# Assessment of AgriTech Startups in Nepal: Prospects, Challenges, Policy Recommendations, and the Way Forward

**Author:** Kiran Mainali (kmainali11111@gmail.com)
Erasmus Mundus Joint Master's Degree in Food Identity, MBA-Agribusiness

**Abstract:**

The Agritech sector in Nepal has gained momentum in recent years, promising to revolutionize the country's agricultural landscape. This article attempts to assess the Agritech Startups landscape in Nepal and delves into the prospects and the challenges encountered by the Agritech startups in Nepal. Alongside this article discusses on the policy recommendations that are required to be implemented promptly in the sector for its sustainable growth. Through a comprehensive secondary analysis of the market dynamics, technological innovations and socio- economic conditions, this study explores the uncharted potential that could assist in agricultural productivity. Furthermore, the research highlights the role of government policies in fostering a conducive environment for Agritech entrepreneurship. The findings emphasize the importance of digital literacy, market linkages, technical support and targeted incentives in propelling the growth of Agritech startups in Nepal. By considering the unique Nepalese context, this research identifies the major players in the market, major segment of the Agritech business currently in operation in Nepal and aims to provide a roadmap for the way forward, fostering the sustainable development of Agritech startups, and contributing to increased food security and economic prosperity in Nepal.

*Keywords:* Agritech, innovation, startups, productivity, advisory, market linkages, policy, opportunities.

## I. Introduction:

### i. Importance of agriculture in Nepal:

Agriculture and its associated activities in Nepal play a significant role in the economy, culture, and livelihood of the people. Although the share of agriculture's contribution to the national GDP is declining, it is still regarded as an economic backstay as it directly contributes to 23.95% of the national GDP and employs 60.4 percent of the country's population (Nepal Rastra Bank, 2022; MOF 2022). Nepal's cultivable land area has dwindled by a staggering 300,000 hectares, plummeting from 2.5 million to 2.2 million hectares, which is a concern as it raises questions about the sustainability of agriculture as a profession (National Statistics Office, 2023). Although the land for the cultivation of major agricultural crops is declining, the average productivity has seen a marginal rise. Although the government's strategies are intended to help farmers transition from subsistence to small-scale enterprise farming, the agriculture sector continues to face a number of challenges (ILO, 2019). The agricultural sector has predominant issues like access to finance, access to quality seeds and fertilisers, access to markets, and access to extension services (Gyawali & Khanal, 2021).

### ii. General Overview of Agribusiness Ecosystem in Nepal:

In general, the agribusiness ecosystem constitutes all the major business activities across the value chain, be it supply of the inputs, production of the agri-food products, transformation, and final delivery to the intended consumers. As a direct outcome of urbanization and consumer preferences for new and easily accessible products, the sector of agribusiness is ever-expanding, and new scopes of agribusiness development have been expanding both nationally and globally. As farming and agricultural-related activities are intricate and require a scientific knowledge guide, new emerging agribusinesses are thriving nationally to assist farmers and increase productivity.

Till date, agribusiness in Nepal is largely unorganized and unstructured, with intermediaries completely deluging the agricultural value chain (Pokhrel & Thapa, 2007). Most of the farmers in Nepal are smallholder farmers, with 52.7 percent of households having less than 0.5 hectares of land holdings (CBS, 2013), and about 70 percent of landholdings are less than 1.0 ha. The smallholder farmers' farmers have limited access to credit, technology, innovation, and market facilitation. The small retail stores are still the lifeline for the supply of vegetables in Nepal, despite the advancements observed in technology and innovation in the country.

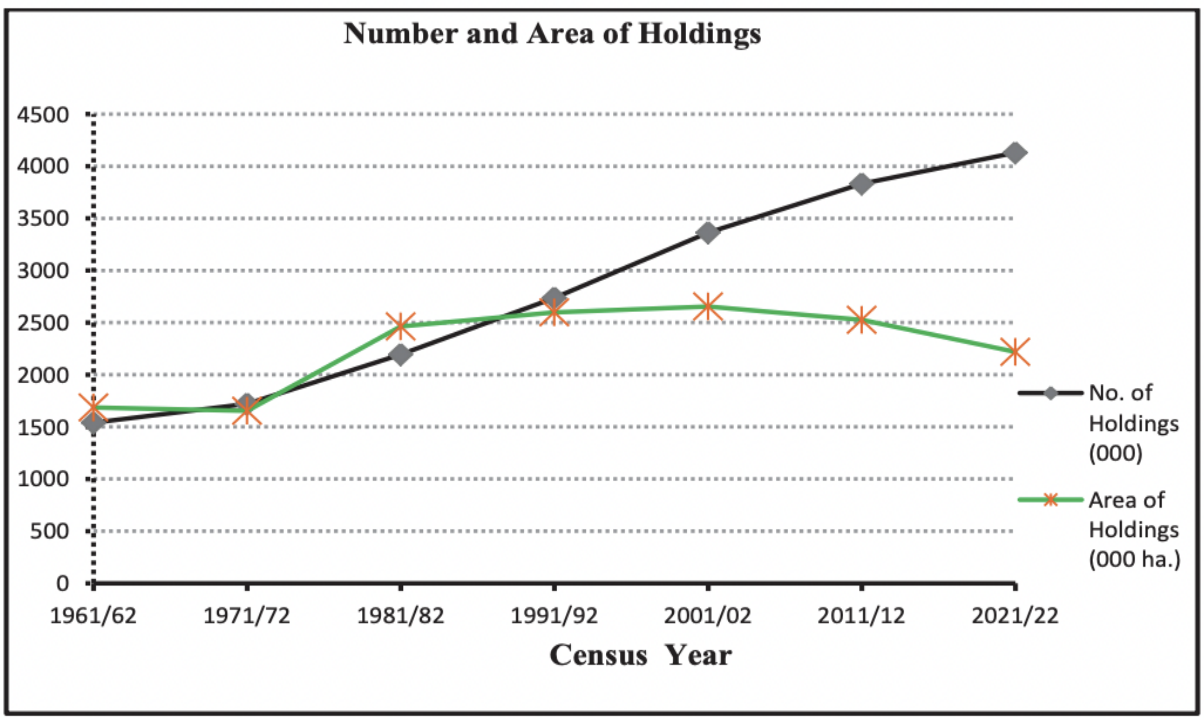


Figure 1: A comparative time plot between number of holdings and area of holdings throughout different agriculture census.

