

EXPLORING ALTERNATE DISTRIBUTION CHANNELS TO OVERCOME FREQUENT FERTILIZER SHORTAGE IN NEPAL

A study conducted as a part of the Daayitwa Nepal Public Policy Fellowship 2023,
together with the Ministry of Agriculture and Livestock Development

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Sincerely,

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ACRONYMS AND ABBREVIATIONS

%	:	Percentage
\$	:	US Dollar
ADS	:	Agriculture Development Strategy
AIC	:	Agriculture Inputs Company
AITC	:	Agriculture Information and Training Center
AKC	:	Agriculture Knowledge Center
APP	:	Agriculture Perspective Plan
CIF	:	Cost, Insurance and Freight
CIMMYT	:	International Maize and Wheat Improvement Center
DAP	:	Diammonium Phosphate
DOA	:	Department of Agriculture
FDC	:	Fertilizer Distributor Company
FGD	:	Focus Group Discussion
FSDMC	:	Fertilizer Supply and Distribution Management Committee
FYM	:	Farm Yard Manure
IPP	:	Import Parity Price
KII	:	Key Informant Interview
KSCL	:	Krishi Samagri Company Limited
LC	:	Local Committee
MoALD	:	Ministry of Agriculture and Livestock Development
MoLCPA	:	Ministry of Land Management, Cooperatives and Poverty Alleviation
MOP	:	Muriate of Potash
Mt.	:	Metric ton
NBS	:	Nutrient Based Subsidy
NPK	:	Nitrogen, Phosphorus, Potash
NRs.	:	Nepalese Rupees
PC	:	Province Committee
PPP	:	Public Private Partnership
RDF	:	Recommended Dose of Fertilizers
STCL	:	Salt Trading Corporation Limited
TC	:	Technical Committee

ABSTRACT

A policy-based-research was conducted to answer the question ‘What roles can different stakeholders play in overcoming frequent fertilizer shortage in Nepal?’ with an objective to explore alternate distribution channels. A list of stakeholders was prepared and their roles were analyzed to categorize them for their interest, influence, importance and impact on/from the fertilizer distribution channels and policies. The process was visualized with the development of Process Visualization Map specific to the Subsidized Fertilizer Distribution Management Directive 2020 and Chemical Fertilizer Control Order, 1998, second edition 2021. Assessment of secondary data on district wise fertilizer requirement, demand estimation and quota allocation revealed that the supply of subsidized chemical fertilizers viz. Urea, DAP and MOP was only 18.16%, 18.34% and 2.39% of the total fertilizers required respectively. One Focus Group Discussion and Four Key Informant Survey were carried out with agriculture cooperatives of Kapilvastu district registered as dealers of Krishi Samagri Company Limited and Salt Trading Corporation Limited. Similarly, Key Informant Interviews were conducted with stakeholders associated with fertilizer distribution at local, provincial and federal level. Interview findings were analyzed to identify the constraints related to cost/benefit, stock/storage, conflict/curses, and database management, and loopholes related to documentation, monitoring, role division and accountability in the current fertilizer distribution channel. The study results indicated that all the involved stakeholders perceive fertilizer shortage as a national problem. The fertilizer distributors, and dealers expressed their priorities on selling the fertilizers as soon as it was made available to them, while the private sectors showed their interest on supplying fertilizers, other than those subsidized by the government, so as to fulfill the deficit. The major reasons for preference of government subsidized fertilizers among farmers were found to be: better quality, price and the presence of a pre-defined channel. Overall, the study recommends alternatives like Public Private Partnership, organic agriculture production, and supply of nutrients in other forms for gap fulfillment; and emphasis on agriculture cooperatives, demand-based distribution and block-chain based technology for improving the performance of fertilizer distribution channel. The pressing problem of fertilizer shortage in Nepal has been analyzed from the distribution perspective through this study.

1. INTRODUCTION

1.1 Background

Nepal has experienced changing policy conditions in fertilizer distribution and subsidy scheme in four different phases viz. phase without subsidy, introduction of subsidy, deregulation of fertilizer trade and the current fertilizer policy (Raut & Sitaula, 2012) as a consequence of inability to meet the quality, quantity and time requirements of fertilizer (Shrestha, 2010). The strength of current input subsidy mechanism lies in prioritization of fertilizer subsidy with the utilization of opportunity of transparent distribution via cooperatives, but the distortion of fertilizer market due to subsidy has resulted in the dismal participation of private sectors (Bista, Dhungel, & Adhikari, 2018).

Salient features of current fertilizer Policy 2002:

- Krishi Samagri Company Limited (KSCL) will be the sole agency to import fertilizers under subsidy scheme and retail fertilizers through KSCL field offices and cooperatives.
- Subsidy Allocation Management Committee is mainly responsible for fixing retail price and subsidy reimbursement to KSCL.
- Subsidized fertilizers will be available for up to 0.75 ha and 4 ha in the hills and terai respectively for three crops a year.
- 20% of the estimated annual fertilizer consumption would be held as buffer stock

Similarly, Salt Trading Corporation Limited (STCL) has also got the rights to distribute subsidized fertilizers, after some updates on the Fertilizer Policy. Three major nutrient based fertilizers viz. urea (NPK ratio 46:0:0), Diammonium Phosphate (DAP; NPK ratio 18:46:0) and Muriate of Potash (MOP/Potash; NPK ratio 0:0:60) have been imported to Nepal by KSCL and STCL and distributed across the country, with subsidized support from Government of Nepal so that farmers have to pay only a minimal amount for its purchase from the registered dealers.

Key points in Subsidized Fertilizer Distribution Directive, 2020:

- Fertilizer Supply and Distribution Management Committee shall be responsible for determining, monitoring and reporting on price, subsidy and distribution status of fertilizers.
- Establishment and mobilization of Technical Committee, Provincial Fertilizer Distribution Management Committee and Local Committee
- Determination of quantity of fertilizer required in the upcoming fiscal year and the amount to be maintained as buffer stock
- Procedure for registration and sales of fertilizer in subsidized price

The major activities performed for fertilizer distribution is listed as follows:

Fertilizer pricing

- Uniform retail price at three entry points (Biratnagar, Birgunj and Bhairahawa)
- Transportation cost and operation cost added to determine the retail price

Fertilizer distribution

- Field offices and cooperatives registered with local government
- Dealership regulation and administration of retailers

Fertilizer procurement

- Invite sealed tenders from international market based on seasonal demand (8 to 10 tenders, 4 to 5 months) – CIF Kolkata/Haldia port (India) or CIF Nepal KSCL border warehouses entry points
- Government to government basis on Import Parity Price (IPP) of India
- Government fertilizer received on grant/aid by donor government

On the other hand, Chemical Fertilizer Control Order, 1998, second edition 2021, has specified the provision for registered importers, producers and dealers to be involved in chemical fertilizer procurement and distribution through their own channels following the given standards and regulations.

1.2 Statement of the problem

Several research studies have been conducted on policy perceptions and implications of fertilizer distribution in Nepal. The study on supply chain of subsidized fertilizer distribution conducted by Panta (2018) highlighted the major problems of fertilizer supply in Nepal viz. policy faults, ineffective regulation and lack of funds and infrastructure. However, the constraints have not been analyzed in detail regarding the point at which each specific constraint occurs.

A recent study by Nepal Seed and Fertilizer Project under International Maize and Wheat Improvement Center (CIMMYT) has made recommendations to Ministry of Agriculture and Livestock Development (MoALD) on restructuring fertilizer subsidy programs, preparing procurement process timeline, maintaining buffer stocks and encouraging private participation in fertilizer distribution (Unpublished). Previous studies have been focused more on existing problems of fertilizer shortage, seeking alternatives as a solution. It is equally important to identify the opportunities and challenges that might occur in adopting the alternatives in the future.

Despite several studies and policy recommendations, the literature lacks a detailed description on potential stakeholders who can contribute to improve the fertilizer distribution channels in Nepal. The role of private sectors i.e., family owned agrovets have been questioned for compliance in national subsidy programs with public-private debates on their ability and trustworthiness on price and quality issues (Gautam, Choudhary, & Rahut, 2022). Involvement of the private sector in

fertilizer selling activities was found to reduce the travel time and cost of farmers as an implication of Fertilizer Distribution Directive 2020 (Thapa, Gaihre, Choudhary, & Gautam, 2023). The effect of changes in chemical fertilizer price on smallholder and large holder farm households have also been studied previously (Takeshima, 2019; Takeshima, Adhikari, Shivakoti, Kaphle, & Kumar, 2017). A review on nutrient management in South Asia explained that abolition of subsidies in fertilizers have not been effective in Bangladesh, Sri Lanka, Nepal and India due to its impact on fertilizers use and productivity increase among farmers thus suggesting for other policy reforms in soil intelligence mapping, development of fertilizer blends, and decontrolling fertilizer prices (Kishore, Alvi, & Krupnik, 2021).

In this context of growing voices to encourage participation of private sectors in fertilizer distribution in Nepal, sufficient qualitative information on performance potential of private sectors as well as other stakeholders has not been recommended. Amid all the previous studies, the literature has not been able to provide evidence to help in decision making and implementation.

The study aims to answer the question ‘What roles can different stakeholders play in overcoming frequent fertilizer shortage in Nepal?’

1.3 Objectives

1.3.1 Broad objective

To explore alternate distribution channels to overcome frequent fertilizer shortage in Nepal

1.3.2 Specific objective

- To study about demand and supply condition of subsidized fertilizer in Nepal
- To conduct stakeholder analysis based on their interest, importance, influence and impact in overcoming fertilizer shortage in Nepal
- To identify the constraints and loopholes in current fertilizer distribution channel
- To assess the priorities, perception and preference of stakeholders involved in fertilizer distribution channel

1.4 Structure of the report

The report has been developed in five sections viz. introduction, methodology, results and discussion, conclusion and appendices. The first section contains background information of policies related to fertilizer distribution in Nepal, stating the research problem and indicating the objectives of the research study. Moving on, the methodology section includes subheadings: selection of study area, secondary data analysis, stakeholder analysis, process visualization map, interviews and analysis of the findings, describing the major activities carried out in data collection, analysis and presentation. The third section starts with a brief review on national plans and visions that have mentioned about fertilizer distribution. This is followed by an assessment of demand and supply status of chemical fertilizers in Nepal, results of stakeholders analysis, and document-based and interview-based description of Process Visualization Map. Constraints faced

by the stakeholders in the fertilizer distribution process and the loopholes of existing distribution channel have been listed and then the perception, priorities and preference of stakeholders are described based on the interview findings. Accordingly, alternatives for the current distribution channel have been recommended based on the results, author's understandings and literature review in the last sub-section. Conclusion of the report and appendices comprise the fourth and fifth section.

2. METHODOLOGY

2.1 Selection of study area

The field visit was planned after thorough discussion with the public partner, funding partner and research supervisor regarding the achievement of specified objectives. Based on the Subsidized Fertilizer Distribution Management Directive 2020, major stakeholders involved in fertilizer distribution were identified. In order to study the fertilizer distribution channel, its functioning and challenges, it was deemed necessary to observe the situation at ground level.

According to statistics on fertilizer distribution, it was found that Lumbini province received the highest quantity of fertilizer in the year 2020/21 among 7 provinces (Table 1). Kapilvastu district of Lumbini province was purposely selected for the study as it is one of the top 10 rice producing districts, and yet has the lowest quantity of fertilizer supply in proportion of area under rice cultivation (Table 2). Interviews were performed in 3 municipalities of Kapilvastu district viz. Banganga Municipality, Buddhabhumi Municipality and Yashodhara Rural Municipality. The municipalities were selected according to the description about their access to fertilizers in the past years provided by province and district level representatives and farmers. The municipalities were also selected for the reasons that they were near to the open Indian border.

In addition to that, other responsible stakeholders i.e., Agriculture Knowledge Center, Kapilvastu; Directorate of Agriculture Development, Lumbini province; and Branch and Province Offices of Fertilizer Distributor Company were also interviewed.

Table 1: Supply quantity of fertilizers at province level, 2020/21

	Urea	DAP	MOP	Total
Koshi	40,962	22,771	2,365	66,098
Madhesh	45,396	39,180	3,362	87,938
Bagamati	49,897	22,518	2,637	75,052
Gandaki	10,676	4,238	517	15,431
Lumbini	53,081	38,321	3,220	94,622
Karnali	3,056	1,831	141	5,028
Sudurpaschim	22,113	12,123	749	34,985

Source: Statistical Information on Nepalese Agriculture 2020/21 (MoALD)

Table 2: Supply of fertilizer per unit area of paddy production, 2020/21

District	Area (paddy); ha	Urea		Total	Supply per unit area of production (Mt/ha)
		supply; Mt	DAP supply; Mt		
Jhapa	93364	10650	5879	16529	0.177038
Morang	86853	15206	8982	24188	0.278494
Sunsari	53555	7653	5182	12835	0.23966
Saptari	50325	5583	5276	10859	0.215777
Dhanusha	58353	3807	3021	6828	0.117012
Bara	58625	8342	6213	14555	0.248273
Rupandehi	64158	16860	13270	30130	0.469622
Kapilvastu	64362	5408	4174	9582	0.148877
Bardiya	50638	6353	4560	10913	0.21551
Kailali	70520	17318	8606	25924	0.367612

Source: Statistical Information on Nepalese Agriculture 2020/21 (MoALD)

2.2 Secondary data analysis

- Quantity-price trend

Fisher's quantity price index number was calculated for the quantity of fertilizers supplied in 4 subsequent years compared to base year 2017/18 by taking into consideration, the average international price of Urea and DAP in the respective years.

$$Fisher's\ Index = \sqrt{\frac{\sum q_1 p_0}{\sum q_0 p_0} * \frac{\sum q_1 p_1}{\sum q_0 p_1}} * 100$$

Where, q_0 : quantity at base year, p_0 : price at base year, q_1 : quantity at given year, p_1 : price at given year

- Demand and supply estimation (Year 2078/79 – since the data is not updated after that)

Steps

1. Production statistics of each district and quantity of fertilizers supplied to each district was obtained from ‘Statistical Information on Nepalese Agriculture 2078/79’ published by Ministry of Agriculture and Livestock Development (MoALD)
2. Based on area under cultivation, top 5 crops (cereals, oilseed, pulses and cash crops) and top 5 vegetables were highlighted. Only those fruits for which zones have been designated by the Prime Minister Agriculture Modernization Project were selected for each district. Spice crops like ginger, turmeric etc., were excluded as chemical fertilizers are not generally used for these crops. Fish was also included in the calculation based on the water surface area used for fish farming.
3. Recommended dose of fertilizer was assessed from ‘Agriculture and Livestock Diary 2023’ published by Agriculture Information and Training Center (AITC).
4. Fertilizer requirement for each crop was calculated using the formulas as below;

$$DAP \text{ Requirement} = \frac{RDF * Area}{0.46}$$

$$Urea \text{ Requirement} = \frac{(RDF_{urea} - (RDF_{DAP} * \frac{0.18}{0.46})) * Area}{0.46}$$

$$MOP \text{ Requirement} = \frac{RDF * Area}{0.6}$$

Where, DAP = Diammonium Phosphate

RDF = Recommended Dose of Fertilizers

MOP = Muriate of Potash

5. The quantity of subsidized fertilizers distributed by Agriculture Input Corporation Limited and Salt Trading Corporation Limited, in proportion to the quantity of fertilizers required as per the crop area coverage was calculated.

