



South Asian Nitrogen Hub



Stakeholders' Activity Summary Report: Nitrogen Management & Agriculture, April 2023

Kathmandu, Nepal

SUMMARY

This report presents a summary of the UKRI South Asian Nitrogen Hub (SANH) Stakeholder engagement activities held in Nepal organized by Kathmandu University, which brought together various stakeholders involved in nitrogen utilization and control outlining key outcomes. This included farmer focus group discussion, student engagement and a national level workshop. Additionally, links to relevant workshop materials and resources are provided.

Nitrogen pollution poses a substantial global and regional concern, particularly in South Asia. The adverse impacts on human health and the environment are attributable to human activities and the production of reactive nitrogen. Thus, it becomes imperative to engage all pertinent stakeholders to establish a comprehensive and sustainable approach to nitrogen management.

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Stakeholder Engagement Activity Overview

Kathmandu University, in collaboration with the UKRI GCRF South Asian Nitrogen Hub (SANH), organized a workshop on reactive nitrogen pollution along with other activities aimed at engaging various stakeholders from the agriculture sector at the local up to national level. Held from April 18th to 21st, 2023 in both Kavre district and Kathmandu, the activities addressed South Asian and Nepal's concerns on nitrogen pollution caused by human activities and reactive nitrogen used in agriculture. These pose significant threats to human health and the environment. The objectives of the workshop included.

- To inform the stakeholders about SANH activities and research.
- To understand the policy positions of various actors (from local farmers to national policy makers) with respect to decisions on nitrogen management by conducting a stakeholder analysis.
- To explore the possibilities of engaging with key stakeholders for future policy decisions on nitrogen use and management.
- To raise awareness among academia about sustainable nitrogen (N) management via poster presentation and interactive session.

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Background

While scientific research has traditionally prioritized findings, it is crucial to effectively communicate those findings to key stakeholders in order to maximize the impact of the research. The [UKRI South Asian Nitrogen Hub](#)¹, which is dedicated to supporting sustainable nitrogen management (SNM) in South Asia, recognizes the importance of engaging stakeholders and seeking their input to enhance research impact and ensuring that the valuable insights reach the intended audience. By actively involving stakeholders throughout the process, SANH aims to foster a collaborative approach that promotes effective decision-making and the implementation of SNM practices.

Nitrogen-related policies have already been identified, analyzed, in Nepal and published in a [policy report](#) (Joshi et al. 2022), highlighting the need for a comprehensive National Action Plan on SNM. Several recent international policy developments have emerged to promote SNM. In March 2019, the United Nations Environment Assembly 4 (UNEA4) resolution on sustainable nitrogen was published, followed by the Colombo Declaration in October 2019, which aimed to reduce nitrogen waste to 50% by 2030. Furthermore, in March 2022, an additional nitrogen resolution was introduced, [UNEA 5.2](#) recommended the establishment of national action plans which has led to further engagement between experts and policy makers to develop guidance on what these action plans could be included. Similarly, in June 2022, the [SACEP-SANH N policy framework workshop](#) was held in Dhaka, Bangladesh where government representatives from across South Asia discussed what was needed to develop national action plans in their respective countries (SANH & SACEP, 2022).

The development of Nitrogen National Action Plans for SNM serves as a transparent and coherent roadmap at the national and sub-national levels to address nitrogen losses to the environment. These plans encompass an overarching vision for SNM, integrating an assessment of national and subnational reactive nitrogen (N_r ¹) flows and policies. They include measurable time-bound objectives that span across multiple sectors and are accompanied by an enforceable

¹ The UKRI GCRF South Asian Nitrogen (SANH) project unites experts from 32 research organizations in South Asia and the UK. With a focus on agriculture and ecosystem impact, SANH collaborates across eight South Asian countries and engages with governments to advance nitrogen management policies. See sanh.inms.international

implementation and evaluation strategy. These plans aim to achieve several co-benefits, such as mitigating various environmental and human health impacts, while also generating significant economic savings through the more efficient and sustainable use of nitrogen inputs.

According to FAO², around 66% of the country's population are engaged in agriculture. Also, it is a significant contributor to the emission of key N_r compounds: NO_x, NH₃ and N₂O. Among these compounds, NH₃ emission have the largest shared contribution accounting for 64%. Moreover, agriculture contributes 15% to NO_x emissions and 76% to N₂O emissions. The use of nitrogen-based fertilizers like Urea and DAP has been consistently increasing over the past decade. Unfortunately, the excessive and unregulated use of fertilizers in the Terai region, coupled with intensive crop cultivation, is negatively impacting soil health and the environment, leading to nitrogen pollution (Joshi et al., 2022).

Thus, in order raise awareness, and to involve stakeholders who play a key role in use and management of nitrogen in agriculture, UKRI SANH team from Kathmandu University conducted several stakeholder engagement activities with farmers, university students and national level stakeholders in Nepal. These activities were completed from 18th April – 21st April, 2023.

The subsequent sections provide a summary of the key content and the outcomes of the discussion and the activities.



Photo 1: Interaction and discussion with stakeholders from ministries, NGOs, CSOs, research bodies, academicians, and fertilizer distribution company. Photograph: SP Pradhan



Photo 2: Interaction and discussion with farmers from Panchkhhal about the nitrogen use and management and stakeholder's role in it. Photograph: SP Pradhan

² Food and Agriculture Organization of the United Nations <https://www.fao.org/nepal/fao-in-nepal/nepal-at-a-glance/en/>

Activity 1: Farmer Focused Group Discussion and Stakeholder Analysis

The first set of activities took place in Panchkhal, Kavre, with the participation of 18 farmers (comprising 8 females and 10 males). The attendees were divided into three groups, to conduct focus group discussion, each group consisted of 6 farmers, 1 facilitator, and 1 note taker.

The objectives of this activity were to understand the farmer's perception and experiences of fertilizer use and management in small scale commercial farming and their understanding of the stakeholders in terms of interest and influence by conducting stakeholder analysis.

The entire session was divided into two activities:

Activity 1a: Focused Group Discussion to understand the farmers' perception regarding fertilizer use, its sustainable use and management in small scale commercial farming.

Activity 1b: Stakeholder Analysis to understand farmers' perception of the policy positions held by different stakeholders concerning decisions related to nitrogen management.



Photo 3: Stakeholder Analysis and Focused Group Discussion with farmers in Panchkhaal municipality: Exploring nitrogen use in agriculture and stakeholder engagement for improvement, featuring stakeholder identification and mapping matrix based on interest and power. Photographs: SP Pradhan

This interactive session enabled a sharing of knowledge between the farmers and the SANH scientists. The discussion outcomes are outlined below.

1. Fertilizer use, its types and importance in agriculture

The farmers participating in the focus groups predominantly identified themselves as small-scale commercial farmers. They rely heavily on nitrogen-based fertilizers, particularly Urea and DAP, followed by potassium and phosphorus fertilizers. To meet their agricultural needs, these farmers heavily depend on government-supplied fertilizers that are accessible within their municipality. The farmers emphasized the critical role that fertilizers play in enhancing crop yield and maintaining plant health. However, they face a significant challenge in achieving increased harvests due to insufficient availability and application of fertilizers. In their view, insufficient fertilizer application remains a major obstacle for farmers striving to improve their yields. Additionally, some farmers expressed concerns about soil quality degradation due to misuse of fertilizers.