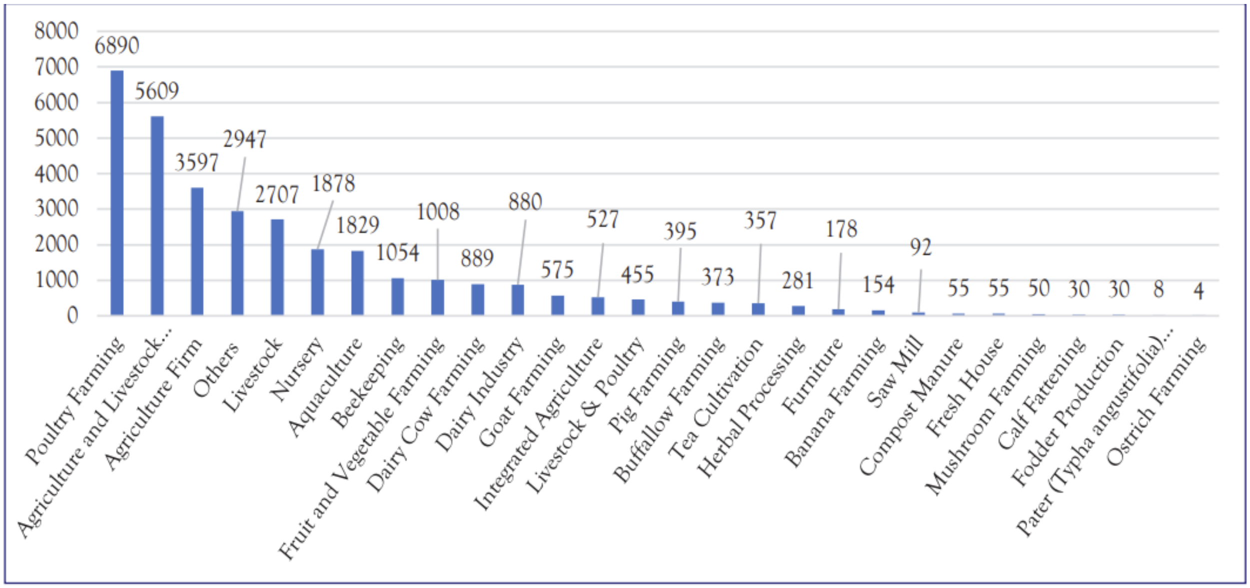

Figure 2: Registration of different agribusiness in Nepal. Source: (Mishra & Paudel, 2023)

A general mapping of agribusiness ecosystem in Nepal is presented below:

| Value chain | **Supply / Support** | **Produce** | **Transformation** | **Retail** |
|---|---|---|---|---|
| **Value Chain Components** | • Farm Inputs<br>• Extension and Agronomy Services<br>• Vet Services<br>• Recommendations on the plantation<br>• Soil Testing | • Nutritional access<br>• Soil enriching<br>• Plantation and care<br>• Weather Forecasting and Monitoring | • Cold Storage<br>• Processing<br>• Manufacturing<br>• Addition of ingredients<br>• Warehousing<br>• Packaging<br>• Delivery | • Traditional Bazars<br>• Trade (Intermediaries)<br>• E-commerce<br>• Government market support (Local level and regional level) |
| **Intermediaries** | Access to finance.<br>Producer's organization | Farmer's Cooperatives<br>Traders and Wholesalers. | | Bazars and markets |

Table 1: Mapping of agribusiness ecosystem in Nepal. Source: Author

### iii. Importance and Emergence of Agri-Tech Startups in Nepal:

Although Nepal is a primary agrarian economy, the majority of the farmers engaged in Nepalese agriculture are regularly confronted with different issues, like (i) outdated technology, (ii) poor infrastructure and extension support, and (iii) proper access to finance and markets. With the beginning of start-up culture and the omnipresence of IT-related solutions, it has undeniably enhanced the agriculture industry overall (Krishna, 2018). The integration of Agri-Tech startups into agricultural practices is motivated to improve the productivity and profitability of the farmers, improve the supply chain, and also combat global sustainability issues like climate change through precision management techniques and reduction of post-harvest losses. According to Moharekar (2022), throughout the entire agricultural value chain, Agritech start-ups are providing innovative and pertinent solutions to a variety of problems. The most important role of agri-tech startups in Nepal is also to connect farmers, retailers, and consumers, facilitating market access.

With the advent of the internet, information technology, and information communication technology, the entire orthodox market structure and the way agriculture was practiced in the earlier century have been flipped upside down. As the Internet of Things (IOT) [1]and and its accessibility have become ubiquitous with the coordination and collaboration of multiple stakeholders, most agricultural actions and practices are on the verge of being highly digitalized all across the globe. The current epoch can be regarded as an age of digital revolution; therefore, it becomes imperative to integrate the notion of agricultural technology into the agricultural plans of the state such that the sector, during its flourishing, would confront minimum inhibitions.

The embedding of ICT-related solutions in the agricultural value chain can benefit the agribusiness sector as a whole. Nepalese Agritech startups are attempting to provide innovative solutions throughout the supply chain by adhering to the support of internet service, big data analytics, digital platforms, and the Internet of Things (IoT). In the wake of COVID-19, the notion of Agritech startups and the delivery of various functions under this came to life as the supply of vegetables and foods through various online e-commerce platforms gained massive acceptance (Lamichanne, 2020). Meanwhile, through the learnings from neighbouring India, like achieving a digital revolution through IT-enabled infrastructure and mobile telephony services to effectively support rural farmers with an uninterrupted supply of inputs such as seeds, fertilizers, and chemicals, startups in the Nepalese agri-tech sector attempted to operate in similar realms of operation. Beside this, there were a handful of agro-enterprises working in the delivery of agricultural products to the market and assisting them for better market accessibility by resorting to internet services.

