Final Report

National Livestock Feed Balance Sheet

Submitted to:

National Animal Feed and Livestock Quality Management Laboratory (NAFLQML)

Lalitpur, Nepal

Submitted by:

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Acknowledgements

We would like to express our sincere gratitude to all individuals and institutions who contributed to the successful completion of this analysis on forage and feed area distribution across Nepal. This study would not have been possible without the generous support and coordination of the **National Animal Feed and Livestock Quality Management Laboratory (NAFLQML)**, which served as the client and guiding institution throughout the process.

We extend our special thanks to the **Chief of NAFLQML Dr. Hem Raj Awasti** whose leadership, encouragement, and oversight played a pivotal role in steering this work. We are equally grateful to the **technical and management team** at NAFLQML, Ram Chandra Pudasainai Senior Livestock Officer, Dr. Sabina Koirala, Senior Livestock Development Officers, Dr. Chaya Khanal for their continuous cooperation, logistical support, and timely feedback, which significantly contributed to the study's depth and clarity.

Our heartfelt appreciation goes to the **study team**, particularly the **Team Leader** Dr. Pradip Chandra Bhattarai, the **Nutrition Specialist**, Ram Raj Lamsal and Subas Chandra Dhakal -coordinator whose dedication, expertise, and field insights ensured a comprehensive and evidence-based assessment. Their collaborative efforts in data gathering, analysis, and synthesis were key to producing this report.

We also acknowledge the **Ministry of Agriculture and Livestock Development (MoALD)** and various **provincial agriculture and livestock offices** for providing access to critical data and technical inputs. Lastly, we thank all stakeholders—researchers, extension officers, and field technicians—whose ongoing work continues to enhance livestock nutrition and feed resource management in Nepal.

This joint effort reflects a shared commitment to building a more resilient and regionally balanced livestock feeding system across the country.

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Abbreviation used

TDN:	Total Digestible Nutrient
DCP:	Digestible Crude Protein
NAFLQML:	National Animal Feed and Livestock Quality Management Laboratory
MoALD:	Ministry of Agriculture and Livestock Development
LU:	Livestock Unit
DLS:	Department of Livestock Service
KII:	Key Informant Interview
FGD:	Focus Group Discussion
SWOT:	Strength, Weakness, Opportunity and Threat
CFUC:	Community Forest Users Committee
NARC:	Nepal Agriculture Research Council
NDDB:	National Dairy Development Board
PDLFD:	Provincial Directorate of Livestock and Fisheries Development
VHLEC:	Veterinary Hospitals and Livestock Expert center
CDCAN:	Central Dairy Cooperative Association of Nepal
I/NGO:	International/National Non-Government Organizations
MT:	Metric Ton
Ha:	Hectare
Kg:	Kilogram

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Executive Summary

In 2022/23, Nepal produced about **10.91 million metric tons (MT)** of cereal grains from **3.34 million hectares**, with **paddy, maize, and wheat** accounting for over **96%** of the total. Despite a slight drop in cultivated area, productivity gains—especially in paddy and wheat—led to higher overall output. Minor cereals (millet, barley, buckwheat) remained vital in hill areas, while oilseeds, potatoes, sugarcane, and legumes also contributed significantly.

The data highlights Nepal's strong reliance on cereals, steady productivity improvements, and ongoing challenges in crop diversification. Declining pulse production, limited growth in oilseeds, and pressure on traditional crops indicate the need for **balanced, resilient agricultural strategies** that support both food and feed security through better inputs, research, and market support.

In 2022/23, Nepal's cereal grains and their residues provided an estimated **8.12 million metric tons (MT)** of Total Digestible Nutrients (TDN), with **4.90 million MT** from grains and **3.22 million MT** from residues. **Paddy, maize, and wheat** accounted for nearly **88%** of this supply, underscoring their critical role in both food and feed systems.

Minor cereals, legumes, and oilseeds added about **0.99 million MT** of TDN, offering potential to diversify and balance livestock diets. Notably, **crop residues contributed around 40%** of total crop-based TDN, proving especially vital for smallholders relying on local resources.

Despite the large volume, challenges like regional disparities, competition with human food, and inefficient residue use limit full feed potential. Improving crop residue management, promoting dual-purpose crops, and supporting balanced feeding strategies are key to enhancing feed security and livestock productivity in Nepal.

In Nepal, **43.4%** of the total digestible nutrient (TDN) supply for livestock comes from **crop residues and milling by-products**, making it the primary feed source. **Forest areas (19%)**, **farm weeds (13.1%)**, and **improved forage (8.9%)** also contribute significantly. Smaller shares come from **grain supplementation (6.5%)**, **grasslands (3.9%)**, **kitchen waste (2.6%)**, and **shrub or barren lands**.

The analysis indicates a strong reliance on **traditional, land-based feed sources**, but also shows growing use of **alternative feeds** like kitchen waste, silage, and grain. Improved forage, though less widespread, is notably efficient and highlights potential for **intensifying and modernizing livestock feeding systems** in Nepal.

In Nepal, **cattle (32.3%)**, **buffaloes (22.6%)**, and **milk production (23.9%)** together account for nearly **79% of the total TDN requirement**, underscoring the dominant feed demands of large ruminants and dairy systems. Among other livestock, **goats (9.1%)**, **poultry (4.7%)**, and **pigs (4.2%)** contribute notable shares, while species like sheep, horses, yaks, ducks, and fish represent smaller but growing portions.

The data highlights the central role of **large ruminants** in feed planning, but also signals a **gradual shift toward diversified and mixed livestock systems**, calling for improved forage, targeted supplementation, and more efficient feeding strategies—especially to sustain rising dairy and small livestock production.
In 2022/23, Nepal had **4.75 million cattle** and **3.08 million buffaloes**, with over **93%** of both species being **local breeds**. The **yak/nak population** was 53,194, all local and concentrated in high-altitude regions. Most cattle and buffaloes were **productive adults (over 3 years)**, making up **over 70%** of each population, while younger age groups showed **strong replacement potential**.

The data reflects a **heavy reliance on local breeds**, which are resilient but generally less productive. With only a small share of improved breeds (6.7% in cattle, 5.3% in buffaloes), there's significant scope for **expanding genetic improvement programs**. Enhancing the productivity of the existing adult stock could bring **quick gains** in milk and draft power, supporting both livelihoods and food systems.

In 2022/23, Nepal's **4.75 million cattle** required an estimated **4.79 million metric tons (MT)** of Total Digestible Nutrients (TDN). **Adult cattle over 3 years** accounted for **70.8%** of the population but consumed **78.7%** of total TDN, reflecting their key roles in milk production, draft power, and reproduction. Younger cattle under 1 year and those aged 1–3 years required **466,507 MT** and **552,417 MT** of TDN, respectively.

Local breeds made up 93.3% of the cattle population and thus contributed the largest share of TDN demand. With improved breeds accounting for just **6.7%**, the national herd remains largely unimproved, limiting genetic potential.

The analysis underscores the need for **age-specific feed strategies**, prioritizing adult cattle while also ensuring adequate nutrition for younger stock to support future productivity. Enhancing feed efficiency among local breeds and promoting improved genetics where appropriate could boost productivity and reduce pressure on feed resources.

In 2022/23, Nepal's **3.08 million buffaloes** required approximately **3.33 million metric tons (MT)** of Total Digestible Nutrients (TDN). **Adult buffaloes over 3 years**, essential for milk, draft, and reproduction, consumed the largest share—**55.2%** (2.24 million MT). Buffaloes under 3 years made up nearly **45%** of the population and required over **1 million MT** of TDN, indicating a **young herd structure**.

Local breeds comprised 94.7% of the buffalo population, resulting in low genetic diversity and limited feed efficiency improvements. The analysis highlights the need for **age-specific feeding strategies**, especially for adult buffaloes, while also improving nutrition for younger animals. Expanding access to quality fodder and promoting selective breeding of improved buffaloes are key to boosting productivity and reducing pressure on natural feed resources.

In 2022/23, Yak/Nak in Nepal required approximately **50,886 metric tons (MT)** of Total Digestible Nutrients (TDN), with **66.2%** consumed by mature animals over 3 years, reflecting their key roles in milk production, traction, and cultural practices in high-mountain pastoral systems. Young animals under 3 years made up about **34%** of the population, indicating stable herd replacement.

Although Yak/Nak populations are small and localized mainly in high-altitude regions, their feed needs are significant for regional planning. Ensuring adequate nutrition for adults is critical to sustain productivity, traction capacity, and herd health in these remote agro-pastoral communities.

In 2022/23, Nepal's **501,849 sheep** required approximately **94,331 metric tons (MT)** of Total Digestible Nutrients (TDN). The majority of demand (**71.7%**) came from sheep aged 6 months and above, reflecting their roles in meat, wool production, and breeding. Lambs under 6 months made up **28.3%** of the population and required **15,573 MT** of TDN.

The sheep population is overwhelmingly local (**99.5%**), indicating limited genetic improvement efforts. These findings emphasize the need to focus feed interventions on adult sheep to boost productivity, while ensuring proper nutrition for young stock to support herd growth. There is also potential to expand improved breeding programs in key sheep-rearing regions.

In 2022/23, Nepal's **14.54 million goats** required about **1.34 million metric tons (MT)** of Total Digestible Nutrients (TDN). The majority (**68.7%**) of this demand came from goats aged 6 months and above, reflecting their key roles in meat production and reproduction. Young goats under 6 months made up **31.3%** of the population and required **248,971 MT** of TDN.

The goat population is predominantly local breeds (**97.3%**), with limited presence of improved or crossbred animals. Feed strategies should focus on adult and breeding goats to maximize productivity, while ensuring adequate nutrition for young stock to maintain herd growth. Investments in forage development, improved browsing, and targeted supplementation are important to enhance goat productivity in Nepal.

In 2022/23, Nepal's **1.36 million pigs** required approximately **112,216 metric tons (MT)** of Total Digestible Nutrients (TDN). Although **56.5%** of pigs were under 6 months old, this group consumed only **25.8%** of TDN due to lower feed needs. Pigs aged 6 months and above, making up **43.5%** of the population, accounted for **74.2%** of TDN demand, reflecting their energy needs for fattening and reproduction.

Local breeds dominate pig populations (**86.7%**), with limited adoption of improved breeds (**13.3%**). Pig farming remains largely traditional with modest genetic and nutritional improvements. Given their relatively low feed requirements, pigs offer a promising low-input, high-output livestock option. Enhancing feed efficiency in mature pigs and promoting improved breeds, alongside targeted feeding strategies, could significantly boost productivity, especially in peri-urban and subsistence systems.

In 2022/23, Nepal's poultry and duck population totaled about **14.7 million birds**, requiring roughly **192,460 metric tons (MT)** of Total Digestible Nutrients (TDN), which is **1.3%** of the national livestock feed demand. Broilers dominated with **12.7 million birds** and the highest feed requirement, followed by layers and ducks. Ducks, with 1.33 million birds, have a significant presence mainly in wetland and Terai regions.

The data highlights the growing importance of commercial poultry and duck production in Nepal's protein supply, driven by broilers' fast growth and market demand. This trend underscores the critical need for reliable, quality feed supplies and effective ration formulation to support sector expansion and sustainability.

In 2022/23, Nepal produced approximately **113,736 metric tons (MT)** of fish meat, requiring about **196,462 MT** of Total Digestible Nutrients (TDN), which is **1.3%** of the national TDN demand for all livestock and aquaculture. Despite relatively low land and livestock unit needs, fish farming demands significant feed due to intensive practices and high feed conversion ratios.

The growing aquaculture sector reflects rising protein demand and economic opportunities for producers. Sustaining this growth will require access to affordable, quality feed and improved feed management to ensure productivity and sector resilience.

In 2022/23, Nepal's horse population, totaling **95,699 livestock units (LU)**, required approximately **104,790 metric tons (MT)** of Total Digestible Nutrients (TDN), averaging about **1.1 MT per horse annually**. Horses primarily support transport, agricultural work, and cultural activities, especially in hilly and mountainous regions.

Though horses represent a small portion of national TDN demand, they play a vital role in rural livelihoods and mobility. Ensuring adequate feed, particularly during dry seasons, through better pasture management and targeted support is essential to sustain their productivity and well-being.

In 2022/23, Nepal's milk production of approximately **2.61 million metric tons** required about **3.52 million metric tons (MT)** of Total Digestible Nutrients (TDN), averaging **1.35 MT of TDN per ton of milk**. This reflects the substantial nutritional needs of lactating cows and buffaloes across diverse production systems.

Milk production drives nearly **25% of the national TDN demand**, highlighting the dairy sector's critical role in feed requirements. Ensuring a reliable supply of quality fodder and concentrates, improving dairy genetics and feed efficiency, and investing in forage and ration management are essential strategies to support dairy growth, rural livelihoods, and national food security.

In 2022/23, Nepal's total supply of Total Digestible Nutrients (TDN) was approximately **11.29 million metric tons (MT)**, while the total livestock feed demand reached about **14.73 million MT**, resulting in a significant **TDN deficit of 3.44 million MT (23.35%)**. This gap poses risks to livestock productivity, health, and sector growth.

To address this shortfall, strategies should focus on enhancing fodder production, better utilization and storage of crop residues, promoting alternative feed sources, and improving feed efficiency through breed improvement and management. Closing this deficit is vital for sustainable livestock development, food security, and rural livelihoods in Nepal.

In 2022/23, Nepal's total national supply of Total Digestible Nutrients (TDN) was about **11.29 million metric tons (MT)**. The Mid-hill and Terai regions contributed nearly equally, around **45% each**, while the High-hill region supplied only about **10%**, reflecting its limited feed resources.

Crop residues and milling by-products were the largest feed source, providing **44%** of TDN, followed by farm weeds and natural forages (**15%**) and forest resources (**20%**). Improved forage and pasture accounted for only **7%**, and commercial silage contributed less than **0.1%**, indicating low adoption.

In the reporting year, Nepal had 862,500 hectares of land under forage or feed production, primarily from the Terai (50.5%) and mid-hills (49.5%), with no feed cultivation reported in high hills. The distribution was highly uneven, with Bagmati Province alone accounting for 74.3% of the total area, indicating strong investment in forage development. Provinces like Lumbini, Koshi, and Madhesh also contributed, while Gandaki had a minimal share, and Karnali and Sudurpaschim had none.
This imbalance reflects disparities in market access, infrastructure, and policy focus. To improve feed security, the report recommends promoting forage development in lagging provinces, expanding pasture in mid-hills, integrating feed planning into livestock strategies, utilizing fallow land, and supporting landless farmers. Addressing these gaps is key to ensuring a more equitable and resilient livestock feed system across Nepal.

The data reveal heavy reliance on low-quality, variable feed sources and underutilization of improved forages. To enhance feed availability and livestock productivity, strategies should focus on scaling up improved forage production, region-specific feed development, and better feed conservation and utilization, especially in the Mid-hill and Terai regions.

In 2022/23, Nepal's large ruminants—cattle, buffalo, and yak—required about **8.10 million metric tons (MT)** of Total Digestible Nutrients (TDN), with cattle demanding 4.76 million MT (59%), buffaloes 3.33 million MT (41%), and yaks a small share under 1%. The Mid Hills and Terai regions accounted for over 75% of this demand, reflecting the distribution of mixed crop-livestock systems and semi-commercial dairying.

Buffaloes have higher per-head TDN needs due to greater body weight and milk production, while yaks are vital for high-altitude pastoral livelihoods. Large ruminants drive nearly 70% of Nepal's total TDN demand, placing pressure on fodder and grazing resources.

Challenges include limited quality forage, seasonal feed shortages, and low adoption of improved feeding practices. Key interventions include promoting forage cultivation and conservation, improving feed efficiency and genetics, managing community pastures, and utilizing crop residues and by-products.

In 2022/23, Nepal's small ruminants—goats and sheep—required about **1.44 million metric tons (MT)** of Total Digestible Nutrients (TDN), with goats accounting for over 93% (1.34 million MT) and sheep less than 7% (94,331 MT). The Mid Hills and Terai regions dominate goat-related feed demand, while sheep are primarily concentrated in the High Hills, reflecting their ecological preferences.

Goats' large population (over 14.5 million) drives a significant cumulative feed demand, making small ruminants responsible for more than 12% of the total national TDN requirement. However, feed supply for these species faces challenges from seasonal scarcity, overgrazing, and limited improved feeding practices.

To improve productivity and sustainability, key actions include promoting fodder trees and silvo-pastoral systems, enhancing grazing management and rangeland restoration, utilizing crop residues and alternative feeds, and expanding farmer extension services.

In 2022/23, Nepal's non-ruminants—pigs, poultry, and ducks—required about **1.33 million metric tons (MT)** of Total Digestible Nutrients (TDN), with poultry demanding the largest share (52%), followed by pigs (46%) and ducks (2%). The Terai region led non-ruminant feed demand, reflecting its concentration of commercial poultry and pig farming, followed by the Mid Hills and High Hills.

Poultry's high TDN demand stems from its large population (over 78 million birds) and intensive production, while pigs contribute significantly due to their size and nutrient needs. Ducks, important in wetland areas, play a smaller but regionally significant role.

This growth in non-ruminant feed demand signals a shift toward commercial, feed-intensive systems, driven by urban demand and better market access. Non-ruminants now account for over 11% of Nepal's total livestock TDN needs.

In 2022/23, the combined Total Digestible Nutrients (TDN) requirement for horses and fish in Nepal was about **301,252 metric tons (MT)**—with fish accounting for 65% and horses 35%. Fish feed demand is heavily concentrated in the Terai due to commercial aquaculture growth, while horse feed needs are mainly in the High and Mid Hills, where equines remain vital for transport and rural livelihoods.

Fish production's large TDN share reflects expanding intensive aquaculture driven by favorable Terai conditions and growing protein demand. Despite smaller numbers, horses require substantial feed due to their role in difficult terrains and cultural importance.

Together, these species make up just under 3% of national TDN demand but hold strategic value regionally. Recommendations to support these sectors include improving local feed supply (high-protein aquafeeds and forage for horses), promoting integrated farming systems, enhancing veterinary and extension services, and investing in water and breed improvements. Adequate feed support for horses and fish is essential for sustaining rural livelihoods, diversifying food systems, and balanced development in Nepal's varied agro-ecologies.