Limitations

1. All the crops cultivated in a district were not included. Some crops (spice crops, coffee etc.) have been excluded from the whole study.
2. The use of Farm Yard Manure can reduce the required quantity of chemical fertilizers. The calculation has not considered organic farming, which is done in some crops and in some places/farms.
3. The quantity of fertilizers required may vary according to soil characteristics of the respective district.

2.3 Stakeholder analysis

The stakeholders involved, directly or indirectly, in fertilizer distribution were identified with the study of policy documents related to chemical fertilizers in Nepal viz. Subsidized Fertilizer Distribution Directive, 2020 and Chemical Fertilizer Control order, 1998, second edition 2021. Different documents like progress report, annual report and website information were studied to identify the major roles of identified stakeholders in distribution and management of subsidized fertilizers. The list of stakeholders and their major roles was prepared (Appendix C) and it was analyzed to categorize them for their interest, influence, importance and impact on/from the fertilizer distribution channels and policies. The analytical categorization method was used, among other methods reviewed by Kivits (2011), as it involved the reference of different government sources, rather than direct participation of stakeholders.

2.4 Process visualization Map

The process of subsidized fertilizer distribution was studied through the Subsidized Fertilizer Distribution Directive 2020 and its implementation status was assessed through Key Informant Interviews and Focus Group Discussion with stakeholder at different levels i.e. cooperatives/dealers, local government (local committee), KSCL and STCL (Fertilizer Distributor Company), Agriculture Knowledge Center (District level), Directorate of Agriculture Development (Provincial committee) and Ministry of Agriculture and Livestock Development (Fertilizer Supply and Distribution Management Committee). The process was visualized with the development of Process Visualization Map (Appendix D) specific to the directive, containing swim-lanes of different activities in horizontal rows and the involvement of different actors in the vertical columns, connecting the actors and the activities by suitable arrows and handoffs, as guided by Conger (2011). Process Visualization Map was also prepared for illustrating the channel of distribution of unsubsidized chemical fertilizers by following the Chemical Fertilizer Control Order, 1998, second edition 2021 (Appendix E).

2.5 Interviews

Key Informant Interviews and Focus Group Discussion were conducted at cooperative, municipal and provincial level, along with the representatives of Fertilizer Distributors at provincial and main offices. The questionnaire was semi-structured, containing 5 broad questions with the aim of assessing the current situation and exploring the potential alternatives. These were supported by several probing questions, depending upon the responses from interviewees.

Study questions

1. What process do you follow for estimating demand for fertilizer in the up-coming year? How is the price determined? What is the working modality of fertilizer distribution in Nepal? How have you been collaborating with other stakeholders during the distribution process? (15 minutes)

2. Please share about the supply situation of fertilizer in the past five years. How do you distribute the available fertilizers to the farmers? (10 minutes)
3. How do you describe the prevailing problem of frequent fertilizer shortage in Nepal? What are the major constraints that you have seen/faced in your region? (10 minutes)
4. What role should the authority play in overcoming frequent fertilizer shortage in Nepal? (10 minutes)
5. What alternatives do you foresee, for improving the frequent fertilizer distribution channel in Nepal? What would be the challenges in implementing these alternatives? What other policy and implementation recommendations would you make? (15 minutes)

Number of interviews performed

- Key Informant Interview: 2 (Representatives, Krishi Samagri Company Limited)
- Key Informant Interview: 1 (Directorate of Agriculture Development, Lumbini Province)
- Key Informant Interview: 1 (Agriculture Knowledge Center, Kapilvastu)
- Key Informant Interview: 2 (Branch Office, Taulihawa and Province Office, Bhairahawa, Krishi Samagri Company Limited)
- Key Informant Interview: 3 (Agriculture Section Officer of each Palikas)
- Focus Group Discussion: 1 (Cooperative dealers from BuddhaBhumi Municipality, representatives from each ward, 11 participants)
- Key Informant Survey: 4 (1 cooperative dealer from Yasodhara Rural Municipality, 3 cooperative dealers of Salt Trading Corporation Limited from Banganga Municipality)
- Telephone conversation: 3 (Private dealers and importers registered in MoALD)

General interaction

- Joint Secretary, Agriculture Development Division, Ministry of Agriculture and Livestock Development
- Agriculture Extension Officer, Chemical Fertilizer Unit, Ministry of Agriculture and Livestock Development
- Soil Scientist, Nepal Agriculture Research Council
- Representative, Nepal Seed and Fertilizer Project, CIMMYT Nepal
- Mayor, Buddhabhumi Municipality, Kapilvastu, Ward chairperson, ward no. 2 of Buddhabhumi Municipality, Kapilvastu
- Three farmers from Kapilvastu district (randomly met during the visit)
- Director, Salt Trading Corporation Limited

Analysis of the findings

The recordings of KII, FGDs and telephone conversation were transcribed and translated to prepare several sheets of responses in excel file under the column headings: Response Code, Question, Answer, Quotes and Codes. Response codes were provided to anonymize the data.

Quotes were kept separately in a different column and similar responses were coded in the last column.

A separate excel workbook was prepared by grouping the responses based on types of research questions viz. process visualization, status, constraints, loopholes, perception, priorities, preference and alternatives; that were addressed by different respondents. The codes were further synthesized to prepare a general theme that represented them well. Based on the codes and themes under each group, the results were derived in the form of bulleted subheadings, by adding relevant literature and researchers' opinion as a discussion.

3. RESULTS AND DISCUSSION

3.1 Plans and vision

Agriculture Perspective Plan (APP) was reviewed to be quite unique and participatory, with identification of key areas of input and output priority (Basnet, 1999) targeting middle-sized landholders and seeking higher net incomes (Cameron, 2009). The plan proposed an increment in fertilizer usage and nutrient content in soil through special attention to public policies and essential research and extension priorities. Increase in fertilizer use could lead either to subsequent increase in subsidy amount causing high fiscal burden or raise prices above relevant border prices. This called for gradual removal of obstacles to participation of private dealers and fertilizer subsidies.

The recommendations made by APP as quoted from the final report about ‘Nepal Agriculture Perspective Plan, 1995’ are as follows¹;

“Fertilizer subsidies should be gradually removed by clear steps, and in their place, policies need to be introduced that will create a strong demand. However, the extent to which this policy can be implemented will be influenced by Indian policy.

In the case of non-subsidized fertilizer, prices should be decontrolled immediately. In the case of subsidized fertilizer, sufficient finance needs to be provided to see that domestic prices are kept no more than 15 to 20 percent higher than the Indian border prices. The APP recommends continuation of the transport subsidy to inaccessible hill and mountain districts.

While the subsidy remains, an annual subsidy amount should be set for the year. The AIC would then estimate total consumption for the year and would calculate and widely publicize the subsidy per bag of fertilizer.”

By the end of 20 years Agriculture Perspective Plan 1995-2015, the shortage of agriculture technologies and fertilizers continued to impact the increment in productivity and only a small part of national requirement had been fulfilled by the subsidized fertilizers. Inclusivity and proportionality had not been completely addressed, while instigating illegal imports of low standard and expired fertilizers². Government of Nepal realized the need to revise APP, thus developing Agriculture Development Strategy (ADS) with 20 years vision and 10 years planning horizon³. ADS has mentioned about addressing farmers’ needs and improving fertilizer distribution system for achieving outcomes of higher productivity and profitable commercialization (Appendix A). However, the indicators like food self-sufficiency and nutrient

¹ Nepal Agriculture Perspective Plan. 1995. Agriculture Project Services Center, Kathmandu and John Mellor Associates, Inc. Washington, D.C. Kathmandu: National Planning Commission, His Majesty’s Government of Nepal

² Agriculture and Water Resource Committee of the Parliament, Government of Nepal (2016). Agriculture Development Strategy: A Thorough Peer Review Report of the Investment Plan

³ Rezaul Khan, Senior Natural Resource and Agriculture Economist. Technical Assistance Completion Report, Environment, Natural Resource and Agriculture Division, Ministry of Agriculture and Cooperatives, later renamed as Ministry of Agriculture and Livestock Development

content in soil have gained negative achievements as of 2017/18 compared to the base year (Khanal et al., 2020).

Supply of fertilizers with price concession and subsidy based on cost participation have been designed as the major program in all the periodic plans⁴ after 2010 but the challenge of easy access and timely supply of agricultural inputs have come together. Nevertheless, the fifteenth five-year plan 2019/20-2023/24 and Long-Term Vision 2043 have also mentioned about ensuring access to inputs, including fertilizers, for increasing the productivity of agriculture sector (Appendix B).

3.2 Demand supply assessment

Every year, the budget speeches have given due emphasis on subsidies for agriculture inputs like improved seeds, chemical fertilizers and organic fertilizers. The subsidy amount allocated for procurement and distribution of chemical fertilizers increased by nearly 3 times, from NRs 5.48 billion⁵ in the year 2014/15 to 15 billion⁶ in the year 2022/23 with additional investment of NRs 16 billion⁷ in the form of fund transfer from other budget titles (रकमान्तर) and resource agreement (श्रोत सहमति). In the year 2021/22, the subsidy amount of NRs. 12 billion was used to distribute 143,482 mt. Urea, 77,720 mt. DAP and 6,633 mt. MOP. This happens to be NRs. 52,570 subsidy per Mt. of fertilizers. Realizing the need of chemical fertilizers in commercialized farming, and addressing the farmers appeal to resolve the seasonal shortage of fertilizers, the subsidy amount has been increased to NRs. 30 billion in the budget speech 2023/24, which is supposed to ensure supply of 570,667 Mt. of chemical fertilizers.

Even with the increasing budget, and significant attention towards fertilizer distribution, the quantity of fertilizer supplied by Krishi Samagri Company Limited and Salt Trading Corporation Limited, in total, showed an unusual pattern, as opposed to expectations of an increasing trend (Figure 1). This is assumed to happen because of changes in international market price due to sanctions (Russia Ukraine war) and export restrictions (China)⁸. However, the Fisher's quantity-price index number showed that the quantity of fertilizer supplied has not increased with increase in government expenditure even when adjusted with international fertilizer prices⁹ (Table 3).

⁴ Periodic Plans. National Planning Commission, Government of Nepal

⁵ Budget Speech 2014/15, Ministry of Finance, Government of Nepal

⁶ Budget Speech 2022/23, Ministry of Finance, Government of Nepal

⁷ Press Release August 2022, Ministry of Agriculture and Livestock Development, Government of Nepal

⁸ Fertilizer prices expected to remain higher for longer (worldbank.org) retrieved online from <https://blogs.worldbank.org/opendata>

⁹ Monthly prices of fertilizer worldwide from January 2017 to December 2022, by type (Statista) retrieved online from <https://www.statista.com>

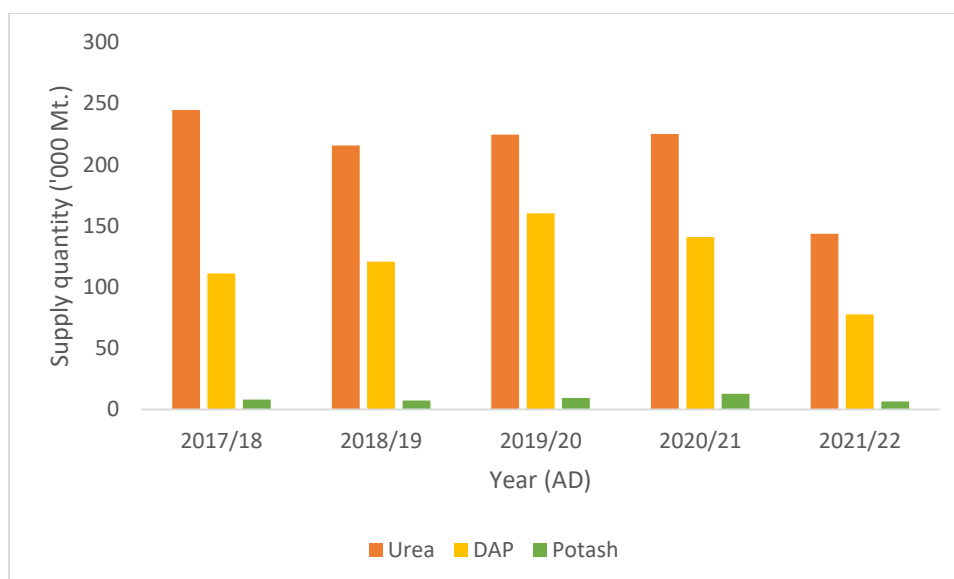


Figure 1: Supply of government subsidized chemical fertilizers in Nepal

Table 3: Fisher's Quantity Price Index Number for supply of subsidized fertilizer supply

Year	Supply quantity ('000 Mt.)		Average International Price (\$/Mt.)		Calculation					Fisher's Index Number
	Urea	DAP	Urea	DAP	q_1p_0	q_0p_0	q_1p_1	q_0p_1		r
2017/18	245					96738.7		96738.7		
8		111	231	362	96738.78	8	96738.78	8		1
2018/19	216					96738.7		104731.		
9		121	262	365	93566.14	8	100700.1	9		0.965
2019/20	225					96738.7		85360.4		
0		160	224	274	109889.5	8	94327.17	2		1.127
2020/21	225					96738.7		127201.		
1		141	307	469	103014.2	8	135191.6	8		1.064
2021/22	143					96738.7		262839.		
2		78	728	762	61259	8	163674.7	5		0.637

Where, q_0 : quantity at base year, p_0 : price at base year, q_1 : quantity at given year, p_1 : price at given year

Source: Author's calculation

The proportion of fertilizer supplied to each province is similar to that of the proportion of area under cultivation of different cereal and vegetable crops (Table 5). Paired t-test comparison (Table 4) showed that the proportion of area under cereal crops cultivation of each district and proportion of subsidized chemical fertilizer distribution to the total value of the whole country were also statistically similar (p-value = 0.989).