2. Crop residue management and use of organic fertilizers

The farmers were asked to discuss about the status of crop residue management and organic fertilizers. It was reported that majority of the farmers preferred using organic fertilizer, including manure produced at home. These organic fertilizers are typically created by utilizing cattle dung and secondary harvests like paddy and wheat straw. The farmers mentioned that they also often leave the secondary harvests in the field or utilize them as feed for their cattle. However, most of the farmers also acknowledged certain limitations associated with organic fertilizers. They expressed concerns about the insufficiency of organic fertilizers when used as the sole source of nutrients for their crops. Additionally, they noted that continuous reliance on synthetic fertilizers had caused their soil to become accustomed to these chemical inputs, which ultimately reduced the effectiveness of organic fertilizers.

Overall, while the farmers demonstrated a preference for organic fertilizers and utilized them in combination with other practices, they recognized the need to address the challenges associated with the exclusive use of organic fertilizers and the impact of prolonged synthetic fertilizer use on soil health.

3. Nitrogen Fertiliser Subsidy

Regarding the subsidies on fertilizers, farmers are well aware of the government's provision of subsidies. However, the majority of them expressed dissatisfaction with the current system, as they find it ineffective in practice. Despite the subsidy, most farmers reported that they still end up purchasing fertilizers at double the prices stated by the government. Furthermore, not all farmers are able to access the fertilizers, even after paying the inflated price.

Considering these challenges, some farmers suggested that improving fertilizer distribution through community sectors could be a more efficient and equitable approach. They believe that a community-based system would ensure fair and widespread access to fertilizers, benefiting all farmers more effectively than the current subsidy system.

4. Knowledge of N amongst the farmers

Some farmers have reported attending training sessions organized by various NGOs and INGOs such as Lagu Nepal, Local Initiatives for Biodiversity, Research and Development (LI-BIRD³), IPM, and KISAN II, where they received education on sustainable agriculture practices. Additionally, some of them also mentioned how these programs helped them learn about plastic mulch and how to grow certain crops like potatoes for their high yield. Furthermore, a few farmers emphasized the significance of nitrogen in promoting healthy and green plant growth. They expressed gratitude for such programs, stating that they have gained valuable knowledge about farming and have been able to adopt new technologies and sustainable practices.

These training initiatives have played a crucial role in empowering farmers with the necessary knowledge and skills required in decision making and adopt sustainable approaches in their agricultural practices. And most of them wanted similar of programs to happen to help them make their farming practices better.

³ LI-BIRD is a non-profit making, non-governmental organization dedicated to harnessing local resources, innovations, and institutions to promote the sustainable management of natural resources, ultimately enhancing the livelihoods of smallholder farmers. libird.org/

5. Farmer's perception on government's role on N management

The farming groups proposed several recommendations to the government in order to improve nitrogen (N) management in agriculture. These included:

- The need for sufficient budget allocations to address this issue.
- Implementing training programs for farmers to educate them on the proper usage of chemical fertilizers and commercial farming techniques.
- For the government to establish fertilizer manufacturing facilities within the country, promoting self-sufficiency in fertilizer production. This would help reduce dependence on imports.
- Subsidies should be directly provided to farmers without involving multiple intermediaries, and the government should assist farmers in reducing their investment costs.
- To ensure fair rates for farmers, the farming group suggests regulating the pricing of agricultural products.
- They highlighted the importance of controlling the black market for agricultural and fertilizer inputs and outputs by implementing effective measures.
- To prevent food wastage, it was recommended to provide and utilize cold storage facilities.
- Stress the need for increased allocation of resources to agricultural research and sharing the findings with farmers to enhance their knowledge and practices.
- Municipalities should play a role in providing guidance to farmers regarding the appropriate application of fertilizers for different crops during each season.

Overall, these recommendations aim to improve nitrogen management, promote self-sufficiency, support farmers financially, ensure fair pricing, control black market activities, prevent food wastage, enhance knowledge and practices through research, and provide guidance to farmers for better fertilizer application.

6. Barriers to sustainable N management

The farmer discussion groups highlighted several challenges farmers face in fertilizer supply and management. The untimely supply of fertilizers, handled by Agriculture Input Company Limited (AICL)/Salt Trading Company Limited (STCL), was mentioned as a significant challenge

affecting crop growth and yield. Many farmers expressed a desire for more knowledge about sustainable agricultural practices to overcome these challenges. They also expressed concern about the country's heavy reliance on imported fertilizers, which hampers SNM. Additionally, farmers unanimously agreed that political instability and inconsistent government policies contribute to uncertainties in the agricultural sector, including fertilizer supply and management. Transportation and logistical considerations were cited as factors adding complexity to the fertilizer supply chain.

Activity 1b: Stakeholder Analysis

An additional activity in the farmer focus group discussion was 'stakeholder analysis' to identify relevant stakeholders and their roles for SNM in Agriculture. A guidance standard on social responsibility (ISO, 2010⁴), defines a stakeholder as an "individual or group that has an interest in any decision or activity of an organization." Stakeholders can be employees, customers, suppliers, local communities, government entities, non-governmental organizations (NGOs), shareholders, and other relevant parties.

In this activity the farmers were firstly asked to firstly identify stakeholders (i.e., those involved, impacted and/or interested in fertilizer use decisions in Nepal). To accomplish this, farmers were asked to list the stakeholders that they think play crucial role in N management in agriculture. Secondly, they were asked to determine what the stakeholder's relative interests and influence are in relation to Nepal's fertilizer policy and policy outcomes.

A stakeholder matrix was used as a tool for the focus group participants to identify the relative levels of influence and interests. The interest influence grid is a 3x3 matrix that helps in prioritizing key stakeholders by considering their interests and influence in important decision-making areas. The term "interest" refers to relative attention a stakeholder may have to that issued related to their concerns, or/and potential benefits regarding these decision areas, while "influence" represents their ability to resist or support recommendations for change. Post activity, stakeholders can then be categorized to understand the roles that stakeholders play in the process of developing and implementing policies.

⁴ International standards Organisation (ISO) ISO [26000:2010 Guidance on social responsibility](#)

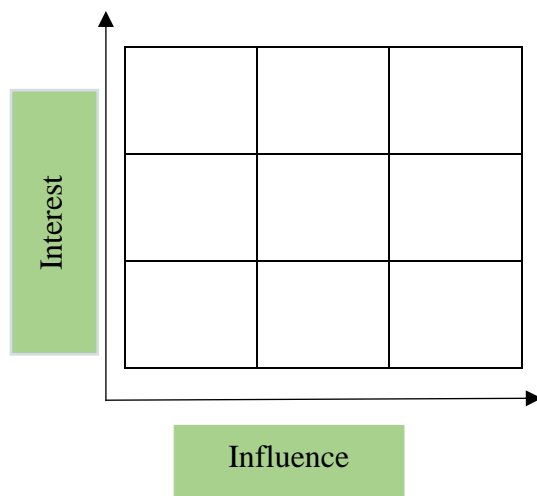


Figure (a)

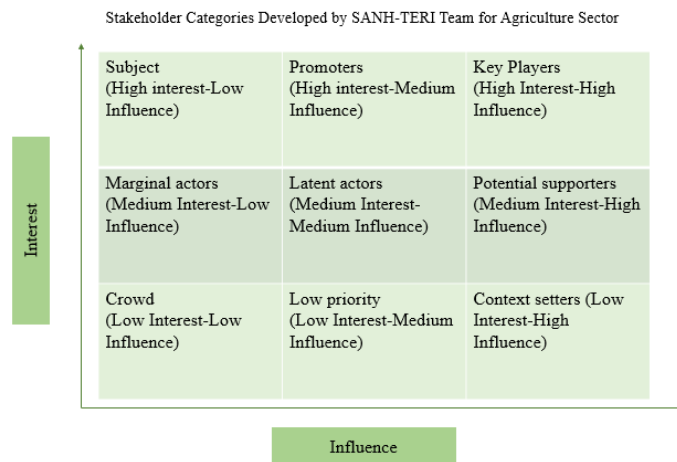


Figure (b)

Figure 1: Stakeholder Analysis matrix for power and interest. Figure **a**) is a stakeholder matrix template for categorizing stakeholders according to the interest and influence e.g. in regards to agricultural N management in Nepal. Figure **b**) illustrates how stakeholders can be categorized depending on where they are placed on the matrix, developed by (Das et al. 2022).

