanned 113 to 114 hectares, while wheat cultivation covered 109 to 110 hectares over the same season. On average, 97% of total land area is used for cultivation, with paddy accounting for 99% and wheat for 95%.

The production status over the last five years has fluctuated slightly from year to year. Regarding paddy, the area and output were at their lowest in 2075, but production improved significantly in 2076 with the same area. The largest area under paddy cultivation was recorded in 2077 at 114.43 hectares, yielding 254.57 metric tons. However, peak production occurred in 2078, when it reached 275.07 metric tons with an area under cultivation of 113.76 hectares. The productivity of paddy changed throughout the last five years, according on acreage and production. The lowest paddy productivity in the last five years was in 2075 at 2.25 metric tons per hectare, followed by an upward trend in future years: 2.29 metric tons in 2076, 2.36 metric tons in 2077, 2.4 metric tons in 2078, and 2.45 metric tons in 2079. It indicates that paddy output was especially good in 2078.

For wheat, the area was at its lowest in 2078 and 2079, both at 109.3 hectares, with the lowest production in 2076 at 239.1 metric tons from an area of 110.6 hectares. Wheat production changed in response to changes in cropped area, with the smallest area under cultivation in 2078 and 2079 (109.3 hectares) generating the maximum production of 260.88 metric tons in 2078, followed by 253.73 tons in 2079. Wheat productivity has varied over the last five years, with the lowest reported in 2076 at 2.23 metric tons per hectare. The following years showed a rising trend: 2.26 metric tons in 2075, 2.36 tons in 2073, 2.38 tons in 2077, and 2.42 tons in 2078. The year 2078 appears to be beneficial for paddy and wheat output. Figure 1 and Table 1 show more details.

**Table 1**

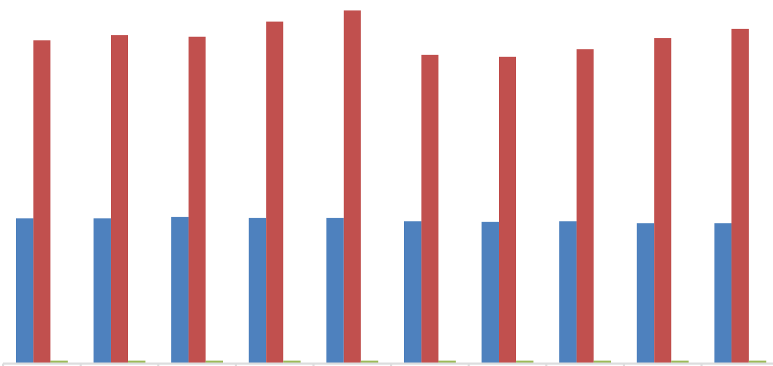
*Area of Paddy and Wheat under Cultivation*

| Crops | Area of Paddy and Wheat under Cultivation in Last 5 Years | | | | |
|---|---|---|---|---|---|
| | 2075 | 2076 | 2077 | 2078 | 2079 |
| Paddy (Ha.) | 113.09 | 113.09 | 114.43 | 113.76 | 113.76 |
| Wheat (Ha.) | 110.80 | 110.60 | 110.80 | 109.30 | 109.30 |
| Total (Ha) | 223.89 | 223.69 | 225.23 | 223.06 | 223.06 |
| Cropping Intensity (%) | 193.34 | 193.17 | 194.50 | 192.63 | 192.63 |

*Source: Field Survey -2023*

**Figure 1**

*Five Years Area, Production and Productivity of Major Cereal Crops (Paddy and Wheat)*



| | Paddy | | | | | Wheat | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2075 | 2076 | 2077 | 2078 | 2079 | 2075 | 2076 | 2077 | 2078 | 2079 |
| Area (Ha.) | 113.09 | 113.09 | 114.43 | 113.76 | 113.76 | 110.8 | 110.6 | 110.8 | 109.3 | 109.3 |
| Production (Mt.) | 251.85 | 255.84 | 254.57 | 266.49 | 275.07 | 240.68 | 239.01 | 245.03 | 253.73 | 260.88 |
| Productivity (Mt./Ha.) | 2.25 | 2.29 | 2.4 | 2.36 | 2.45 | 2.26 | 2.23 | 2.38 | 2.36 | 2.42 |

*Source: Field Survey -2023*

## Fertilizer Use Pattern and Type of Fertilizer Used

The research area has a 92% fertilizer usage rate, while 8% of the population does not use fertilizers. Various forms of fertilizers are used by farm households, including DAP, Urea, Potash Murat, Farm yard manure/compost, and vermin compost. However, not all households use the same fertilizer, and the quantities vary.