In 2022/23, Nepal's total supply of Total Digestible Nutrients (TDN) was about **11.29 million metric tons (MT)**, predominantly sourced from crop residues and milling by-products (44%), followed by forest-based feeds (20.5%) and farm weeds and natural forages (15.1%). Crop residues remain the backbone of livestock feeding, especially in mixed and subsistence farming systems, while forests and natural forages support grazing in hill and peri-urban areas.

Regionally, Koshi and Madhesh provinces led in crop residue-based TDN supply, Bagmati showed the highest use of improved forage reflecting commercial dairy growth, and Karnali depended largely on grazing from grasslands and shrublands. Commercial silage, kitchen waste, and grain supplementation were minimal nationally but emerging in more intensive production zones.

The current feed system relies heavily on bulky, low-quality resources, which limits nutrition for high-producing animals. To improve feed availability and quality, strategic interventions should focus on promoting improved forage systems, reducing forest pressure via fodder plantations, expanding silage and hay technologies, enhancing feed processing and conservation, and tailoring feed balance plans to provincial needs.

In 2022/23, Nepal's total Total Digestible Nutrients (TDN) requirement across all livestock and production sectors was approximately **14.73 million metric tons (MT)**. Large ruminants—cattle and buffalo—dominated this demand with about **8.09 million MT** (55%), underscoring their key role in mixed farming and dairy livelihoods. Cattle required around 4.76 million MT, buffalo 3.33 million MT.

Regionally, **Koshi Province** led with 22% of the national TDN demand (3.25 million MT), driven by high livestock populations and strong milk and poultry sectors. Bagmati and Lumbini followed, each contributing about 16%, while Madhesh, Sudurpashchim, Gandaki, and Karnali accounted for the remainder, reflecting widespread mixed livestock systems.

Other species like goats (1.34 million MT), pigs (0.61 million MT), and poultry (0.69 million MT despite nearly 79 million birds) play growing roles in food security and

incomes. Milk production alone required 3.52 million MT, highlighting its strong linkage with feed demand, especially in commercial dairy hubs. Fish farming's TDN demand was smaller (0.20 million MT) but poised to grow.
This data highlights cattle and buffalo as the backbone of Nepal's livestock feed economy, with smaller species and poultry increasingly important for diversified rural livelihoods.

Using linear regression based on data from 2016/17 and 2022/23, the projected Total Digestible Nutrients (TDN) supply from other feed sources in Nepal is expected to grow from approximately **11.29 million metric tons (MT) in 2022/23** to **11.69 million MT in 2027/28**, and further to **15.25 million MT by 2032/33**—a 35% increase over ten years. This growth reflects gradual improvements in feed resource mobilization but lags behind the faster rise in overall TDN demand.

Key feed source trends:

- **Crop residues and milling by-products** remain dominant, supplying around 40–44% of TDN, increasing from 4.90 million MT to 6.25 million MT by 2032/33, showing continued reliance on low-cost, low-quality feed.
- **Improved forage and pasture** supply is projected to surge sixfold—from 1.01 million MT to 6.40 million MT—highlighting strong potential for expanding high-quality cultivated fodder, especially in deficit regions.
- **Natural resource-based feeds** (forests, shrublands, grasslands, farm weeds) continue as major contributors:
- Forest feeds remain stable (2.15 to 2.39 million MT), posing sustainability concerns.
- Farm weeds and natural forages increase from 1.48 to 2.13 million MT.
- Grasslands' contribution doubles to 1.06 million MT, reflecting better marginal land use.
- **Declining sources:** Kitchen waste and barren land feeds sharply decrease, likely due to better waste management and land-use changes.
- **Grain-based and commercial feeds** expand notably: grain supplementation grows from 736,550 MT to 1.59 million MT, supporting intensive livestock systems; commercial silage rises gradually from 14,000 MT to 46,067 MT.

- Projected data shows Nepal's Total Digestible Nutrients (TDN) demand for livestock rising sharply from about **14.73 million metric tons (MT) in 2022/23** to **18.36 million MT in 2027/28**, and further to **26.60 million MT by 2032/33**, marking an 81% increase over a decade and highlighting growing pressure on feed resources.

  Key species trends include:

- **Milk-producing animals (cattle and buffalo):** Largest and fastest-growing TDN demand, with milk production-related TDN nearly doubling from 3.52 million MT to 6.24 million MT by 2032/33. Buffalo demand rises from 3.33 to 4.42 million MT, while cattle demand slightly declines, indicating herd composition shifts.

- **Small ruminants:** Goat demand surges from 1.34 to 3.20 million MT; sheep demand grows from 94,331 to 243,617 MT, driven by increased meat consumption and livelihood diversification.
- **Monogastrics:** Poultry demand grows from 690,000 to over 1 million MT; pig demand rises moderately from 615,000 to 668,000 MT, reflecting steady semi-commercial growth.
- **Fish production:** Exceptional expansion with TDN demand skyrocketing over 27-fold from 196,462 MT to 5.32 million MT, signaling aquaculture as a future major feed consumer.
- **Other species:** Ducks show sharp TDN growth (from 26,520 to 194,725 MT), while yak/nak demand slightly declines, possibly due to climate or livelihood changes in high-altitude areas.
- **Implications:**
  The data highlights a transition toward more intensive livestock systems—dairy, goat, poultry, and aquaculture—requiring substantial investments in feed production, processing, and efficiency improvements.

Using linear regression on data from 2016/17 and 2022/23, the projected Total Digestible Nutrients (TDN) supply from **crop and crop residues** is estimated to increase from **8.12 million metric tons (MT) in 2022/23** to **8.91 million MT in 2027/28**, and reach **9.44 million MT by 2032/33**—reflecting a **16% growth** over a decade. While this indicates steady expansion, it remains insufficient compared to the projected growth in national TDN demand.

Major Contributors:

- **Paddy, maize, and wheat** consistently supply over 88% of the total TDN from crop sources:
- *Paddy* remains the leading contributor, increasing from 3.93 to 4.19 million MT.
- *Maize* shows the fastest growth—from 2.11 to 3.02 million MT (43% increase), underscoring its growing feed role.
- *Wheat* contributes steadily, increasing from 1.09 to 1.29 million MT.
- **Minor Cereals and Pulses:**
- *Millet* remains stable; *buckwheat* rises modestly; *barley* shows a gradual decline, likely due to reduced cultivation.
- Pulses show mixed trends:
- *Lentil* and *pigeon pea* decline in contribution, possibly due to shifting cropping patterns.
- *Soybean* and *black gram* show growth, with soybean increasing from 38,369 MT to nearly 49,762 MT, signaling its expanding feed potential.
- **Oilseeds and Others:**
  Oilseeds like *mustard*, *linseed*, *sunflower*, and *sesame* maintain small but stable contributions, indicating their consistent yet limited role in national feed supply.

Recommendations:

Key recommendations include:

- Enhancing region-specific forage and fodder development, especially in high-demand provinces

- Investing in feed technologies like hay, silage, and nutrient blocks to manage seasonal shortages
- Promoting ration balancing and feed efficiency for non-ruminants via extension and training
- Strengthening livestock value chains with improved veterinary care, breeding, and milk collection
- Though TDN supply shows promising growth, especially from improved forages, it falls far short of the rapidly increasing TDN demand projected to reach 26.60 million MT by 2032/33. This will create a significant deficit exceeding 11 million MT, underscoring the urgent need for:
- Accelerated investment in improved forage and pasture systems, especially in high-demand areas.
- Sustainable management of forest and shrubland feed to prevent environmental degradation.
- Expansion of commercial feed industries, including silage and grain processing.
- Integrated national feed strategies connecting land use, livestock planning, and climate-smart agriculture.
- While crop-based TDN supply is projected to grow modestly, its pace is slow compared to rising demand, highlighting a likely feed supply gap. Key recommendations include:
- Enhancing yields of major feed crops, especially *maize* and *paddy*.
- Promoting dual-purpose crop varieties that offer both high grain yield and quality residues.
- Improving conservation and utilization of stovers, especially from *maize* and *wheat*.
- Addressing the decline in pulse-derived feed by revisiting legume promotion strategies to secure protein-rich feed sources.
- Overall, while crop residues will remain central to Nepal's livestock feed system, complementary feed strategies will be essential to meet future demand sustainably.

Recommended actions:

- Integrated feed planning aligned with rising demand, especially for dairy and aquaculture.
- Promotion of high-yield fodder crops and efficient feeding to improve feed conversion.
- Region-specific livestock development strategies targeting potential TDN deficits.
- Careful monitoring of aquaculture feed markets to ensure sustainability and avoid feed competition with terrestrial livestock.

1. Background

The livestock sector in Nepal plays a crucial role in the country's national economy, contributing significantly to the livelihoods of rural households and enhancing food security. Livestock is one of the primary sources of income, employment, and nutrition. Livestock farming supports farmers and commercial livestock owners throughout the country. The diversity of livestock species viz: cattle, buffalo, sheep, goats, pigs, poultry is persisted in the country providing essential animal products such as milk, meat, eggs, wool and also serves as a vital component of the cultural and social aspect of Nepalese society.

1. 1 Introduction

The feed and feeding constitute 60-65% of the total cost of production is governed by feed and feeding. In Nepal, in terms of livestock feed, Nepal utilizes a mixed feed resource. The primary types of feeds include green fodder, dry fodder, grains, and concentrate feeds. Besides these, agricultural by-products also comprise major feed sources of livestock in Nepal. Despite the availability of these resources, challenges such as seasonal fluctuations, land degradation, feed shortages, imbalanced nutrition, and lack of local research on livestock dietary needs impact livestock productivity and health.

Given the importance of optimizing feed resources, the development of a Livestock Feed Balance Sheet is essential for effective feed management in Nepal. Such a balance sheet would provide a comprehensive overview of the availability and utilization of different feed types, helping stakeholders identify gaps and opportunities within the feed supply chain. Furthermore, it can guide policy decisions aimed at improving feed production and ensuring sustainable livestock growth and cost effectiveness.

A study was conducted by National Animal Feed and Livestock Quality Management Laboratory in 2019 to assess the feed availability and demand in Nepal, revealing higher requirement than the supply of feed. However, the feed (TDN) balance at national level has dropped from 30.9% in the 1980's to 17.56% in 2016/17. Further regarding future feed balance, the report stated that the feed deficit is expected to reach -28% in 2021/22 and -32% in 2026/27, if additional forage intervention does not take place. The study highlighted that the country faced a shortfall in quality feed resources, necessitating urgent attention to improve livestock nutrition. Though the projections made in this study provided valuable insights, the dynamic nature of the agricultural sector, shifting market demands and changing climatic conditions, demands the need for an updated analysis is not spell out. Conducting a new feed balance sheet in the present context will enable stakeholders to adapt to these changes, ensuring that the livestock sector remains resilient and productive. In this context, National Animal Feed and Livestock Quality Management Laboratory hire N.E.P.C. Research to conduct study.

1.2 Objectives

Following are the objectives of the study:

- Assess the current availability of animal feed resources, including crop residues, by- products, pasture, forest fodders and so on.
- Estimate feed demand based on the current livestock population, production systems, and nutritional requirements.
- Identify feed deficits or surpluses at national and sub-national (province) levels.
- Provide future projections of feed supply and demand considering changes in land use, livestock population, and production trends.
- Offer recommendations for feed development strategies and policy interventions to address identified gaps.

1.3 Scope of Work

The consulting service provided high quality professional services for the preparation of livestock feed balance sheet. The scope of services carried out included following:

1.3.1 Data Collection and Review

- Review existing national and international reports on feed supply, demand, and balance, including previous feed balance studies conducted in 2018 and 2019.
- Collect updated data on livestock populations, crop production, forest and pastureland resources, feed imports, and feed industry production from relevant government agencies and other stakeholders.
- Assess the impact of natural and policy-driven changes in land use (e.g., urbanization, deforestation, and reforestation) on feed resources.

1.3.2 Estimation of Feed Supply

Estimate feed availability from various sources including:

- Green fodder and forage
- Crop residues (e.g., paddy straw, maize stalks).
- Agricultural by-products (e.g., milling by-products, oilseed cakes).
- Pastures, forests, and shrubs.
- Commercial feed production and imports.
- Other unconventional feed sources (e.g., kitchen waste, silage).

1.3.3 Estimation of Feed Demand

- Estimate the feed demand based on the nutritional requirements of different livestock species, including cattle, buffalo, sheep, goats, poultry, pigs, and fish.
- Convert livestock populations into Livestock Units (LUs) and calculate Total Digestible Nutrients (TDN) requirements for maintenance, growth, and production (e.g., milk and meat).

1.3.4 Preparation of Feed Balance Sheet

- Develop a comprehensive feed balance sheet showing the supply and demand of feed at national and provincial levels.

- Provide ecological belt-wise analysis of feed balance, highlighting feed surpluses and deficits.
- Analyze the trends and project the feed balance for the next 5 and 10 years.

1.3.5 Recommendations

- Provide actionable recommendations to address feed deficits, including strategies for improving feed availability, promoting forage production, and optimizing the use of crop residues and by-products.
- Recommend policy interventions to enhance feed self-sufficiency, promote commercial feed production, and improve feed import management.

2. Methodology

2.1 Literature Review:

The literatures, published, unpublished reports, research articles, proceedings related to animal feed and feeding in the country, neighboring countries and across the globe were collected and reviewed. The global, regional, national and sub national TDN requirement and supply was analyzed. The total number of livestock by lifecycle status, age, weight, production level, production potential level was collected and analyzed. Despite it, analyze existing research, reports, and policies on animal nutrition, feed balance, and livestock management in Nepal, south Asia and globally.

2.2 Consultation meeting with concern officials

Short consultative meeting was hold with senior officials in National Animal Feed and Livestock Quality Management Laboratory to have greater insight on the objectives and scope of the assignment. The experience obtained by the DLS officials in feed and feeding and nutritional status of livestock species at national, regional and sub national level. Also discussed on the methodology utilized by different institutions for such studies in the country and across the globe will also be discussed.

2.3 Checklist preparation

Based on the review of literatures and consultative meeting with concern authorities, checklist for first hand and secondary information collection was prepared.

Key Informants Interview (KII)- Semi structured open ended checklist was prepared to collect the first-hand information from the stakeholders with respect to livestock feed and feeding requirement, availability, source of feeding materials, feed production level/ access and availability and new feed stuffs that can be utilized to bridge the gap between the requirement and supply of the feed i.e . feed balance sheet. This checklist will also try to dig out the policy landscape, the intervention applied and the feed supply chain to fill the gap.

Focus Group Discussion (FGD)- Semi structured, open ended FGD guideline was prepared to collect the information collectively to cross check and validate the information from secondary source and from the KII.

Consultation with concern stakeholders: A broader level open ended checklist was prepared to gather the Strength, Weakness, Opportunities and Threat (SWOT) analysis in livestock feed and feeding in the country. Also try to cover the import of livestock feed, shortfall due to Community Forest policy, pasture land management and encroachment in the pasture land for other purpose use.

Secondary information collection: A close ended secondary information collection checklist will be prepared to gather the required information specifically from different reports and government publications.

2.4 Inception report production and submission

An inception report was prepared after completing the desk study, consultative meeting with concern officials and the checklist preparation. The inception report consisted of the detailed methodology, work plan, checklist and report format. The draft inception report was submitted to NAFLQML for review comments and feedback. After incorporating feedback from the NAFLQML in draft inception report, final inception report was prepared and submitted for approval.

2.5 Data collection

Upon the approval of inception report data collection process was initiated.

Key Informants Interview (KII)- Using the approved semi structured open ended checklist KII was conducted. The KII was taken from the concern officials in MoALD, DLS, NARC, NAFLQML, NDDB and others. While KII from online and telephone was taken from the officials in provincial Directorate of Livestock and Fisheries (DLF), officials in Veterinary Hospitals and Livestock Expert center (VHLEC), Cattle Feed Industry, other private feed industries, feed raw materials suppliers, silage producers and suppliers, registered farms, Central Community Forest Users Committee (CCFUC), CDCAN, livestock scholars, Local Level elects, staffs and others.

Focus Group Discussion (FGD)- Using the semi structured, open ended guideline FGD was conducted online. The participants were among others the farmers (women farmers), members from Community Forest Users Committee (CFUC), farmers, entrepreneurs and others.

Consultation with concern stakeholders: A broader level open ended checklist was prepared to gather the Strength, Weakness, Opportunities and Threat (SWOT) analysis in livestock feed and feeding in the country. Consultation was done with the major central level stakeholders i.e. MoALD, DLS, NARC, NDDB, CDCAN, CCFUC, producers, Feed suppliers, AEC and others.

Secondary information collection: Secondary information was collected from the Central Statistical Office (CSO), MoALD, DLS, NARC publication, NDDB reports, different I/NGO reports/ publication and published document globally, department of custom and others.

2.6 Situation Analysis:

The collected data from the primary and secondary sources was compiled in tables and triangulated. The number and type of livestock species, their age, stage of life cycle, production level will be disaggregated. Similarly, available feed substances, their nutritive value, feeding practices was tabled disaggregated. By this method, the total requirement, availability and access to the feed for livestock was calculated and analyze thoroughly.

2.7 Data Analysis and draft report:

The analysis was done analyzing demand and supply trend taking historical data series. The finding covered:

- Sources of Feed
- Demand of Feed
- Supply of Feed
- Gap Analysis
- Feed Balance Sheet at National, Provincial, and Ecological level.
- Feed Balance Projection

The analysis ecosystem was specially focus to:

Estimate feed availability from various sources including:

- Green fodder and forage
- Crop residues (e.g., paddy straw, maize stalks).
- Agricultural by-products (e.g., milling by-products, oilseed cakes).
- Pastures, forests, and shrubs.
- Commercial feed production and imports.
- Other unconventional feed sources (e.g., kitchen waste, silage).

Estimation of Feed Demand

- Estimate the feed demand based on the nutritional requirements of different livestock species, including cattle, buffalo, sheep, goats, poultry, pigs, and fish.
- Convert livestock populations into Livestock Units (LUs) and calculate Total Digestible Nutrients (TDN) requirements for maintenance, growth, and production (e.g., milk and meat).