## II. Objectives

Nepalese agriculture is transitioning from subsistence-based farming practices to commercial farming practices (GC & Hall, 2020). The newly endorsed government policies and interventions from various INGOs and developmental organisations supported by foreign assistance have aided in the changeover of the Nepalese agricultural system. Despite major challenges, Nepalese agriculture has been upgrading to market-oriented agriculture, with a focus on natural forms of farming like organic and regenerative farming. The major challenges confronted by Nepalese agriculture are proper support from the government, land fragmentation, limited access to modern technology, climate change, a lack of infrastructure, actual value perceptions among the farmers,

[1] IOT short form of Internet of Things refers to a network of physical objects with sensors, software and other technologies for the purpose of connecting and exchanging data to other devices through the internet.

and a lack of agricultural-related data to generate deducible decision-making insights (Gauchan, 2018). To rapidly tackle the dwindling agricultural productivity, efforts need to be made to invest heavily in fostering the development of agritech ecosystems and enablers. In the context of Nepal, some of the agri-tech players in the ecosystem of agribusiness have evolved to improve the lives of the farmers.

The following objectives were aimed at being covered and represented in the paper:

- To recognize the prevailing landscape within the Nepalese agri-tech ecosystem and gain insights into the realm of Nepalese agri-tech startups.
- To enhance understanding of the opportunities and challenges encountered by agritech startups in Nepal.
- To assess the existing policy-level support regarding the development of agri-tech startups.
- To recognize the increasing significance of agritech startups in the current context and assess and propose measures that government and policy-making bodies could take to foster a favorable environment for these emerging entrepreneurs (referred to as "agripreneurs") and promote the proliferation and enduring sustainability of agritech startups.

## III. Agritech Business within the Value Chain

Within the entirety of the agricultural value chain, agri-tech business could be initiated at different stages to assist the farmers or relevant stakeholders to enhance productivity, profitability and efficiency of farming operations. Some of the stages with in the value chain of the agriculture where the agri-tech business could potentially step in to support the farmers is enlisted below:

| ***Stages within the value chain*** | ***Agritech Business (Functions)*** |
|---|---|
| *Farm Inputs* | • Platforms to connect farmers with quality input suppliers at affordable price points. |
| *Advisory and Extension Services* | • Digital assistance through IoT<br>• Weather Forecasting and communication<br>• Assistance in selection of plant/crop depending upon market, or type of soil.<br>• Soil testing and related advisory services.<br>• Assistance in identification and remedial measures of any pathogens and plant diseases during cultivation phases.<br>• Access to finance and insurance for farming security<br>• Risk management by proper counseling with the farmers prior to farming using ICT. |
| *Farming, Cultivation and Harvesting.* | • Renting of farm equipment’s as per use<br>• Farm management and recommended doses as per optimizations (resource management) |

| | |
|---|---|
| | • Record keeping and book keeping to evaluate financial performance of the agribusiness firms<br>• Precision agriculture and related tools to optimize productivity with minimum application of inputs<br>• Moisture detection, sensor-based irrigation<br>• Use of advanced robotics for harvesting operations to minimize post-harvest losses. |
| *Transportation* | • Traceability and inventory management during storage<br>• Cold storage and boots during storage to minimize post-harvest losses. |
| *Market linkages* | • Platform to connect the farmers with direct consumers<br>• Real time price monitoring and forecasting using big data analytics.<br>• Use of integrated block chain to enable traceability of the produces for the consumer. |

Table 2: Different existing agri-tech business in various stages of the supply chain.

## IV. Discussion: Agritech business in Nepal

### i. Current Status and Market in Nepal:

It is an undeniable fact that as technology has become more omnipresent, its bandwidth has equally influenced the agricultural sector in Nepal as well. Reports from the Nepal Telecommunication Authority suggest that nearly 1.5 out of 2 citizens of Nepal have access to the internet, accounting for nearly 77.1% of the entire population (The Kathmandu Post, 2020). Therefore, these statistics can be used as a reference to realize the enhanced outreach of the internet among the farmers in Nepal. The agricultural sector in the country, which was earlier considered to be limited to rudimentary and conventional practices, has been largely boosted with the integration of technology. The wave of e-commerce sites over the years has attempted to expedite the supply chain and value chain in the trading of agricultural goods (K.C. & Timalsina, 2016). There are prominent players in the e-commerce of agricultural commodities like Kheti, MetroTarkari, and Mato, which have been conducting their business activities in major cities of the countries to facilitate easy market reach of the commodities for farmers or farming groups. However, other major actors within the industry, like Green Growth and Esatya, have been striving to introduce sophisticated block chain [2]technology in the realms of agricultural e-commerce with the objective of simplifying the supply chain with enhanced transparency. According to Gautam (2020), all engagement of the business venture in channelizing the agricultural market and production process has been proliferating over the years and is regarded as pivotal for microenterprise success;

[2] Block chain technology in agriculture stores relevant data in different blocks in a network connected through peer-to-peer nodes.

however, needless to say, from the government, the least arrangements have been made to facilitate the growth of such business ventures and strict policy formulations to administer and monitor the progress of such business groups.

On the other end, extension services, which were limited to the enumerators visiting the site and providing recommendations, are anticipated to witness radical reforms as different business groups attempt to provide expansion and extension services using the support of IT and other technologies like GIS[3] sothat the farm fields can be monitored, escalating the dwindled productivity and profitability of the agricultural farmers. Currently, there are some organisations working and in the testing phase to improve the productivity of the farmers through precision management using different effective farm management software; however, the pressing issue is that the country's government doesn't have concrete plans and a policy framework to regulate such sectors.

### ii. Business-model of Agritech players globally and in Nepal

The agri-tech players in Nepal have been operating in different business model landscape. Although the agricultural entrepreneurs in the country have attempted in diversification of their revenue model, there still exists multifarious sectors within agri-tech that can be explored in context of Nepal.