Of the 65 families that use fertilizers, 59 use Urea, 236 use DAP, 8 use Murat of Potash, 120 use FYM/compost, and 2 use vermin compost. Fertilizer users utilize various mixtures of these fertilizers.

DAP + Urea is the most popular combination, accounting for 27 houses and 45.56% of fertilizer users. Another major combination is DAP + Urea + Compost, with 23 households accounting for 39.26%. The third biggest combination is the usage of just Urea, which is used by four houses, accounting for 7.41% of fertilizer users. Other combinations include compost alone by 2 households (2.96%), compost + DAP + Urea + Murat of Potash by 1 household (1.48%), DAP + Urea + Murat of Potash by 1 household (1.11%), and assorted combinations by 1 family (2%).

**Table 2**

*Fertilizer Use and Type of Fertilizer Used with their Combinations*

| Fertilizer using categories | Numbers of HH | Percentage |
|---|---|---|
| Households Using Fertilizers | 59 | 91.53 |
| Households not Using Fertilizers | 6 | 8.47 |
| Total | 65 | 100 |
| **Combinations of Used Fertilizers by Fertilizer Using House Holds** | | |
| DAP + Urea | 27 | 41.53 |
| DAP + Urea + Compost | 23 | 35.38 |
| Urea only | 4 | 6.15 |
| Compost only 2 | 2 | 3.07 |
| Compost + DAP + Urea + Murat of Potash | 2 | 3.07 |
| DAP + Urea + Murat of Potash | 6 | 9.23 |
| Other | 1 | 1.53 |
| Total | 65 | 100 |

*Source: Field Survey -2023*

## Fertilizer Used Quantity on Major Crops within Last Five years (Paddy and Wheat)

### *Fertilizer Used Trend in Paddy Crop*

The market offers a variety of fertilizers, including DAP, Urea, MOP, FYM, and Vermi compost. The use of vermin compost is not prevalent in practice. Over the last five years, FYM application has ranged from 620 to 670 kg/ha. Urea is the most often used chemical fertilizer, with an annual application rate of 68 to 77 kg/ha, followed by DAP at 52 to 59 kg/ha and MOP at 500 grams/ha.

Table 4 shows the trend in the use of chemical fertilizers. The use of DAP has steadily increased during the previous five years. Urea consumption climbed significantly over the first four years, but decreased in the fifth year, 2079, presumably due to its scarcity during the harvest season. Similarly, the use of MOP grew in the first year but subsequently fell in successive years.

The combined use of three chemical fertilizers (DAP, Urea, and MOP) was 121.2 kg, 121.94 kg, 129.53 kg, 136.4 kg, and 137.3 kg/ha from 2070 to 2074, respectively. Overall, the use of total chemical fertilizer in paddy crops has increased during the last five years, from 2075 to 2079.

The optimal NPK ratio for irrigated paddy is 100:30:30 kg NPK per hectare. This suggestion calls for 65.22 kg of DAP, 191.9 kg of urea, and 50 kg of MOP per hectare. Thus, the total amount of chemical fertilizer required for optimal paddy crop production is 307.12 kg/ha. Farmers, on the other hand, use only 40 to 45% of the necessary amount, indicating a considerable difference of 55 to 60%.

A comparison of individual fertilizer use trends among farmers and recommendations shows that DAP use is progressively growing and nearing the required dose, with the first year being 20% lower and the last year being 9% lower. Farmers' usage of urea appears to be more or less steady year after year, gradually growing toward the recommended amount but steadily decreasing, with 64% less in the first year and 60% less in the last year. The usage of MOP has remained generally steady throughout the last five years, with a significant variation from the prescribed dose, which was 50% lower in 2078 and 99% lower in other years.