Preparation of Feed Balance Sheet

- Develop a comprehensive feed balance sheet showing the supply and demand of feed at national and provincial levels.
- Provide ecological belt-wise analysis of feed balance, highlighting feed surpluses and deficits.
- Analyze the trends and project the feed balance for the next 5 and 10 years.

Recommendations

- Flourish SMART and actionable recommendations to address feed deficits, including strategies for improving feed availability, promoting forage production, and optimizing the use of crop residues and by-products.
- Recommend policy interventions to enhance feed self-sufficiency, promote commercial feed production, and improve feed import management.

2.8 Draft report production and submission

Based on the analysis draft report with above mentioned thematic area, draft report was prepared and submitted to NAFLQML for review comments and suggestion.

2.9 Validation meeting/workshop:

A central level workshop was conducted to disseminate the report and validate with key stakeholders to present preliminary findings and gather feedback. The comments and feedback were collected to improve the report.

2.10. Final report preparation and submission:

After incorporating the comments and feedback from the stakeholders, in the draft report, a comprehensive and consolidated report have been prepared with SMART and actionable recommendations for balanced feed practices in the context of livestock sector of Nepal. Recommendations are duly address and consider economic feasibility, sustainability, and ease of implementation at farmers' level that facilitate for practical feed balance improvements in the livestock sector of Nepal.

2.11 Reporting and Supervision

N.E.P.C. Research reported to the chief of National Animal Feed and Livestock Quality Management Laboratory and work closely with relevant stakeholders. Regular progress updates required throughout the project.

3.Findings of the study

Livestock feed in Nepal comprised of dry fodder, cultivated green fodder, tree leaves, pastures and grazing land, kitchen waste, crop byproducts, community forest, leasehold forest, ridges and bonds of agricultural land and grains. Concentrate feed /compound feed is also supplemented, especially to milch animals and leftover to swine. Significant quantity (95%) of the total concentrates used for livestock feeding are imported and are the most expensive component of the feed, especially protein meals/cakes. Feeds and fodders are fed haphazardly resulting high cost of production.

3.1 TDN availability by sources

3.1.1 Total crops produced

Table 3.1 elaborate on the total crop produced in Nepal. From the crop production data for the year 2022/23, it was estimated that the total area under **major cereal crops** (paddy, maize, wheat, millet, buckwheat, and barley) in Nepal was approximately **3.34 million hectares**, producing around **10.91 million metric tons (MT)** of grain. Despite a slight reduction in overall cultivated area compared to the previous year, national cereal production increased, primarily due to **gains in crop productivity**.

The analysis shows that three major cereal crops—**paddy, maize, and wheat**—together contributed over **10.56 million MT**, accounting for more than **96%** of the total cereal production. Paddy alone contributed approximately **5.49 million MT**, followed by maize (**2.98 million MT**) and wheat (**2.10 million MT**). These staple crops are the cornerstone of Nepal's food and feed system, supporting both human consumption and livestock nutrition through grain and crop residues.

Table: 3.1 Crop area and production in Nepal

Crop	Crop production and productivity					
	2021/22			2022/23		
	Crop area Ha	Production, MT	Yield (kg/ha)	Crop area Ha	Production, MT	Yield (kg/ha)
Paddy	1,477,378	5,130,625	3.47	1447789	5486472	3.79
Maize	985,565	3,106,397	3.15	940256	2976490	3.17
Wheat	716,978	2,144,568	2.99	697762	2098462	3.01

Crop	Crop production and productivity					
	2021/22			2022/23		
	Crop area Ha	Production, MT	Yield (kg/ha)	Crop area Ha	Production, MT	Yield (kg/ha)
Millet	267,071	339,462	1.27	227934	310847	1.36
Buckwheat	16,123	19,290	1.20	11857	15083	1.27
Barley	23,134	32,156	1.39	17536	25912	1.48
Subtotal	3,486,249	10,772,498		3343134	10913266	
Oil seed	260,645	287,344	1.10	244046	270482	1.11
Potato	198,256	3,410,829	17.20	203812	3487816	17.11
Sugarcane	62,567	3,159,634	50.50	62833	3130109	49.82
Jute	7,195	10,217	1.42	7220	10205	1.41
Cotton	155	172	1.11	60	65	1.08
Subtotal	528,818	6,868,196		517971	17811943	
Lentil	198,454	252,283	1.27	173011	200787	1.16
Chick pea	10,793	12,196	1.13	10408	11980	1.15
Pigeon pea	15,512	15,977	1.03	11745	12710	1.08
Black gram	28,383	26,114	0.92	26239	24754	0.94
Grass pea	10,407	12,072	1.16	5643	6404	1.13
Horse gram	12,248	14,330	1.17	6109	6097	1.00
Soybean	24,921	35,138	1.41	26842	36672	1.37
Himali bean				6560	8336	1.27
Other legumes	33,832	40,260	1.19	29700	32468	1.09
Subtotal	334,550	408,370	1.22	296257	340208	

Source: Statistical Information on Nepalese Agriculture, 2013 and 2023

The remaining cereal production came from **millet, barley, and buckwheat**, which together yielded about **352,000 MT**. Though smaller in scale, these traditional crops are critical in mid-hill and high-hill agro-ecologies, where larger cereals are less viable. They also contribute to diet diversification, climate resilience, and local feed availability.

In addition to cereals, other key crops such as **oilseeds, potatoes, sugarcane, and legumes** formed a significant part of the overall agricultural output. Oilseed production stood at **270,482 MT**, while **potato and sugarcane** contributed **3.49 million MT** and **3.13 million MT** respectively, maintaining high levels of productivity. Legume crops—such as lentil, soybean, chickpea, and others—produced a combined total of **340,208 MT** over nearly **296,000 hectares**, though both area and yield declined slightly compared to the previous year.

These findings suggest that **Nepal's agricultural production system remains strongly cereal-dominated**, with increasing emphasis on improving yields rather than expanding land. The noticeable productivity gains in paddy and wheat, and the sustained yields in maize and potatoes, demonstrate encouraging progress toward intensifying production within existing land constraints.
However, challenges persist. The declining trend in **pulse cultivation**, limited expansion in **oilseed crops**, and modest gains in **minor cereals** indicate that crop diversity is under pressure. Moreover, reliance on weather-sensitive yields and continued competition between **food and feed uses** of key crops underscore the need for balanced agricultural planning.

In conclusion, the crop production landscape in 2022/23 highlights both opportunities and vulnerabilities. **Boosting crop productivity while protecting crop diversity and promoting underutilized species** is essential for building a more resilient and feed-secure future. This will require integrated approaches involving **research, extension services, improved inputs, and market incentives** to ensure that both food and livestock systems grow sustainably and equitably across Nepal.

3.1.2 TDN Availability from crop and crop residue

From the crop and crop residue data for the year 2022/23, it was estimated that the **total supply of Total Digestible Nutrients (TDN)** from cereal grains and their residues amounted to approximately **8.12 million metric tons (MT)**. This included about **4.90 million MT** of TDN from grain and **3.22 million MT** from crop residues.

The analysis shows that **three major cereal crops—paddy, maize, and wheat—accounted for nearly 88%** of the total TDN derived from crops and residues. Paddy alone contributed approximately **3.93 million MT**, followed by maize (**2.11 million MT**) and wheat (**1.09 million MT**). These crops are the primary pillars of feed energy supply in Nepal, not only for human consumption but also for livestock production through by-products and residues.

The remaining TDN supply came from a variety of minor cereals (millet, barley, buckwheat), legumes (lentil, chickpea, soybean, etc.), and oilseeds (mustard, linseed, sesame, etc.), which together contributed roughly **0.99 million MT**. Though smaller in quantity, these sources can play a vital role in diversifying feed options and improving nutrient balance, particularly in mixed crop-livestock systems.

These findings suggest that **crop production and residue use constitute a critical foundation of Nepal's livestock feed system**, covering a significant share of the total national TDN supply. The substantial contribution of crop residues (around 40% of crop-based TDN) highlights their importance, especially for smallholder farmers who rely heavily on on-farm resources for feeding animals.
However, while the volume of crop-based TDN is considerable, **issues such as uneven regional production, competition with human food needs, post-harvest losses, and inefficient residue management practices** may limit the effective availability of these resources. Therefore, to optimize the utilization of crop-based TDN, strategic interventions are needed—such as promoting dual-purpose crop varieties, improving residue collection and storage methods, and encouraging balanced feeding practices at the farm level.

In conclusion, crop and crop residue sources represent a **key opportunity for improving national feed security**. Enhancing their management and integration into livestock systems can help address seasonal shortages, reduce feed costs, and improve overall livestock productivity in Nepal.

Table: 3.2 TDN Availability from crop and crop residue

SN	Crop	Production (Mt)	TDN from grain	TDN from crop residue
1	Paddy	5486472	2202235	1724363
2	Maize	2976490	1176011	933130
3	Wheat	2098462	948241	138059
4	Millet	310847	129312	129312
5	Buckwheat	15083	7186	5385

SN	Crop	Production (Mt)	TDN from grain	TDN from crop residue
6	Barley	25912	9035	7655
7	Sugarcane	3130109	149424	141518
8	Lentil	200787	77700	51445
9	Chick pea	11980	4465	2536
10	Pigeon pea	12710	6561	3623
11	Black gram	24754	10858	10858
12	Grass pea	6404	2542	1703
13	Horse gram	6097	2084	2084
14	Soybean	36672	31351	7019
15	Other legumes	32468	14222	14222
16	Mustard	270,482	84967	25235
17	sun flower	5,528	11713	4405
18	Linseed	11,671	10811	3838
19	Sarsayu	19,969	5992	5992
20	Rayo	9738	1785	1785
21	Sesame	8324	3739	2137
22	Groundnut	4,965	3327	3327
23	Niger	1,745	1849	1849
	Total	14707670	4895410	3221480

Source: : *Statistical Information on Nepalese Agriculture, 2023 and Livestock, Poultry and Fish Nutrition in Nepal,2078, Dr C R Upreti and S Upreti*

3.1.3 Land available for feeding stuffs

From the analysis of available feed sources in Nepal, it was found that **43.4%** of the total digestible nutrient (TDN) supply comes from **crop residues and milling by-products**, making it the largest single source of animal feed. **Forest areas** contributed **19.0%**, followed by **farm weeds and forages** at **13.1%**, and **improved forage and pasture** at **8.9%**. Additionally, **6.5%** of the total TDN was supported through **grain supplementation**, while **3.9%** came from **grassland** and **2.6%** from **kitchen waste**. **Shrub land** and **barren areas** contributed **1.8%** and **0.7%** respectively. A small portion, **0.1%**, came from **commercial silage** production.

These results show that the majority of livestock feed in Nepal is still dependent on traditional and natural sources such as crop residues, forests, and weeds. However, improved forage, though occupying relatively small land area, has proven to be a highly efficient and productive feed source. The contribution of non-land-based sources like kitchen waste, silage, and grain supplementation also highlights the emerging role of alternative and commercial feeding strategies in the evolving livestock sector.

Table 3.3 Available TDN (MT) by Source

S No	Sources of feed	Total area, ha	Available TDN, MT	Percent share
1	Forest	6399341	2144861.19	19.0
2	Shrub land	397916	206078.5065	1.8
3	Grassland	2169462	442301.6143	3.9
4	Crop residues and milling by-products	NA	4895410.223	43.4
5	Farm weeds (forages) etc.	3893872	1479671.612	13.1
6	Improved forage and pasture	97346*	1008500.263	8.9
7	Barren area	1236320	74179.31278	0.7
8	Commercial silage silage Production: 20000Mt** @70%TDN	NA	14000	0.1
9	Kitchen wastes***	NA	289997	2.6
10	Grain supplementation @5% of total TDN requirement in general ***	NA	736550	6.5
	Total TDN supply		11291549.72	100.0

Source: National Land cover monitoring system of Nepal, Ministry of Forest and Environment, Forest Research and Training Center, 2022
** KII: RC Pandey, Animal Nutrition and Pasture expert. ** Reserch paper on Analysis of Silage from large producers,2024, Dr N R Pradhan and others. .*
**** Balance Sheet of Animal Feed, IRDS, 2019*

3.2 Total TDN Requirement by livestock category

The TDN requirement is estimated by converting the livestock population by livestock type to Livestock Unit. By multiplying the LU by the required TDN total TDN requirement is calculated.

3.2.1 Total TDN Requirement by livestock type

As per data TDN requirement across livestock categories in Nepal, it was found that **cattle** account for the largest share, requiring **32.3%** of the total digestible nutrient (TDN) supply, followed by **buffaloes** at **22.6%**, and **milk production** which contributes an additional **23.9%** to the overall feed requirement. Together, these three categories represent nearly **79%** of the total TDN demand, highlighting the significant feed needs of large ruminants and dairy production systems.

Among small ruminants and non-ruminants, **goats** account for **9.1%**, **poultry** for **4.7%**, and **pigs** for **4.2%** of the total TDN requirement. Other animals like **horses** (0.7%), **sheep** (0.6%), **yak/nak** (0.3%), and **ducks** (0.2%) contribute relatively minor shares. **Fish production** requires **1.3%** of the total TDN, reflecting growing diversification in animal-source food production systems.

These results indicate that while cattle and buffaloes remain the dominant drivers of feed demand, the increasing share of poultry, goats, and pigs points to a gradual shift toward mixed livestock systems. The significant feed requirement for milk production also underlines the importance of targeted feeding strategies and quality forage development to support dairy productivity in Nepal.

Table: 3.4 Total TDN Requirement by livestock type

S No	Categories	Population	Livestock Unit	TDN required (Mt)	Percentage share of TDN (Mt)
1	Cattle	4750329	4222967	4764965	32.3
2	Buffaloes	3081062	3036056	3326343	22.6
3	Yak/Nak	53194	46260	50654	0.3
4	Sheep	501849	86148	94331	0.6
5	Goat	14541244	1226754	1343295	9.1
6	Pig	1357507	249368	614973	4.2
7	Poultry	78592241	171895	689941	4.7
8	Duck	1325999	6630	26520	0.2
9	Horse/donkey/mule	95473	95699	104790	0.7
10	Milk Production (Mt)	2613843		3518725	23.9
11	Fish Production (Mt)	113736		196462	1.3
		Total		14731000	100.0

Source: Statistical Information on Nepalese Agriculture, 2023; LU estimation by DLS; LU for internation comparision, FAO 2011; Guidelines for the preparation of Livestock Sector Review, FAO; Eurostat, 2019.

3.2.2 Total TDN Requirement by livestock type and category

From the livestock population data for 2022/23, it was found that there was a total of **4,750,329 cattle**, of which **93.3%** were **local breeds** and only **6.7%** were **improved breeds**. Among buffaloes, the total population was **3,081,062**, with **94.7% local** and **5.3%**

improved breeds. The **yak/nak population** stood at **53,194**, which are entirely local and mostly concentrated in high-hill and mountain regions.

By age group, the majority of cattle and buffaloes fall under the **productive adult category (above 3 years)**. Specifically, **3,363,090 cattle** and **1,699,482 buffaloes** were above 3 years, representing **over 70% of the total** population for both species. Animals in the **under 1 year** category accounted for **833,048 cattle** and **769,806 buffaloes**, showing strong replacement rates. The age group **1–3 years** included **554,191 cattle** and **611,774 buffaloes**, indicating a healthy pipeline for future production.

These results highlight a **continued dominance of local breeds** in Nepal's livestock system, which, while more adapted to local environments, generally have **lower productivity** than improved breeds. The relatively small proportion of improved cattle and buffaloes (only 6.7% and 5.3% respectively) suggests that genetic improvement programs still have **limited reach**. Given the large adult population, interventions aimed at improving the productivity of mature animals—especially in terms of milk and draft power—can have immediate benefits.

Table: 3.5 Number of cattle/ buffalo by breed type and age in 2022 23

Categories	Cattle			Buffaloes			Yak/Nak
	Local	Improved	Total	Local	Improved	Total	Total
Under 1 year	748416	84632	833048	734278	35528	769806	11113
1-3 years	510990	43200	554191	587015	24759	611774	6888
Above 3 years	3170670	192420	3363090	1596326	103156	1699482	35193
Total	4430077	320252	4750329	2917619	163443	3081062	53194

Source: Population Livestock (MoALD, 2023 and agewise data adjusted by CBS)

3.2.3 Total required TDN for cow by breed type and age in 2022 23

From the analysis of TDN requirements for cattle by breed type and age group in 2022/23, it was found that a total of **4,750,329 cattle** required approximately **4,785,585 metric tons (MT)** of Total Digestible Nutrients (TDN). Of this, **cattle above 3 years of age accounted for the largest share—70.8% of the total cattle population and 78.7% of the total TDN demand**, equivalent to **3,766,661 MT**. This reflects their primary role in productive functions such as milk production, draft power, and reproduction.

Cattle in the **under 1 year age group made up 17.5%** of the total population, requiring **466,507 MT** of TDN, while the **1–3 years age group, representing 11.7%**, required **552,417 MT**. This distribution indicates a steady and substantial feed demand across all age groups, highlighting the importance of adequate nutrition not only for current productivity but also for growth and herd replacement.

By breed type, **local cattle overwhelmingly dominate the population**, with **4,430,077 head (93.3%)**, compared to **320,252 improved cattle (6.7%)**. Consequently, the majority of TDN demand is attributed to local breeds. Out of the total **Livestock Units (LU) for cattle—4,272,844 units**, local breeds account for the vast majority, underscoring the low penetration of improved breeds and limited genetic enhancement in the national herd.

These findings emphasize the need for **balanced and age-specific feed planning**, particularly focusing on the nutritional needs of mature cattle who drive most of the TDN demand. At the same time, **targeted investment in the nutrition of younger cattle** is vital to ensure healthy herd replacement and sustained productivity. Improving the **feed efficiency of local breeds** or encouraging the adoption of **improved breeds** where feasible could help optimize nutrient use and reduce pressure on natural feed resources.