Table 4: Paired t-test comparison results for district wise proportion of fertilizer supply and area under cereals cultivation

Variable: districts' proportion to country	Fertilizer supply	Cereals area
Mean	0.012987	0.013007
Variance	0.000368	8.23E-05
Observations	77	77
Pearson Correlation	0.803531	
Hypothesized Mean Difference	0	
df	76	
t Stat	-0.01361	
P(T<=t) one-tail	0.49459	
t Critical one-tail	1.665151	
P(T<=t) two-tail	0.989181	
t Critical two-tail	1.991673	

Source: Author's calculation

On an observation of five years data from 2017/18 to 2021/22 on fertilizer distribution in different provinces¹⁰, Madhesh province received the highest quantity of subsidized fertilizers in all years except 2020/21, when Lumbini province was allocated with the highest quantity of fertilizers. Similarly, according to geographical regions, Terai region has received the highest quantity of fertilizers, which is about 3/4th of the total fertilizer supply (Table 5).

¹⁰ Statistical Information on Nepalese Agriculture, 2021/22 an annual publication of Ministry of Agriculture and Livestock Development, Government of Nepal

Table 5: Proportion of crops cultivation area and fertilizer supply according to province and geographic regions

Year/Province	Cultivation area		Fertilizer supply proportion (%)				
	proportion (%)		2017/1	2018/1	2019/2	2020/2	2021/2
	Cereals	Vegetables	8	9	0	1	2
Koshi	21	18	16	14	18	17	18
Madhesh	20	29	31	33	30	23	34
Bagmati	13	18	17	16	16	20	14
Gandaki	10	8	4	3	3	4	3
Lumbini	19	15	23	25	24	25	22
Karnali	6	5	1	1	1	1	1
Sudurpashchi							
m	11	7	8	7	8	9	7
Mountain			1	1	3	2	2
Hill			19	15	16	23	16
Terai			76	76	77	71	79

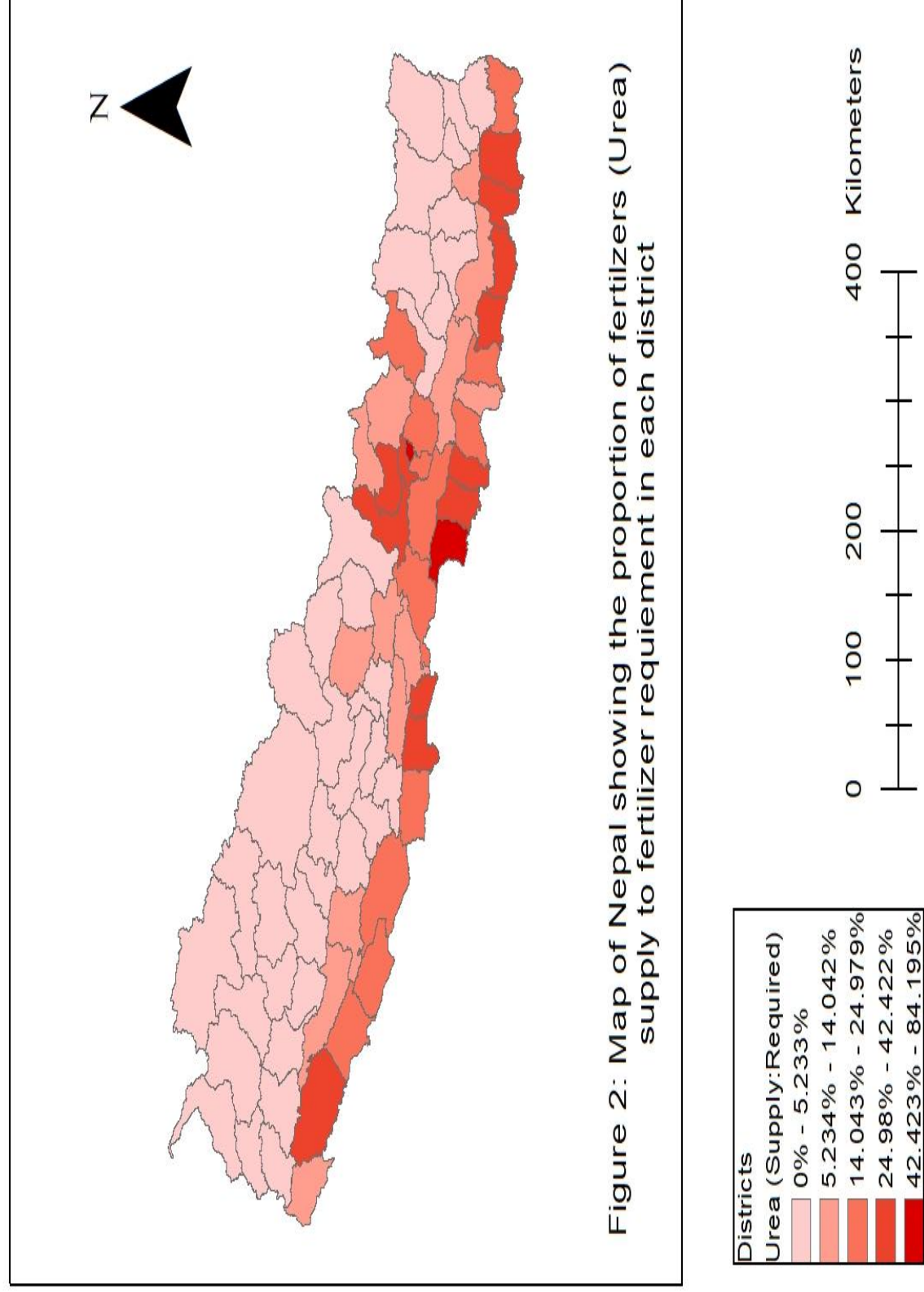
Source: Author's calculation

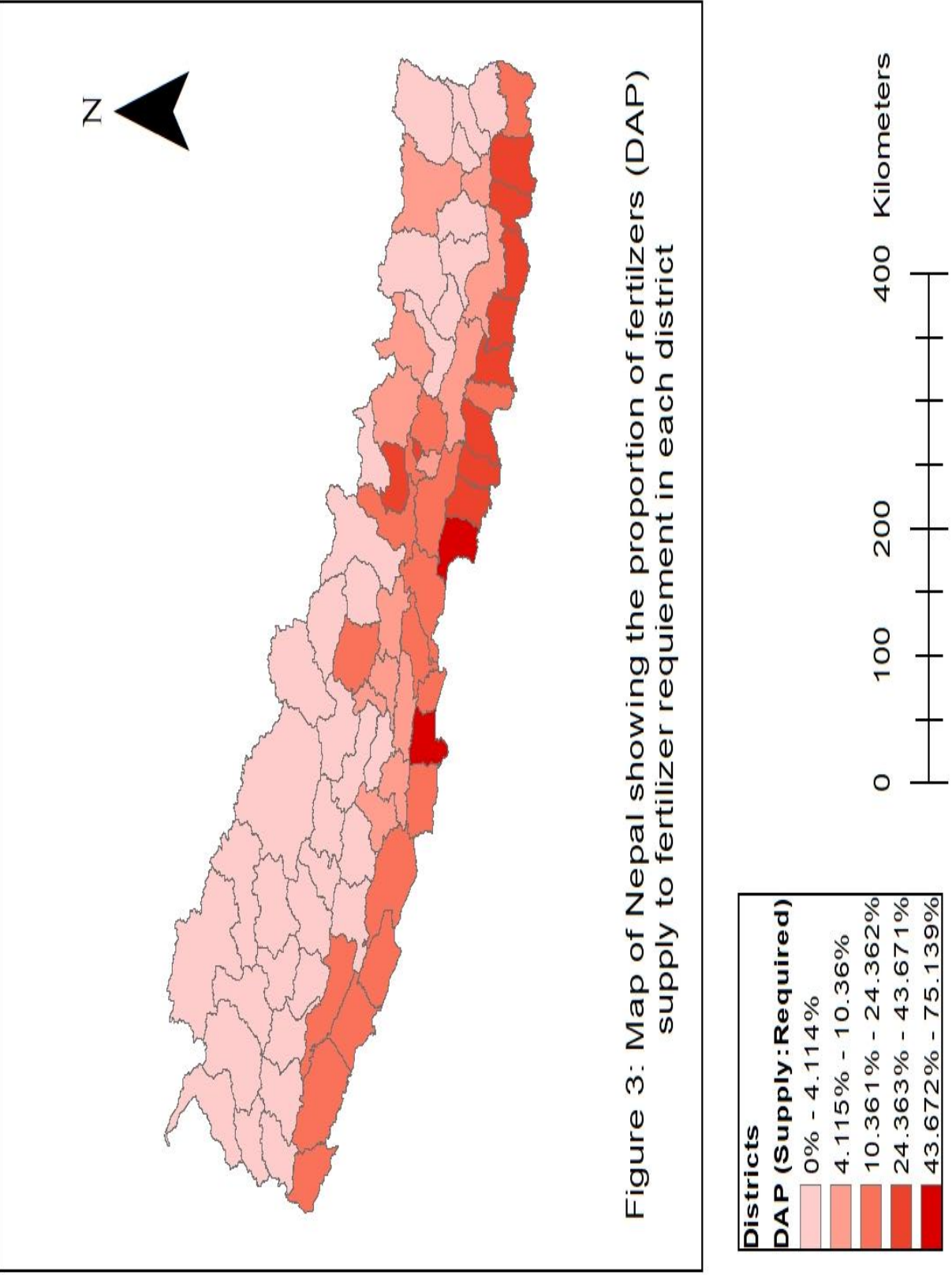
This implies that the quota allocation for fertilizer distribution is based on the proportion of area under crops cultivation in each province as well as in each district, rather than the active demand status. The allocation of quota for fertilizer distribution was found to be biased towards cereal crops cultivation, and lacked sufficient scientific basis for calculation. The recommended dose of fertilizer for each crop is different, which is considered in a lump sum basis for demand estimation. Similarly, the critical time of fertilizer requirement is not considered, and just the supply is based on estimates of year-round requirement.

Subsidized Fertilizer Distribution Directive 2020 has mentioned that area under cultivation, cropping intensity and sales status of previous years should be taken as the basis of calculation for fertilizer quota allocation. On this basis, the overall fertilizer allocation follows the proportion of cultivable land, one with higher gets higher quantity comparatively, but none is fully sufficed when the same thing is viewed from requirement perspective. Moreover, it does not consider the quantity of fertilizer that would be actually purchased by the farmers, since they

The agriculture production statistics revealed that each district of Nepal has been cultivated with several cereal crops, vegetable crops, fruits, cash crops as well as fish, that require certain amount

of Nitrogen, Phosphorus as well as Potassium in soil for better growth and development. The calculation of requirement of three major chemical fertilizers according to the recommended dose of each crop showed that 790,098.8 Mt Urea, 423,722.8 Mt. DAP and 277,169.5 Mt. MOP was required for the year 2021/22. But the supply of these fertilizers was only 18.16%, 18.34% and 2.39% of the total fertilizers required (Appendix F). This proportion of fertilizer supplied to fertilizer required was found to be different in different districts. Districts, palikas and cooperatives mention about their deficit in the proportion of requirement (Figure 2, 3 and 4), while the higher authority focusses on equitable access to all. The concept of equitable access has challenged the need-based application, and subsidized chemical fertilizers have just remained to be like ‘God’s prasad’.