**Table 3**

*Quantity of Used Fertilizers on Paddy Crop within Last 5 Years*

| **Used Fertilizer** | **Quantity of Fertilizer Used within Last 5 Years.** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2075 | 2076 | 2077 | 2078 | 2079 | 2075 | 2076 | 2077 | 2078 | 2079 |
| | Total used quantity | Total used quantity | Total used quantity | Total used quantity | Total used quantity | Used Hector | Used hector | Used hector | Used hector | Used hector |
| **DAP (kg)** | 5915 | 5920 | 6352 | 6561 | 6765 | 52.3 | 52.35 | 55.51 | 57.68 | 59.47 |
| **Urea (kg)** | 7737 | 7786 | 8414 | 8898 | 8796 | 68.41 | 68.85 | 73.53 | 78.22 | 77.32 |
| **Murat of Potash (kg)** | 55 | 84 | 56 | 57 | 58 | 0.49 | 0.74 | 0.49 | 0.5 | 0.51 |
| **FYM/ Compost (Mt)** | 70.02 | 72.45 | 76.96 | 75.03 | 76.68 | 0.62 | 0.64 | 0.67 | 0.66 | 0.67 |
| **Vermi Compost (Mt)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Source: Field Survey -2023*

## Fertilizer Used Trend in Wheat Crop

Fertilizers available on the market include DAP, Urea, MP, FYM, and vermin compost. The use of vermin compost was only observed in 2070, and the amount used was insignificant. FYM application rates have varied between 640 and 700 kg/ha during the last five years. Wheat crops had a somewhat higher FYM rate than paddy crops. Over the last five years, Urea has been used more than any other chemical fertilizer, with yearly quantities ranging from 70 to 84 kg/ha, followed by DAP at 56 to 66 kg/ha and MOP at 400 to 500 grams/ha.

Table 5 shows the trend in the usage of chemical fertilizers in wheat crops. The use of DAP has been steadily increasing over the previous five years, as seen in the table. Urea usage increased in the first four years, but fell slightly in the fifth year, 2074. The reduced amount of urea utilized in 2074 could be related to its scarcity throughout the agricultural season. Similarly, the use of MOP has decreased during the previous five years.

The combined use of three chemical fertilizers (DAP, Urea, and MP) amounted to 127.87 kg, 131.74 kg, 141.47 kg, 150.02 kg, and 151.35 kg/ha in the years 2070 to 2074, respectively. The overall trend in the use of total chemical fertilizer in wheat crops has been increasing over the last five years, from 2070 to 2074.

The recommended NPK ratio for irrigated wheat crops is 100:50:25 kg NPK/ha. According to this recommendation, the required quantities of DAP, Urea, and MOP are 108.7 kg, 174.9 kg, and 41.67 kg/ha, respectively. Thus, following the recommendation, the total quantity of chemical fertilizer required for optimal wheat crop production is 325.27 kg/ha. However, farmers are using only 39 to 47% of the recommended dose, indicating a substantial gap between the utilized and recommended doses.

A comparison of the individual fertilizer use trends by farmers and recommendations reveals that the use of DAP and Urea is increasing over the last five years, but there is still a significant gap between the used dose and the recommended dose. The used dose of DAP is lower than the recommended dose, being 48% below in the first year and 38% below in the last year. Similarly, the used dose of Urea is also lower than the recommended dose, with 60% below in the first year and 52% below in the last year. The use of MOP has remained relatively constant over the last five years, with a substantial difference from the recommended dose, being 99% below the recommended dose.