- **Margin based models:** In this form of business revenue strategy, the Agritech startups assist the farm operators to increase their business profitability and efficiency by assisting on the inefficiencies or opportunities to improve productivity and in return claims certain percentage of the increases value from the farmers or other stakeholders for increase in the business performance (Štefan & Richard, 2014). PlantSat is one such company working in such business model in Nepal.
- **Subscription based models:** In this business model, most of the Agritech companies Charges customers (maybe a farmer or other stakeholder a recurring fee for access to your technology or services (Adhya & Sahoo, 2022). Through the subscription-based model the agri-tech companies assist the farmers or other stakeholders to increase the quality of the product, increase the productivity or also track the product for quality verification throughout the value chain of the product. Esatya, company working relentlessly on the block chain integration of the agricultural products in collaboration with different processors, or farmers works in this model of business operationalization.
- **Transaction based model:** In this business model, the farmers or other stakeholder are charged based on usage, such as per acre, per animal, or per data analysis. For e.g., Loans.
- **Supplier to Farmers Supply chain Integrated**: In this type of Agritech business, the platforms strive to connect the input supplier's liker machineries dealers, or renters, seed, fertilizers and other suppliers to farmers customized on their needs. R&D solutions is one of the agribusinesses which has been working under this business operational model.

[3] GIS abbreviation of Geographical Information System is a conceptualized framework to capture and analyze spatial and geographical data's.

- **Farmers to Consumers Supply Chain Integrated: Furthermore, in this type of Agritech business, the business platforms connect** farmer's fresh produce or fresh produces directly to the consumers who seek for high quality products. Agritech firms like Farm to finger, Kheti have been exploiting this business model in Nepal.

Strengths of new agri-tech business model compared to traditional agribusiness model:

1. The use of precision farming could boost in improving the efficiency of farming operations (McKinsey and Company, 2022).
2. As the traceability of the food products are maintained throughout the supply chain, better renumeration are provided by the food processing industries to the farmers.
3. Less wastages of agri-food products can be ensured which can be critically important as the world is currently combating with the issue of food insecurity.
4. The confidence of agricultural insurance and financial institutions increases as the record keeping of the farming activities of the farmers related will be transparent.
5. Better risk management plan of the farmers could be formulated with assistance from the agri-tech business and their consultations on input price volatility, weather forecasting, demand price of the produced goods and analysis of the supplied good over the durations of time.
6. An Agritech company sources products directly from manufacturers or primary distributors and utilizes its network of warehouses to provide the same products to retailers (and consequently, farmers) at a slightly reduced price point.

### iii. Innovation and Research: Overview of the Innovative Practices:

Companies providing enhanced farm inputs, software, tech enabled hardware for crop, livestock, aquaculture and insect farming can be termed as Agritech startups. This contains companies based out of Nepal (TrackXn, 2023). There are 21 major AgriTech startups in Nepal which include aQysta, Smart Krishi, Pathway Technologies, Off Grid Bazaar, AgriClear.

Some of the major Agritech startups and their innovative practices in assisting the knowledge sharing and innovative extension practices are presented below in the tabulated form:

| ***Name of the company*** | ***Founded Year*** | ***Functions/Innovative Practices in Agriculture*** |
|---|---|---|
| ***aQysta*** | 2013 | Provider of hydro-powered pump. It provides water management solutions to farmers. It also provides renewable energy-based consulting services.<br><br>aQysta was founded by three engineers who developed renewable hydro-powered pumps to help farmers with irrigation at zero operating costs. Since then, aQysta has grown into a |

| | | |
|---|---|---|
| | | complete farming solution provider for farmers facing challenges in their struggle to thrive and help increase their income by up to 9 times. |
| ***Pathway Technologies*** | 2009 | Pathway Technologies is a provider of software services for the agricultural industries. It offers solutions such as website development, app development, data collection, customized research, decision support systems, and much more. |
| ***Off grid Bazar*** | 2010 | Provider of irrigation solutions and services for yield improvement. The offering of the company includes a solar irrigation system, financing, and personalized agri advisory. The company uses algorithms to analyze farmers' information for providing a solar water pump. Its mobile application and the digital platform allow microfinance to manage farmers and also provides advisory services where the farmers receive customized, and real-time alerts via SMS on issues like selection and use of agri-inputs like seeds and fertilizers, a suitable amount of irrigation, pest and disease management, market prices, and weather alerts. |
| *AgriClear* | 2020 | Provider of farm data management and traceability solutions. It offers a platform capable of recording information from crop production to sales. It also helps users in maintaining crop cycle records securing product traceability using blockchain, maintaining trade calendars and analytical dashboards. |
| *Krishak ra Pradbhidi* | 2019 | Krishakraprabidhi is a digital platform which provides content related to agriculture. It provides content under various categories |

| | | |
|---|---|---|
| | | including agribusiness, agricultural entrepreneurship, news, techniques, and assignment or project. It monetizes through display advertisements. |
| *GeoKrishi* | 2017 | Geokrishi specializes in providing precision agriculture and connected farming solutions. It offers web-based platforms and a smartphone app called Geo Krishi Digital Dashboard, Geo Krishi Bazar, and Geo Krishi mobile app. Its solutions include smart agriculture, connected farming, smart advisory service, and drone-based & data-driven precision farming. |
| *Ficus Biotech* | 2013 | Manufacturer of organic Paulowia, Bamboo plant using tissue culture technology. It provides after sale services through plant visits. Moreover, it provides support services on a case-to-case basis for soil survey and plant development. It plans to diversify into a complete agro service solution firm and start the product line of agrochemicals and seeds in the coming years. |
| *DV Excellus (Kheti)* | 2016 | Provider of an app and web-based tailored services for farmers. It integrates the entire value chain in food production and consumption in its platform and delivers services to farmers and consumers. It also acts as an interacting platform for cooperatives, governments, and product and service providers. Its mobile application is available for the Android platform |
| *Kisan Care* | 2020 | Aimed to systematize daily farming activities and providing quality inputs throughout the nation. kisan care is driven to manage the commercial farms that ensures the maximum productivity with effective use of agriculture inputs and by lowering the cost of production and providing transparent market platform ultimately leading to farmer’s success. |