Among the three focus groups the opinions and knowledge of stakeholders often overlapped but sometimes could differ. We identified the similarities and divergence amongst the groups responses in regards to the stakeholder’s list and their placement in the matrix (see Table 1 for the result summary). Figure 2 illustrates the final stakeholder matrix results based on the average responses provided by the three discussion groups.

Government bodies, like the Ministry of Agriculture and Livestock Development were mostly categorized in highest interest and influence grid but one group considered their influence to be low as some farmers expressed the government’s lack of comprehensive planning to address farmers' needs at the field level, which are vital for promoting enhanced agricultural practices. International NGOs, USAID KISAN II⁵, were placed as high and low by different groups,

⁵ Knowledge-based Integrated Sustainable Agriculture in Nepal (KISAN) II, this involves a partnership with 180 private sector stakeholders to reach over 200,000 farming households in Nepal producing key agricultural commodities. The aim is through these interventions to increase the resilience, inclusiveness, and sustainability of income growth through agricultural development.
<https://www.usaid.gov/nepal/fact-sheets/ego-kisan-ii>

therefore we averaged them as having medium interest and influence. Likewise, for farmers there was some divergence in opinions as Group 1 believed that they have the least influence in policies, whereas Group 3 believe they have high influence . On average farmers were perceived to have medium influence with highest interest. The discussion outcomes are outlined below in Table 1. The results provide the combined perspectives provided by the four-discussion groups.

Table 1. Farmer focus group discussion results identifying fertilizer stakeholders in Nepal and their interest and influence

Name of stakeholder	Description	Comment for Interest	Comment for Influence
<p>Non-government organizations (NGOs) included:</p> <ul style="list-style-type: none"> - Local Initiatives for Biodiversity, Research and Development (LI-BIRD) <p>International non-government organization (INGOs) included:</p> <ul style="list-style-type: none"> - Knowledge-based Integrated Sustainable Agriculture in Nepal (KISAN II) by USAID, - Community Integrated Pest Management Program (CIPM) by FAO 	<p>These NGOs/INGOs, such as USAID KISAN II and CIPM programs, play a significant role in training farmers and providing technical guidance on sustainable practices. For instance, farmers reported that KISAN II conducted training sessions on seed and seedling preservation for crops like tomatoes and potatoes, as well as training on the use of plastic mulch. Similarly, LI-BIRD built the capacity of farming women and helped in promotion of locally grown crops. CIPM focused on educating farmers about the utilization of organic manure in agriculture.</p> <p>These stakeholders were identified by two discussion groups (<i>Groups 1 & 3</i>).</p>	<p>Based on the farmers' opinions, <i>Group 3</i> identified the NGOs/INGOs as having a high interest, as they found the training provided by them to be highly effective.</p> <p>In contrast, <i>Group 1</i> unanimously considered the NGOs/INGOs to have low interest due to their criticism of a particular NGO for providing misleading advice.</p> <p>Overall, when considering the farmers' opinions, the NGOs/INGOs were perceived to have a medium interest level on average. It indicates a mixed perception among the farmers regarding the level of interest and effectiveness of the NGOs/INGOs in</p>	<p><i>Group 3</i> regarded the NGOs/INGOs as having the highest influence on farming practices, as they believed they could bring about significant changes.</p> <p>In contrast, <i>Group 1</i> unanimously believed that the NGOs/INGOs had the least influence, finding their interventions to be ineffective. They had a negative perception of the impact of the NGOs/INGOs' efforts.</p> <p>Overall, according to the farmers' opinions, the NGOs/INGOs were seen to have a medium influence on average. This indicates a mixed perspective among the farmers regarding the actual influence and effectiveness of the NGOs/INGOs in making meaningful changes to farming practices.</p>

Name of stakeholder	Description	Comment for Interest	Comment for Influence
<p>Agrovets</p>	<p>Agrovets are stores where farmers can buy agricultural items such as seeds, equipment, insecticides, and fertilizers. These stores serve as vital outlets for farmers to obtain the products they require for their farming activity. Agrovets serve an important role in ensuring the availability and accessibility of agricultural inputs, as well as assisting farmers with crop management and cultivation.</p> <p>This stakeholder was identified by two discussion groups (<i>Groups 1 & 2</i>)</p>	<p>supporting their agricultural practices.</p> <p><i>Group 1 & 2</i> identified Agrovets to have the least (low) interest as they believe their only concern is to earn money/profit.</p> <p>Thus, on average agrovets (private firms) belong in the low interest grid.</p>	<p>According to the opinions of <i>Group 2</i>, Agrovets were considered to have a high influence. Farmers in this group believed that Agrovets could bring about changes in policy by understanding the requirements and needs of farmers. They recognized Agrovets as important stakeholders in the agricultural sector.</p> <p><i>Group 1</i> perceived Agrovets to have a medium influence. While they acknowledged the significant role that Agrovets could play, they believed that the government had a greater influence in shaping policies and decisions related to agriculture.</p> <p>On average Agrovets can be considered to have a medium level of influence.</p>
<p>Ministry of Agriculture and Livestock Development (MoALD)</p>	<p>The MoALD in Nepal is in charge of developing agricultural policy, encouraging sustainable practices, and ensuring food security. Agricultural research,</p>	<p><i>Group 1 and Group 3</i> both placed the (MoALD) in the highest interest category. They have emphasized that the MoALD serves as the governing body</p>	<p>All three groups have unanimously classified themselves within the highest influence category, highlighting the fact that their policy choices may have a substantial impact on</p>

Name of stakeholder	Description	Comment for Interest	Comment for Influence
	<p>extension services, irrigation, crop production, development of livestock, marketing, rural development, and poverty alleviation are all priorities. The ministry seeks to increase output, assist farmers, and guarantee the general development of Nepal's agricultural industry.</p>	<p>responsible for formulating and implementing crucial rules and regulations in the agricultural sector. Furthermore, they have highlighted the ministry's significant level of involvement and genuine interest in advancing the country's agricultural practices.</p> <p>In contrast, <i>Group 2</i> has expressed a different viewpoint, considering the MoALD to have a low interest level. They have specifically pointed out the ministry's lack of comprehensive planning to address farmers' needs at the field level, which are vital for promoting enhanced agricultural practices.</p> <p>On average, the farmer groups considered the MoALD to have medium interest.</p>	<p>a number of different aspects of the fertilizer business.</p>
Local Municipalities	Municipalities in Nepal provide multiple	According to <i>Group 1</i> , the local municipality shows	However, both <i>Groups 1 & 3</i> have mentioned that the

Name of stakeholder	Description	Comment for Interest	Comment for Influence
	<p>functions. In agriculture, they develop plans and strategies to promote sustainable agriculture practices, and they often provide agriculture extension services to farmers. Similarly, they can help in the distribution of agricultural inputs such as seeds, fertilizers, and equipment. To advance agricultural research and development at the local level, municipalities also work with academic institutions and research organizations.</p> <p>These stakeholders were identified by two discussion groups (<i>Groups 1 & 3</i>).</p>	<p>the least interest in advancing the region's agriculture. They believe that the municipality does not prioritize agricultural development as much as it should.</p> <p><i>Group 3</i> has, on the other hand, perceived the local municipality to have high interest. They emphasized that the municipality receives a budget dedicated to agriculture, showing a great interest in the agricultural sector. Another factor in the municipality's reported high level of interest is their active participation in budget planning and efforts to stay informed about agricultural issues.</p> <p>On average the municipality was considered to have medium interest.</p>	<p>municipality has the highest influence as they it was mentioned that the municipality receives the budget and have the power to use it accordingly.</p> <p>On average, the local municipality is considered to have a high influence.</p>
Farmers	Farmers are critical players in nitrogen management and utilization. They participate in the production and sale of	All three groups agree that the farmers have the highest interest in agricultural reforms. They	The groups held differing opinions on the influence of farmers, ranging from the low to the high.