Table 3.6 Total required TDN for cow by breed type and age in 2022 23

Categories	Cattle			%	LU	Required TDN
	Local	Improved	Total			
Under 1 year	748416	84632	833048	17.54	416524	466507
1-3 years	510990	43200	554191	11.67	493230	552417
Above 3 years	3170670	192420	3363090	70.80	3363090	3766661
Total	4430077	320252	4750329	100.00	4272844	4785585

Source: Population of Livestock (MoALD, 2023); calculation of TDN requirements and it's contextualization, based on several sources of literatures.

3.2.4 Total required TDN for buffaloes by breed type and age in 2022 23

From the analysis of TDN requirements for buffaloes by breed type and age in 2022/23, it was found that **a total of 3,081,062 buffaloes** required approximately **3,327,517 metric tons (MT)** of **total digestible nutrients (TDN)**. Of this, the largest share of TDN—**55.2%**, equivalent to **2,235,158.7 MT**—was required by buffaloes **above 3 years**, reflecting their central role in milk production, draft use, and reproduction.

Buffaloes **under 1 year** accounted for **25.0%** of the total population and required **421,853.5 MT** of TDN, while those in the **1–3 years** age group represented **19.9%** of the population and required **670,504.6 MT** of TDN. These age distributions indicate a relatively young buffalo population structure, with nearly **45% of the herd** below 3 years of age.

By breed type, **local buffaloes dominate the population**, comprising over **94.7%** of the total herd, which mirrors trends seen in the cattle population. Out of the total **3,036,056 livestock units (LU)** calculated for buffaloes, the overwhelming majority comes from local breeds. Improved buffaloes, though small in number, contribute slightly higher feed efficiency but remain limited in coverage.

These findings underscore the importance of focusing feed management strategies on **productive adult buffaloes**, which are the largest consumers of TDN, and also **ensuring adequate nutrition for young stock** to secure future productivity. There is also room for genetic improvement and selective breeding, as the population of improved breeds remains low. Strengthening fodder availability, particularly for lactating and pregnant animals, can enhance productivity and reduce stress on natural feed sources.

Table 3.7 Total required TDN for buffaloes by breed type and age in 2022 23

Categories	Buffaloes			%	LU	Required TDN
	Local	Improved	Total			
Under 1 year	734278	35528	769806	24.99	384903	421853.5
1-3 years	587015	24759	611774	19.86	611774	670504.6
Above 3 years	1596326	103156	1699482	55.16	2039378	2235158.7
Total	2917619	163443	3081062	100.00	3036056	3327516.9

Source: Population of Livestock (MoALD, 2023); calculation of TDN requirements and it's contextualization based on several sources of literatures.

3.2.5 Total required TDN for Yak/Nak by breed type and age in 2022 23

The total digestible nutrient (TDN) requirements for **Yak/Nak** in 2022/23 was approximately **50,886 metric tons (MT)** for Chauri/yak. The **majority of feed demand (66.2%)** came from **mature animals above 3 years**, which consumed around **38,712 MT** of TDN. This reflects their importance in terms of milk, traction, and cultural significance in high mountain pastoral systems.

The **under 1 year** age group made up **20.9%** of the population and required **6,112 MT** of TDN, while those in the **1–3 years** category accounted for **12.9%** and needed **6,061 MT**. Together, young stock (under 3 years) comprised **nearly 34%** of the Yak/Nak population, indicating a **stable replacement rate** and future productive potential.

The total **livestock units (LU)** for Yak/Nak stood at **46,260**, with mature animals again contributing the most significantly. Since Yak/Nak are exclusively local and are found in limited geographic areas (mainly high-mountain regions), their numbers are relatively small compared to cattle and buffaloes, but their feed needs are still important in terms of localized resource planning.

These results show that while Yak/Nak represent a **small fraction of the national livestock population**, they have a distinct and important role in **mountain agro-pastoral systems**, requiring careful attention to **seasonal forage availability** and **mobility-based feeding practices**. Ensuring adequate nutrition, particularly for adult stock, is essential for maintaining milk yields, traction power, and herd health in remote areas.

Table 3.8 Total required TDN for Yak/Nak by breed type and age in 2022 23

Categories	Yak/Nak Total	%	LU	TDN
Under 1 year	11113	20.89	5557	6112
1-3 years	6888	12.95	5510	6061
Above 3 years	35193	66.16	35193	38712
Total	53194	100.00	46260	50886

Source: Population of Livestock (MoALD, 2023); TDN requirement calculation based on several sources of literatures and adjusted it to Nepalese context.
(Note: It is apllied for all the tables in this report where TDN is estimated.)

3.2.6 Total required TDN for Sheep by breed type and age in 2022 23

From the analysis of the sheep population and their feed requirements in 2022/23, it was found that a total of **501,849 sheep** required approximately **94,331 metric tons (MT)** of **total digestible nutrients (TDN)**. Of this, the majority of the feed demand—**71.7%** or **78,758 MT**—was from sheep aged **6 months and above**, reflecting their role in wool, meat production, and breeding.
Sheep **under 6 months** of age accounted for **28.3%** of the population and required around **15,573 MT** of TDN. The total **livestock units (LU)** calculated for sheep were **86,148**, with higher LUs concentrated in the older age group due to their greater feed requirements.

By breed, the population remains overwhelmingly **local**, with **99.5%** of sheep being native breeds and only **0.5%** improved breeds. This indicates that **genetic improvement programs for sheep remain limited**, and that traditional, locally adapted breeds continue to dominate the sector.
These results highlight the importance of targeting feed interventions toward adult sheep to support **meat and wool productivity**, while also ensuring adequate nutrition for lambs and young stock to maintain herd growth. The limited presence of improved breeds suggests potential for **enhanced breeding programs** in regions where sheep play a central role in livelihoods.

Table 3.9 Total required TDN for Sheep by breed type and age in 2022 23

Categories	Local	Improved	Total	%	Total LU	TDN
Under 6 months	140627	1590	142217	28.34	14222	15573
6 months and above	358826	806	359632	71.66	71926	78758
Total	499453	2396	501849	100.00	86148	94331

Source: Population Livestock (MoALD, 2023 and agewise data adjusted by CBS)

3.2.7 Total required TDN for Goat by breed type and age in 2022 23

From the analysis of goat population and their TDN requirements in 2022/23, it was found that a total of **14,541,244 goats** required approximately **1,343,295 metric tons (MT)** of **total digestible nutrients (TDN)**. Of this, the majority—**68.7%** or **1,094,324 MT**—was required by goats aged **6 months and above**, reflecting their contribution to **meat production and reproduction**.

Goats **under 6 months** constituted **31.3%** of the total population and required about **248,971 MT** of TDN. The corresponding **livestock units (LU)** were **1,226,754**, with a much higher concentration among older goats due to their greater body size and energy needs.

By breed type, the sector is still **dominated by local breeds**, with **97.3%** of goats being indigenous and only **2.7% improved**. This highlights a **low penetration of improved or crossbred goats**, indicating that productivity enhancements through genetic improvement are still at an early stage in many areas.

These results show that feed planning for goats should prioritize **adult and breeding stock**, which are the primary consumers of feed and the main contributors to household income through meat sales. However, **young goat nutrition is also critical** for ensuring herd sustainability. Given the large goat population and their moderate but consistent TDN demand, investments in **community-managed forage plots, improved browsing access, and targeted supplementation** could significantly boost productivity in goat-rearing regions

Table 3.10 Total required TDN for Goat by breed type and age in 2022 23

Goat	Local	Improved	Total	%	Total LU	Required TDN
Under 6 months	4403496	143921	4547417	31.27	227370.9	248971

6 months and above	9746109	247718	9993827	68.73	999382.7	1094324
Total	14149605	391639	14541244	100.00	1226754	1343295

Source: Population of small Ruminant (MoALD, 2022/23 agewise adjusted by CBS)

3.2.8 Total required TDN for pig by breed type and age in 2022 23

From the analysis of pig population and their feed requirements in 2022/23, it was found that a total of **1,357,507 pigs** required approximately **112,216 metric tons (MT)** of **total digestible nutrients (TDN)**. Interestingly, the majority of pigs—**56.5%**—were in the **under 6 months** age group, yet this group accounted for only **25.8%** (28,987 MT) of the total TDN demand, due to their smaller body weight and lower feed requirements. In contrast, pigs aged **6 months and above**, though fewer in number (**43.5%**), required the majority of TDN—**74.2%**, or about **83,229 MT**—reflecting their higher energy needs for fattening and reproduction.

The total number of **livestock units (LU)** for pigs was calculated at **249,368**, with a higher concentration in the older age group. This reflects the structure of pig production systems, which tend to keep mature pigs longer for breeding or market-ready fattening.

In terms of breed composition, **local breeds still dominate**, representing **86.7%** of the total population, while **improved breeds** make up only **13.3%**. This suggests that although improved pig breeds have entered some production systems, **their adoption remains limited**, particularly in remote or subsistence-based pig farming areas.

These results indicate that pig farming systems are still largely traditional, with limited genetic and nutritional intensification. Given the relatively low TDN requirement compared to larger livestock, pigs offer potential as a **low-input, high-output livestock species**. However, improving feed efficiency, particularly in the adult fattening stage, and promoting improved breeds could further enhance productivity. There is also a case for targeted interventions in feed formulation and waste-based feeding systems in peri-urban areas.

Table 3.11 Total required TDN for Pig by breed type and age in 2022 23

Categories	Local	Improved	Total	%	Total	Required TDN
Under 6 months	662320	104329	766649	56.47	64414.7	28986.615
6 months and above	513896	76962	590858	43.53	184953.6	83229.12
Total	1176216	181291	1357507	100.00	249368.3	112215.735

Source: Population Livestock (MoALD, 2023 and agewise data adjusted by CBS)

3.2.9 Total required TDN for Poultry and duck by type in 2022 23

From the data for 2022/23, it was found that the **total poultry and duck population** stood at **14,712,990 birds**, with a combined **livestock unit (LU)** of **48,115**, requiring approximately **192,460 metric tons (MT)** of **total digestible nutrients (TDN)**. This accounts for **1.3% of the national total TDN requirement** for all livestock.

Among poultry types, **broilers** represented the largest share, with a population of **12.7 million**, requiring **152,701 MT of TDN**, followed by **layers** with **661,938 birds**, requiring **13,239 MT of TDN**. Meanwhile, **ducks** accounted for **1.33 million birds**, with a total LU of **6,630** and a corresponding TDN requirement of **26,520 MT**.

These findings suggest that broilers remain the dominant poultry type in terms of both population and feed demand, largely driven by their fast growth rate and popularity in the meat market. Layers, although fewer in number, still contribute significantly to the feed demand due to their longer production cycles. Ducks, while less prominent compared to chickens, show a notable presence, especially in wetland and Terai regions where duck farming is more feasible.

The data reflect the **increasing role of commercial poultry and duck production** in meeting protein demand in Nepal. Their **dependence on compound feed** also underlines the need for consistent supply of feed ingredients and proper ration formulation. Ensuring feed quality, availability, and affordability will be essential to sustain growth in these sectors.

Table 3.12 Total required TDN for Poultry and Duck by type in 2022 23

Poultry type	Total	LU	Required TDN Mt
Broilers	12725053	38175	152701
layers	661938	3310	13239
Duck	1325999	6629.995	26520
Total	14712990	48115	192460

Source: Nepal statistical year book 2023, NSO and Dr D Gautam, Poultry Consultant,NFIA

3.2.10 Total required TDN for Fish in 2022 23

From the data for 2022/23, it was found that Nepal produced approximately **113,736 metric tons (MT)** of fish meat, which required an estimated **196,462 MT of total digestible nutrients (TDN)** for fish farming. This accounts for around **1.3% of the total national TDN requirement** across all livestock and aquaculture systems.

Fish farming, though relatively low in land and livestock unit requirements, demonstrates a **significant feed demand**, primarily due to the intensive nature of aquaculture practices. The high feed conversion ratio and reliance on formulated feed contribute to the substantial TDN need. The sector has been growing steadily in recent years, reflecting increasing consumer demand for animal protein and the economic viability of aquaculture for smallholders and commercial producers alike.

These figures indicate that **fish farming has become a noteworthy contributor** to the national feed requirement profile. The sustainability and expansion of aquaculture will depend on the **continued availability of affordable, high-quality feed**, and effective feed management practices.

Table 3.13 Total required TDN for Fish in 2022 23

Fish	Fish meat (Mt)	TDN mt/yr
Total	82000	196462

Source: Statistical Information on Nepalese Agriculture, 2023 (MoALD)

3.2.11 TDN requirement for Horse

From the analysis of **Total Digestible Nutrients (TDN) requirement for horses** in the year 2022/23, it is estimated that a total of **104,790 metric tons (MT)** of TDN is required to support the nutritional needs of Nepal's **95,699 livestock units (LU)** of horses.

This indicates an average requirement of approximately **1.1 MT of TDN per horse per year**, consistent with the dietary needs of equines used for transport, agricultural labor, or ceremonial purposes in various parts of the country, particularly in hilly and mountainous regions.

Conclusion:

Although horses account for a **small share** of the total national TDN demand, their role remains important in **rural mobility and livelihoods**, especially in remote areas where motorized transport is limited. The analysis highlights the need to ensure adequate feed resources, particularly during dry seasons, through improved **pasture management**, **feed conservation**, and **targeted support for equine-owning households**.

Table 3.14 TDN requirement for Horse

S No	Categories	LU	TDN required (Mt)
1	Horse	95699	104790
	Total		104790

Source: International journal of Zoology and Animal Biology, 2020, ISNN-2639..

3.2.12 TDN requirement for Milk Production

From the analysis of Total Digestible Nutrients (TDN) requirement for milk production in the year 2022/23, it is estimated that a total of 3,518,725 metric tons (MT) of TDN is required to support the production of approximately 2,613,843 metric tons of milk in Nepal.

This translates to an average of around 1.35 MT of TDN per ton of milk produced, reflecting the nutritional demand of lactating animals, primarily cows and buffaloes, across various production systems—from subsistence-level household dairying to semi-commercial farms.

Conclusion:
Milk production constitutes a major driver of national TDN demand, accounting for nearly one-fourth of the total TDN requirement in 2022/23. This underscores the central role of the dairy sector in shaping feed needs and the importance of:

- Ensuring consistent supply of high-quality fodder and concentrate feed for lactating animals,
- Promoting improved dairy genetics and feed conversion efficiency, and
- Investing in forage development and ration balancing programs to sustain and enhance milk productivity.

Meeting the nutritional needs of milk-producing animals will be critical to achieving Nepal's goals for dairy sector growth, rural income generation, and national food and nutrition security.

Table 3.14 TDN requirement for Milk Production

S No	Categories	Mt	TDN required (Mt)
1	Milk Production	2613843	3518725
	Total		3518725

Source: Statistical Information on Nepalese Agriculture, 2023 and calculation

3.2.13 TDN Balance sheet (Mt)

From the analysis of the national TDN balance sheet for the year 2022/23, it was estimated that the **total supply of Total Digestible Nutrients (TDN)** amounted to approximately **11,291,550 metric tons (MT)**. In contrast, the **total TDN demand**—driven by the feed requirements of livestock populations including cattle, buffaloes, goats, sheep, pigs, poultry, and fish—was estimated at **14,730,999.78 MT**.

This resulted in a **TDN deficit of 3,439,450 MT**, representing a **shortfall of approximately 23.35%** relative to national demand. This substantial gap between supply and requirement indicates a critical imbalance in feed availability, which may directly affect livestock productivity, health, and long-term sectoral growth.

The deficit highlights the urgent need for interventions focused on improving feed availability and efficiency. These may include:

- **Enhancing fodder production** through improved pasture management and high-yield forage crops.
- **Utilizing crop residues more effectively** with better storage and treatment techniques.
- **Promoting alternative feed resources** like agro-industrial by-products.
- **Improving feed conversion efficiency**, particularly among local breeds, and promoting improved breeds where contextually suitable.

Addressing this TDN deficit is crucial for ensuring sustainable livestock development, food security, and rural livelihoods dependent on animal agriculture.

Table: 3.15 TDN Balance sheet (Mt)

SN	TDN Supply	11291549.72
1	TDN Demand	14,730,999.78
2	Deficient	-3439450
3	%	-23.35

3.3 TDN supply by region from other sources

From the analysis of Total Digestible Nutrients (TDN) supply by region in 2022/23, it was estimated that the **total national TDN supply amounted to approximately 11.29 million metric tons (MT)**. The **Mid-hill and Terai regions contributed almost equally**, accounting for **44.9% and 44.8%** of the total supply respectively, while the **High-hill region contributed only 10.3%**, reflecting its more limited feed resource base.

Among the various sources of feed, **crop residues and milling by-products emerged as the largest contributor**, supplying **4.96 million MT of TDN**, or **44% of the total national supply**. This was followed by **farm weeds and natural forages**, which provided **1.71 million MT (15%)**, and **forest-based feed resources**, contributing **2.31 million MT (20%)**.

In terms of regional distribution:

- In the **Mid-hill region**, the highest TDN supply came from **crop residues (1.97 million MT)** and **forest resources (1.39 million MT)**.

- In the **Terai**, **crop residues again dominated**, providing **2.75 million MT**, while **improved forage and pasture**, **kitchen waste**, and **farm weeds** also played significant roles.
- The **High-hill region** had comparatively lower contributions across all sources, with forests (330,300 MT) and grasslands (163,987 MT) being the most significant contributors.

Improved forage and pasture made up only **7% of the total TDN supply**, highlighting underutilization of improved fodder technologies. **Commercial silage**, despite its high nutritive value, contributed almost insignificantly (<0.1%) to the overall supply, suggesting a lack of widespread adoption.

This regional and source-wise breakdown reveals that Nepal's livestock sector is **heavily reliant on low-quality, variable feed sources such as crop residues, forest biomass, and weeds**, with limited integration of improved forage or concentrated feed. The findings point to a clear need for:

- **Scaling up improved forage production**, especially in feed-deficit areas.
- **Investing in regional feed development strategies** tailored to the specific agro-ecological conditions.

Enhancing feed conservation and utilization efficiency, particularly in the Terai and Mid-hill, to ensure year-round availability.