| | | |
|---|---|---|
| | | Access to quality inputs and technology transfer<br><br>Develop tools to simplify the agriculture system to improve the farm efficiency.<br><br>To provide advisory and consultation services in agricultural production, safe food production model and agri-business development<br><br>To connect the local government for better production control system |
| *PlantSat* | 2019 | PlantSat is an agri-insurtech startup focused on digitalizing crop insurance in South Asian countries, beginning with Nepal. The mission is to simplify and streamline the registration and claim verification processes for both farmers and insurance companies. By leveraging a combination of geotagged photos, satellite data, and weather information, they aim to reduce operational costs and moral hazards, thereby helping insurance companies save 25–27% of the premium cost and making agri-insurance more accessible to farmers. |

Table 3: Consolidation of Innovative practices adopted by different Agritech Business in Nepal.

## V. Potential and Challenges of Agritech Business in Nepal:

Agricultural extension services, which need to be robust and complement farming activities, have not been able to perform to their optimum. According to Dhital (2017), major issues found publicly extension systems are lack of motivation among the agricultural youths, farmers; natural resources degradation and global climate change and sustainability issues; the inadequate number of the extension workers and their qualification and skills; inadequate infrastructure and capacity to be used of ICTs among the bottom level extension workers; lack of monitoring and assessment of the impact of extension activities in rural farmers; low level of need- based extension coverage particularly for tiny farmers; ineffective and weak linkages between stakeholders at different levels; low level of education of farmers; insufficient budget and investment for extension activities; domination of supply-driven approaches instead of demand-driven; inadequate extension services in parts of import addition and market exposure. However, these ingrained issues of improper extension services experienced by the farmers could be largely supported by the introduction of agri-tech businesses that operate to assist the farmers with more farmer-focused, decentralized approaches.

Similarly, the rapid boom and availability of the internet and internet and communication technology have opened new gateways for the expansion and rollout of numerous Agritech companies, especially in the agrarian economy. Nepal, slightly on the slower side, is gradually trying to climb the ladder by embracing the idea of the integration of IT in agriculture to reform the conventional system of agriculture that has been practiced since the mediaeval era. The farmers or people interdependent on agriculture for their economies have been still facing numerous issues; however, with the advent of IT and its ease of availability and accessibility in major portions of the country, different organizations can provide assistance to this beleaguered group by perfectly dissecting their pain points. According to Basnet (2017), most of the farmers, traders, or industry processors in Nepal are disgruntled about irregularities and discrepancies in the pricing system of the market. For the time being, this issue can be resolved by setting up a platform that would enhance the market linkages of the product and even foster an environment for easy availability of farm inputs. Similar issues of limited access to technological accessibility can be tackled by adhering to the sophisticated and advanced precision agriculture techniques that are entirely powered by the integration of technology into agriculture. The inconsistencies in quality and large-scale testing pain for farmers can be effectively combated by introducing quality management and traceability methodologies like block chain technology. In the present scenario, most of the major Agritech players have been engrossed in devising solutions to the entrenched complexity of the inefficient supply chain of the country and have achieved satisfying results as well, but their center of attention has been just limited to the farmers circling the major urban market of the country. The other entrenched concern, which is abstaining most of the farmers of the country from conducting agriculture on a regular basis, has been identified as the unavailability of abundant financial resources. Therefore, Agri-FinTech [4]services, which haven't been on the priority list of most Agritech entrepreneurs in Nepal, might witness a rapid surge in the upcoming days as it has been proven to be one of the lucrative sectors to delve into if compared with the Agritech development of neighboring India. The relative influence of the Indian entrepreneurship culture on the Nepalese industry players cannot be disproved or refuted; therefore, seeing the unbridled burgeoning of Agritech sectors in India where major market players like Bijak, BharatAgri, Agricx, Tartan Sense, Ninja Kart, and E-Choupal are in play, addressing the major pain points of the related stakeholders, a conclusion can be drawn that the agri-tech sector in Nepal is on the verge of expansion in the near future. If all this sector can be accounted for, speculations can be clearly drafted for the wider development of agri-tech flourishing in Nepal, which demands the immediate attention of policymakers to facilitate the process and administer the growth of such organizations for agricultural reformation.

### i. Challenges for Agritech Business in Nepal:

**Confidence of the investors**: As this sector is newly blooming with very few players currently competing in the market, it requires arduous efforts for the agribusiness entrepreneurs to convince the investors to be easily onboard on the unique business idea. Similarly, as there are limited investors in Nepal, it is always difficult to secure investments for any firms with disruptive ideas.

[4] AgriFinTech services generally means facilitating agricultural credit systems and maintaining the agricultural accounts of the clients through a technology powered by IT and related software.

**Limited accessibility of technology**: Lack of reliable internet access has a trickle-down effect on farmers. As innovations in Agritech system directly relies to the availability of internet and electrification, connectivity has been more than important than ever. Due to this, it can hinder the acceptance of sophisticated agricultural technology, IoT and data analytics.

**Land fragmentation**: As majority of the land holdings are less than 1 ha in the country, it becomes difficult to implement large scale technological solutions aimed at the farmers and due to high operational costs of usability of the technological services, farmers might be reluctance of using the high-tech solution to address their problem. Innovations has to be made to ideate small scale solutions to assist the existing smallholders' famers pervasive throughout the country.

**Lack of awareness and digital literacy**: Majority of the farmers in Nepal have limited exposure to modern agricultural technologies aimed for better productivity. Due to limitations in understanding of the working mechanism, agri-tech companies have to efforts more to educate and train local farmers regarding the applicability of their technologies which might prove out to be cumbersome in some of the cases.

**Policies of the government:** Although the country has seen digital leaps in terms of broadcasting of information through various social media channels, the government is still to put in place policies aimed at digital revolution within the country. Learnings can be emulated from neighboring country India and national tagline and roadmap on concepts like "Digital Nepal", "Startup Nepal" could potentially help the Agritech entrepreneurs to excel in their envisaged goals.