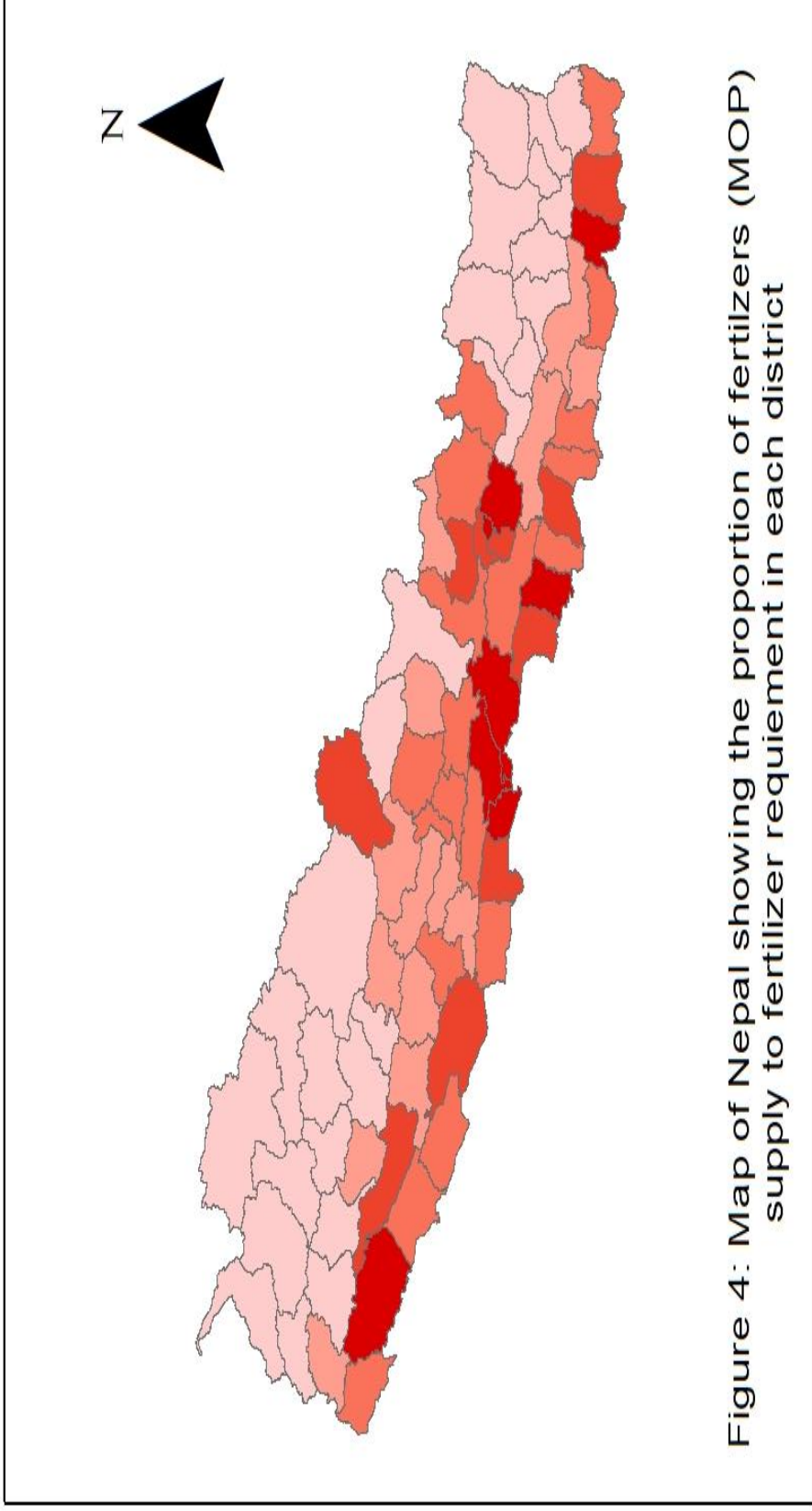
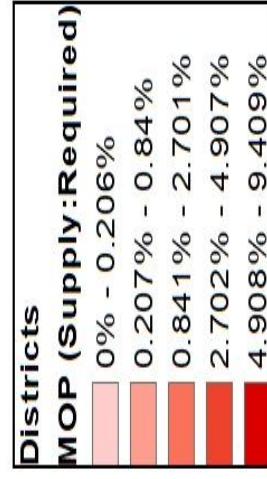


Figure 4: Map of Nepal showing the proportion of fertilizers (MOP) supply to fertilizer requirement in each district



3.3 Stakeholder analysis

National Fertilizer policy 2002 was developed with the objective of increasing the use of fertilizers through policy improvement and management of infrastructure, focusing on policies for fertilizer availability, price, subsidy and buffer stock. The policy was based on the principle that government should play the role of regulator and facilitator while providing equal opportunity to government, cooperative and private sector to be involved in fertilizer trade¹¹. This was revised in 2009 to give sole responsibility of fertilizer distribution to Krishi Samagri Company Limited, and later Salt Trading Corporation Limited got the responsibility of distribution of 30% of subsidized fertilizer. For the effective operation of fertilizer distribution channel, Subsidized Fertilizer Distribution Management Directive 2020 was launched with provision for formation of different working committees and assignment of responsibilities to government stakeholders from local to federal level.

Following organizations, institutions and agencies were identified as the stakeholders involved in the fertilizer procurement, distribution, management and pricing, based on document study and Focus Group Discussion. The detail of activities, roles and objectives of each stakeholder is included in Appendix C.

Influence

1. National Planning Commission
2. Ministry of Finance
3. Ministry of Agriculture and Livestock Development
4. Ministry of Forest and Environment
5. Agriculture related province ministry
6. Ministry of Internal Affairs and Laws
7. Public Procurement Monitoring Office
8. District Administrative Office

Importance

1. Ministry of Federal Affairs and General Administration
2. Ministry of Home Affairs
3. Ministry of Agriculture and Livestock Development
4. Nepal Agriculture Research Council
5. Central Laboratory, Department of Agriculture
6. Ministry of Forest and Environment
7. Agriculture related province ministry
8. Directorate of Agriculture Development
9. Soil and Fertilizer Testing Laboratory
10. Municipality/Rural Municipality

¹¹ National Fertilizer Policy, 2002

11. Rastriya Banijya Bank

Interest

1. Federation of Nepalese Chambers of Commerce and Industry
2. Agriculture Inputs Corporation Limited
3. Salt Trading Corporation Limited
4. Importers
5. Dealers

Impact

1. Ministry of Land Management, Cooperatives and Poverty Alleviation
2. Department of Agriculture
3. Krishi Samagri Company Limited

3.4 Process Visualization

Focus Group Discussion and Key Informant Interviews revealed that the stakeholders duly follow the Subsidized Fertilizer Distribution Management Directive 2020 during the fertilizer distribution process. The process of distribution has been illustrated with process visualization map (Appendix D). The map shows that activities like planning, study, quota allocation and pricing are carried out by the Fertilizer Supply and Distribution Management Committee (FSDMC) and Technical Committee (TC) which comprises stakeholders from federal level. Farming details, demand collection, and distribution record maintenance is primarily performed by Provincial (PC) and Local Committee (LC) in coordination with the Fertilizer Distributor Company (FDC). Krishi Samagri Company Limited and Salt Trading Corporation Limited are the two Fertilizer Distributor Companies and they have certain number of provincial offices, branch offices and dealers registered in the respective local government body (palika) for the sales of fertilizers in the designated area. The responsibility of monitoring the pricing and distribution process is given to all the committees at their level, thus reporting to the higher level in every 4 months.

The process looks clear and concise in documents. However, it is viewed slightly differently at ground level. The understanding of cooperatives about fertilizer availability and distribution, their capacity and their requirement have to be analyzed and incorporated well into the distribution process. Table 5 enlists the roles that have been, can be and should be played by agriculture cooperatives i.e., the fertilizer dealers.

Table 6: Visualizing fertilizer distribution process from the lens of agriculture cooperatives

Process	Comments
Plan preparation	This is done at the higher level.
Study	Cooperatives can provide a good deal of information for preparing the demand estimates and distribution proportion.
Keep records	Cooperatives have been keeping records of land ownership through collection of documents and maintenance of passbooks. Being close to farmers, they have a good idea about fertilizer requirement in their coverage area.
Demand determination	Cooperatives are not asked about how much is their demand; they have to accept whatever they are allotted with.
Subsidy allocation	Government decides the budget amount for subsidized fertilizer distribution, which then determines the quantity of fertilizer that would be procured, based on international price.
Quota allocation	The basis for quota allocation is not standardized among palikas, districts (Agriculture Knowledge Center) and provinces. Proportion is primarily determined based on area under cultivation, with optional consideration of cropping intensity, diversity and demand.
Pricing	Price is determined at the palika, according to pre-specified operation cost and district rate for transportation cost.
Orientation	Learning by doing: dealers have learnt how to deal with farmers during shortage. Cooperatives lack technical knowledge about determining the fertilizer requirement in the coming year, but can learn and implement well if trained accordingly.
Distribution	Cooperatives have prepared their own basis for distribution, which is not scientific, but is adjusted to local understanding, and quantity and time of fertilizer availability.
Maintain records	Cooperatives prepare bills/receipts while selling fertilizer to farmers, and then submit the sales details to palika as well as the distributor company.
Monitoring	Ward representatives are called for their presence during distribution to ensure transparency and just distribution. Sometimes, Municipality representatives come for observation and general inquiry.

Source: Field interviews, 2023

Similarly, Chemical Fertilizer Control Order 2055, Second Edition 2021, was prepared to integrate private sectors in the fertilizer procurement and distribution process. The stakeholders involved in production, import, distribution and management of chemical fertilizers, and their roles, according to this order, have been illustrated in Appendix E. In order to integrate private sectors into the

fertilizer distribution process, comments about different processes enlisted in Table 6 have to be considered.

Table 7: Visualization of unsubsidized fertilizer distribution process from the lens of private distributors

Process	Comments
Registration	Dealers and importers are registered in the Agriculture Ministry. However, the registration process is very burdensome. Many of the products that they import i.e., nutrients are not registered in Nepal.
Certification	The imported products are certified and labeled before entering the country. These are not re-tested in Nepal.
Reporting/ Monitoring	Quality, quantity and labels of fertilizers are not monitored. Palikas and provincial committees do not have information about private distributors of chemical fertilizers registered and working in their areas.

Source: Field interviews, 2023

3.5 Constraints

- Cost/Benefit

Practically, the per unit cost for dealers becomes high when the quantity of purchased fertilizer is not enough to fully load a vehicle. The selling price is determined by the palika for each ward which is not contingent upon the quantity of sales. The dealers are bound to bring and distribute the fertilizers, even if the quantity is less and whenever they get the notice. Example: If only 10 bags of fertilizer was allotted for a dealer, he still has to hire the same vehicle which could carry 100-200 bags, he has to spend the same time and operational activities in getting the letter, preparing for transportation, distributing to farmers and maintaining the records. Thus, the per unit cost becomes higher than the selling price.

The additional responsibility of fertilizers purchase, distribution and management increases the financial burden to agriculture cooperatives. Cooperatives have felt the need for specific staff, assets like computers, record books etc., storage infrastructures, and capacity building training. However, the marginal benefit of selling the fertilizers is not enough to cover all these expenses.

- Stock/Storage

Fertilizer Distributor Company is not allowed to keep stock of fertilizers for later use. All the available fertilizers have to be divided among dealers and the stock should be cleared as soon as

possible. When any dealer does not purchase the allotted fertilizer, the company can re-distribute it only after 4 months, which is a very long period.

Dealers have to purchase the fertilizers even if it arrives when there is no demand for fertilizers from farmers. In such cases, they have to store the fertilizers at their own cost until the season of requirement.

Farmers have already been habituated with the fertilizer scarcity at times of need. Hence, they try to buy as much fertilizer as they can, so as to save for future use, thus demanding more than the available quantity. This further creates shortage and conflicts.

- Conflict/Curses

Extreme shortage leads to conflict among farmers. Everyone needs fertilizer. Bags are opened and divided among the farmers in the smallest possible unit. Events of quarrels, debates and violence are often observed.

Cooperatives are scolded for bringing insufficient quantity of fertilizers. Ignorant farmers curse them for the shortage, while some people blame them for hiding the government subsidized fertilizers to sell in black.

- Database management

Online system has been initiated but not fully implemented due to lack of skills related to digitally operated systems. The system is accessible to fertilizer distributor company and dealers only. Government organizations at local and province level receive information through emails and written documents.

Many cooperatives do not own an office building, let alone the equipment like computers. They have to be engaged in other activities related to savings and credit, and thus are less dedicated towards administrative activities related to fertilizer distribution.

Distribution through passbooks is not applicable due to fertilizer shortage. When the fertilizer cannot be provided according to land ownership, there is no worth of maintaining individual records.

Analyzing the overall situation, the major constraints faced by different stakeholders in fertilizer distribution process have been pointed out as follows;

1. Extreme fertilizer shortage
2. Gap between time of requirement and supply
3. Long procedure of tender announcement, selection and procurement
4. Inability to maintain buffer stock due to shortage
5. Insufficient infrastructure for storage and distribution
6. Illegal imports and black marketing

3.6 Loopholes

- Documentation

The directives and order prepared by the government have included different schedules for the format of record keeping, reporting and demand collection. However, the schedules are still implemented in computers and papers, and shared through emails. The system lacks a digital framework for the effective and quick implementation of documentation works. Though it is mentioned that Fertilizer Distributor Company should prepare an electronic system for statistical management and give access to all the associated government stakeholders, the document lacks clear indication of how the system should be developed, operated and governed.

- Monitoring

There is no framework for monitoring the activities at local and provincial level. Certain indicators have to be set such that the monitoring body would feel obliged to perform the detailed assessment for preparing the report to be submitted at the upper responsible agency. Complaints and feedback are received only in oral form from the farmers and cooperatives, which remain unheard, due to lack of written documents, prescriptions and report credentials.

- Role division

Organizations at the local, district and province level have faced ambiguity in role division and task assignment. There is not a single organization that has the complete responsibility of recording, monitoring and reporting. The channel has lengthened with the federal system of government, and hence every tier is included, but is dependent upon others for their activities. Examples include:

- A) Farming records are kept by palikas, but the province committee re-analyses its own records during compilation.
- B) District Administration Office has the role of monitoring black market, when it is not empathized with farmers' urgency of fertilizer requirement.

In the name of monitoring, only a general observation has been carried out at random times. Awareness, training and orientation are done either informally, or parallelly during other programs/events. The recruitment, roles and responsibility of inspectors and surveyors are not described in detail in any of the policy documents.

- Accountability

News about protests and conflicts during fertilizer distribution are heard every year, from almost every district. However, there is no clarity on who is accountable for this crisis and the unpredictability of fertilizer availability. Questions about 'How is subsidy used?', 'What was the basis of quota allocation?' and 'Why is the distribution uneven?' are answered vaguely. Farmers are under the veil of the policy document i.e., the Subsidized Fertilizer Distribution Management

Directive 2020 and have made a generalized assumption about the distribution channel and its functioning.