Name of stakeholder	Description	Comment for Interest	Comment for Influence
	<p>agricultural outputs, and are actively involved in agricultural activities. Farmers' crucial involvement in the agricultural industry has a considerable impact on how nitrogen resources are used and maintained.</p>	<p>recognize that farmers are highly invested and committed to driving positive changes in the agricultural sector. This highlighted the important role farmer's play in shaping and advancing agricultural reforms.</p>	<p><i>Group 1</i> believes that while farmers have a keen interest in agricultural policies, they have limited to no power in bringing about significant changes. In contrast, <i>Group 2</i> emphasized that farmers possess the ability to make numerous changes, as they are the ones who abide by the rules and can effect necessary transformations if they unite.</p> <p><i>Group 3</i>, on the other hand, considers farmers to have a medium influence on agriculture. Although they may not hold high authority, it is also recognized that farmers do exert a certain level of influence.</p> <p>On average, farmers overall were perceived to have medium influence.</p>
<p>Research bodies</p>	<p>Agricultural researchers, whether in private or public institutions, are the major stakeholders in performing comprehensive agricultural research. Their research and findings are critical in informing policymaking. By investigating diverse areas of</p>	<p><i>Group 3</i> discussed the interest of researchers and categorized it as medium interest. They have expressed the view that researchers may not exhibit full interest in all aspects of the subject matter, resulting in their placement</p>	<p><i>Group 3</i> acknowledged them as having a lot of influence. They stressed the importance of research bodies in conducting studies and disseminating important findings to the government and farmers. Researchers make a substantial contribution to agricultural</p>

Name of stakeholder	Description	Comment for Interest	Comment for Influence
	<p>agriculture, these academics give essential insights that aid in the development of effective agricultural policies.</p> <p>Only <i>Group 3</i> referred to them as a stakeholder.</p>	<p>within the medium interest category.</p>	<p>development by providing insights and recommendations for adopting sustainable farming methods. As a result, <i>Group 3</i> classified researchers as having a high influence.</p>
Department of agriculture	<p>In Nepal, the Department of Agriculture is critical in developing agricultural policies, conducting research, providing extension services, ensuring agricultural input availability, developing farmer and extension worker capacity, monitoring program implementation, and collaborating with national and international agencies. These roles contribute to sustainable agricultural practices, increased output, and food security, with the ultimate goal of improving the livelihoods of Nepalese farmers.</p> <p>Only <i>Group 2</i> referred to them as a stakeholder.</p>	<p>Only <i>Group 2</i> identified this as an important stakeholder in the medium interest grid. They explained that because this department is administered by the government, they have an interest in agriculture, but not a strong one.</p>	<p>It was also listed in the medium influence grid by the same group. <i>Group 2</i> stated that they have impact at the local level but only a medium influence at the state level to change policies.</p>
Transport division	<p>Nepal's Ministry of Physical Infrastructure and Transport greatly contributes to the</p>	<p>The transport division was put in the low interest category by Group 2</p>	<p>According to Group 2, the transport department has the highest influence. They</p>

Name of stakeholder	Description	Comment for Interest	Comment for Influence
	<p>country's agriculture industry through its emphasis on market access, infrastructure development, and transportation planning. It ensures the development and maintenance of roads and transportation networks connecting agricultural regions, promotes the efficient movement of agricultural inputs and harvested crops, and collaborates with other ministries to align transportation policies with agricultural objectives.</p> <p>Only <i>Group 1</i> referred to them as a stakeholder</p>	<p>because, in their opinion, the division is not committed to enhancing its services. The transportation division, in the opinion of Group 2, largely prioritizes monetary gain and neglects to make required adjustments that would improve its efficiency. As a result, Group 2 considers the transportation sector is uninterested in actively upgrading its services in regards to agriculture</p>	<p>understand the critical function that transporters play in getting crops and fertilizer from the farm to market. Group 2 argues that as carriers, the transportation division has the ability to influence agricultural policies and make required changes.</p>

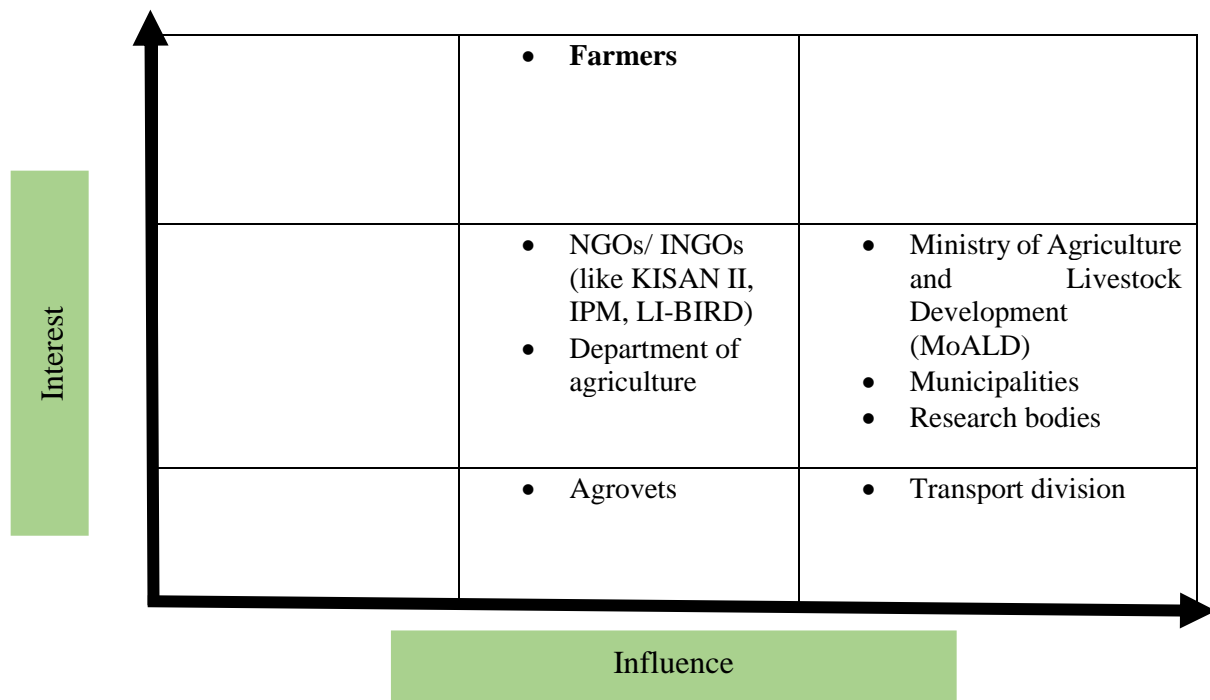


Figure 2: Stakeholder Analysis interest and influence matrix of stakeholder in achieving sustainable N management in Nepal according to farmers. This is the result based on the average of three focused group discussions on April 18th, 2023. The focused group discussion was conducted with farmers from Panchkhaal municipality in Panchkhaal

When considering strategies and actions pertaining to (N_r) policies, a comprehensive stakeholder analysis proves invaluable in identifying key actors and, their interests, and in highlighting any potential conflicts of interest. It helps understand better the power dynamic and current and potential alliances that impact policy decisions or could do so in future.