**Access to finance:** Securing funding for Agritech startups in Nepal can be challenging. As the trend reflects access to capital, especially for early-stage companies, is limited, and attracting investment may require significant effort. Therefore, despite of having an innovative technological solution it might be difficult for the early-stage businesses to sustain their business idea and give it a complete physical form.

**Access to Data**: As the practice of agriculture in Nepal is not that way organized, relevant data related to agriculture in Nepal may be limited, making it challenging to develop data-driven agritech solutions. Most of the agri-tech business operates with data management and forecasting based on the extracted data to inform the farmers about the decision making of their farm, it might be challenging for them. Similarly, coordination is required with multiple agencies to extract reliable data's which is onerous and might deter the business to continue their ideas for long.

**Access to Quality Inputs**: Agritech business in Nepal are motivated to harmonize the backward supply chain of the product. In this regard, to keep the faith and trust of the farmers, rigorous groundwork is required in selection of the suppliers for seed, fertilizers. Therefore, Agritech companies may need to work on improving the supply chain for agricultural inputs.

## VI. Policy and Regulatory Framework:

It is disappointing to say that Nepal has no policy provisions concerning Agritech business establishment and development in Nepal. It can also be largely attributed to the weak voice of the Nepali Agritech startups, which are fewer in number and also don't significantly operate with larger funding. Attempts have not been made till date to devise policies related to Agritech-based startups, which demand plenty of work in the near future. If we compare this context with our neighboring country, India, it has been regularly interested and motivated to assist in the foundational development of Agritech clusters and ecosystems in India. The term Agritech has been in use in the Union Budget of India, where they have considered tech-enabled agricultural solutions to largely benefit smallholder farmers and also effectively combat contemporary issues like food security issues and climate change (Times of India, 2023). Similarly, according to Sharma (2023), Niti Aayog in India has suggested that respective states within the country formulate their respective Agritech policies to promote Agritech-based startups by digitizing the licensing regime, ensuring access to quality data, and providing last-mile connectivity to such startups to expand operations. Such practices have to be replicated and endorsed by relevant policy research institutes, which should impel policymakers to devise such strategies for providing a conducive policy framework and environment for agri-tech business operations in Nepal.

Similarly, Nepal does not possess a concrete policy framework related to the integration of other agri-ecommerce platforms, which have been doing relatively decent business over a period of time. The e-commerce agri-supply elite chain actors are being governed by the Ministry of Industry, Commerce, and Supplies, and the latest e-commerce bill was tabled in parliament for deliberation (Siwakoti, 2023). While the neighboring countries, India and China, instigated giant strides in facilitating the growth of such agri-commerce entities, Nepal still has a long journey to navigate in terms of policy execution and implementation. Most of the policies that have been drafted for the welfare of agriculture and related stakeholders in the country are outdated and need immediate revamping to provide passage for the booming of the tech-integrated agricultural business. Although the Agribusiness Promotion Policy of 2063 has listed to promote development and facilitation of the e-commerce sector, the country still waits for more focused and determined policy development to create an enabling environment for the development of the Agritech ecosystem in the country (National Planning Commission, 2013).

**i. Policy gaps creating Unclarity and Incoherency:**

Arriving at such an advanced stage of digitization and wider interconnectivity between people powered by the tools and accessories of ICT, Nepal doesn't have any formidable plan laid down regarding proper ways of managing the Agritech system in Nepal. If all the latest trends and patterns are scrutinized, it becomes clear that Agritech would completely blanket the way agriculture is being practiced in the country and lead to a paradigm shift in the culture, fostering a digital revolution in the agricultural business. Albeit, the policymakers at this very moment have been living in limbo and are unaware of the complexities that might ensue once such businesses embrace the notion of Agritech start flourishing in the country. There is only one major policy, the Agribusiness Promotion Policy, drafted in the pre-era of the digital revolution, with limited sections talking about fostering the growth of agri-commerce in the country, thereby neglecting the wide array of expansion probabilities of the Agritech ecosystem. For instance, some business organizations, due to incoherency, have been periodically facing major issues during their business functionality, which in turn have been hindering the seamless operation of the business. If we take an analogy to compare the situation with that of neighboring country India, which is also an agriculture-dependent economy, the country has been driven by the wave of Agritech solutions for the predominant farming issues. According to Assem (2020), the Agritech market potential of India through intervention at different discrete stages of agricultural operation nearly accounts for 24 billion US dollars. This can be used as a reference to analyze how briskly the Agritech system can expand its horizons in countries like Nepal, with every bit of life being highly digitalized and even penetration to the people residing at the bottom of the pyramid, the farmers. However, the lack of policy, guidelines, and governmental directives can cause serious issues and evolve as impediments to the successful dispersion of Agritech in the country if not taken seriously.

### ii. Policy Recommendations:

The elaborative briefing of the policy has identified following measures to be promptly carried out in order to create enabling environment for Agritech ecosystem to thrive in agrarian economy like Nepal:

- **Deregulation of Agriculture Produce Market Committee:** The recent deregulation of the Agriculture Produce Market Committee in India has provided the farmers of India large opportunity to directly trade their products to bulk scale buyers without being exploited by the middlemen or the intermediaries, such enactment of new policies and law in India have unleashed possibilities of wide scale operational and rolling out of Agritech enterprises. The government of Nepal might consider such drafting of rules where the monopoly which prevails among intermediaries and wholesalers in the country can get removed which would create an enabling environment for such Agritech business entities to come under operations.
- **Creating a favorable atmosphere for investment:** In the present scenario, many ingenious minds in the country have a handful of ideas related with integration of IT in agriculture, however they have restrained themselves as development of such platform's costs exorbitantly high. In this regard, the government can encourage youths to invest time in such ideas and provide properly channelized funds through different governmental programs and schemes. Similarly, different guidelines related with the international social organization and private sector funding in the Agritech programs needs to be developed which would allure such entities to invest in Agritech digitization for a prosperous and stable economy.
- **Allowing strategic alliance with international apex technology service providers:** The expedition of digitizing Nepalese agriculture cannot be a reality without the assistance of some elite technology provider. For instance, some of the agriculture extension startups which are providing recommendation services to the farmers need support from GIS operators for efficient functioning. In this regard, more lenient guidelines and terms of conditions should be proposed such that those enterprises can induce synergistic effect by forming collusion with the Agritech startups in the state.
- **Regulatory board for Agritech players:** As the notion of IT is ever-evolving and new modifications can be expected in the sector on a regular interval, the rules of business operations can be changing frequently which the Agritech startups might be completely unaware. To avert such awful situations occurring, a governing regulatory umbrella organization can be formed with the panel members selected from different Agritech

enterprises which would operate as per the administrative directives of the government under all considered obligations and legalities.