3.7 Perception

Stakeholders perceive that ‘Fertilizer shortage is a national problem; the only solution is the increase in import of chemical fertilizers.’ Hence the federal government was pointed out as the only responsible stakeholder for solving the fertilizer shortage problem. On the other hand, farmers are expected to understand the situation of shortage, and accept the quantity that would be made available for them. Their attitude of demanding more than required, to save for future use have been found to add to the shortage issue and create conflict in the society. Cooperatives have felt that the burden of dealing with farmers has been poured upon them by all the stakeholders, thus being scolded for unavailability and delayed supply of fertilizers. Each agency within the distribution channel has highlighted that they distribute the fertilizer to the next channel as soon as they receive it from the preceding channel, thereby indicating delayed responses from the others. Further now, establishment of fertilizer producing industry in Nepal does not seem feasible, involvement of private sectors is not perceived trustworthy, and the increment in the budget for subsidy in chemical fertilizer has given some hopes of solution.

3.8 Priorities

Fertilizer Distributor Company

- i. Sell the available fertilizers to the dealers as soon as possible
- ii. Maintain buffer stock so as to supply in time of seasonal requirement
- iii. Involve in sales and distribution of other inputs along with the government subsidized chemical fertilizers

Agriculture co-operatives/Dealers

- i. Timely distribution of available fertilizers
- ii. Involve in sales of government subsidized fertilizers only
- iii. Build infrastructures necessary for storage and distribution of chemical fertilizers
- iv. Recruit staff, build capacity and purchase assets for effective management of fertilizer distribution process
- v. Satisfy farmers by dividing the fertilizers in equal proportion to all

Private sectors registered as importers and dealers of chemical fertilizers

- i. Import and distribution of low volume and highly effective nutrients, rather than urea, DAP and MOP which are government subsidized
- ii. Establish linkages with certain producer companies of India or other countries
- iii. Develop channels with agro-vets and other agriculture related shops in different areas of the country

Farmers

- i. Shift from use of organic/livestock manure to chemical fertilizers
- ii. Buy chemical fertilizers from agro-vets and illegal channels even at high price to recover the deficit

3.9 Preference

Farmers, cooperatives, as well as the other government stakeholders showed preference of government subsidized fertilizers to the fertilizers procured by private sectors or brought illegally from the open border of India. The major reasons for preference of government subsidized fertilizers were:

Better quality

1. Fertilizers once applied in the field should dissolve into the soil in a short period. The fertilizers brought from other channels remain undissolved for more than the cultivation period of given crops.
2. Government subsidized fertilizers are packed well and can be stored well for longer time.
3. The farmers claim that the composition mentioned in the labels are trustworthy, as they are believed to be tested well while importing.

Price

1. Government provides subsidy in the chemical fertilizers, which helps in reducing the cost of inputs for farmers. In the other case, cost would be 3-5 times higher and farmers cannot compete with Indian agriculture products in the market.
2. The price is determined at each depo offices, as well as at each ward by the government organizations i.e., the committees formed according to the Subsidized Fertilizer Distribution Management Directive 2020. Hence, there are lesser chances that farmers would be cheated for price.

Predefined channel

1. Every individual is informed about the availability of fertilizers through the specified channel. The information channel for fertilizer availability is



2. Agriculture cooperatives follow the co-operative principles and are highly accountable to the local people. Hence, farmers can complain or appreciate the works of cooperative dealers at the respective local government.

3.10 Recommended alternatives

3.10.1 For gap fulfillment

- Public Private Partnership

The implementation of a well-structured private partnership policy could play a pivotal role in bridging the fertilizer supply gap. The private sector can participate in identifying specific projects within the fertilizer sector, such as establishing modern fertilizer production or blending plants, improving distribution networks, or promoting organic fertilizer production. By adhering to institutional frameworks, robust legal provisions, and implementing timely monitoring and evaluation of the initiatives as per the policy, involvement of private sector can be enhanced in the fertilizer sector.

Government should promote the integration of private sectors in fertilizer supply through tax relief, incentives and suitable policy provisions. This, in turn, would eventually lead to meeting the fertilizer demand in the country. The well-defined guidelines within the Public Private Partnership and Investment Act 2019 have the potential to incentivize private agencies to explore entry into PPP arrangements, thereby facilitating investments in projects tailored to specific needs of fertilizer procurement, production and distribution. Private agencies can utilize the act as a guiding instrument for their investments, leveraging its provisions to navigate their participation in PPP initiatives. Moreover, this framework positions them to solicit government assistance whenever deemed necessary.

- Organic fertilizer production

Private as well as government sectors should be involved actively in organic fertilizer production. The deficit of essential nutrients equivalent to the shortage of chemical fertilizers has been calculated for each district. Based on the standards of organic manure set by Organic and Bio-fertilizers Directive 2021, the calculation indicates how much organic manure has to be produced to fill the gap in the respective districts (Appendix G). This target has to be set by each district and make efforts to promote organic agriculture.

- Supply of nutrients in other forms

The deficit of soil nutrients can also be fulfilled with the supply of chemical fertilizers other than Urea, DAP and MOP. The Ministry of Agriculture and Livestock Development has prepared the list of chemical fertilizers which can be imported to Nepal by following the specification of chemical composition. The maximum requirement of different chemical fertilizers (containing the mixture of NPK) for the fulfillment of nutrient supply gap have been calculated for each district (Appendix G). Agriculture related government organizations have to set their targets of supplying either of these fertilizers in the calculated requirement quantity by promoting the involvement of private sectors. Also, government has to think about incentivizing the use of such other forms of nutrients through schemes like Nutrient Based Subsidy (NBS) as practiced in India (K.V., K S, M L, & Sharma, 2018)

3.10.2 For performance improvement

- Emphasis on agriculture cooperatives

Agriculture cooperatives are the institutions closest to farmers, and have been working for the welfare of farmers with the involvement of farmers themselves. Cooperatives can play a major role in keeping farm records, supply details as well as in estimating fertilizer demand in the coming years. The benefits of agriculture cooperatives have been studied for increasing inputs use and improving livelihood of farmers (Blekking, Gatti, Waldman, Evans, & Baylis, 2021; Getnet & Anullo, 2012).

For this, there is an urgent requirement to upgrade the assets, skills and authority status of agriculture cooperatives. The studies done by different researchers (Moon & Lee, 2020; Ribašauskienė et al., 2019) explain how public policies contribute to capacity improvement of rural cooperatives.

- Demand based distribution

The use of factors like cultivation area, cropping intensity and crop diversity can be a good basis for determining the quantity of fertilizer that needs to be imported in a given year. However, the distribution should be based on demand for fertilizers from farmers. The system of quota allocation is neither scientific, nor ensures optimum application of fertilizers in farmers' fields. Rather, the distribution would be genuine if the distribution channel is strengthened to collect active demand status each year from cooperatives, and supply is managed accordingly.

- BlockChain based technology

Subsidies in fertilizer distribution are effective when the objective is to increase rural income, crop productivity and to ensure food security. International Center for Soil Fertility and Agriculture Development (IFDC) has successfully implemented different voucher programs for farm inputs in Afghanistan (Emergency Fertilizer Development Project), Malawi (Sustaining Productive Livelihoods Through Inputs for Assets) and Nigeria (Developing Agri-Input Markets in Nigeria). But this comes with the high opportunity cost of government expenditure, state monopoly and equity arguments.

High administrative cost of voucher system, on the other hand, was considered ineffective for Africa (Minot, 2009), thus proposing a smart subsidy program. It runs on a digitally operated system, for distribution of input vouchers to end users, keeping records on cloud storage, and ensuring regular monitoring. This system can integrate private sector distribution networks, and also ensure optimum application of fertilizers by farmers. The implementation of waybill design similar to Government of Ghana can also be a good alternative, in which the fertilizer supply chain actors submit receipts to be verified by the government stakeholders, farmers are provided the passbooks and voucher schemes are operated electronically (Danielle & David, 2016).

The whole process of fertilizer supply and distribution can be integrated into a single digital framework. The Block Chain based technology was also proposed by Ahmed and colleagues, (2020) for Bangladesh to replace the conventional pen and paper based distribution system. Features like automation, data security and easy access to information make the system connect users in a single framework with cloud storage, transparency and real time updates.

Table 8: Policy recommendations for gap fulfillment and performance improvement of fertilizer distribution channel

Recommendation	Objectives	Indicators	Responsible agency	Targeted stakeholders
A. For gap fulfillment				
1. Public Private Partnership	1.1 To provide enabling environment for private sector investment in fertilizer distribution channel	1.1 Establishment of at least one fertilizer production/blending plant at national level	MoALD	Interested private sectors
	1.2 To study about policy revision requirement	1.2 Revised policy regarding tax, incentives and agreement prospects of private investment	MoALD	Private investors
2. Organic fertilizer production	2.1 To promote livestock integrated farming system	2.1 Set targets for livestock population in respective municipality/rural municipality	Local Government	Farmers
	2.2 To strengthen the distribution channels of organic fertilizers and bio-fertilizers	2.2 Access to packaged organic fertilizers meeting specified nutrient requirements	DOA, MoALD	Organic agriculture entrepreneurs
	2.3 To establish a network of organic farmers and manufacturers of organic fertilizers	2.3 Exact record on area under organic production that does not require chemical fertilizers	DOA, MoALD	Organic agriculture entrepreneurs

Recommendation	Objectives	Indicators	Responsible agency	Targeted stakeholders
3. Supply of nutrients in other forms	3.1 To facilitate private sectors in importing quality fertilizers	3.1 Provision for testing the quality of imported fertilizers	MoALD	Private importers and dealers
	3.2 To supplement fertilizer deficit through low volume and highly effective nutrients	3.2 Import of deregulated fertilizers through a legally defined channel	MoALD	Private importers association
	3.3 To operationalize the private fertilizer distribution channel effectively	3.3 Agro-vets and cooperatives allowed to sell unsubsidized fertilizers after trusted labelling by government	DOA, MoALD	Agro-vets, cooperatives, private importers and dealers
	For performance improvement			
1. Emphasis on cooperatives	1.1 To empower cooperatives for demand estimation and efficient distribution	1.1 Availability of trained staff, computer and storage infrastructures at cooperative level	MoLCPA, MoALD, Provincial agriculture ministry, Local Government	Cooperatives, local people
2. Demand based distribution	2.1 To collect active demand status from each province	2.1 Seasonal estimation of demand through online updates	MoALD	Cooperatives, Local Government

Recommendation	Objectives	Indicators	Responsible agency	Targeted stakeholders
3. Block Chain based technology	2.2 To distribute fertilizers in optimum quantity for prioritized crops	2.2 Fertilizers supplied to cooperatives for specified area, crops and season	Provincial agriculture ministry	Cooperatives
	2.3 To provide orientation to cooperatives about precise demand estimation	2.3 Cooperatives able to estimate demand for the next season based on area under the cultivation of specified crops by maintaining records of affiliated farmers	MoALD	Cooperatives, Farmers
	3.1 To integrate all the stakeholders in a single digital framework	3.1 Implementation of digital system for fertilizer requirement calculation, demand estimation and supply allocation	MoALD, FDC	All stakeholders
	3.2 To provide access to government agencies and fertilizer distributors for keeping records	3.2 Real time updates about farming details, fertilizer distribution quantity and availability of fertilizers in stock	MoALD, FDC	All stakeholders

4. CONCLUSION

The study was carried out with the objective of exploring alternate fertilizer distribution channels to overcome frequent fertilizer shortage in Nepal. It need not be explained that alternative channels cannot fulfill the deficit. My analysis focused primarily on the distribution channel, rather than the procurement and supply quantity. Observation of distribution channels from ground level revealed several prospects of improvements and modifications. Starting from the study of policy documents, national plans and strategies, interviews and focus group discussions were carried out to understand the current scenario of fertilizer distribution in Nepal. The quantitative analysis of data related to fertilizer requirement and supply at district and province level indicated the inefficiency of proportional quota allocation system. Stakeholders' analysis and process visualization followed by identification of constraints and loopholes of prevailing distribution process led to the realization of importance of agriculture cooperatives in demand estimation and justified distribution. Similarly, the participation of private sectors in the distribution process was studied during the process visualization. Qualitative analysis of responses from participants revealed the perception about fertilizer shortage among farmers, cooperatives and government organizations. The priorities of stakeholders about their involvement in fertilizer distribution and preference of farmers towards government subsidized fertilizers were also highlighted. The overall assessment led to the exploration of several alternatives that can engage private sectors and agriculture cooperatives more efficiently in the fertilizer distribution process. The study recommends developing a block chain based digital ecosystem for the effective management of available subsidized chemical fertilizers, along with promotion of organic manure and other deregulated chemical fertilizers.

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APPENDIX

Appendix A: Mention about fertilizer distribution in Agriculture Development Strategy 2015-2035

Category	Mention about fertilizers distribution
Outcome 2	Higher Productivity
Output 2.1	Decentralized extension system responsive to farmers and agro-enterprises' need
Activity	Promote a voucher system to empower farmers to access the best available extension and advisory services that meet their demand
Output 2.8	A pragmatic solution to fertilizer supply that is acceptable in the short-term, clearly indicates a strategy for the medium and long term, and aims at improving productivity
Description	Maintain fertilizer and other subsidies at current level in the short term, review them in the medium term and adjust them in the long term while initiating a number of measures to improve productivity and fertilizer use efficiency, promote organic/bio-fertilizer as supplementary and complementary to chemical fertilizer, and facilitate effective distribution and supply to meet demand.
Activity 2.8.1	Improvement in fertilizer distribution system with appropriate level of subsidy This will involve implementing a study possibly entitled 'Review of Impact of Fertilizer Subsidy' every 5 years during ADS
Indicators	Market system insures fertilizer supply on time
	Quality of fertilizer available in the market
	Efficiency of fertilizer use increased
Activity 2.8.2	Complementary measures for efficient fertilizer use (under PPP arrangement)
Outcome 3	Profitable commercialization
Output 3.1	Improved Investment Climate for Agricultural Commercialization

Category	Mention about fertilizers distribution
Output 3.5	Competitive Agricultural Value Chains that Increase Value Added and Benefits to Smallholders Farmers and Agro-enterprises
	Enhance the development of the MAIZE value chain: Support activities for increased and judicious use of production inputs (seeds, fertilizers, chemicals and irrigation) for productivity increase

Appendix B: Mention about fertilizer distribution in National Plans and Visions

Document Section	Category	Mention about fertilizers distribution
Long Term Vision 2043		
Macroeconomic and Sectoral Vision: Economic Sector: Agriculture, Forest and Natural Resource		The agriculture sector will be made more productive through the provision of financial incentives and the supply of inputs.
Fifteenth Five Year Plan (2019/20-2023/24)		
National Strategy		To increase agriculture production and productivity: adoption of fertilizer and technologies, guarantee of the availability of fertilizers and seeds
Economic Sector: Agriculture and Natural Resource: Agriculture	Vision	A sustainable, competitive, and prosperous agricultural economy with food and nutrition security and food sovereignty
	Strategy	To make production and marketing profitable for productive farmers by enhancing their technical, professional, and institutional capacities on the basis of local feasibility and recognizing their rights.
	Working Policy	Arrangements will be made at the local level to provide necessary inputs and services from one window system.