This analytical framework helps enhancing stakeholder engagement in context of decision-making and resource allocation from farmers' point of view facilitating a bottom-up approach for better SNM practices in Nepal, particularly at the farm level. To illustrate, farmers have notably underscored the significance of the transport division as a great influencer, given its substantial role in fertilizer transportation. This understanding may be crucial in incorporating the viewpoint of the transport division into the creation of policy. Similarly, non-governmental organizations (NGOs) and international non-governmental organizations (INGOs) play a key role in terms of interest and impact. Collaboration with these organizations, who train farmers and communicate information to them, will aid in developing SNM policy.

Activity 2: Students' interaction and poster presentation session

The second activity, held on 19th April 2023, was the student's interaction and poster presentation session which took place in Kathmandu University, Dhulikhel. Sixty students from the Department of Environmental Science and Engineering, Chemical Engineering, Agriculture and Department of Pharmacy attended. The entire session was 3 hours long and was divided in three different parts;

- I. Presentation by Prof. Sharma, Dr. Anastasia Yang, and Keesje Avis
- II. Breakout session: Interactive activity
- III. Poster presentation

The main purpose of these activities was to raise awareness amongst the students about the significance of nitrogen management and the importance of social science in environmental research. The breakout session provided students to share their own knowledge and ideas on what are the main issues and potential solutions around SNM.

Breakout session outcomes

In this interactive session we aimed to assess students' knowledge of nitrogen pollution, its effects, and their perception of the key stakeholders responsible for achieving SNM. Furthermore, the activity provided students with an opportunity to showcase their posters.

The students formed six breakout groups, with up to 10 students per group. In the groups students were asked to discuss the issues and potential solutions to SNM in agriculture, and list the stakeholders who play an important role to solve them. The students identified the following issues:

Issues related to N management in agriculture:

i. Limited Leaf Color Chart Adoption: Farmers' failure to use the Leaf Color Chart as a tool for analyzing crop nutrient status, resulting in poor nitrogen management.

ii. Inadequate Crop Rotation Implementation: Inadequate crop rotation practice results in decreased soil fertility and greater reliance on synthetic fertilizers.

iii. Inefficient application of Split Dose: Poor adoption of split dose application methods, hinder optimal nutrient uptake by crops and causing nitrogen losses.

iv. Insufficient fertilizer availability: Limited access to fertilizers makes it difficult for farmers to meet their agricultural needs and produce the best crop yields.

v. Government-supplied fertilizer accessibility issues: Challenges in effectively distributing government-provided fertilizer supplies to farmers, resulting in limited availability and accessibility.

vi. Low Nitrogen Use Efficiency: Inefficient utilization of nitrogen by crops, leading to reduced productivity, increased input costs, and environmental pollution.



Photo 4: Student Interaction Session at Kathmandu University: Exploring the challenges of nitrogen misuse in agriculture and identifying potential solutions and stakeholders. Photographs: SP Pradhan

The student groups proposed the following potential solutions.

Proposed Solutions:

i. Fertilizer use awareness campaigns: Conducting educational programs and awareness campaigns to educate farmers about the right and efficient use of fertilizers, particularly the need of adhering to recommended doses and application methods.

ii. Policy review and interventions for fertilizer management: Fertilizer management policies must be reviewed and revised on a regular basis to ensure effective fertilizer distribution, availability, and accessible to farmers.

iii. Construction of Urea plants: Investing in the development of urea manufacturing plants within the country to reduce reliance on imported fertilizers, improve domestic production, and ensure farmers have a consistent and reliable supply of fertilizers.

iv. Improved distribution networks: Ensuring the construction of well-functioning agricultural cooperatives and extension agent networks to promote the equitable distribution of fertilizers among farming communities and to successfully reach farmers in rural locations.

v. Increased information flow: Improving communication channels and information-sharing mechanisms among agricultural stakeholders, such as farmers, extension services, research institutions, and government agencies, in order to disseminate current and relevant information on fertilizer use and management practices.

vi. Leaf Color Chart (LCC) Implementation: Encourage farmers to adopt and use the Leaf Color Chart as a visual tool for analyzing crop nutrient status and directing fertilizer application decisions, hence increasing efficient nitrogen management.

vii. Promotion of intercropping and polyculture: Encouraging farmers to use intercropping and polyculture techniques to improve soil health and production, improve nutrient cycling, and lessen their reliance on fertilizers.

viii. Use of slow-release fertilizers: Encourage the use of slow-release fertilizers, which gradually release nutrients over time, decreasing nutrient losses and assuring a more balanced nutrient supply to crops.

ix. Nutrient management through soil testing: Encourage farmers to undergo frequent soil testing to check soil nutrient levels and customize fertilizer application based on individual crop requirements, supporting effective nutrient management.

x. Investment in quantitative research and funding: Allocating funds and resources for nitrogen management, fertilizer efficiency, and sustainable agricultural practices, giving scientific information and evidence-based recommendations for enhanced fertilizer use.

The students further identified the stakeholders who play an important role in the solving the issues with proposed solutions (see Table 2). The following are the stakeholder's identified along with their generic description.

Table 2. Student activity: Stakeholder Identified and their generic description

Stakeholders	Description
<i>Farmers</i>	Farmers, as stakeholders, assume crucial responsibilities in the realm of nitrogen use and management. They are actively involved in agricultural practices, implementing policies related to farming, and overseeing the production and sale of harvests. Due to their integral role in the agricultural sector, farmers have a significant impact on nitrogen utilization and its effective management.
<i>Central government/ policy makers i.e., Ministry of Agriculture and Livestock Development (MoALD)</i>	MoALD bears overall responsibility for the growth and development of agriculture and livestock sector. It allocates budget, formulate policies and regulate government department of agriculture in the country.
<i>Agriculture fertilizer distribution companies: Distributors Agricultural Inputs Company Limited (AICL)/ Salt Trading Corporation Limited (STCL)</i>	The government has designated distributors (AICL/STCL) as the responsible organizations for the procurement and distribution of fertilizers nationwide. These distributors are actively involved in the production, procurement, and importation of various mineral fertilizers to cater to the local demand. They also import raw materials required for fertilizer manufacturing and engage in both domestic distribution and export activities. To maintain a stable supply, the distributors maintain a buffer stock of fertilizers acquired through grants, government aid, and contributions from donor countries and organizations. Additionally, they procure and distribute subsidized fertilizers across the country. To ensure profitability, the distributors also undertake various other business and service-oriented activities.
<i>Researchers and academics</i>	Agricultural researchers, whether working in private or government institutions, are the key stakeholders responsible for conducting extensive research in the field of agriculture. Their studies and findings play a crucial role in informing policy formulation. By exploring various aspects of agriculture, these researchers contribute valuable insights that assist in shaping effective policies for the agricultural sector.
Nepal Agricultural Research Council (NARC)	The Nepal Agricultural Research Council's (NARC) principal purpose is to improve the economic position of Nepali people via qualitative research on agriculture, including research relevant for informing SNM. It also

works with the government to undertake research and disseminate knowledge. As a result, they play an important role in exploring new areas of research to improve the country's agricultural.

Activity 3: National Level Stakeholder Engagement Workshop

The third activity included the National Level Stakeholder Engagement Workshop (Activity 3) which took place on the 21st April 2023, in Kathmandu, Nepal with the participation of 18 stakeholders (comprising 5 females and 13 males). This event involved participating stakeholders from the Ministry of Agriculture and Livestock Development, Ministry of Forestry and Environment, Department of Agriculture, fertilizer Distribution Company, research bodies like NARC, NAST, Civil society organizations (CSOs), private research firms, and academics.