Strengthening feed supply systems—through better management of natural resources and wider adoption of improved forages—will be critical to reducing the TDN deficit and ensuring sustainable livestock productivity across the regions.

Table: 3.16 TDN supply by region from other sources

S No	Sources of feed	High hill		Mid hill		Terai		Total	Total
		Available TDN, MT	% of total TDN supply	Available TDN, MT	% of total TDN supply	Available TDN, MT	% of total TDN supply		% of total TDN supply
1	Forest	330300	2.9	1394224	12.3	586799	5.2	2311323.8	20
2	Shrub land	72108	0.6	101398	0.9	20234	0.2	193740.4	2
3	Grassland	163987	1.5	45629	0.4	75879	0.7	285495.5	3
4	Crop residues and milling by-products	245399	2.2	1972193	17.5	2746828	24.3	4964420.2	44
5	Farm weeds (forages) etc.	161661	1.4	821325	7.3	723382	6.4	1706367.7	15

S No	Sources of feed	High hill		Mid hill		Terai		Total	Total
		Available TDN, MT	% of total TDN supply	Available TDN, MT	% of total TDN supply	Available TDN, MT	% of total TDN supply		% of total TDN supply
6	Improved forage and pasture	34891	0.3	283915	2.5	460334	4.1	779139.5	7
7	Barren area	69782	0.6	30419	0.3	5059	0.0	105259.8	1
8	Commercial silage silage Production: 20000Mt @70%TDN	0	0.0	0	0.0	5059	0.0	5058.6	0
9	Kitchen wastes	32565	0.3	192656	1.7	207403	1.8	432624.4	4
10	Grain supplementation @5% of total TDN requirement in general	52336	0.5	228146	2.0	227638	2.0	508119.7	5
	Total TDN supply	1163030	10.3	5069906	44.9	5058614	44.8	11291549.7	100

Source: National Land cover monitoring system of Nepal, Ministry of Forest and Environment, Forest Research and Training Center, 2022, and estimation

3.4 Demand of TDN by geographical region

3.4.1 TDN demand by geographical region for milking animal, milk production

From the livestock data for the year 2022/23, it was estimated that the total requirement of Total Digestible Nutrients (TDN) for large ruminants—**cattle, buffalo, and yak**—amounted to approximately **8.10 million metric tons (MT)**. This comprised around **4.76 million MT** of TDN required for cattle, **3.33 million MT** for buffaloes, and **about 50,654 MT** for yaks, which are primarily found in the high hills.

The analysis shows that cattle alone accounted for **around 59%** of the total TDN requirement for large ruminants, followed by buffaloes at **41%**, while yak contributed a very small share (<1%). The **Mid Hills and Terai** together made up more than **75%** of this total feed demand, with the Mid Hills contributing the largest share for both cattle and buffaloes. This regional concentration reflects the distribution of Nepal's livestock systems, where mixed crop-livestock farming and semi-commercial dairying are dominant in the lower elevations, while extensive grazing is more common in the hills.

Buffaloes, although fewer in number than cattle, showed a relatively higher TDN requirement per head, indicating their heavier body weight and higher nutritional needs, particularly for milk production. Yaks, despite their limited population and geographic range, play a vital role in sustaining high-altitude pastoral systems, particularly for transport and milk in the high hills.

These findings suggest that large ruminants are the **largest drivers of feed demand** in Nepal, consuming nearly **70% of the total national TDN requirement**. This places immense pressure on both cultivated fodder and natural grazing resources, especially during dry seasons and in fodder-deficit regions.

However, meeting the TDN needs of large ruminants is challenged by factors such as low availability of quality forage, limited adoption of improved feed practices, and seasonal imbalances in feed supply. Therefore, to improve feed efficiency and support livestock productivity, the following interventions are essential:

- Promoting **forage cultivation and conservation practices**, especially in the Mid Hills and Terai,
- **Improving feed conversion efficiency** through better livestock genetics and ration balancing,
- Expanding access to **community-managed pasturelands** and improving grazing management in hill regions,
- Encouraging the use of **agricultural by-products** and crop residues as alternative feed sources.

In conclusion, the TDN requirements of Nepal's large ruminant population represent a critical consideration for feed planning and livestock sector development. Addressing their nutritional demands effectively will be key to enhancing dairy and meat production, increasing rural incomes, and strengthening the resilience of Nepal's mixed farming systems.

Table: 3.17 TDN demand by geographical region for milking animal, milk production

Cattle	Total	<1yr		1-3 yr		>3yr		Total LU	Total TDN
Regions		population	LU	population	LU	population	LU		
High hills	992390.3	174031.9	87015.96	115775.9	92620.72	702582.5	702582.5	882219.1	995447.9
Mid hills	1962849	344217.7	172108.9	228993.1	183194.5	1389638	1389638	1744941	1968896
Terai	1795090	314798.5	157399.3	209421.8	167537.5	1270870	1270870	1595807	1800621
Total	4750329	833048.2	416524.1	554190.9	443352.7	3363090	3363090	4222967	4764965
Buffalo									
High hills	370180.9	92489.98	46244.99	73502.96	73502.96	204188	245025.6	364773.5	399650.7
Mid hills	1312572	327947.1	163973.5	260623.7	260623.7	724001.1	868801.3	1293399	1417065

Cattle	Total	<1yr		1-3 yr		>3yr		Total LU	Total TDN
Terai	1398309	349368.6	174684.3	277647.6	277647.6	771292.8	925551.4	1377883	1509627
Total	3081062	769805.6	384902.8	611774.3	611774.3	1699482	2039378	3036055	3326343
Yak									
High hills	53194	11113	5556.5	6888	5510.4	35193	35193	35193	50654
Total	53194	11113	5556.5	6888	5510.4	35193	35193	35193	38536.11
Milk									
High hills	214802.8								214802.8
Mid hills	1726023								1726023
Terai	1577900								1577900
Total	3518725								3518725
Total	11403310.5	1613967	806983.4	1172853	1060637	5097765	5437662	7294215	11660687

Source: Nepal statistical year book 2023, and estimation

3.4.2 TDN demand by geographical region for small ruminants

From the livestock data for the year 2022/23, it was estimated that the total requirement of Total Digestible Nutrients (TDN) for small ruminants—**sheep and goats**—amounted to approximately **1.44 million metric tons (MT)**. This comprised around **1.34 million MT of TDN for goats** and approximately **94,331 MT for sheep**, reflecting the species composition and population size of Nepal's small ruminant sector.

The analysis shows that **goats alone accounted for over 93% of the total TDN requirement for small ruminants**, while sheep contributed less than 7%. Regionally, the **Mid Hills** emerged as the dominant zone for goat rearing, responsible for over **42%** of goat-related TDN demand, followed by the **Terai (40%)** and the **High Hills (17%)**. In contrast, **sheep were most concentrated in the High Hills**, where traditional herding systems remain prevalent and accounted for more than half of sheep-related TDN demand.

This distribution reflects the agro-ecological preferences of these species—**goats thriving across all elevations** and production systems due to their adaptability, and **sheep favoring cooler, high-altitude pastures** for seasonal grazing and wool production.

Although smaller in stature, goats have a higher cumulative feed demand due to their large population—over 14.5 million head nationally. Sheep, with a population of just over 0.5 million, contribute modestly to overall feed requirements but are regionally significant, especially in highland subsistence systems.

These findings suggest that small ruminants are a **significant and growing contributor to national feed demand**, accounting for more than **12% of total TDN requirement** across livestock species. Their rising numbers, particularly goats, imply increasing pressure on communal grazing lands, crop residues, and household-level feed resources.

However, the feed supply for small ruminants remains vulnerable to seasonal scarcity, overgrazing, and lack of improved feeding practices. To address these challenges and enhance small ruminant productivity, the following measures are essential:

- **Promoting fodder trees, legumes, and silvo-pastoral systems**, especially in hill and mountain regions,
- **Improving grazing management** and restoring degraded rangelands through community involvement,
- **Encouraging use of crop residues and non-conventional feed resources** to reduce pressure on natural pastures,
- **Expanding extension support for smallholder goat and sheep farmers**, including feeding, health, and breeding advice.

In conclusion, the TDN requirements of Nepal's small ruminant population—particularly goats—represent a vital dimension of the country's livestock feed planning. Strengthening feed resource management for these animals will be key to improving rural livelihoods, ensuring sustainable land use, and enhancing the resilience of Nepal's diversified livestock systems.

Table: 3.18 TDN demand by geographical region for small ruminants

Sheep		<6 monts		> 6 months		Total LU	Total TDN
Regions	Total	population	Popn LU	population	Popn LU		
High hills	255639.634	72444.7	7244.47	183194.9	36638.99	43883.46	48052
Mid hills	168630.6704	47787.58	4778.758	120843.1	24168.62	28947.38	31697
Terai	77578.59721	21984.69	2198.469	55593.91	11118.78	13317.25	14582
Total	501848.9015	142217	14221.7	359631.9	71926.39	86148.08	94331
Goat							
High hills	2501678.74	782338.6	39116.93	1719340	171934	211050.9	231100.7
Mid hills	6206691.343	1940990	97049.52	4265701	426570.1	523619.6	573363.3
Terai	5832874.408	1824088	91204.41	4008786	400878.6	492083	538830.7
Total	14541244.49	4547417	227370.9	9993827	999382.7	1226754	1343295
Sub Total	15043093.39	4689634	241592.6	10353459	1071309	1312902	1437625

Source: Nepal statistical year book 2023, and estimation

3.4.3 TDN demand by geographical region for non-ruminants

From the livestock data for the year 2022/23, it was estimated that the total requirement of **Total Digestible Nutrients (TDN) for non-ruminants—pigs, poultry, and ducks—amounted to approximately 1.33 million metric tons (MT)**. This comprised around **614,974 MT of TDN for pigs**, **689,941 MT for poultry**, and approximately **26,520 MT for ducks**, reflecting both population scale and species-specific feed needs in Nepal's rapidly expanding non-ruminant livestock sector.

The analysis shows that **poultry alone accounted for 52% of the total TDN requirement** for non-ruminants, followed by **pigs at 46%**, with **ducks contributing around 2%**. Regionally, the **Terai** emerged as the dominant zone, accounting for over **54% of the total TDN demand** in this group. It was followed by the **Mid Hills (36%)** and the **High Hills (10%)**. Terai's lead position reflects the concentration of commercial poultry and pig farms as well as integrated rice-duck farming systems.

Poultry, with an estimated population exceeding **78 million birds**, had the highest overall TDN demand due to its commercial scale, fast turnover, and intensive feed-based production. Pigs, though fewer in number, contributed significantly due to their larger body weight and relatively high nutrient requirements. Ducks, while modest in population, are especially important in certain pockets of the Terai where they are raised in wetland agroecosystems.

This regional and species-level distribution highlights the growing shift toward **commercial, feed-intensive systems** in Nepal, especially for pigs and poultry. The **Mid Hills and Terai** zones, in particular, are evolving as non-ruminant production hubs, driven by growing urban demand for meat and eggs and supported by better road access and market connectivity.

These findings suggest that non-ruminants are now **key contributors to national feed demand**, together accounting for over **11% of total TDN requirements** across all livestock species. Their intensification presents opportunities for income generation and food supply, but also raises concerns regarding feed cost volatility, competition for grains, and environmental management of concentrated production units.

To support sustainable growth of non-ruminant sectors and meet their feed demands efficiently, the following strategic measures are recommended:

- **Strengthening local production of feed ingredients**, such as maize and soybean, to reduce dependency on imports and lower production costs,

- **Promoting balanced ration formulation and efficient feed conversion practices**, especially among small-scale poultry and pig producers,
- **Encouraging integrated livestock-agriculture models**, such as rice-duck and poultry-fish systems, to optimize nutrient flows and reduce waste,
- **Expanding extension support and veterinary outreach** for non-ruminant farmers, with a focus on feed management, health, and biosecurity.

In conclusion, the rising TDN requirements of Nepal's non-ruminant population—particularly poultry and pigs—signal a dynamic shift in the country's livestock landscape. Ensuring efficient and sustainable feed strategies for these species will be critical to enhancing productivity, reducing rural-urban nutritional gaps, and building a resilient and inclusive livestock sector.

Table: 3.19 TDN (MT)demand by geographical region for non-ruminants

Pig		<6 months		> 6 months			
Regions	Total	population	Popn LU	population	Popn LU	Total LU	Total TDN0
High hills	133348.4256	75308.22	6327.48	58040.2	18168.06	24495.54	60409.05
Mid hills	509132.7641	287531.6	24158.72	221601.2	69366.82	93525.54	230645.6
Terai	715026.2665	403809.5	33928.52	311216.8	97418.78	131347.3	323918.8
Total	1357507.456	766649.3	64414.72	590858.2	184953.7	249368.4	614973.5
poultry							
High hills	1634038.79					3573.929	14344.81
Mid hills	29163380.05					63785.42	256017.9
Terai	47794822.16					104535.6	419578.6
Total	78592241					171895	689941.3
Duck							
High hills	35243.93651					176.2197	704.8787
Mid hills	149563.9205					747.8196	2991.278
Terai	1141190.722					5705.954	22823.81
Total	1325998.579					6629.993	26519.97
Sub Total	81275747.04	766649.3	64414.72	590858.2	184953.7	427893.4	1331435

Source: Statistical Information on Nepalese Agriculture, 2023, and calculation

3.4.4 TDN (MT) demand by geographical region for horse and fish

From the livestock and aquaculture data for the year 2022/23, it was estimated that the **total requirement of Total Digestible Nutrients (TDN) for horses and fish** amounted to approximately **301,252 metric tons (MT)**. This comprised around **104,790 MT of TDN**

for horses and **196,462 MT for fish**, reflecting both the population distribution and the ecological roles of these species within Nepal's livestock and aquatic production systems.

The analysis shows that **fish accounted for about 65%** of the combined TDN requirement, while **horses contributed the remaining 35%**. Regionally, the **Terai dominated fish-related TDN demand**, contributing **over 98%** of the national total, due to the high concentration of commercial aquaculture. In contrast, **horse-related TDN demand was concentrated in the High Hills (49%) and Mid Hills (45%)**, areas where equines continue to serve as essential transport animals in difficult terrain.

Fish, with an estimated population of **over 196,000 metric tons**, required the largest TDN share due to the expansion of intensive aquaculture practices in lowland regions. The high demand in the Terai reflects favorable climatic conditions, availability of water resources, and growing consumer demand for fish protein. Horses, while limited in population (about 95,000 animals), have substantial individual feed needs and are culturally and economically significant in hill and mountain regions.

This spatial and species-level distribution underlines the **divergent but important roles** of these species—fish in **nutritional security and market integration**, and horses in **transport, cultural value, and rural livelihood support**, especially in remote areas.
Together, horses and fish contributed **just under 3% of Nepal's total TDN requirement** in 2022/23. However, their feed demands are **geographically concentrated and strategically important**. The increasing emphasis on aquaculture in the Terai is expected to push fish-related TDN demand higher in the coming years, while the continued reliance on equines in the High Hills may sustain horse feed needs.

To support these sectors, the following strategic actions are recommended:

- **Enhancing local feed formulation and supply chains**, including low-cost, high-protein aquafeeds and regionally adapted forage for equines,
- **Promoting integrated farming systems**, such as rice-fish and agro-forestry-based equine feed production, to improve nutrient recycling and resource use efficiency, **Strengthening veterinary and extension services** for horse keepers and fish farmers, with a focus on feed, health, and sustainable management,
- **Investing in water management, infrastructure, and breed improvement programs** to support aquaculture expansion and equine productivity in their respective zones.

In conclusion, while horses and fish contribute a smaller share to overall national TDN demand, their importance is magnified by **their regional roles and strategic value**. Ensuring adequate and sustainable feed support for these species will be crucial to **livelihood resilience, food system diversification, and balanced rural development** in Nepal.

Table: 3.20 TDN (MT) demand by geographical region for horse and fish

Horse	Total Population							Total LU	Total TDN
Regions									
High hills	46453.47463							46563.44	50986.77
Mid hills	42756.94529							42858.16	46929.5
Terai	6262.580077							6277.405	6873.731
Total	95473							95699	104790
Fish									
High hills	92.47635712								92.47636
Mid hills	4247.881361								4247.881
Terai	192121.6423								192121.6
Total	196462								196462
Sub Total	291935	0	0	0	0	0	0	95699	301252
Grand Total	108014085.9	7070250	1112991	12117171	2316900	5097765	5616187	9130709	14731000

3.4.5 Summary of TDN requirement by animal species by ecological region

From the livestock data for the year 2022/23, it was estimated that the total requirement of Total Digestible Nutrients (TDN) for **cattle and buffalo** amounted to approximately **8,090,308 metric tons (MT)**. This comprised around **4,764,965 MT** of TDN for cattle and **3,326,343 MT** for buffalo, reflecting the central role of large ruminants in Nepal's mixed farming and dairy production systems.

The analysis shows that **cattle accounted for about 59%** of the combined TDN requirement, while **buffalo contributed the remaining 41%**. Regionally, the **Mid Hills** led in cattle-related TDN demand with **1.97 million MT**, followed closely by the **Terai** with **1.80 million MT**, and the **High Hills** with just under **1.00 million MT**. For buffalo, the **Terai** slightly exceeded the **Mid Hills** in total TDN demand (1.51 vs 1.42 million MT), with the **High Hills** contributing about **12%** of the national buffalo feed requirement.

Buffaloes tend to be kept in lowland and mid-hill areas, where dairying is more commercialized and infrastructure for milk collection is available. Meanwhile, cattle are more widely distributed across all ecological zones, especially in areas with access to natural grazing and crop residues.

This spatial and species-level distribution emphasizes the vital importance of cattle and buffalo in **dairy production, manure supply, and draft power** in Nepal. Their high TDN demand corresponds with both their body size and productive roles—particularly **milk**

production, which alone required an additional **3.52 million MT** of TDN nationally, mostly attributed to these two species.