Document Section	Category	Mention about fertilizers distribution
Economic Sector: Agriculture and Natural Resource: Agriculture: Food Security and Nutrition	Challenges	Ensuring access for small farmers and the most vulnerable communities to government services and facilities including improved seeds, fertilizers, and appropriate agricultural implements, government subsidies, insurance and financial incentives is also challenging.
Economic Sector: Industry, Commerce, Supplies and Tourism: Supplies	Strategy	To develop and effectively implement supply monitoring system.
	Working Policy	In view of the legal basis for food sovereignty, arrangements will be made for the supply of seeds and fertilizers adhering to agreed standards, quality, and weight.
Cross-cutting sectors: Statistical system	Expected Results	Quarterly and annual estimates of national accounts, supply utilization accounts, input-output accounts, and production and price related statistics and indicators will have been prepared.
Results Indicator: Fertilizer Supply (Chemical/Organic)	Targets	Fertilizer Supply (Mt. in thousands) Base year (2018/19): 364 2019/20: 386 2020/21: 500 2021/22: 550 2022/23: 600 2023/24: 600

Appendix C: Stakeholder analysis for fertilizer distribution in Nepal

Functionaries	Roles	Analytical Remarks
National Planning Commission ¹²	Preparation of periodic plans	Influence
	Resource estimation, identification and prioritization	Importance
Ministry of Federal Affairs and General Administration ¹³		
Federal Affairs Division	Social mobilization and coordination at local level	Importance
Planning and Development Cooperation Coordination Division	Review and record progress, status and statistics of local level	Importance
Ministry of Finance ¹⁴	Allocation of fiscal resources, projection of national investment and fiscal management	Influence
	Formulation, implementation and regulation of budget	Influence
	Implementation and regulation of policy, rules related to public expenditure	Influence
Ministry of Home Affairs ¹⁵	Policies, laws, standards and regulations related to control and prevention of illegal activities	Importance

¹² Periodic Plans, published by National Planning Commission, retrieved from npc.gov.np

¹³ Division/Section Terms of Reference, Ministry of Federal Affairs and General Administration, retrieved from mofaga.gov.np

¹⁴ Government of Nepal, Division of Labor Rules, 2074

¹⁵ Government of Nepal, Division of Labor Rules, 2074

Functionaries	Roles	Analytical Remarks
Ministry of Agriculture and Livestock Development ¹⁶		
Agriculture Development Division: Agriculture Inputs Management and Technology Section	Policy, laws, standards, quality determination, coordination and regulation related to production, import and use of chemical and organic fertilizers	Influence
Planning and Development Cooperation Coordination Division	Policy level management for execution of Agriculture Development Strategy	Influence
Planning and Development Cooperation Coordination Division: Statistics and Analytics Section	Develop directives for statistical reports, conduct trainings	Importance
Ministry of Land Management, Cooperatives and Poverty Alleviation ¹⁷		Impact
	Policy, law and standards related to cooperatives	
Nepal Agriculture Research Council ¹⁸	Generation and promotion of technology, knowledge, and information that respond to client demands	Importance

¹⁶ Government of Nepal, Division of Labor Rules, 2074

¹⁷ Government of Nepal, Division of Labor Rules, 2074

¹⁸ NARC vision 2011-2030

Functionaries	Roles	Analytical Remarks
Department of Agriculture ¹⁹	Ensure accessibility of inputs for quality agriculture production	Impact
Central Laboratory, Department of Agriculture ²⁰		
Soil and Fertilizer Testing Section	Research and Development on soil and fertilizers	Importance
Ministry of Forest and Environment		
Environment Standard and Monitoring Section ²¹	Research for development of environmental standards	Influence
Environment Standard and Monitoring Section ²²	Manage for environmental monitoring and testing	Importance
Federation of Nepalese Chambers of Commerce and Industry ²³	Promote the economic and social development of Nepal while protecting and defending the rights and interests of the business persons of the entire country	Interest
Agriculture related province ministry ²⁴	Supply management and regulation of fertilizers	Importance
	Development, promotion, capacity build up and mobilization of cooperatives sector	Importance

¹⁹ Strategies, Department of Agriculture, Government of Nepal, retrieved from: doa.gov.np

²⁰ Agriculture Productivity Division, retrieved from doa.gov.np

²¹ Environment and Biodiversity Division, Ministry of Forest and Environment, retrieved from mofe.gov.np

²² Environment and Biodiversity Division, Ministry of Forest and Environment, retrieved from mofe.gov.np

²³ Objectives of Federation of Nepalese Chambers of Commerce and Industry, retrieved from fncci.org

²⁴ Provincial Government, Division of Labor Rules, 2074

Functionaries	Roles	Analytical Remarks
Food Security and Agriculture Business Promotion Section	Regular monitoring of supply status of agriculture inputs and provide feedback to provincial ministry	Influence
Planning and Monitoring Division	Collect data and share information for planning, monitoring and evaluation	Importance
Ministry of Internal Affair and Laws ²⁵	Operation, management and coordination of local administration	Influence
Directorate of Agriculture Development ²⁶	To support the provincial government by regularly monitoring the supply status of agricultural materials such as fertilizers and seeds at the provincial level; to control the quality of agricultural materials including fertilizers and seeds at the provincial level	Importance
	Collecting and updating data related to agriculture at provincial level	Importance
Soil and Fertilizer Testing Laboratory ²⁷	Analyze the soil fertility status, and prepare plans at provincial level to solve relevant problems	Importance
	Study the quality of fertilizers available in market and create awareness about quantity, quality and requirements of fertilizers	Importance
Municipality/Rural Municipality ²⁸		
Section related to agriculture and livestock,	Supply of agriculture inputs and operation and regulation of farmers capacity development programs	Importance

²⁵ Provincial Government, Division of Labor Rules, 2074

²⁶ Websites of provincial ministry

²⁷ Websites of provincial ministry

²⁸ Local Government Operation Act, 2074

Functionaries	Roles	Analytical Remarks
agriculture production management, animal health, cooperatives		
Public Procurement Monitoring Office ²⁹	Prepare public procurement policy and recommend measures of implementation to the government for improvement and proper functioning of the public procurement system	Influence
	Monitor the public procurement law and implementation through visit and documentation procedure	Influence
	Coordination in public procurement at all levels including conduction of debarment proceedings	Influence
District Administrative Office ³⁰	Arrest or charge people involved in black market, or other social crimes	Importance
Krishi Samagri Company Limited ³¹	Produce, procure and import different types of mineral fertilizer and distribute it across the country on the basis of local demand	Interest
	Import raw materials for the production of different product mix of fertilizers and distribute and export as well	Impact
	Maintain buffer stock of fertilizers received under grant/aid from the government, donor countries and organizations to control supply interruption	Interest

²⁹ Functions of Public Procurement Monitoring Office, retrieved from ppmo.gov.np

³⁰ Black market and other social crime and punishment act, 1975

³¹ About Us, Krishi Samagri Company Limited, retrieved from kscil.gov.np

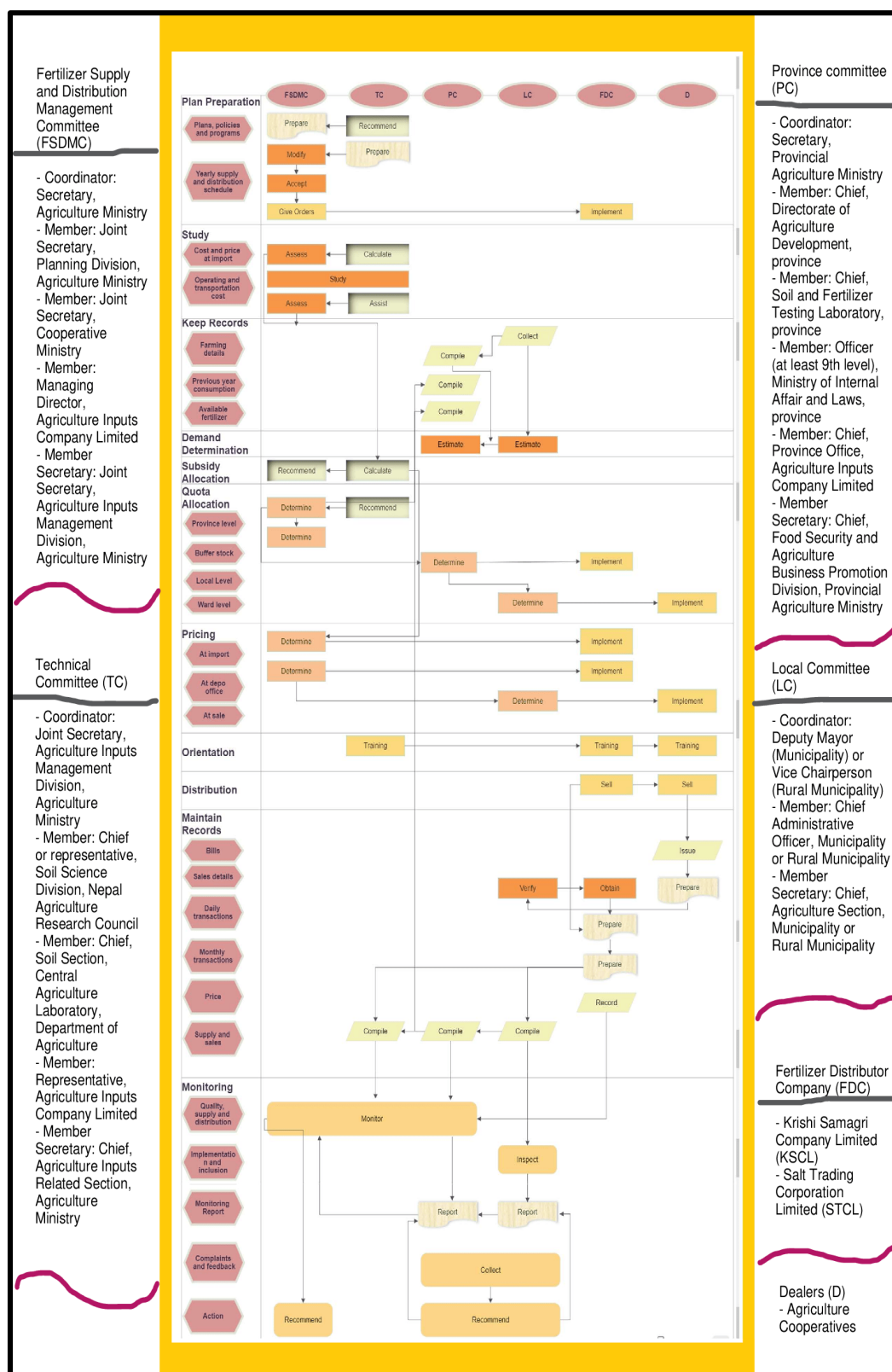
Functionaries	Roles	Analytical Remarks
Salt Trading Corporation Limited ³²	Open and operate branches sub-branch depots and offices in different parts of the country for purpose of import, export and distribution activities	Interest
	Produce, import, sell and distribute chemical fertilizers	Interest
Rastriya Baniija Bank ³³	Open affidavit from importers to provide import permission	Importance
Importers	Import fertilizers through tenders and agreement	Interest
Dealers	Distribute imported fertilizers within the country	Interest