**Table 4**

*Quantity of Used Fertilizers on Wheat Crop within Last 5 Years*

| Used Fertilizer | Quantity Used within Last 5 Years. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2075 | 2076 | 2077 | 2078 | 2079 | 2075 | 2076 | 2077 | 2078 | 2079 |
| | Total used quantity | Total used quantity | Total used quantity | Total used quantity | Total used quantity | Used /ha. | Used /ha. | Used /ha. | Used /ha. | Used /ha. |
| **DAP (kg)** | 6256 | 6423 | 6847 | 7133 | 7321 | 56.46 | 58.08 | 61.8 | 65.26 | 66.98 |
| **Urea (kg)** | 7849 | 8091 | 8770 | 9206 | 9173 | 70.84 | 73.16 | 79.16 | 84.23 | 83.93 |
| **Murat of Potash (kg)** | 63 | 55 | 57 | 58 | 48 | 0.57 | 0.5 | 0.51 | 0.53 | 0.44 |
| **FYM/ Compost(Mt)** | 70.45 | 73.31 | 75.7 | 76.2 | 75.78 | 0.64 | 0.66 | 0.68 | 0.7 | 0.69 |
| **Vermi Compost (Mt)** | 0.61 | 0 | 0 | 0 | 0 | 0.01 | 0 | 0 | 0 | 0 |

*Source: Field Survey -2023*

### Farmers' Perspectives on Fertilizer Usage Quantity

In the study area, farmers' opinions were categorized into three groups: sufficient, insufficient, and average satisfactory. Analysis revealed that 84% of the farming population expressed average satisfaction with the quantity of fertilizer they had used. Approximately 10% of the farming population recognized that the quantity they employed was insufficient for their crops, while 6% believed it was adequate.

### Preferential Chemical Fertilizers for Paddy and Wheat Crops

The chemical fertilizers available in the market include DAP, Urea, and Murat of potash. Among these options, 79% of the population favored both DAP and Urea for paddy and wheat crops, 18% preferred only Urea, and 3% opted for all three fertilizers for the major crops of paddy and wheat in the study area.

## Reasons for Low Fertilizer Use/Consumption

Several challenges contribute to the low quantity of fertilizer use, including untimely availability, financial constraints, limited knowledge about fertilizers, and perceived lack of necessity for crops. Among these factors, 68% of the population faced issues with obtaining fertilizers in a timely manner, 29% encountered financial difficulties, and 3% were unfamiliar with chemical fertilizers. Ensuring timely access to chemical fertilizers could enhance consumption rates in the study area.

## Utilization of Farm Yard Manure (FYM)/Compost

A mere 9% of the population exclusively used FYM, while the remaining majority employed a combination of chemical fertilizers with FYM or relied solely on chemical fertilizers. The practice of mixing FYM with chemical fertilizers has been relatively stable or decreasing due to limitations in major nutrient supply, insufficient availability, and a decrease in cattle herds in the study area.

## Perceptions and Comments Regarding Chemical Fertilizers

Farmers' opinions on chemical fertilizers in relation to crop production were surveyed. A significant 90% of the population believed that chemical fertilizers were essential for enhancing soil fertility and crop production. Another 5% perceived chemical fertilizers as detrimental to soil fertility, while an additional 5% did not attribute any role to chemical fertilizers in increasing production and soil fertility. The majority of farmer comments supported the view that chemical fertilizers were necessary to boost crop production in the study area.

## Fertilizer Usage Patterns and Production of Major Cereals (Paddy and Wheat)

Various factors, including fertilizer usage, play a crucial role in increasing crop production and productivity. As the fertilizer dosage increased, the productivity of both paddy and wheat crops showed a corresponding increase. Details on fertilizer usage quantities and crop productivity for paddy and wheat are presented in Tables 26 and 27, with trends illustrated in Figures 33 and 34. Statistical interpretations can be found in Tables 6 and 7.