The workshop was divided into 3 sessions;

Activity 3a. Nitrogen issues, and research dissemination overview

Activity 3b. Breakout session: Stakeholder Analysis and mapping

Activity 3c. Breakout session: Barriers and solutions to SNM in Nepal.

Activity 3a: Nitrogen issues, and research dissemination overview

The first session included a number of presentations that provided an overview into:

- UKRI SANH project activities in different South Asian countries, and the Importance of research on N for the environment provided by Prof. Mark Sutton.
- Overview of SANH project in Nepal by Prof. Dr. Subodh Sharma.
- Role of social science in research by Prof. Roger Jeffery.
- Preliminary output of N fertilizer usage in Nepal with field survey by Dr. Vera Eory
- National action plan and importance of policies for SNM by Dr. Anastasia Yang.

Activity 3b. Breakout session: Stakeholder Analysis and mapping

For the third activity, the attendees were divided into four groups, each consisting of 6 stakeholders, including 1 facilitator, and 1 note taker. The stakeholder analysis mapping approach was conducted as was done previously with the farmer groups. This session lasted almost 50 minutes, and as before, it involved the identification of stakeholders in SNM in agriculture and the



Photo 5: Stakeholder Matrix Mapping: Collaborative session with nitrogen use and fertilizer experts to assess stakeholders based on their power and interest in Sustainable Nutrient Management (SNM) in Nepal.

use of a stakeholder matrix to understand relative levels of perceived interest and influence in policy and decision-making process around N fertilizer policy in Nepal.

This interactive session enabled the stakeholders to exchange knowledge amongst different crucial bodies on how N can be managed sustainably. The discussion outcomes are outlined below in Table 3. The results provide the combined perspectives provided by the four discussion groups.

Table 3. National level workshop stakeholder analysis mapping results identifying fertilizer stakeholders in Nepal and their interest and influence

Stakeholders	Level of interest	Level of influence	Overall reason
Ministry of Agriculture and Livestock Development (MoALD)	High	High	This ministry drafts the policies regarding agriculture and fertilizer use, as well as it facilitates food and its supply. It also regulates all the government bodies and estimate the budget for agricultural improvement.
Provincial government Only one group identified this as a stakeholder	High	High	Provincial government have the authority to make their own laws, and also can set up capacity development programs for improving the province’s agriculture. They also allocate budget for local governments and act as a bridge for local governments to connect with the ministry.
Local government Only one group identified this as a stakeholder	High	High	Local governments receive all the budget for the growth of the local and municipalities. They are in direct contact with the farmers. They can distribute budgets according to the priorities in their area. Also, they act as a bridge between the farmers and the provincial government.
Department of Agriculture Only one group identified this as a stakeholder	High	High	The government’s department of agriculture which oversees the other divisions of agriculture in the country. There are several divisions under it like infrastructure, soil, etc. They also have a high power to alter the agriculture status at local level too. Thus, they have the highest power and highest influence.
Agricultural Inputs Company Limited (AICL)/ Salt Trading Corporation Limited (STCL)	High	Medium	These public sector agencies fertilizer distribution and this is why it makes them highly interested in agriculture. Some policies are also made by the government after taking their feedbacks. But the group also said, as they function under government’s instruction, they are not as highly influential.
Civil Society Organizations (CSOs)	High	Medium	They are responsible for capacity building of the farmers. They give them trainings on how to use certain tools and techniques and

Stakeholders	Level of interest	Level of influence	Overall reason
			communicate. However, since they are not involved in policy making, they cannot be highly influential, but they can influence how farmers can respond to those laws
Farmers	High	Low	Farmers execute the rules that are formulated, they keep great interest in the changes in policies as it might affect agriculture. However, they don't have much influence as they cannot bring direct changes in the policies.
Agrovets	Medium	Medium	They mentioned that their only aim is to sell fertilizers and pesticides to the farmers. These bodies are not active all time of the year, thus doesn't have higher influence.
Ministry of Energy, Water Resources and Irrigation Note: one group identified as this a stakeholder	High	Low	The group mentioned that, they draft policies for water resources use and irrigation in agriculture. They are also plan to formulate policies regarding pollution in water. Even though they have higher interest in agriculture in this regard, they don't have much influence in agricultural N management as MoALD plays a higher role.
Organic Fertilizer producing companies Note: one group identified as this a stakeholder	High	Low	There are several organic fertilizers producing private companies in Nepal and they have very high interest in agricultural related reforms as they sell their products to the farmers, however, they have very low influence because they cannot bring about changes in policies.
Universities	Medium	Low	On average, most of the stakeholders responded that universities and academia have medium interest in nitrogen management. As they teach as well as conduct research, they highly qualified experts and have broad knowledge and thus they keep themselves updated. However, they cannot have any significant influence in agriculture. They can only conduct research and do the analysis and prepare a report finding. Rest is up to the government whether to implement it or not.

Stakeholders	Level of interest	Level of influence	Overall reason
Federation of Nepalese Chamber of Commerce & Industries (FNCCI)	Medium	Low	They play a key role in promoting business and industry in the country.
Ministry of Forestry and Environment	Medium	Low	Most of the attendees mentioned that nitrogen management should be done in a larger context as the nitrogen leached from the agriculture can mix into the river water or can get volatilized into the air. Even if the impact of nitrogen pollution is not reported in Nepal as of now, it is very important to keep its track, and this should be done by the Ministry of Environment and Forestry. Such tracking by the ministry will affect the policies formulation. Therefore, this ministry goes in medium interest and low influence in present context.
Ministry of Finance	Medium	High	This is the ministry that allocates the budget. Every procedure related to fertilizers and allocation of budget is regulated by this ministry. They mobilize all the funds for the agricultural works too. However, they are perceived to have a medium interest. It is important to list them as a key stakeholder in the management of nitrogen in agriculture.

Stakeholders	Level of interest	Level of influence	Overall reason
Nepal Agricultural Research Council (NARC)	Medium	Medium	Most of the attendees mentioned this stakeholder. On average, it was said that NARC is highly interested in agricultural research. They are the government's body of research. However, their research findings are not being implemented by the nation as they are supposed to be. Also, NARC lack proper resources and interaction with the farmers regarding the dissemination of knowledge. However, some also mentioned that, they have aided government to prepare annual reports regarding Nepal's agricultural status, thus, they have somewhat medium influence.
NGOs/INGOs	Medium	Medium	On average the stakeholders feedback agreed on keeping NGOs/INGOs on this grid. They mentioned that, they have lots of budget to work on agriculture and they conduct several capacity buildings, and trainings. They directly work with farmers and have higher interest in agricultural policies. Since they all work in collaboration at all three governments; central government, provincial and local governments, they can influence the change in the farmers level, however it is difficult for them to make an influence in the policies.
International fertilizer manufacturing company	Medium	Medium	The decision of the attendees was to keep international fertilizer manufacturing companies in this grid. They mentioned that, Nepal is dependent on its neighboring countries for fertilizer import. Thus, these international manufacturers are very interested in the policies regarding agriculture in Nepal as it also affects their export schemes. We also can see that their export scheme budget allocations fluctuates but they don't have very high influence.