Source: Author's analysis

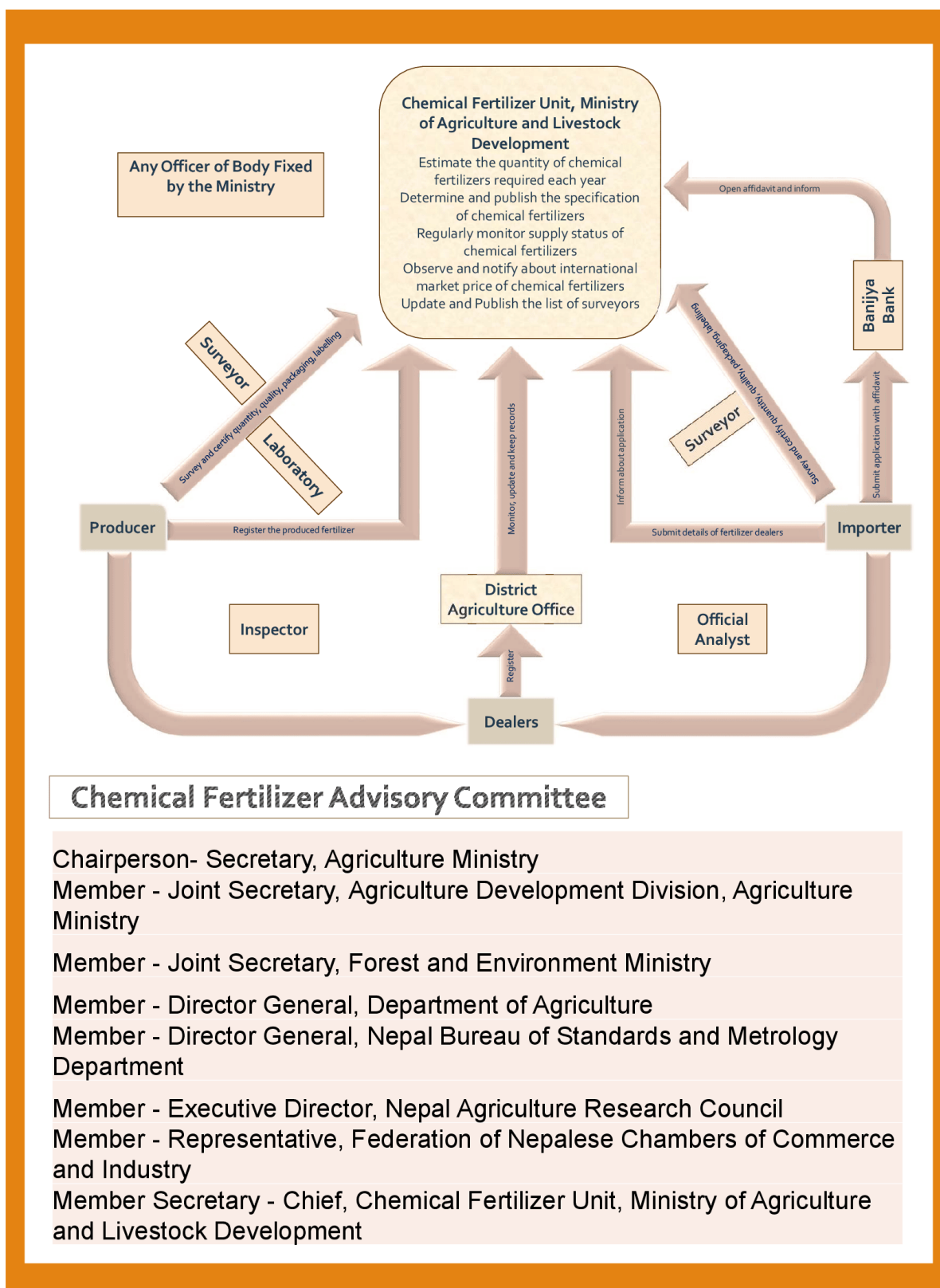
³² Objectives of Salt Trading Corporation Limited, retrieved from stcnepal.com

³³ Chemical Fertilizer Control Order 1998, Second Edition 2021

Appendix D: Process Visualization Map showing the process involved in fertilizer distribution in Nepal



Appendix E: Process Visualization Map showing the process of production, import and distribution of unsubsidized chemical fertilizers



Appendix F: Requirement vs supply assessment of chemical fertilizers in Nepal at district level

District	Cereal crops				Vegetable crops				Fish		Fruits		Total Required				Supply				Supply: Required (%)			
	Ur ea	DA P	Pot		Ur ea	DA P	Pot		Ur ea	DA P	Ur ea	DA P	Urea	DAP	Potas h	Urea	DA P	Pota sh	Urea	DA P	Pota sh	Urea	DA P	Pota sh
Taplejung	461 7	290 6	163 7		74	88	36	0	0	0	715	561	43 0	5406	3555	2104	58	5	2	1.0 6	0.1 3			
Sankhuwas abha	588 4	328 3	192 2		130	139	75	2	1		624	466	42 7	6640	3889	2424	165	189	0	2.4 9	4.8 5			
Solukhumb u	454 0	348 7	183 8		37	36	17	1	1		161	99	11 3	4739	3622	1968	0	0	0	0.0 0	0.0 0			
Panchathar	635 2	393 5	222 6		130	154	85	5	4		526	413	31 6	7014	4505	2628	65	26	0	0.9 3	0.5 7			
Illam	109 38	700 2	383 8		328	390		12	8		58	29	29	11337	7429	4077	396	185	8	3.4 9	2.4 9			
Terathum	518 8	319 7	181 9		171	188	86	4	3		20	15	12	5383	3403	1917	53	124	0	0.9 8	3.6 5			
Dhankuta	499 0	294 7	166 9		683	783	39	2	2		485	302	46 3	6161	4033	2530	532	418	3	8.6 3	10. 36			
Bhojpur	113 89	659 6	364 2		206	242	8	1	0		414	274	36 0	12010	7112	4150	0	157	2	0.0 0	2.2 0			
Khotang	125 59	733 9	423 7		103	123	55	4	3		0	0	0	12666	7465	4292	43	8	0	0.3 4	0.1 1			
Okhaldhun ga	484 8	309 6	176 4		114	133	64	1	1		0	0	0	4962	3229	1827	107	30	0	2.1 6	0.9 4			
Udayapur	771 1	417 8	247 6		98	106	49	52	36		238	148	22 7	8098	4468	2752	1086	391	18	13. 41	8.7 5			
Jhapa	330 62	170 20	120 84		849	850		290	201		12	20	3	34214	18091	12529	6032	309	197	17. 63	17. 09			
Morang	284 88	124 19	994 7		497	590		683	473		0	0	0	29667	13481	10292	1122 5	467 1	392	37. 84	34. 65			
Sunsari	173 30	784 4	618 0		473	426		448	310		0	0	0	18251	8580	6440	7082	348 9	429	38. 80	40. 66			
Siraha	172 24	821 8	580 0		692	667		831	575		115 1	747 9	90 9	19897	10208	7034	5808	314 1	34	29. 19	30. 77			

District	Cereal crops			Vegetable crops			Fish		Fruits			Total Required			Supply			Supply: Required (%)		
	Ur ea	DA P	Pot	Ur ea	DA P	Pot	Ur ea	DA P	Ur ea	DA P	Pot	Urea	DAP	Potas h	Urea	DA P	Pota sh	Urea	DA P	Pota sh
Saptari	159 47	702 0	514 0	125 9	130 2	63 1	691 7	478 0	122 7	797 0	97 0	19123	9597	6741	6281 7	314 7	182	32. 85	32. 80	2.70
Dhanusha	234 51	100 55	747 3	516 456	26 5	5 33	101 569	706 370	569 370	45 0	45 0	25556	11587	8188	4890	365 2	186	19. 13	31. 52	2.27
Mahottari	195 86	862 5	610 1	644 125	539 9	4 64	768 466	532 323	0 0	0 0	0 0	20998	9696	6434	2949	203 3	83	14. 04	20. 97	1.30
Sarlahi	231 89	106 67	698 7	125 6	124 9	64 1	466 132	319 875	2 0	927 0	16 0	24911	12240	7628	4765 0	416 0	261	19. 13	33. 99	3.42
Rautahat	156 23	723 8	516 2	438 493	27 8	8 53	460 126	319 875	2 0	927 0	16 0	17844	8976	7054	5137	298 5	158	28. 79	33. 26	2.24
Bara	219 30	995 5	723 4	826 792	792 1	1 16	4 452	313 16	0 0	0 0	0 0	24021	11623	7765	7453	385 2	545	31. 03	33. 14	7.01
Parsa	167 96	771 1	553 6	339 291	16 4	4 12	452 1	313 1	0 5	0 3	0 0	17587	8315	5700	1009 0	609 6	275	57. 37	73. 31	4.83
Dolakha	333 1	228 2	133 9	312 329	12 19	1 4	1 5	1 3	5 0	3 0	3 0	3649	2614	1462	775	249	23	21. 23	9.5 2	1.60
Sindhupalc hock	104 49	624 2	368 5	359 401	19 4	4 19	5 5	3 3	0 0	0 0	0 0	10812	6646	3879	901	484	51	8.3 3	7.2 9	1.31
Rasuwa	130 0	108 7	576 3	40 44	21 21	0 0	0 0	0 0	0 0	0 0	0 0	1341	1132	597	136	35	3	10. 13	3.0 5	0.53
Ramechap	789 6	483 1	273 3	69 80	43 43	2 2	463 2	1 1	463 288	288 2	44 2	8429	5200	3218	392	126	6	4.6 5	2.4 2	0.20
Sindhuli	109 22	606 5	356 7	224 257	12 4	4 12	13 9	9 0	0 0	0 0	0 0	11159	6331	3691	1357	431	15	12. 16	6.8 0	0.41
Kavre	104 08	709 1	397 5	108 922	50 8	6 6	9 9	6 6	0 0	0 0	0 0	11340	8185	4481	2832	170 2	270	24. 98	20. 79	6.02
Bhaktapur	185 6	109 4	703 4	175 194	10 1	1 11	15 0	11 0	0 0	0 0	0 0	2045	1299	804	1722	567	76	84. 19	43. 67	9.41
Lalitpur	362 0	225 3	127 5	189 210	11 1	7 0	10 0	7 0	0 0	0 0	0 0	3819	2470	1386	701	173	42	18. 36	6.9 9	3.02
Kathmandu	355 7	222 3	130 4	156 145	90 90	13 9	0 0	0 0	0 0	0 0	0 0	3726	2377	1395	1253	383	68	33. 63	16. 11	4.91

District	Cereal crops				Vegetable crops				Fish		Fruits		Total Required				Supply				Supply: Required (%)			
	Ur ea	DA P	Pot	Ur ea	DA P	Pot	Ur ea	DA P	Urea	DAP	Potas h	Urea	DA P	Potas h	Urea	DA P	Urea	DA P	Urea	DA P	Urea	DA P	Potas h	
Nuwakot	8083	3990	2519	147	304	3277	147	0	9	0	0	0	0	0	8400	4326	2666	26819	1569	122	31.92	36.28	4.59	
Dhading	8232	4286	2627	468	4595	335	14	0	0	0	0	0	0	0	8713	4755	2962	24288	1158	77	27.87	24.36	2.61	
Makawanpur	9650	5612	3170	443	4552	232	44	0	0	0	0	0	0	0	10138	6098	3402	21010	1060	46	20.73	17.38	1.36	
Chitwan	15414	7755	4568	676	7246	246	447	0	0	0	0	0	0	0	16537	8788	4814	32550	1931	318	19.68	21.97	6.61	
Manang	199	239	122	18	21	10	0	49	30	9					266	290	141	3		5	0.5	0.7	0.00	
Mustang	120	141	75	21	31	19	0	288	179	55					429	351	149	267	144	1	3.2	3.2	3.35	
Gorkha	8008	4280	2650	159	183	85	16	11	0	0	10	139	7	0	8183	4473	2735	356	86	10	4.4	1.8	0.04	
Lamjung	7777	4281	2470	122	139	64	12	8	177	139	7				8088	4567	2641	647	362	46	8.3	8.2	0.37	
Tanahu	7502	4071	2377	246	270	130	26	18	0	0	0	0	0	0	7774	4358	2506	952	675	50	10.02	13.58	1.84	
Kaski	9283	4764	3083	149	160	87	28	19	40	31	24				9500	4974	3193	265	155	28	4.5	4.6	1.55	
Parbat	5788	3242	1940	63	70	33	6	4	0	0	0	0	0	0	5857	3316	1972	632	381	58	2	8	1.41	
Syangja	11706	6503	3891	185	234	110	15	10	770	479	473				12676	7225	4726	139	69	10	3.4	2.7	1.22	
Myagdi	3643	2223	1287	85	103	45	3	2	260	162	8				3991	2490	1580	445	109	24	5.2	2.0	0.64	
Baglung	8396	5073	3053	96	128	62	5	4	0	0	0				8497	5205	3115	951	594	172			0.78	
Nawalparasi	7840	3992	2683	137	153	71	147	102	80	50	76				8204	4296	2830	794	468	53	11.59	13.83	6.06	
Palpa	7249	4121	2401	214	226	105	10	7	493	307	47				7967	4661	2976				9.9	10.04	1.78	

District	Cereal crops			Vegetable crops			Fish		Fruits			Total Required				Supply				Supply: Required (%)			
	Ur ea	DA P	Pot ash	Ur ea	DA P	Pot ash	Ur ea	DA P	Ur ea	DA P	Pot ash	Urea	DAP	Potas h	Urea	DA P	Potash	Urea	DA P	Potash	Urea	DA P	Potash
Gulmi	773	445	261															145	162	17	1.7	3.4	0.58
Argakhanchi	640	374	221	73	84	54	11	8	303	188	8	8120	4737	2955				248	197	14	3.8	5.0	0.61
Nawalparasi West	883	373	293															3249	121	479	27.	20.	
Rupandehi	240	951	806	230	258	7	176	122	247	173	30	11710	5851	6074				1088	817	374	42.	75.	7.89
Kapilbastu	247	955	822	637	655	6	102	707	0	0	0	25664	10874	8388				4711	208	156	18.	20.	4.45
Dang	177	968	595	259	251	9	419	290	0	0	0	25417	10100	8350				4549	201	185	24.	18.	1.86
Banke	168	830	549	798	894	7	185	128	0	0	0	18750	10705	6228				3247	124	86	18.	13.	2.98
Bardiya	164	764	532	557	530	4	215	149	0	0	0	17654	8985	5830				3751	163	127	20.	18.	1.48
Rukum East	262	211	116	607	622	5	331	229	682	478	3	18105	8977	6485				108	27	6	4.0	1.2	1.96
Pyuthan	563	336	207	31	38	17	0	0	35	22	17	2688	2171	1201				263	188	25	4.6	5.4	0.46
Rolpa	521	317	193	158	187	86	2	2	0	0	0	5379	3362	2018				74	138	8	1.3	4.1	1.18
Dolpa	112																	0	0	0	0.0	0.0	0.41
Mugu	121			24	30	31	0	0	226	141	47	1467	821	540				0	0	0	0.0	0.0	0.00
Humla	542	472	289	12	26	20	0	0	533	332	2	1087	829	411				0	0	0	0.0	0.0	0.00
Jumla	279	184	112	48	55	35	0	0	630	392	0	3475	2293	1277				0	0	0	0.0	0.0	0.00
Kalikot	235	147	950	18	21	8	0	0	187	117	36	2555	1617	994				1	0	0	0.0	0.0	0.00