- **Funding, accelerators and incubators of Agritech business:** The major pain point of the Agritech business is lack of funding opportunities which has been an enduring inhibitor. Therefore, it is more advisable to establish different government operated local Agritech business incubators which could potentially give a complete tangible form to the business idea and continue with their business innovation. If the reports of the fundings received by Trackxn is reviewed, out of the 10 leading Agritech business in Nepal, only 4 have successfully claimed funding from private institutions. Therefore, the government needs to be ensured that the Agritech business with leading business innovation received better financial support and necessary policies on financial support and mentorship support needs to be arranged accordingly.

### iii. Learnings from India’s approach of handling Agritech business: Regulatory insights

In terms of revenue, the global agritech market was valued at US$ 17,442.7 million in 2019 and is projected to reach US$ 41,172.5 million by 2027; it is expected to grow at a CAGR of 12.1% during the forecast period from 2020 to 2027 (The Insight Partners, 2021). nI 2022, India had approximately 450 Agritech startups, with the number increasing by 25% year on year. India's Agritech sector opportunity is valued at US$ 24 billion, with a market penetration of less than 1%. The large disparity between potential and actual value realization suggests a significant opportunity for many new Agritech start-ups, as well as business development chances for current start-ups.

Some of the efforts made by the Government of India in terms of promoting Agritech business are enlisted below: (Adhya & Sahoo, 2022)

1. **Public-Private Partnerships (PPP) for Agritech Start-ups:** The Finance Minister announced that agritech start-ups and companies would be engaged in PPPs to deliver advanced technology solutions to farmers and assist in their implementation. This indicates a commitment to leverage technology for the benefit of the agricultural sector.
2. **Dedicated Grant for Agritech Start-ups:** The government of India is setting up a grant specifically for agritech start-ups. This financial support is designed to encourage innovation and growth within the agritech sector.
3. **Fund for Agriculture and Rural Enterprise:** A fund with merged capital through co-investment is being enabled through NABARD to finance start-ups focused on agriculture and rural enterprises. This fund aims to support various activities, including backing Farmer Producer Organizations (FPOs), providing machinery for farmers on a rental basis, and offering IT-based support.
4. **MSP (Minimum Support Price) Payments:** The government plans to pay INR 2.7 lakh crores directly to wheat and paddy farmers as MSP. This is an essential step to ensure fair prices for their produce.
5. **Kisan Drones (Agricultural Drones):** The government is keen on implementing "Kisan Drones" or agricultural drones for purposes such as monitoring, crop assessments,

digitizing land records, and spraying insecticides. This technology can significantly improve farm management and productivity.

6. **PM-Kisan Yojana:** An estimated INR 6.75 lakh crore will be provided for the PM-Kisan Yojana, which is a direct income support scheme for farmers.
7. **Crop Insurance Schemes:** INR 15,500 crore is allocated for crop insurance schemes to provide financial protection to farmers in case of crop losses.
8. **Krishi Unnati Yojana:** INR 7,183 crore is allocated for the Krishi Unnati Yojana, which aims to promote agricultural growth and innovation.
9. **Rashtriya Krishi Vikas Yojana:** INR 10,433 crore is allocated for the Rashtriya Krishi Vikas Yojana, which focuses on improving agricultural infrastructure and productivity.
10. **Scheme-Price Support Scheme through Market Interface:** About INR 1,500 crore is allocated for a scheme aimed at supporting prices through market interfaces, which can help stabilize agricultural income.
11. **NITI Aayog and IBM Collaboration:** NITI Aayog is partnering with IBM to provide artificial intelligence solutions for developing crop-yield protection simulations. This collaboration reflects the commitment to leverage technology, specifically AI, to enhance agricultural outcomes.

## VII. Way forward: Role of Technology, Segmentation and Opportunities of Agritech business in Nepal

### i. Role of Technology in promotion of agricultural productivity in Nepal

| Issues | Problems as an outcome of the issues in Nepalese agribusiness | Possible solution that can be solved with the help of Agritech business in Nepal |
|---|---|---|
| **Inefficiency of the supply chain** | Recent studies have reported overall postharvest loss of around 20–35% in fruit and vegetables; however, it can reach as high as 50% for some crops (Bhattarai 2018; Gautam et al. 2021). As a result of this, the farmers often receive lesser value for their product which is concerning. | Technology like blockchain can be useful in tracking, traceability to minimize post-harvest losses. In addition, quality controlling tools (like sensors, IoT) can be used to conduct several aspects of quality control with aim to control the post-harvest losses and timely delivery of the products depending upon different physical and chemical properties of the food products. |
| **Market accessibility** | The middlemen also often referred as the intermediaries control the supply chain of the product, and act as a moderator of the price. | Evolving Agritech business in Nepal strive to connect the farmer's produce directly harvested from the farms to the consumers with transparent supply chain, which results in fair |

| | | |
|---|---|---|
| | | renumeration to the farmers and also decent price to the consumers. |
| **Access to useful farm inputs** | In general, scant technology, inputs, and services for farmer increase the cost of productivity in Nepal (UNCDF, 2021). Due to small land holdings of the farmers, farmers often face issues of low agricultural inputs or poor-quality products. | Agritech startups following the business model of Farming as a service can be handful in such case to provide sophisticated machinery and farm equipment. Water use efficiency and crop water use efficiency can also be enhanced with the help of different soil moisture detection sensor to overall help in optimally using the available resources for maintaining agricultural productivity. |
| **Agri-extension and advisory services to alleviate risks and combat issues of climate change** | The smallholders' farmers are deprived of information related with the weather forecasting, access to insurance and crop management during cultivation.<br>Limited uptake of climate-resilient agricultural practices, such as zero-tillage and organic farming, in order to address climate-related challenges. | Remote assessment of the soil nutrient levels to boost the productivity. Remote monitoring of the weather-related climatic parameters, also constant observing of essential parameters during farming purposes. |