Together, **cattle and buffalo contributed about 55%** of Nepal's total TDN requirement in 2022/23. Their feed demands are not only **quantitatively significant** but also **strategically central** to rural livelihoods, market supply chains, and the national food system.
To sustain and improve productivity in these key livestock sectors, the following strategic actions are recommended:

- Strengthening forage development, including high-yielding grasses, legumes, and community pasture management to reduce reliance on crop residues,
- Expanding silage and hay-making technologies, especially for dry season feeding in the hills and peri-urban dairy zones,
  Improving ration balancing and feed efficiency, with extension support to optimize nutrient use and reduce costs,
- Enhancing dairy value chains and animal health services, including breed improvement and disease control, to improve returns on feed investment.

In conclusion, while cattle and buffalo together form the **backbone of Nepal's livestock economy**, their substantial TDN demands highlight the need for **robust, locally adapted, and sustainable feed strategies**. Supporting these large ruminants with improved nutrition and management is critical for achieving food security, climate resilience, and rural development goals.

Table: 3.21 Summary of TDN Demand by Species and ecological Region (2022/23, in Metric Tons) by animal species and production

Species	High Hills	Mid Hills	Terai	Total
Cattle	995,448	1,968,896	1,800,621	4,764,965
Buffalo	399,651	1,417,065	1,509,627	3,326,343
Sheep	48,052	31,697	14,582	94,331
Goat	231,101	573,363	538,831	1,343,295
Pig	60,409	230,646	323,919	614,973
Poultry	14,345	256,018	419,579	689,941
Duck	705	2,991	22,824	26,520
Yak	38,536	0	0	38,536
Horse	50,987	46,930	6,874	104,790
Milk	214,803	1,726,023	1,577,900	3,518,725

Species	High Hills	Mid Hills	Terai	Total
Fish	92	4,248	192,122	196,462
Total	2,054,128	6,257,877	6,406,879	14,718,881

Source: Statistical Information on Nepalese Agriculture, 2023, and calculation

3.5 TDN supply by Province

3.5.1 TDN supply from other source by Province

From the feed supply data for the year 2022/23, it was estimated that the **total availability of Total Digestible Nutrients (TDN)** in Nepal amounted to approximately **11.29 million metric tons (MT)**. This supply came from diverse sources, with the largest share derived from **crop residues and milling by-products (4.96 million MT or 44%)**, followed by **forest-based feeds (2.31 million MT or 20.5%)**, and **farm weeds and forages (1.71 million MT or 15.1%)**.

The analysis shows that **crop residues alone contributed nearly half of the national TDN supply**, underscoring their central role in livestock feeding systems, particularly in mixed and subsistence farming households. Forests, although under ecological pressure, remain a major traditional source of fodder, especially in hill regions. Farm weeds, natural forages, and fallow vegetation continue to support grazing-based systems, particularly in mid-hill and peri-urban areas.

Among the provinces, **Koshi and Madhesh provinces emerged as leading contributors** of TDN from crop residues—each exceeding 1 million MT—due to their high cereal production. Bagmati Province showed the highest share of improved forage and pasture (198,417 MT), reflecting greater investment in commercial dairy development and feed innovation. Karnali Province, by contrast, had the highest TDN derived from grasslands and shrublands, indicating its reliance on extensive grazing systems and limited access to improved forage technologies.

Use of **commercial silage and kitchen waste** remains marginal nationally, accounting for less than 5% of the total supply. However, their inclusion—particularly in Bagmati and Madhesh—suggests emerging feed diversification in areas with more intensive livestock production and better waste management infrastructure. **Grain supplementation**, estimated at 508,120 MT, provided about 4.5% of the total TDN supply, likely used more in high-producing animals and commercial systems.
This spatial and source-level distribution of feed supply reflects both **agro-ecological conditions** and **market access**. Provinces like Bagmati and Lumbini, with peri-urban dairy systems and relatively higher infrastructure access, rely more on improved forage and grain-based supplementation. In contrast, Karnali and Sudurpaschim depend more on

natural vegetation, barren lands, and traditional sources, reflecting more subsistence-oriented livestock systems.

Overall, the feed system in Nepal remains **heavily reliant on low-quality, bulky feed resources** such as crop residues and forest fodder, with limited contribution from improved or high-density feed sources. While this provides resilience and low-cost inputs, it also poses nutritional limitations, especially for high-yielding or productive animals.

To sustainably enhance feed availability and quality across provinces, the following strategic interventions are recommended:

- **Promote improved forages and pasture systems**, especially in hill and mountain provinces, through seed distribution, training, and pasture rehabilitation.
- **Reduce pressure on forests** by encouraging fodder plantations on private and community land, and promoting cut-and-carry systems.
- **Expand silage and hay-making technologies**, particularly in dairy hubs and areas with surplus seasonal fodder production.
- **Enhance feed processing and conservation techniques**, including densification of crop residues, urea treatment, and local feed block production.
- **Develop province-specific feed balance plans**, linking supply sources with livestock demographics and feed demand hotspots.

In conclusion, while Nepal has a sizeable natural base for livestock feeding, the TDN supply system is uneven, and future livestock productivity will depend on a **more diversified, balanced, and regionally adapted feed strategy**. Investing in improved forages, efficient use of residues, and knowledge transfer will be key to building a resilient and productive livestock sector.

Table: 3.22 TDN (MT) supply from other sources by province

Province/ Region	Forest	Shrub land	Grassland	Crop residues and milling by-products	Farm weeds (forages) etc.	Improved forage and pasture	Barren area	Commercial silage	Kitchen wastes	Grain supplementation	Total TDN Supply
Nepal	2,311,324	193,740	285,496	4,964,420	1,706,368	779,140	105,260	5,059	432,624	508,120	11,291,550
Koshi	420,264	35,065	23,512	1,002,379	324,189	150,601	14,966	0	80,399	96,461	—
Madhesh	112,500	6,267	28,020	1,015,202	257,722	152,819	990	1,518	78,326	77,879	—
Bagmati	409,015	12,021	17,722	651,045	231,393	198,417	11,153	3,541	92,975	76,321	—

Province/ Region	Forest	Shrub land	Grassla nd	Crop residues and milling by-products	Farm weeds (forages) etc.	Improved forage and pasture	Barren area	Comm ercial silage	Kitchen wastes	Grain supplem entation	Total TDN Supply
Gandaki	271,559	43,237	56,942	517,945	175,183	123,953	22,350	0	42,921	60,055	—
Lumbini	391,652	19,627	31,574	977,948	339,660	84,391	4,819	0	70,031	90,276	—
Karnali	311,499	48,825	99,512	270,423	172,189	32,534	36,689	0	27,558	47,000	—
Suduepas chim	394,835	28,699	28,213	529,479	206,031	36,425	14,292	0	40,414	60,131	—
% of total TDN supply	20.47%	1.72%	2.53%	43.97%	15.11%	6.90%	0.93%	0.04%	3.83%	4.50%	100%

3.5.2 TDN supply from concentrate feed by ecological region and Province (MT)

From the feed area data across ecological belts and provinces, it was estimated that a total of 862,500 hectares of land were under forage or feed production during the reporting year. This included contributions from both the mid-hills and Terai regions, while the high hills reported no designated area for feed cultivation. The Terai alone accounted for 435,357 hectares (50.5%), followed closely by the mid-hills with 427,143 hectares (49.5%).

The analysis shows a highly uneven distribution across provinces. **Bagmati Province** dominated the national feed area, contributing **640,714 hectares or 74.3%** of the total, spread across both mid-hill and Terai zones. This suggests significant investment in improved forages and pastureland, likely driven by the presence of peri-urban dairy systems and relatively advanced livestock management practices.

Lumbini Province followed with **82,143 hectares (9.5%)**, all situated in the Terai, reflecting its agro-ecological suitability and integration into commercial crop-livestock systems. Similarly, **Koshi** and **Madhesh** Provinces accounted for **65,714 hectares (7.6%)** and **57,500 hectares (6.7%)**, respectively, both entirely from Terai regions. These figures are consistent with their role as key cereal production zones and their reliance on crop residues and forages from lowland areas.
In contrast, **Gandaki Province** contributed only **16,429 hectares (1.9%)**, entirely from the mid-hills, highlighting limited forage expansion in more mountainous terrain. **Karnali** and **Sudurpaschim Provinces** reported **no designated area** for feed or forage production, which raises concerns about feed insecurity and continued dependence on natural vegetation or forest grazing in these regions.

This spatial disparity underscores a critical challenge in feed system development—**provinces with greater commercial orientation and market access (like Bagmati, Lumbini, and Koshi) are progressing in forage development, while others lag behind**, possibly due to terrain constraints, infrastructure gaps, or limited policy focus.

To address these imbalances and improve feed security across Nepal, the following actions are recommended:

- **Promote forage development in underrepresented provinces**, especially Karnali and Sudurpaschim, through targeted investments in climate-resilient pasture species and extension support.
- **Scale up mid-hill pasture development**, especially in Gandaki, to reduce overreliance on forest fodder.
- **Integrate feed area planning with provincial livestock roadmaps**, ensuring that high livestock density areas are matched with adequate forage land.
- **Encourage intercropping and fallow land utilization for forage production** in Terai and hill regions to enhance land productivity.
- **Support landless and marginal farmers through community-managed forage plots or subsidized access to conserved fodder.**

In conclusion, while the total designated forage area in Nepal appears substantial, its **concentration in a few provinces and zones limits equitable livestock productivity gains**. Bridging these spatial gaps through localized interventions, technology dissemination, and better resource planning will be essential for a more inclusive and resilient livestock feeding system.

Table: 3.23 Total Digestive Nutrient from concentrated feeds (Mt)

Provinces	High hills	Mid hills	Terai	Total	Percent share
Province Koshi	0		65714	65714	**7.6**
Province Madhesh	0		57500	57500	**6.7**
Province Bagmati	0	410714	230000	640714	**74.3**
Province Gandaki	0	16429	0	16429	**1.9**
Province Lumbini	0	0	82143	82143	**9.5**
Province Karnali	0	0	0	0	**0.0**
Province S. Paschim	0	0	0	0	**0.0**
Total	0	427143	435357	**862500**	**100.0**

3.6 TDN demand by Province

From the provincial livestock and production data for the year 2022/23, it was estimated that the **total requirement of Total Digestible Nutrients (TDN)** across Nepal amounted to approximately **14.73 million metric tons (MT)**. This includes the feed demands from cattle, buffalo, yak, small ruminants (sheep and goat), pigs, poultry, ducks, horses, and productive activities such as milk and fish production.

The analysis shows that **cattle and buffalo** together made up the largest portion of the total TDN requirement—**about 8.09 million MT**, or **55%** of the national total—reaffirming their central role in Nepal's mixed crop-livestock systems and dairy-based rural livelihoods. Cattle alone required around **4.76 million MT**, while buffalo contributed **3.33 million MT**.

At the regional level, **Koshi Province** led with the **highest overall TDN requirement**, totaling **3.25 million MT**, which represented **22%** of the national demand. This was driven by a combination of high livestock populations (especially goats and pigs), strong milk production, and a sizeable poultry sector. **Bagmati** and **Lumbini Provinces** followed, each accounting for **16%** of total TDN needs. Bagmati's demand was heavily influenced by its large poultry population and pig farming systems, whereas Lumbini had significant contributions from buffalo, goats, and dairy.
Madhesh Province, despite having fewer pigs and sheep, registered **14%** of the national demand due to its high buffalo numbers and strong milk sector. **Sudurpashchim** contributed **13%**, showing balanced feed demand across cattle, buffalo, goats, and milk production. **Gandaki** and **Karnali**, though with fewer total animals, contributed **10%** and **9%** respectively, still highlighting the widespread nature of mixed livestock rearing in all regions.

Among other species, **goats accounted for about 1.34 million MT**, and **pigs for 0.61 million MT**, indicating their growing importance in household-level food security and income. Poultry, while very large in number (nearly 79 million birds nationwide), contributed **only 0.69 million MT** of TDN demand due to their lower per-head feed requirement.

Notably, **milk production alone accounted for 3.52 million MT** of TDN demand, underscoring the close interlinkage between feed inputs and the outputs of Nepal's dairy economy. This was especially visible in Koshi, Lumbini, and Bagmati—regions with commercial dairy belts and established market linkages.

In contrast, **fish production**, still in a developmental stage, required only **0.20 million MT** of TDN, though this demand is expected to grow in future with rising aquaculture investments.

This spatial and species-wise distribution clearly shows that **large ruminants (cattle and buffalo)** dominate the national feed economy, not only due to their size but also their multifunctional roles—providing milk, draft power, and manure. Meanwhile, smaller species and poultry are increasingly important in diversified farming systems and income portfolios of rural households.

Key Recommendations:
To sustainably meet the rising TDN demand across all provinces and livestock types, the following strategies are recommended:

- **Enhance forage and fodder development**, especially region-specific grasses, legumes, and silvipastoral systems in high-demand zones like Koshi, Bagmati, and Lumbini.
- **Invest in improved feeding technologies**, such as **hay, silage**, and **nutrient blocks**, particularly in mid-hills and peri-urban dairy clusters to address dry season shortages.
- **Promote ration balancing and feed efficiency**, especially for poultry and pig producers, through targeted extension services and feed formulation training.
- **Strengthen livestock value chains**, including improved access to veterinary care, breed upgrades, and milk collection networks to increase returns on feed investments.

Conclusion:

Nepal's livestock sector in 2022/23 showed a complex yet coordinated demand for feed across provinces and species. **Cattle and buffalo remain the backbone** of this system, driving the majority of TDN requirements due to their productive functions. However, **goats, poultry, pigs, and dairy outputs** are gaining ground in shaping regional feed patterns and economic returns. The future of Nepal's livestock productivity and resilience will depend heavily on **locally adapted, cost-effective, and sustainable feed and fodder strategies** that align with the evolving nature of rural livelihoods and market systems.

Table: 3.22 TDN Demand and Population by Province and Species

Province		Cattle	Buffalo	Yak	Sheep	Goat	Pig	Poultry	Duck	Horse	Milk Prod.	Fish Prod.	Total TDN	% Share
Koshi	Head	1338729	376833	–	39071	3285175	780711	11619076	314362	–	510030	13730	3249314	22%
	TDN	1342853	406832	12102	7344	303479	353675	102001	6287	4428	686596	23716		
Madesh	Head	411546	564438	–	9318	1451585	22383	7548787	279770	0	475870	65949	1994565	14%
	TDN	412814	609373	0	1752	134095	10140	66269	5595	0	640611	113916		
Bagmati	Head	609639	468902	–	24443	2935773	125583	36612261	176281	–	436823	7212	2387591	16%
	TDN	611517	506231	10242	4594	271202	56891	321410	3526	1476	588045	12457		
Gandaki	Head	255191	480264	–	62521	1626961	133644	9159288	102943	–	307442	1950	1512888	10%
	TDN	255978	518498	10210	11752	150296	60543	80407	2059	5904	413874	3368		

Province		Cattle	Buffalo	Yak	Sheep	Goat	Pig	Poultry	Duck	Horse	Milk Prod.	Fish Prod.	Total TDN	% Share
Lumbini	Head	539624	696443	–	82562	2407153	192901	8488460	376428	–	495201	21989	2409555	16%
	TDN	541287	51887	14	15519	222369	87388	74518	7529	4428	666634	37983		
Karnali	Head	678061	175023	–	203850	1390614	15893	2136940	25828	–	118779	113	1321450	9%
	TDN	680150	188957	16342	38317	128463	7200	18760	517	82651	159899	196		
Sudurp Aschim	Head	917540	319158	–	80084	1443982	86392	3027428	50388	–	269699	2793	1855638	
	TDN	920367	344566	1743	15053	133393	39137	26577	1008	5904	363065	4825		13%
Total	Head	4750329	3081062	53194	501849	14541244	1357507	78592241	1325999	95473	2613843	113736	14731000	100%
	TDN	4764965	3326343	50654	94331	1343295	614973	689941	26520	104790	3518725	196462		

3.7 Time Series data of livestock population for last 10 years

From the time series data on livestock for the year **2022/23**, the total livestock population was estimated to be slightly above **105 million head**, reflecting a decline compared to the peak of around **127 million in 2019/20**. This decrease marks a significant shift in Nepal's livestock dynamics over the past decade, indicating emerging challenges or transformations in production systems and household-level rearing practices.

The analysis shows that **fowl has remained the dominant species** throughout the last ten years, contributing the largest share to the total livestock count. In **2022/23**, the fowl population alone accounted for an estimated **72 million head**, making it the backbone of Nepal's poultry and egg sector. Closely associated with this trend, the number of **laying hens** also remained substantial—though it slightly declined from previous years—indicating its continuing importance in household nutrition, women's livelihoods, and rural food security.

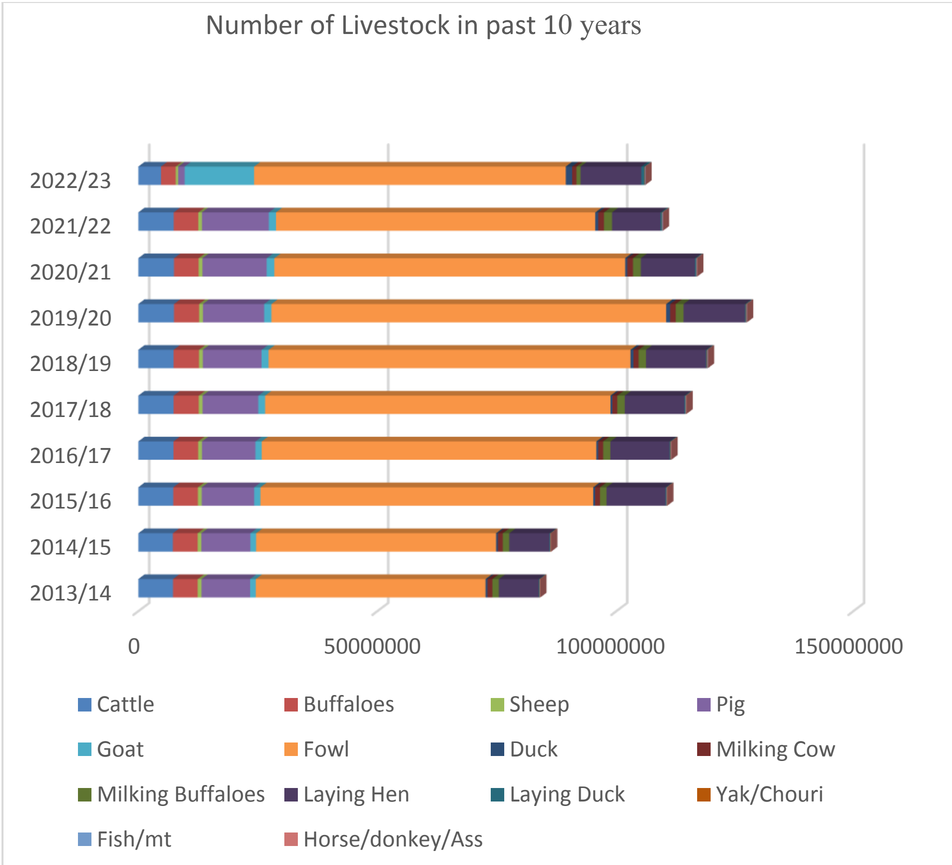
In terms of **large ruminants**, **cattle** showed an unusual increase in 2022/23 compared to previous years, suggesting either restocking efforts or renewed emphasis on dairy/meat production.