District	Cereal crops				Vegetable crops				Fish		Fruits			Total Required				Supply				Supply: Required (%)		
	Ur ea	DA P	Pot ash	P	Ur ea	DA P	Pot ash	P	Ur ea	DA P	Ur ea	DA P	Ur ea	Urea	DAP	Potas h	Urea	DA P	Potas h	Urea	DA P	Urea	DA P	Potas h
Rukum West	3823	2275	1466		95	108	49		2	2	0	0	0	3920	2385	1515	0	0	0	0	0	0	0	0.00
Salyan	7892	4926	3014		129	165	81		5	4	0	0	0	8026	5095	3095	549	192	26	6.8	4	3.7	6	0.84
Jajarkot	4920	3110	1926		75	66	39		1	0	38	23	10	5033	3200	1975	111	9	1	2.2	0	2	9	0.06
Dailekh	8366	5000	3078		181	227	7		2	1	379	236	2	8928	5464	3547	152	97	14	1.7	1.7	0	8	0.40
Surkhet	9046	4559	2843		130	128	79		10	7	0	0	0	9186	4695	2923	1101	723	92	11.99	15.39	3	1.6	3.16
Bajura	4072	2451	1659		50	56	29		1	1	85	53	21	4208	2561	1709	31	16	1	0.7	4	2	0.6	0.06
Bajhang	4482	2405	1709		33	41	24		0	0	0	0	0	4516	2446	1732	81	34	3	1.7	8	7	0.15	
Darchula	3103	1723	1137		62	59	34		0	0	122	76	90	3288	1858	1260	36	14	1	1.0	9	4	0.06	
Achham	7345	3840	2653		35	43	28		0	0	0	0	0	7380	3883	2681	123	46	1	1.6	6	8	0.04	
Doti	5865	3326	2287		120	140	81		0	0	299	186	5	6284	3652	2653	80	9	1	1.2	8	5	0.04	
Baitadi	6535	3948	2537		75	83	38		0	0	0	0	0	6610	4031	2576	20	16	2	0.3	0	3	0.08	
Dadeldhura	3632	2268	1516		133	135	71		2	1	0	0	0	3766	2404	1587	39	7	6	1.0	4	8	0.36	
Kailali	25218	11664	8146		352	364	8		176	122	0	0	0	25746	12150	8324	7282	2868	513	28.28	23.61		6.16	
Kanchanpur	18865	8113	5795				264				0	0	0	19489	8673	6059	2446	1855	143	12.55	21.39		2.36	
Nepal														790098.8	423722.8	277169.5	143482	77720	6633	18.16	18.34		2.39	

Source: Author's calculation with data from Statistical Information on Nepalese Agriculture 2021/22 and Fertilizer recommendations from Agriculture and Livestock Diary, 2023

Appendix G: Equivalent quantity of organic manure or other unsubsidized chemical fertilizers to be produced for gap fulfillment of nutrient requirement and supply in each district

Particulars	Deficit			Equivalent deficit			Requirement								
							Organic manure	NPK					NPK+ B	NPK+ Zn	NPK+ B
	Urea	DAP	Potash	N	P	K		10:26 :26	12:32 :16	20:20 :10	15:15 :15	19:19 :19			
District															
Taplejung	5349	3550	2102	3100	1633	1261	326625	30996	25830	15498	20664	16314	10:20 :10:0.2	20:20: 20:1	30996
Sankhuwasabha	6475	3700	2424	3644	1702	1454	364450	36445	30371	18222	24297	19182	36445	18222	36445
Solukhumbu	4739	3622	1968	2832	1666	1181	333246	28319	23599	14159	18879	14905	28319	14159	28319
Panchathar	6949	4479	2628	4003	2060	1577	412080	40028	33357	20014	26686	21068	40028	20014	40028
Illam	10941	7244	4068	6337	3332	2441	666490	63371	52809	31685	42247	33353	63371	31685	63371
Terathum	5330	3279	1916	3042	1508	1150	304203	30420	25350	15210	20280	16011	30420	15210	30420
Dhankuta	5629	3616	2527	3240	1663	1516	332626	32402	27001	16201	21601	17054	32402	16201	32402
Bhojpur	12010	6955	4148	6777	3200	2489	677679	67768	56473	33884	45179	35667	67768	33884	67768
Khotang	12623	7457	4292	7149	3430	2575	714898	71490	59575	35745	47660	37626	71490	35745	71490
Okhaldhunga	4855	3199	1827	2809	1472	1096	294310	28093	23411	14046	18729	14786	28093	14046	28093
Udayapur	7012	4077	2734	3960	1876	1640	395956	39596	32996	19798	26397	20840	39596	19798	39596

Particulars	Deficit			Equivalent deficit			Requirement								
							Organic manure	NPK					NPK+B	NPK+Zn	NPK+B
	Urea	DAP	Potash	N	P	K		10:26 :26	12:32 :16	20:20 :10	15:15 :15	19:19 :19			
District															
Jhapa	28182	14999	12332	15663	6900	7399	1566342	1566344	130529	78317	104423	82439	10:20 :10:0.2	20:20:20:1	10:20:20:0.3
Morang	18442	8810	9899	10069	4053	5940	1006898	100690	83908	59396	67127	52995	100690	50345	100690
Sunsari	11169	5091	6011	6054	2342	3607	605415	60541	50451	36067	40361	31864	60541	30271	60541
Siraha	14089	7067	7000	7753	3251	4200	775323	77532	64610	42001	51688	40806	77532	38766	77532
Saptari	12842	6450	6558	7068	2967	3935	706822	70682	58902	39351	47121	37201	70682	35341	70682
Dhanusha	20666	7935	8003	10935	3650	4802	1093476	109348	91123	54674	72898	57551	109348	54674	109348
Mahottari	18049	7663	6351	9682	3525	3811	968206	96821	80684	48410	64547	50958	96821	48410	96821
Sarlahi	20147	8080	7367	10722	3717	4420	1072180	107218	89348	53609	71479	56431	107218	53609	107218
Rautahat	12707	5991	6896	6924	2756	4138	692358	69236	57697	41375	46157	36440	69236	34618	69236
Bara	16568	7771	7221	9020	3575	4333	901998	90200	75166	45100	60133	47474	90200	45100	90200
Parsa	7497	2219	5425	3848	1021	3255	384822	38482	32069	32550	25655	20254	38482	19241	38482
Dolakha	2874	2365	1438	1748	1088	863	217568	17479	14566	8740	11653	9200	17479	8740	17479
Sindhupalchok	9911	6162	3828	5668	2835	2297	566919	56683	47236	28342	37789	29833	56683	28342	56683
Rasuwa	1205	1097	594	752	505	357	100949	7519	6266	3760	5013	3958	7519	3760	7519

Particulars	Deficit			Equivalent deficit			Requirement								
							Organic manure	NPK					NPK+B	NPK+Zn	NPK+B
	Urea	DAP	Potash	N	P	K		10:26:26	12:32:16	20:20:10	15:15:15	19:19:19			
District															
Ramechhap	8038	5074	3211	4611	2334	1927	466825	46106	38422	23053	30737	24266	46106	23053	46106
Sindhuli	9802	5900	3676	5571	2714	2205	557092	55709	46424	27855	37139	29321	55709	27855	55709
Kavre	8507	6484	4211	5080	2983	2527	596507	50803	42336	25402	33869	26739	50803	25402	50803
Bhaktapur	323	732	728	280	337	437	67306	2804	2731	4370	2914	2300	4370	2185	2804
Lalitpur	3118	2297	1344	1848	1057	806	211355	18479	15399	9239	12319	9726	18479	9239	18479
Kathmandu	2473	1994	1326	1496	917	796	183413	14963	12469	7958	9975	7875	14963	7481	14963
Nuwakot	5719	2756	2544	3127	1268	1526	312681	31268	26057	15634	20845	16457	31268	15634	31268
Dhading	6285	3597	2885	3539	1654	1731	353861	35386	29488	17693	23591	18624	35386	17693	35386
Makawanpur	8037	5038	3355	4604	2317	2013	463491	46038	38365	23019	30692	24230	46038	23019	46038
Chitwan	13282	6858	4496	7344	3155	2698	734431	73443	61203	36722	48962	38654	73443	36722	73443
Manang	266	290	141	174	134	84	26701	1745	1454	872	1163	918	1745	872	1745
Mustang	426	349	144	259	160	87	32075	2589	2158	1295	1726	1363	2589	1295	2589
Gorkha	7916	4329	2734	4421	1991	1640	442074	44207	36840	22104	29472	23267	44207	22104	44207
Lamjung	7732	4481	2631	4363	2061	1578	436320	43632	36360	21816	29088	22964	43632	21816	43632
Tanahu	7127	3997	2460	3998	1838	1476	399804	39980	33317	19990	26654	21042	39980	19990	39980
Kaski	8549	4299	3144	4706	1978	1886	470618	47062	39218	23531	31375	24769	47062	23531	47062
Parbat	5592	3161	1945	3141	1454	1167	314137	31414	26178	15707	20942	16534	31414	15707	31414

Particulars	Deficit		Equivalent deficit			Requirement									
						Organic manure	NPK					NPK+B	NPK+Zn	NPK+B	
							10:26:26	12:32:16	20:20:10	15:15:15	19:19:19				
District	Urea	DAP	Potash	N	P	K		10:26:26	12:32:16	20:20:10	15:15:15	19:19:19	10:20:10	20:20:20:1	10:20:20:0.3
Syangja	12044	6844	4668	6772	3148	2801	677228	67723	56436	33861	45149	35644	67723	33861	67723
Myagdi	3852	2421	1570	2208	1114	942	222704	22078	18398	11039	14718	11620	22078	11039	22078
Baglung	8053	5097	3091	4622	2344	1855	468890	46216	38514	23108	30811	24324	46216	23108	46216
Nawalparasi East	7253	3702	2658	4003	1703	1595	400260	40026	33355	20013	26684	21066	40026	20013	40026
Palpa	7172	4193	2923	4054	1929	1754	405394	40539	33783	20270	27026	21337	40539	20270	40539
Gulmi	7975	4575	2938	4492	2105	1763	449204	44920	37434	22460	29947	23642	44920	22460	44920
Argakhanchi	6250	3689	2297	3539	1697	1378	353915	35392	29493	17696	23594	18627	35392	17696	35392
Nawalparasi West	8461	4637	5595	4727	2133	3357	472669	47267	39389	33570	31511	24877	47267	23633	47267
Rupandehi	14777	2703	8015	7284	1244	4809	728403	72840	60700	48089	48560	38337	72840	36420	72840
Kapilbastu	20706	8019	8194	10968	3689	4916	1096823	109682	91402	54841	73122	57728	109682	54841	109682
Dang	14201	8692	6042	8097	3999	3625	809712	80971	67476	40486	53981	42616	80971	40486	80971
Banke	14407	7736	5744	8020	3559	3446	801961	80196	66830	40098	53464	42208	80196	40098	80196

Particulars	Deficit			Equivalent deficit			Requirement									
							Organic manure	NPK					NPK + B	NPK + Zn	NPK + B	
	Urea	DAP	Potash	N	P	K		10:26 :26	12:32 :16	20:20 :10	15:15 :15	19:19 :19				
District																
Bardiya	14353	7343	6357	7924	3378	3814	792422	79242	66035	39621	52828	41706	79242	39621	79242	79242
Rukum East	2580	2143	1195	1573	986	717	197201	15727	13106	7864	10485	8278	15727	7864	15727	15727
Pyuthan	5465	3278	2088	3104	1508	1253	310410	31041	25867	15520	20694	16337	31041	15520	31041	31041
Rolpa	5305	3223	2009	3021	1483	1206	302062	30206	25172	15103	20137	15898	30206	15103	30206	30206
Dolpa	1394	1021	564	825	470	338	93929	8248	6873	4124	5499	4341	8248	4124	8248	8248
Mugu	1467	821	540	823	378	324	82289	8229	6857	4114	5486	4331	8229	4114	8229	8229
Humla	1087	829	411	649	381	246	76260	6492	5410	3246	4328	3417	6492	3246	6492	6492
Jumla	3475	2293	1277	2011	1055	766	210952	20112	16760	10056	13408	10585	20112	10056	20112	20112
Kalikot	2554	1617	994	1466	744	597	148736	14658	12215	7329	9772	7715	14658	7329	14658	14658
Rukum West	3920	2385	1515	2233	1097	909	223271	22327	18606	11164	14885	11751	22327	11164	22327	22327
Salyan	7477	4904	3069	4322	2256	1841	451125	43221	36018	21611	28814	22748	43221	21611	43221	43221
Jajarkot	4922	3191	1974	2839	1468	1184	293560	28387	23655	14193	18924	14940	28387	14193	28387	28387
Dailekh	8776	5367	3533	5003	2469	2120	500286	50029	41691	25014	33352	26331	50029	25014	50029	50029
Surkhet	8085	3972	2831	4434	1827	1698	443420	44342	36952	22171	29561	23338	44342	22171	44342	44342
Bajura	4177	2545	1708	2379	1171	1025	237944	23794	19829	11897	15863	12523	23794	11897	23794	23794

Particulars	Deficit			Equivalent deficit			Requirement								
							Organic manure	NPK					NPK+B	NPK+Zn	NPK+B
								10:26:26	12:32:16	20:20:10	15:15:15	19:19:19			
District	Urea	DAP	Potash	N	P	K									
Bajhang	4435	2412	1730	2474	1110	1038	247436	24744	20620	12372	16496	13023	24744	12372	24744
Darchula	3252	1844	1259	1828	848	755	182769	18277	15231	9138	12185	9619	18277	9138	18277
Achham	7257	3837	2680	4029	1765	1608	402891	40289	33574	20145	26859	21205	40289	20145	40289
Doti	6204	3643	2652	3509	1676	1591	350929	35093	29244	17546	23395	18470	35093	17546	35093
Baitadi	6590	4016	2574	3754	1847	1544	375407	37541	31284	18770	25027	19758	37541	18770	37541
Dadeldhura	3727	2397	1581	2146	1103	949	220566	21458	17881	10729	14305	11294	21458	10729	21458
Kailali	1846 ₄	9282	7811	1016 ₄	4270	4687	101642 ₁	10164 ₂	84702	50821	67761	53496	10164 ₂	50821	10164 ₂
Kanchanpur	1704 ₃	6817	5916	9067	3136	3549	906700	90670	75558	45335	60447	47721	90670	45335	90670