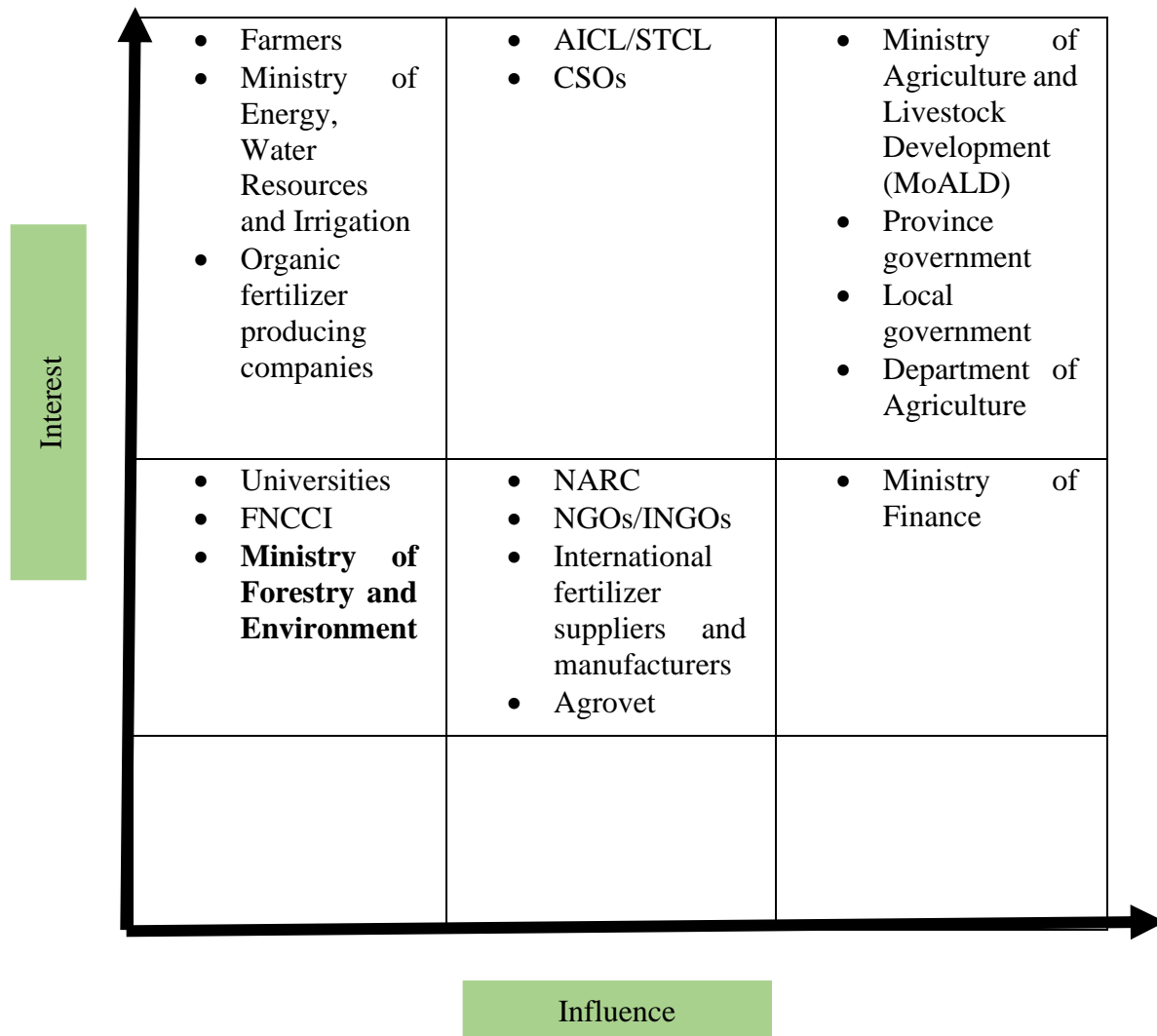


Figure 3: National-level workshop stakeholder analysis mapping results of stakeholders' interest and influence on fertilizer policy in Nepal. These results are based on the average of four breakout groups consisting of stakeholders and experts from the field of agriculture. The workshop took place on April 21st, 2023, in Kathmandu, and discussions were held with stakeholders from MoALD, NARC, Tribhuvan University, Kathmandu University, Civil Society Organizations, NGOs, the Department of Agriculture, and the Ministry of Forests and Environment.

In terms of thinking about N policy or actions for SNM, these findings help us to identify the key actors, their interests, and any potential conflict of interest. It helps understand the power dynamic and current and potential alliances that impact policy decisions or could do so in the future. This could help better stakeholder management in the context of any decision/resource management context. Given that CSOs and fertilizer distribution companies also play a significant role in SNM,

as shown by the national stakeholder engagement program, policymakers working in collaboration with these organizations can also aid in the formulation of an effective policy. Similar findings show that farmers are more interested in policy development; as a result, it is critical to communicate the policy developed for better execution.

Activity 3c. Breakout session: Barriers and solutions to sustainable N management in Agriculture

In the second breakout session, stakeholders were asked to discuss the barriers and solutions to SNM in agriculture, this took 40 minutes. The following points were noted by the discussion groups:



Photo 6: Stakeholders sharing barriers and solutions to sustainable N management in Agriculture discussed within their respective groups

4.1 The breakout groups identified Barriers for achieving SNM in agriculture in Nepal:

I. Budgeting and funding issues	Insufficient budget allocation and funding hinder the ability to meet farmers' demands, impacting sustainable nitrogen (N) management.
II. Timing and amount of fertilizer application	Inadequate knowledge and awareness regarding the appropriate timing and dosage of fertilizers contribute to challenges in SNM.
III. Fertilizer management, import, distribution, and supply	Poor management of fertilizer-related processes, including import, distribution, and supply, affects sustainability in agriculture.
IV. Lack of policy review and updates	The absence of regular policy review and updates creates barriers to achieving SNM in agriculture.

V. Overuse of fertilizers and lack of awareness	The lack of timely availability of fertilizers and insufficient awareness regarding recommended dosage led to overuse of fertilizers and reduced yield.
VI. Gaps in policies and execution	Inconsistencies and gaps in policies, particularly in the distribution of fertilizers, contribute to sustainability challenges in agriculture.
VII. Availability and quality of fertilizers	Farmers face issues with the availability and quality of fertilizers, impacting their effectiveness in promoting crop growth.
VIII. Proper techniques of using organic manures	Farmers may face challenges in using farm yard manure correctly, potentially causing leaching into the soil.
IX. Contradictions in policies between local and federal governments	Inconsistencies and contradictions in policies between local and federal governments create barriers to SNM.
X. Inadequate knowledge and awareness among farmers	Farmers lack adequate knowledge and awareness regarding the appropriate amount of fertilizer to use, impacting SNM.
XI. Insufficient knowledge about organic fertilizers:	Farmers have limited knowledge about organic fertilizers, resulting in a preference for synthetic fertilizers with higher negative effects.
XII. Lack of monitoring and control	Inadequate monitoring and control measures contribute to challenges in SNM.
XIII. Inadequate research and poor dissemination	The lack of sufficient research and poor dissemination of information impede progress in SNM.
XIV. Lack of alternative fertilizers	Farmers face limitations due to the lack of alternative fertilizers, reducing options for SNM.