Buffaloes remained relatively stable across the decade. Within these categories, **milking cows and milking buffaloes**—as key contributors to the dairy economy—continued to show consistent trends, highlighting the resilience of dairy production practices even amidst external shocks.
Small ruminants such as **goats, sheep, and pigs** witnessed a **slight but steady decline** in recent years. This trend could be attributed to multiple factors including limited access to veterinary services, disease outbreaks, labor shortages, or shifts in farmer preference towards more commercially viable species like poultry and dairy animals.

Other minor livestock types—including **ducks**, **laying ducks**, and **Chauri/Yak**—contributed only **marginally to the total population**, with no major change in their year-on-year numbers. While these species hold cultural and ecological value in high-altitude or wetland areas, their contribution to the national livestock economy remains limited and localized.

These findings suggest that while **poultry remains the dominant and commercially dynamic segment** in Nepal's livestock sector, the recent **decline in overall livestock numbers post-2019/20** could pose a risk to national feed demand planning, rural incomes, and long-term resilience. The stable performance of **dairy animals** points to sustained investment and knowledge in that area, but the drop in **small livestock and poultry** highlights the need for targeted policy support and recovery initiatives—particularly in the aftermath of COVID-19 disruptions.

In conclusion, the time series data highlights both **progress and emerging vulnerabilities** in the livestock sector. Ensuring sustainable and inclusive growth will require focused investments in **animal health systems, quality feed and breed access, climate-adapted livestock management, and inclusive market systems**—particularly for poultry and small ruminants that serve as critical livelihood assets for millions of rural households across Nepal. **Details are presented in Annex: 1, table: 1.**



3.8 TDN Demand projection for 10 years

Using **Linear Regression**, a statistical technique that models the relationship between time (years) and population counts to predict future values. Despite some recent volatility (especially sharp declines in 2022/23 for some categories), linear regression offers a simple, transparent way to project long-term trends based on past data is utilized for this projection.

3.8.1 TDN demand projection by livestock type for 10 years

From the analysis of projected Total Digestible Nutrients (TDN) demand by livestock species for the years 2022/23, 2027/28, and 2032/33, it is estimated that the total national demand for TDN will rise sharply from approximately **14.73 million metric tons (MT)** in 2022/23 to **18.36 million MT** in 2027/28, and further to **26.60 million MT** by 2032/33.

This represents a **nearly 81% increase** over the decade, underscoring the intensifying pressure on Nepal's feed resources.

Among the various livestock categories, **milk-producing animals (cattle and buffalo)** account for the largest and fastest-growing share of TDN demand. Milk production-related TDN requirement alone is projected to nearly **double**, from **3.52 million MT** in 2022/23 to **6.24 million MT** in 2032/33, reflecting strong growth in the dairy sector. Similarly, buffalo-related demand is expected to grow from **3.33 million MT** to **4.42 million MT**, while demand from cattle slightly declines, suggesting a shift in species composition within the dairy herd.

Small ruminants such as **goats and sheep** are also projected to drive a substantial increase in TDN demand. Goat-related demand is estimated to grow from **1.34 million MT** to **3.20 million MT**, while sheep-related demand increases from **94,331 MT** to **243,617 MT**, likely reflecting rising consumer demand for meat and increased adoption of small ruminants for livelihood diversification.

In the case of monogastrics, **poultry** TDN demand is projected to rise from **689,941 MT** to over **1 million MT** by 2032/33, and **pig** demand shows moderate growth from **614,973 MT** to **668,409 MT**, indicating sustained but stable growth in semi-commercial livestock production systems.
An exceptional increase is observed in **fish production**, whose TDN requirement is projected to rise dramatically from **196,462 MT** to **5.32 million MT**, a **more than 27-fold increase**. This signals a massive expansion of the aquaculture sector, positioning it as a future key driver of national feed demand.

Other species such as **ducks and horses** show relatively smaller but notable increases in demand. Duck-related TDN demand, in particular, rises sharply from **26,520 MT** to **194,725 MT**, indicating emerging interest in diversified poultry production.

Meanwhile, **yak/nak** show a slight decline in TDN requirement over the decade, likely due to climate impacts or changing livelihood patterns in high-altitude regions.
This species-wise projection reveals that Nepal's future livestock growth will be increasingly driven by intensive systems—especially dairy, goat, poultry, and aquaculture—requiring substantial investments in **feed production, processing, and efficiency enhancement**. The findings highlight the need for:

- **Integrated feed planning** to match rising demand, particularly in dairy and aquaculture.
- **Promotion of high-yield fodder crops and efficient feeding practices** to improve feed conversion rates.
- **Support for region-specific livestock development strategies**, especially where TDN deficits are likely to emerge.

- **Monitoring of the aquaculture feed market** to ensure sustainability and avoid competition with terrestrial livestock.

Addressing these emerging feed demands through improved production systems, better resource use, and targeted policy interventions will be critical to ensuring the long-term sustainability and productivity of Nepal's livestock sector.

Conclusion:

The projected rise in TDN demand—from **14.73 million MT in 2022/23** to **26.60 million MT in 2032/33**—signals a transformative shift in Nepal's livestock sector, driven primarily by the growth of **dairy, small ruminants, poultry, and aquaculture**. While this growth presents economic opportunities, it also raises serious concerns about the adequacy and sustainability of feed resources. Without strategic interventions, the widening gap between feed demand and supply could pose a major constraint to livestock productivity.

Therefore, **urgent and targeted investments** are needed to:

- Scale up **improved forage production**,
- Enhance **feed resource efficiency**, and
- Promote **sustainable intensification** of livestock and aquaculture systems.

Proactive feed planning and adaptive policies will be essential to meet the growing nutritional requirements of Nepal's livestock while ensuring environmental sustainability and resilience in the face of climate and market uncertainties.

Table: 3.23 Projected TDN Demand by livestock type for 10 years

Livestock Species	2022/23	2027/28	2032/33
Cattle, including bullocks	4764965	4,751,929	4,738,928
Buffalo, including bullock/bull	3326343	3,834,326	4,419,885
Milk production	3518725	4,684,306	6,235,987
Yak/Nak	50654	47,911	45,823
Goat	1343295	2,175,175	3,198,545
Sheep	94331	159,799	243,617
Horse	104790	137,836	181,303
Pig	614973	641,135	668,409
Poultry	689941	831,473	1,002,040
Duck	26520	71,862	194,725

Livestock Species	2022/23	2027/28	2032/33
Fish Production (Mt)	196462	735,013	5,318,873
Total	14731000	18,357,983	26,598,392

Source: Statistical Information on Nepalese Agriculture, 2023, and calculation

3.8.2 Projected supply of TDN for 10 years from others sources

Linear Regression: This method fits a straight line to the data points from 2016/17 and 2022/23 and extends it to predict values up to 2034. It's suitable when only two data points are available, and you assume a stable trend is utilized for making this projection.

From the analysis of the **projected Total Digestible Nutrients (TDN) supply from other feed sources** for the years 2022/23, 2027/28, and 2032/33, it was estimated that the **total national TDN supply** will increase from approximately **11.29 million metric tons (MT)** in 2022/23 to **11.69 million MT** in 2027/28, and further to **15.25 million MT** by 2032/33. This marks a **35% increase** over ten years, reflecting gradual improvement in feed resource mobilization but still trailing behind the more rapid rise in TDN demand.

Among the various sources of feed, **crop residues and milling by-products** remain the largest contributor, supplying **4.90 million MT** in 2022/23, projected to increase to **6.25 million MT** by 2032/33. This source consistently contributes around **40–44%** of total TDN supply, underscoring continued dependence on low-cost, low-quality residues from cereal and pulse crops.

A remarkable increase is projected in **improved forage and pasture**, with TDN supply rising from **1.01 million MT** to **6.40 million MT** by 2032/33. This sixfold growth highlights significant potential for scaling up cultivated fodder as a high-nutrition, reliable feed source, particularly in regions facing seasonal deficits.

Natural resource-based feeds such as forest, shrubland, grassland, and farm weeds continue to provide a substantial portion of the TDN supply:

- **Forest-based feeds** are projected to contribute **2.15 to 2.39 million MT**, representing stable yet unsustainable pressure on forest ecosystems.
- **Farm weeds and natural forages** rise from **1.48 million MT** to **2.13 million MT**, signaling growing use of uncultivated biomass.
- **Grasslands** are expected to double their TDN contribution, reaching **1.06 million MT** by 2032/33, reflecting improved utilization of marginal lands.

In contrast, **kitchen waste** and **barren land** show declining contributions:

- Kitchen waste drops sharply from **290,000 MT** to **59,987 MT**, likely due to improved waste segregation and declining reliance in commercial systems.

- Feed from barren land nearly disappears, from **74,179 MT** to **14,507 MT**, possibly due to land use changes or environmental degradation.

Grain-based and commercial feeds are projected to expand:

- **Grain supplementation**, assumed at 5% of total TDN demand, grows from **736,550 MT** to **1.59 million MT**, supporting high-yielding livestock systems.
- **Commercial silage**, while still limited in volume, increases from **14,000 MT** to **46,067 MT**, pointing to gradual adoption of modern feed technologies.

Conclusion:
The projected growth in TDN supply—from **11.29 million MT to 15.25 million MT** over a decade shows encouraging trends in **improved forage adoption** and **more efficient use of natural resources**. However, this increase is **not sufficient** to meet the rapidly growing TDN demand, which is expected to reach **26.60 million MT by 2032/33**, leading to a projected **deficit of over 11 million MT**.

This growing gap highlights an urgent need for:

- **Accelerated investment in improved forage and pasture systems**, especially in high-density livestock regions.
- **Sustainable management of forest and shrubland feed sources** to avoid environmental degradation.
- **Expansion of commercial feed industries**, including silage and grain processing, to support intensive production systems.
- **Integrated national feed strategies**, linking land use, livestock planning, and climate-smart agriculture.

Addressing these gaps through coordinated policies and regional feed development programs will be vital to ensuring **sustainable and resilient livestock growth** in Nepal.

Table: 3.24 Projected Supply of TDN for 10 years from other source

Sources of feed	2022/23	2027/28	2032/33
Forest	2144861.19	2,169,704	2,393,285
Shrub land	206078.5065	215,764	302,937
Grassland	442301.6143	504,559	1,064,880
Crop residues and milling by-products	4895410.223	5,046,000	6,250,715

Sources of feed	2022/23	2027/28	2032/33
Farm weeds (forages) etc.	1479671.612	1,463,965	2,129,760
Improved forage and pasture	1008500.263	1,113,084	6,401,304
Barren area	74179.31278	68,212	14,507
Commercial silage silage Production: 20000Mt** @70%TDN	14000	17,207	46,067
Kitchen wastes****	289997	266,996	59,987
*****Grain supplementation @5% of total TDN requirement in general	736550	821,675	1,587,797
Total TDN supply	11291549.72	11,687,165	15,247,705

3.8.3 Projected Supply of TDN for 10 years from grains and crop residues

Linear Regression: This method fits a straight line to the data points from 2016/17 and 2022/23 and extends it to predict values up to 2034. It's suitable when only two data points are available, and you assume a stable trend is used to make this projection.

From the analysis of the **projected Total Digestible Nutrients (TDN) supply from crop and crop residues** for the years 2022/23, 2027/28, and 2032/33, it was estimated that the **total TDN supply from these sources** will increase from approximately **8.12 million metric tons (MT)** in 2022/23 to **8.91 million MT** in 2027/28, and further to **9.44 million MT** by 2032/33. This reflects a **16% increase** over the decade, indicating a steady yet limited expansion in feed availability from crop-based sources.

Major Contributors:
Among the different crops, **three major cereals—paddy, maize, and wheat—continue to dominate the TDN supply**, collectively contributing over **88%** of the total crop-based TDN in all three years:

- **Paddy** remains the single largest source, with projected TDN supply increasing from **3.93 million MT** in 2022/23 to **4.19 million MT** in 2032/33.
- **Maize** shows significant growth, rising from **2.11 million MT** to **3.02 million MT**—a nearly **43% increase**, reflecting its growing importance as both food and feed crop.
- **Wheat** supply increases from **1.09 million MT** to **1.29 million MT**, contributing steadily to the TDN pool.

Minor Cereals and Pulses:

Other cereals such as **millet, buckwheat, and barley** contribute smaller amounts, with millet remaining stable and buckwheat increasing modestly. However, **barley shows a gradual decline**, possibly due to reduced cultivation or productivity.

Pulses such as **lentil, chickpea, pigeon pea, black gram, grass pea, and horse gram** show mixed trends:

- **Lentil** and **pigeon pea** exhibit declining TDN contributions over time, indicating a possible shift in cropping patterns.
- **Black gram** and **soybean** show positive trends, with soybean increasing from **38,369 MT** to nearly **49,762 MT**, indicating its rising role as a protein-rich feed source.

Oilseeds and Others:

Oilseed crops such as **mustard, linseed, sunflower, sesame**, and **groundnut** contribute modest amounts to TDN supply, with little to no change projected over the years. Their stable contributions reflect the minor but consistent role of oilseeds in the national feed basket.

Conclusion:
The projected increase in crop-derived TDN—from **8.12 million MT to 9.44 million MT**—shows that cereal and pulse crops will continue to be **foundational to Nepal's livestock feed system**. However, the relatively **slow growth rate (16%)** compared to projected TDN demand highlights a potential feed supply gap in the coming decade.

Key implications include:

- **Enhancing productivity** of major feed-contributing crops such as maize and paddy is critical.
- **Promoting dual-purpose varieties** (high-yielding grain + stover quality) can optimize both food and feed outputs.
- **Conservation and utilization of crop residues**, especially maize and wheat stovers, will be important for addressing feed shortages.
- The **decline in pulse-based feed sources** suggests a need to reassess legume promotion strategies to ensure protein-rich feed availability.

To meet future TDN requirements, Nepal must invest not only in increasing crop production but also in improving post-harvest utilization and integrating crop-livestock systems for efficient biomass use. For detail see annex 1, table:3.

Table: 3.25 Projected Supply of TDN for 10 years from other source

S No	Crop	2022/23	2027/28	2032/33
1	Paddy	3926598	4058553	4190507.2
2	Maize	2109141	2566829	3024516.9
3	Wheat	1086300	1186368	1286435
4	Millet	258625	263052	267479.3
5	Buckwheat	12571	14984	17397.3
6	Barley	16690	14065	11440
7	Sugarcane	290942	281552	272161.4
8	Lentil	129145	97692	67138
9	Chick pea	7001	7567	8134.1
10	Pigeon pea	10184	7268	4351.1
11	Black gram	21716	25345	28974.7
12	Grass pea	4245	3120	1994.1
13	Horse gram	4168	4421	4588.9
14	Soybean	38369	44065	49761.9
15	Other legumes	28444	27507	26569
16	Mustard	110202	110202	110202
17	sun flower	16118	16118	16118
18	Linseed	14649	14649	14649
19	Sarsayu	11984	11984	11984
20	Rayo	3570	3570	3570
21	Sesame	5876	5876	5876
22	Groundnut	6654	6654	6654
23	Niger	3698	3698	3698
	Total	8116890	8908944	9436231.9

3.8.3 Projected TDN Demand and Supply for 10 years

From the analysis of the **projected Total Digestible Nutrients (TDN) demand and supply situation** from 2023 to 2034, Nepal is expected to face a **growing deficit** in feed availability despite gradual improvements in supply. In 2023, the TDN demand is projected at **30.29 million metric tons (MT)** while the supply is estimated at **23.14 million MT**, resulting in a deficit of approximately **7.14 million MT**. By 2034, this deficit is expected to widen to **10.62 million MT**, as demand climbs to **39.36 million MT** and supply increases only to **28.74 million MT**.

This reflects a **rising annual shortfall**, with the TDN deficit growing by nearly **50% over the 12-year period**. Despite year-on-year improvements in feed supply—driven by modest increases in crop residue utilization, improved forage adoption, and feed system investments—these efforts fall short of keeping pace with the rapid rise in demand, primarily due to expansion in dairy, goat, poultry, and fish production systems.

Land Requirement for Forage Cultivation:
To bridge this growing gap, the estimated **hectares of land required for forage cultivation** also steadily increases:

- In 2023, approximately **476,298 hectares** are needed.
- By 2034, the requirement rises to over **708,150 hectares**, indicating a **49% increase** in land area needed for dedicated forage production.

This projection underscores the **critical role of land use planning** and **forage-based interventions** in addressing the feed deficit. Without deliberate efforts to expand and intensify forage cultivation, the livestock sector risks feed-driven productivity losses and unsustainable exploitation of forest and communal grazing lands.

Conclusion:
The analysis reveals a **deepening structural gap** between TDN demand and supply in Nepal's livestock sector over the next decade. With an annual deficit crossing **10 million MT by 2034**, the country must urgently prioritize:

- **Scaling up improved forage production**, especially on fallow, underutilized, or marginal lands.
- **Enhancing feed productivity per hectare** through improved forage varieties, irrigation, and sustainable intensification.
- **Reducing post-harvest losses** in crop residues and optimizing their use for feed.
- **Integrating feed planning into national livestock development strategies**, with dedicated targets for forage land expansion.