**Table 5**

*Fertilizer Used and Productivity of Paddy*

| Items | Fertilizer Used and Productivity of Paddy (kg/Ha) | | | | |
|---|---|---|---|---|---|
| | 2070 | 2071 | 2072 | 2073 | 2074 |
| **Fertilizer Used** | 121.2 | 121.94 | 129.53 | 136.4 | 137.3 |
| **Productivity** | 2250 | 2290 | 2400 | 2360 | 2450 |

*Source: Field Survey -2023*

**Table 6**

*Fertilizer Used and Productivity of Wheat*

| Items | Fertilizer Used and Productivity of Paddy (kg/Ha) | | | | |
|---|---|---|---|---|---|
| | 2070 | 2071 | 2072 | 2073 | 2074 |
| **Fertilizer used** | 127.87 | 131.74 | 141.47 | 150.02 | 151.35 |
| **Productivity** | 2260 | 2230 | 2380 | 2360 | 2420 |

*Source: Field Survey -2023*

The majority of farmers in Baijnath Tole of Bhimdatta municipality, use chemical fertilizers to raise grain crops. Chemical fertilizers like as nitrogen, phosphorus, and potassium are commonly used. Farmers reported large increases in crop yield after employing chemical fertilizers. Rice and maize harvests produced particularly high yields. Soil analysis revealed nutritional imbalances, with certain nutrients abundant and others deficient. The continuing use of chemical fertilizers in the absence of appropriate soil testing and nutrient management systems has resulted in soil degradation. The rising use of chemical fertilizers has raised concerns about environmental deterioration. Fertilizer runoff from fields may contaminate nearby bodies of water. Chemical fertilizers increased agricultural yields, although some farmers reported increased pest and disease susceptibility. This stresses the importance of integrated pest management techniques. Despite higher yields, the cost of purchasing and applying chemical fertilizers has driven up farmers' production costs. The economic viability of this practice warrants more investigation. Many farmers are unaware of the proper use of chemical fertilizers, soil health, and sustainable agriculture practices. There is a need for educational activities that encourage responsible fertilizer use and sustainable farming practices.

## Conclusion

Based on the analysis provided earlier, it is apparent that the socio-economic conditions in the study area are somewhat dissatisfactory. The majority of household heads are males falling within the 40 to 60 age range, and their educational background is predominantly uneducated. Most household heads are married, and the Tharu community constitutes a significant portion of the population, followed by Brahmin and Chettri ethnic groups, adhering to the Hindu religion. Nuclear family structures are prevalent, averaging six family members. The male population slightly outnumbers the female population, with a higher percentage of educated males compared to females.

Decisions regarding farming are typically made jointly by husbands and wives. The average family landholding size is 0.39 hectares, mostly equipped with irrigation facilities. Agriculture serves as the primary source of income for most families, and Paddy-Wheat cropping patterns are prevalent on the total agricultural land. Although the area dedicated to Paddy and Wheat crops has remained relatively consistent over the past five years, there is a slight fluctuation in production and productivity. Less than half of the population obtains adequate food from their own production, leading to dependence on alternative income sources, such as services, to address food insufficiency.

In terms of institutional support, farmers underutilize available resources, with only a few households participating in cooperatives, farmer groups, and agricultural training. This underscores the need for organized and widespread agricultural training programs. While the Dhan Zone program is implemented in the area, a considerable number of farmers are unaware of its existence, emphasizing the necessity for a comprehensive awareness campaign to achieve program goals. Most farm families invest their own income in agricultural production, and despite the availability of crop insurance, very few farmers take advantage of this facility. Farmers typically bear the risks of crop production themselves, highlighting the need for extensive promotion of crop insurance policies.

Major inputs for crop production include chemical fertilizers, specifically DAP, Urea, and MOP. The utilization pattern of these mineral fertilizers has consistently increased year by year. The predominant practice among farm families is the combination of DAP and Urea, followed by the combination of DAP, Urea, and compost. Although the combination of Compost, DAP, Urea, and Murat of potash is considered effective, only 1% of households have adopted this approach. The use of MOP is on a declining trend, indicating a lack of appropriate fertilizer combination. The quantity of fertilizer used generally falls below recommended levels, suggesting a tendency among farmers to use fertilizers without conducting soil tests or adhering to basic recommendations. Larger family sizes, extensive land holdings, and agriculture as the primary source of income are associated with increased fertilizer application. Fertilizer application is higher on leased land compared to owned land, underscoring the need for improved education and guidance on appropriate fertilizer use in agricultural practices.

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