4.2 The breakout groups proposed solutions for SNM in agriculture in Nepal

I. Farmers' contribution and reduced subsidies	Farmers can contribute financially if subsidies are reduced, creating a sense of ownership and responsibility.
II. Imbalanced use of fertilizers	The over-reliance on nitrogen (N) fertilizers has led to soil degradation, while phosphorus and potassium-based fertilizers are underutilized.
III. Balanced fertilizer uses and subsidy reduction	Encouraging balanced fertilizer use and reducing subsidies can promote sustainable nutrient management.
IV. Cost implications and government pricing	Removing subsidies may increase costs for farmers, especially if market prices for fertilizers are already high.
V. Timely availability and affordable prices	Ensuring timely availability and affordable prices of fertilizers can incentivize farmers to purchase them, leading to increased demand.
VI. Policy intervention and review	Policy interventions are necessary to address issues related to subsidy allocation, pricing, and fertilizer distribution.
VII. Farmer awareness and accountability	Farmers should be educated about the environmental consequences of fertilizer application and encouraged to manage fertilizers properly.
VIII. Awareness campaigns and proper supply	Farmer awareness campaigns should be combined with timely and adequate fertilizer supply to effectively promote sustainable practices
IX. Demand and supply management	Effective management of fertilizer demand and supply is essential for SNM.
X. Soil and land management	Considering soil nutrient levels and implementing appropriate conservation practices are vital aspects of SNM.
XI. Learning from other countries' policies	Studying policies from other countries, such as nutrient-based fertilizer policies, can provide insights for improving fertilizer management.
XII. Collaboration and channelling of knowledge	Collaboration among stakeholders and effective knowledge sharing can contribute to addressing fertilizer overuse issues.
XIII. Site-specific research and optimal fertilizer use	Conducting site-specific research on fertilizer use and providing instructions on time-specific dosage can optimize fertilizer application.

XIV. Promotion of organic alternatives	Promoting organic fertilizers and alternatives to synthetic fertilizers can help reduce dependency on chemical fertilizers.
XV. Consistent subsidies and policy implementation	Ensuring consistent subsidies for fertilizers and proper implementation of policies can contribute to SNM.
XVI. Awareness, education, and training	Grassroots-level awareness programs, education, and training initiatives are crucial to enhance farmers' understanding of SNM.
XVII. Strengthening research and coordination	Strengthening research and coordination efforts between stakeholders can contribute to improved nitrogen management practices.
XVIII. Diplomatic collaboration and priority	Collaboration with international stakeholders and giving priority to SNM by the government are recommended.
XIX. Linking farmers with stakeholders and site-specific research	Linking farmers with relevant stakeholders and conducting site-specific research on nitrogen use efficiency can improve fertilizer practices.

Overall Summary and Findings

From the findings, we can deduct the given information that we got from farmers focused group discussion and insights and from national workshop, there are diverse as well as big overlapping perceptions of the stakeholders' interest and influence in Nepal's agriculture.

From **Table 1 and Figure 2**, Farmers' perspectives on the interests and influence of various stakeholders indicated a range of opinions. NGOs/INGOs were viewed as having medium interest and influence, with mixed opinions about their effectiveness in N management. Despite their perceived lack of interest, agrovets were regarded as key stakeholders. Similarly, the Ministry of Livestock and Development (MoALD) and municipalities were identified as having a significant level of interest and influence, emphasizing their responsibilities in developing policies and budget allocation. Farmers themselves said that they have high interest but perceived their influence as limited in policy changed. Research bodies were reviewed with medium interest and high influence, attributed to their studies and recommendations.

From **Table 3 and Figure 3**, Policymakers' and experts' perspectives offered an additional perspective. MoALD was recognized as an important stakeholder with substantial influence and interest in formulating agriculture policies and maintaining food security. Local and provincial governments were acknowledged as important stakeholders with high interest in and influence over their respective levels. High interest and influence were demonstrated regarding the Department of Agriculture, Agricultural Inputs Company Limited/Salt Trading Corporation Limited, and CSOs. Farmers were acknowledged as crucial stakeholders with high interest but limited influence. Other stakeholders, such as universities, international fertilizer manufacturing companies, and political parties, were categorized in mixed levels of interest and influence.

While there were some similarities between the perspectives of the farmers and the views of the experts, there were also some differences. The farmer FGD assigned NGOs/INGOs with a medium level of interest and influence, whilst experts had mixed opinions about them. Farmers regarded agrovets as having a medium level of influence, while experts believed they had a low one. Despite having different nuances, both farmers and professionals acknowledged the Ministry of Agriculture and Livestock Development's high interest and impact. Additionally, different perspectives on the influence of farmers emerged, with farmers believing their influence as low and experts considering that their influence to be important but limited.

This highlights the diverse perception held by key stakeholders in Nepal's agricultural nitrogen management. While there are areas of agreement, disparities between the perspectives of farmers and the insights of experts are apparent. Despite receiving subsidies, a significant majority of farmers have disclosed that they continue to get fertilizers at twice the cost. Moreover, it has been identified that not all farmers can easily access these fertilizers, even when paying additional prices. Meanwhile, the government believes that they have made substantial efforts, yet certain aspects of management are lacking. These disparities underscore the urgent need for improved communication, collaboration, and coordination among stakeholders to bridge gaps and unite their efforts towards sustainable agricultural practices.

Some farmers are advocating for transparency in scientific findings and clear budgeting for fertilizer use. Similarly, stakeholders at the national level have suggested implementing fertilizer use policies tailored to specific sites. These findings indicate that while all stakeholders share a

common goal, they require additional support, particularly from policy makers, to translate these ideas into action.

In a broader context, the primary issues identified include the untimely supply of fertilizers, deficient policy formulation and execution, and limited collaboration among stakeholders. Addressing these concerns, focusing on research, and bridging gaps have emerged as key recommendations. Recognizing and understanding the differing perspectives and priorities of stakeholders is pivotal for formulating and implementing effective policies and practices in the management of nitrogen in Nepal's agriculture. Bottom-up approach is essential to ensure successful policy formulation and necessary amendments.

To advance the cause of sustainable nitrogen practices in Nepal, it is advisable to encourage further research and discussions that foster synergy and cooperation among stakeholders. This holistic approach will ultimately contribute to the comprehensive advancement of sustainable nitrogen practices in Nepal's agricultural.

References:

- Das, S., Tyagi, N., Choubey S. (2022), Barriers and Challenges to effective Nitrogen Management: Stakeholder Analysis of Agriculture Policies in India; A Summary Document, TERI advanced studies, Delhi, India.
- Joshi, R., Shrestha, R., Pokharel, A., Sharma, S., Yang, A. (2022), Nepal Nitrogen Policy Report: Scientific Evidence, Current Initiatives and Policy Landscape, SANH Policy Paper PP2. Kathmandu.
- Yang. A., Jefferey. R., Alexander. P., Bansal. S., Ahmed. Z., Rahman. M., & Joshi. R. (2022). SACEP-SANH 2nd Sub-Regional Workshop on 'South Asia Nitrogen Framework Policy' .

Appendix:

ⁱ Nitrogen is an important component in plant and animal growth, but excess reactive nitrogen is an increasing environmental concern. Nitrogen is essential for the development of proteins and important in other living functions. In our environment, N exists in many forms. In its inert gaseous state, N_2 , it is very stable and makes up over 70 percent of the earth's atmosphere but is unavailable for plant and animal growth. The many other forms of N in the environment, including ammonia (NH_3), ammonium (NH_4), nitrite (NO_2) and nitrate (NO_3), nitric oxide (NO) and nitrous oxide (N_2O) are collectively referred to as reactive N or Nr. These forms of N are all interrelated and are constantly in flux in the environment. Learning to recognize and manage these changes has future implications for agriculture. Through the conversion of N_2 to NH_3 and NH_4 (ammonia and ammonium), N becomes available for life uses. This conversion of N_2 to its ammonia forms takes place under two natural processes: 1) N_2 is converted to NH_4 by bacteria living in the nodules of legume plants (clovers, alfalfa, beans, peas) and 2) a burst of energy from a bolt of lightning converts N_2 to NH_4 . In the early 20th century, the advent of the Harber (or Harber-Bosch) process for converting N_2 to NH_3 was commercially adopted and the manufacture of commercial N fertilizers began. Each process requires significant inputs, either bacterial or energy, to complete the conversion.

Source: https://www.canr.msu.edu/news/what_is_reactive_n_and_why_should_i_care