Meeting these targets will be essential to ensure **nutritional security for livestock**, improve **farm-level productivity and incomes**, and reduce overreliance on **forest-based and low-quality feed sources**. Failure to address the widening TDN gap could significantly undermine the sustainability and resilience of Nepal's growing livestock economy.

Table: 3.26 Projected TDN demand and supply situation

Year	Demand	Supply	Deficit	hectare land to cultivate forage land to cultivate
2023	30,286,705	23,142,232	7,144,473	476298.2

Year	Demand	Supply	Deficit	hectare land to cultivate forage land to cultivate
2024	31,111,411	23,650,503	7,460,908	497393.8667
2025	31,936,116	24,158,773	7,777,343	518489.52
2026	32,760,822	24,667,043	8,093,779	539585.24
2027	33,585,528	25,175,514	8,410,014	560667.5867
2028	34,410,234	25,684,184	8,726,050	581736.6933
2029	35,234,940	26,192,855	9,042,085	602805.6933
2030	36,059,646	26,701,525	9,358,121	623874.7467
2031	36,884,352	27,210,195	9,674,157	644943.8133
2032	37,709,057	27,718,865	9,990,192	666012.8133
2033	38,533,763	28,227,535	10,306,228	687081.8667
2034	39,358,469	28,736,206	10,622,263	708150.8667

The projection is based on table 3.27 below

Table 3.27 Estimated TDN Yield from Mixed Forage (per hectare per year)

Forage System	Green Fodder Yield (t/ha/year)	Dry Matter (%)	TDN Content (%)	TDN Yield (t/ha/year)
Mixed cereal-legume rotation	80–120	20–25%	60–65%	9.6–19.5
Perennial grass-legume combination	100–150	20–25%	58–62%	11.6–23.3
Intensive multi-cut forage system	150–200	20–25%	60–64%	18–32

4.Conclusion and recommendations:

4.1 Conclusion:

Total Digestible Nutrients (TDN) derived from crop and crop residues form the backbone of Nepal's livestock feeding system. As of 2022/23, these sources contributed approximately 8.12 million metric tons (MT) of TDN—constituting a significant share of the national feed supply. The majority of this comes from three key cereals: paddy, maize, and wheat, which together provide more than 88% of the total TDN from crop-based sources. While this highlights the enduring importance of staple cereals not just as food but also as feed, it also reveals a vulnerability—one that ties livestock nutrition closely to crop production trends, climate variability, and market fluctuations.

The projection using linear regression suggests that the TDN supply from crop and crop residues is likely to increase to 8.91 million MT by 2027/28 and reach 9.44 million MT by 2032/33. This represents a 16% growth over ten years—a positive but modest gain, especially when viewed against the backdrop of rapidly rising TDN demand from the livestock sector. While maize is expected to show a strong upward trend, other key sources such as paddy and wheat exhibit slower growth, and minor cereals and some pulses show stagnation or decline. Oilseed crops remain stable but contribute minimally overall.

These trends point to both strengths and constraints in Nepal's crop-livestock integration. On the one hand, the country continues to rely heavily on crop residues—an accessible, low-cost feed source that supports millions of smallholder farmers. On the other hand, the feed value of these residues is often low in quality and quantity, and their availability is limited by seasonal patterns, changing land use, and competition with alternative uses like fuel or compost.

Moreover, the declining contribution from pulses—traditionally important for protein-rich residues—raises concerns about the nutritional balance of available feed, particularly for small ruminants and poultry. The steady yet limited role of oilseeds further reinforces the need for diversification in feed sources.

In totality, while crop and crop residues will remain an indispensable part of Nepal's livestock feed ecosystem, their current and projected growth is insufficient to close the widening TDN gap. Without strategic interventions, this could exacerbate nutritional stress among livestock, reduce productivity, and undermine the broader goals of food security and rural livelihood improvement.

Moving forward, a multi-pronged strategy is essential. This should include:

- Increasing crop productivity and promoting dual-purpose varieties with both grain and high-quality stover value.
- Enhancing residue collection, conservation, and treatment practices to minimize losses and improve feed quality.
- Reinvigorating legume-based cropping systems to restore protein-rich feed sources.
- Integrating crop-livestock planning within broader land use and agricultural development policies.

  Only by aligning crop production systems with livestock feed demands—both in volume and nutritional quality—can Nepal build a more resilient, efficient, and sustainable agri-food system.

4.2 Recommendations:

- Enhancing region-specific forage and fodder development, especially in high-demand provinces

- Investing in feed technologies like hay, silage, and nutrient blocks to manage seasonal shortages
- Promoting ration balancing and feed efficiency for non-ruminants via extension and training
- Strengthening livestock value chains with improved veterinary care, breeding, and milk collection
- Though TDN supply shows promising growth, especially from improved forages, it falls far short of the rapidly increasing TDN demand projected to reach 26.60 million MT by 2032/33. This will create a significant deficit exceeding 11 million MT, underscoring the urgent need for:
- Accelerated investment in improved forage and pasture systems, especially in high-demand areas.
- Sustainable management of forest and shrubland feed to prevent environmental degradation.
- Expansion of commercial feed industries, including silage and grain processing.
- Integrated national feed strategies connecting land use, livestock planning, and climate-smart agriculture.
- While crop-based TDN supply is projected to grow modestly, its pace is slow compared to rising demand, highlighting a likely feed supply gap. Key recommendations include:
- Enhancing yields of major feed crops, especially *maize* and *paddy*.
- Promoting dual-purpose crop varieties that offer both high grain yield and quality residues.
- Improving conservation and utilization of stovers, especially from *maize* and *wheat*.
- Addressing the decline in pulse-derived feed by revisiting legume promotion strategies to secure protein-rich feed sources.
- Overall, while crop residues will remain central to Nepal's livestock feed system, complementary feed strategies will be essential to meet future demand sustainably.

Recommended actions:

- Integrated feed planning aligned with rising demand, especially for dairy and aquaculture.
- Promotion of high-yield fodder crops and efficient feeding to improve feed conversion.
- Region-specific livestock development strategies targeting potential TDN deficits.
- Careful monitoring of aquaculture feed markets to ensure sustainability and avoid feed competition with terrestrial livestock.

Annex: 1

Table: 1 Ten years' time series data by animal type

Categories	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Cattle	7243916	7241743	7302808	7347487	7376306	7385035	7458885	7466841	7413197	4750329
Buffaloes	5178612	5167737	5168809	5177998	5277819	5308664	5257991	5159931	5132931	3081062
Sheep	789216	789292	800658	801975	800749	798889	806079	793725	771205	501894
Pig	10177531	10251569	10986114	11165099	11647319	12283752	12811953	13442614	13990703	1357507
Goat	1190138	1203230	1291308	1328036	1435369	1488338	1519593	1588838	1504624	14541244
Fowl	48079406	50195285	69630638	70007151	72245732	75709330	82598879	73418077	66803117	65205250
Duck	390209	390287	392255	394775	404670	616400	827226	432226	605944	1325999
Milking Cow	1024513	1025947	1026135	1029529	1039538	1078775	1166156	1209041	1223061	916579
Milking Buffaloes	1345837	1345164	1355384	1509512	1535948	1560584	1635492	1630642	1666827	851272
Laying Hen	8350237	8412247	12353515	12388889	12517558	12526979	12927842	11344011	10131642	12725053
Laying Duck	169447	179480	180927	183940	186912	190747	191701	220532	302473	661938
Yak/Chouri	70588	69888	69346	69546	69978	69,588	68949	59892	55647	55245
Fish/mt	31221	37427	41481	55842	83898	91,832	99434	104623	108385	113736
Horse/donkey/Ass	53577	69346	69978	69588	70005	65,406	59762	54864	54248	17332

Table: 2 Ten years projection of the animal

Year	Cattle	Buffaloes	Sheep	Pig	Goat	Fowl	Duck	Milking Cow	Milking Buffaloes	Laying Hen	Laying Duck	Chauri/ Yak	Fish (MT)	Horse/ Donkey/ Ass
2023/24	6,429,354	4,361,317	674,144	9,633,190	6,855,239	78,408,074	966,021	1,132,995	1,429,647	12,967,390	430,760	56,293	133,247	40,359
2024/25	6,307,663	4,246,801	657,558	9,418,967	7,609,087	80,411,479	1,036,570	1,143,735	1,427,098	13,258,233	464,206	54,552	143,512	37,077
2025/26	6,185,972	4,132,285	640,972	9,204,744	8,362,936	82,414,884	1,107,119	1,154,475	1,424,549	13,549,076	497,651	52,811	153,777	33,795
2026/27	6,064,281	4,017,768	624,386	8,990,521	9,116,784	84,418,289	1,177,669	1,165,214	1,422,000	13,839,919	531,097	51,070	164,042	30,513
2027/28	5,942,590	3,903,252	607,799	8,776,298	9,870,633	86,421,694	1,248,218	1,175,954	1,419,451	14,130,762	564,542	49,329	174,307	27,231

Year	Cattle	Buffaloes	Sheep	Pig	Goat	Fowl	Duck	Milking Cow	Milking Buffaloes	Laying Hen	Laying Duck	Chauri/ Yak	Fish (MT)	Horse/ Donkey/ Ass
2028/29	5,820,899	3,788,736	591,213	8,562,075	10,624,481	88,425,099	1,318,768	1,186,694	1,416,902	14,421,605	597,988	47,589	184,573	23,949
2029/30	5,699,208	3,674,220	574,627	8,347,852	11,378,329	90,428,504	1,389,317	1,197,433	1,414,353	14,712,448	631,433	45,848	194,838	20,667
2030/31	5,577,517	3,559,704	558,041	8,133,630	12,132,178	92,431,909	1,459,866	1,208,173	1,411,804	15,003,291	664,879	44,107	205,103	17,385
2031/32	5,455,826	3,445,188	541,455	7,919,407	12,886,026	94,435,314	1,530,416	1,218,912	1,409,255	15,294,134	698,324	42,366	215,368	14,103
2032/33	5,334,135	3,330,672	524,869	7,705,184	13,639,875	96,438,719	1,600,965	1,229,652	1,406,706	15,584,977	731,770	40,626	225,634	10,821
2033/34	5,212,444	3,216,156	508,282	7,490,961	14,393,723	98,442,124	1,671,514	1,240,392	1,404,157	15,875,820	765,215	38,885	235,899	7,539
2034/35	5,090,753	3,101,640	491,696	7,276,738	15,147,571	100,445,529	1,742,064	1,251,131	1,401,608	16,166,663	798,661	37,144	246,164	4,257

Table: 3 Projection for requirement of TDN in coming 12 years

Year	Cattle	Buffalo	Milk Prod.	Yak/Nak	Goat	Sheep	Horse	Pig	Poultry	Duck	Fish Prod.	Total
2023/24	4,762,355	3,422,248	3,725,952	50,093	1,479,231	104,819	110,695	620,119	716,175	32,371	273,233	15,297,291
2024/25	4,759,746	3,520,917	3,945,384	49,538	1,628,923	116,472	116,933	625,307	743,407	39,513	380,003	15,926,143
2025/26	4,757,139	3,622,432	4,177,739	48,990	1,793,763	129,422	123,522	630,539	771,674	48,231	528,495	16,631,946
2026/27	4,754,533	3,726,873	4,423,777	48,447	1,975,284	143,810	130,483	635,815	801,016	58,872	735,013	17,433,923
2027/28	4,751,929	3,834,326	4,684,306	47,911	2,175,175	159,799	137,836	641,135	831,473	71,862	1,022,231	18,357,983
2028/29	4,749,326	3,944,877	4,960,178	47,380	2,395,294	177,565	145,603	646,499	863,089	87,717	1,421,684	19,439,212
2029/30	4,746,724	4,058,615	5,252,297	46,855	2,637,688	197,306	153,808	651,908	895,907	107,070	1,977,230	20,725,408
2030/31	4,744,124	4,175,632	5,561,619	46,336	2,904,611	219,242	162,475	657,363	929,973	130,693	2,749,865	22,281,933
2031/32	4,741,525	4,296,023	5,889,158	45,823	3,198,545	243,617	171,631	662,863	965,334	159,528	3,824,419	24,198,466
2032/33	4,738,928	4,419,885	6,235,987	45,316	3,522,224	270,702	181,303	668,409	1,002,040	194,725	5,318,873	26,598,392
2033/34	4,736,332	4,547,318	6,603,241	44,814	3,878,658	300,798	191,520	674,002	1,040,141	237,687	7,397,309	29,651,820
2034/35	4,733,738	4,678,426	6,992,124	44,318	4,271,162	334,240	202,312	679,641	1,079,691	290,128	10,287,927	33,593,707

Note: **Fish Production** shows the steepest increase—from ~196,000 MT in 2022/23 to over **10 million MT by 2034/35**, due to very high historical CAGR.
Goats and Milk Production will nearly double or more, significantly contributing to rising feed demand.
Cattle TDN demand remains stable with a slight decline, indicating plateaued or managed herd size.
Total national **TDN requirement will more than double** in 12 years.

Table 4.1 : Projected TDN supply from crops for coming 12 years

Crop	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Paddy	3952989	3979380	4005771	4032162	4058553	4084944	4111335	4137725	4164116	4190507	4216898	4243289
Maize	2200679	2292216	2383754	2475291	2566829	2658367	2749904	2841442	2932979	3024517	3116055	3207592
Wheat	1106314	1126327	1146341	1166354	1186368	1206381	1226395	1246408	1266422	1286435	1306449	1326462
Millet	259511	260396	261282	262167	263052	263938	264823	265709	266594	267479	268365	269250
Buckwheat	13054	13536	14019	14501	14984	15467	15949	16432	16915	17397	17880	18363
Barley	16165	15640	15115	14590	14065	13540	13015	12490	11965	11440	10915	10390
Sugarcane	289064	287186	285308	283430	281552	279674	277796	275918	274040	272161	270283	268405
Lentil	122834	116524	110213	103902	97692	91581	85470	79359	73249	67138	61027	54917
Chick pea	7113.5	7226.9	7340.3	7453.7	7567.1	7680.5	7793.9	7907.3	8020.7	8134.1	8247.5	8360.9
Pigeon pea	9600.8	9017.5	8434.2	7850.9	7267.6	6684.3	6101	5517.7	4934.4	4351.1	3767.8	3184.5
Black gram	22442	23168	23894	24620	25345	26071	26797	27523	28249	28975	29701	30426
Grass pea	4020	3794.9	3569.8	3344.7	3119.6	2894.5	2669.4	2444.3	2219.2	1994.1	1769	1543.9
Horse gram	4210	4252.1	4294.2	4336.3	4378.4	4420.5	4462.6	4504.7	4546.8	4588.9	4631	4673.1
Soybean	39508	40648	41787	42926	44065	45205	46344	47483	48623	49762	50901	52041
Other legumes	28257	28069	27882	27694	27507	27319	27132	26944	26757	26569	26382	26194
Mustard	110202	110202	110202	110202	110202	110202	110202	110202	110202	110202	110202	110202
Sun flower	16118	16118	16118	16118	16118	16118	16118	16118	16118	16118	16118	16118
Linseed	14649	14649	14649	14649	14649	14649	14649	14649	14649	14649	14649	14649
Sarsayu	11984	11984	11984	11984	11984	11984	11984	11984	11984	11984	11984	11984
Rayo	3570	3570	3570	3570	3570	3570	3570	3570	3570	3570	3570	3570
Sesame	5876	5876	5876	5876	5876	5876	5876	5876	5876	5876	5876	5876
Groundnut	6654	6654	6654	6654	6654	6654	6654	6654	6654	6654	6654	6654
Niger	3698	3698	3698	3698	3698	3698	3698	3698	3698	3698	3698	3698
Total	8250534	8382156	8513778	8645400	8777122	8908944	9040766	9172588	9304410	9436232	9568054	9699876

Note: Projection Method Used: *Linear Regression based on values from 2019 and 2022. This method assumes a steady annual growth or decline rate over the years.*

Table: 4.2 Projected TDN supply from other sources

Year	Forest	Shrub land	Grassland	Crop residues & milling by-products	Farm weeds	Improved forage	Barren land	Commercial silage	Kitchen waste	Grain supplement	Total TDN Supply (Mt)
2023	2,169,704	215,764	504,559	5,046,000	1,463,965	1,113,084	68,212	17,207	266,996	821,675	11,687,165
2024	2,194,546	225,450	566,817	5,196,589	1,448,258	1,217,668	62,245	20,413	243,995	906,799	12,082,781
2025	2,219,388	235,136	629,075	5,347,178	1,432,551	1,322,252	56,278	23,620	220,994	991,924	12,478,396
2026	2,244,231	244,822	691,333	5,497,768	1,416,844	1,426,835	50,310	26,827	197,993	1,077,049	12,874,012
2027	2,269,073	254,508	753,591	5,648,357	1,401,138	1,531,419	44,343	30,033	174,992	1,162,173	13,269,628
2028	2,293,916	264,194	815,849	5,798,947	1,385,431	1,636,003	38,376	33,240	151,991	1,247,298	13,665,243
2029	2,318,758	273,879	878,107	5,949,536	1,369,724	1,740,587	32,409	36,447	128,990	1,332,423	14,060,859
2030	2,343,600	283,565	940,365	6,100,125	1,354,017	1,845,170	26,441	39,653	105,989	1,417,547	14,456,474
2031	2,368,443	293,251	1,002,622	6,250,715	1,338,310	1,949,754	20,474	42,860	82,988	1,502,672	14,852,090
2032	2,393,285	302,937	1,064,880	6,401,304	1,322,604	2,054,338	14,507	46,067	59,987	1,587,797	15,247,705
2033	2,418,128	312,623	1,127,138	6,551,894	1,306,897	2,158,922	8,540	49,273	36,986	1,672,921	15,643,321
2034	2,442,970	322,309	1,189,396	6,702,483	1,291,190	2,263,505	2,573	52,480	13,985	1,758,046	16,038,937

Annex: 2 Photographs