### ii. Segmentation of Agritech Industries and avenues that can be explored in Nepal:

In general, Agritech business encompasses a broad set of business operating ranging from downstream Agritech to upstream Agritech. Particularly, in case of Nepal, there are still many segments of the Agritech business which has been left uncharted. The range of Agritech business that has potential to grow in nearby future are detailed below:

a. **Downstream Agritech:** This type of Agritech business is more prominent in Nepalese Agritech business ecosystem at present. They aim to directly connect the farmers with business or consumers in B2B or B2C models. As the penetration of the internet services is on rise in Nepal among the consumers, such business could have wider scope in the future, if management sustainably and ethically.
b. **End to end ecosystem:** These form of Agritech business have strong presence throughout the entire value chain of the agricultural activities from input supplies, advisory, credit financing, to ensuring market for the products of the farmers. Till now, there are limited

Agritech companies that have adopted to this model, however companies like Kheti are close to adopting these models in serving the farmers throughout the value chain. Considering the small land holding of the farmers in Nepal, these types of Agritech business has true potential of thriving in days to come as it supports the farmers at all discrete stages of the value chain of the product increasing their productivity thereby increasing the profitability.

**c. Precision Agritech:** Precision Agritech provides support through precision management in application of the inputs to the farmer's field. Due to the laggardness of technological adaptation in Nepal, such business is finding it difficult to thrive as still the farming system in the country is traditional, labor intensive and geographical constraints.

**d. Agribiotech:** On the face of climate change and its threats, advancements are the agribiotechnology has been paramount and the rise in the Agribiotech firms in the country developing resilient and new products validates it as well. Such Agritech business in Nepal are thriving and also receiving good support from Investors and government institutions and has potential to expand in Nepal.

e. **Upstream Agritech:** On contrary to the downstream Agritech business modality, these agribusinesses are the platform for input linkages, which provides quality seeds, agrochemicals and different nutrition to the individual farmers. In practice, there are limited Agritech business like this, however players involved in end-to-end ecosystem and Agro-advisory services are providing this platform to farmers in Nepal.

f. **Agricultural mechanization and automation:** This type of Agritech startups attempt to connect farmers who are in need of agricultural mechanization support through internet. Also, these types of Agritech business provides farmers with mechanized solutions like drones for fertilizers spraying or tractors in hiring basiss. This type of Agritech business have scope of expansion in Nepal, however, it has not been able to gain attractiveness currently in Agritech ecosystem of Nepal.

g. **Agriculture fintech**: Agrifintech service providers support the rural farmers and related farming stakeholders with credit assistance for certain duration of time. Due to regulatory constraints, there have been no informal financing mechanism as such, however it can be a prospective business idea which can flourish in coming years as majority of the smallholder farmers laments of not receiving sufficient financial assistance.

### iii. Opportunities of Agritech business in Nepal:

a. **Dominance of smallholder farmers:** Smallholdings account for 84% of the world's 570 million farms and also majority (70%) of the land holdings in Nepal is less than 1 ha. It's extremely difficult for the governmental efforts to reach all of these dispersed farmers and provide them assistance with aim to enhance productivity. Establishment of Agritech business would ensure all of the smallholder farming communities even at the remotest location are properly served under expert guidance. It also improves the access to loans, inputs, and other essential agro-extension services effectively received to the farmers. The farm profitability can be increased with the market assistance support provided to the farming community by such Agritech business.

b. **Consequences of the climatic unpredictability:** As an outcome of the threats imposed by the climate change, agriculture has been more precarious. Crop production is affected biophysically by changing meteorological variables, including rising temperatures, changing precipitation regimes, and increasing levels of atmospheric carbon dioxide (Kaiser, 1991). In this context, with the advancements of the tools like AI and GIS (Geographical Information System), advisory services based on this remote sensing techniques to assist the farmers could potentially thrive in the country.

**c. Adoption of the mobile phone and internet services:** The availability of the internet services in the remotest location of the country and the use of the mobile phones among the farmers has evolved out as the positive prospect in the adoption of the services provided by Agritech business. The unique and innovative solution offered by the Agritech services could easily reach out to the farmers with high adaptability of internet services.

**d. Altering consumer behavior:** The shift of consumer focus towards more clean, green and sustainably sourced food products due to urbanization has given a platform for agri-ecommerce to work on the forward downstream supply chain model where they source the products responsibly from the farmers and supply it directly to the consumers. Due to this, there is wide scope for Agritech business to work on the traceability and supply chain aspects of the produced goods by proper coordination with local farmers. As of now, Nepal has seen major rise in such Agritech business and these is further expected to increase in future.

**e. Support from government and incubators:** The increasing penetration of internet and the service industry developing as a result of that has attracted the attention of the policy makers. In these aspects, newly drafted policies focused on the bringing agri-tech revolution can be expected. The interest of government to increase the number of Agritech related business, development of business incubators like NABIC and another private sector’s incubator could play essential role in emergence of Agritech Startup in Nepal.

## VIII. Conclusion

The issues confronted by the Nepalese agricultural system within the value chain could be effectively optimized with the emergence of Agritech businesses. Agri-tech businesses have been proven successful in improving the supply chain and facilitating productivity among farmers through various services. However, this requires assistance and support as the progress of the development of such industries is still in the nascent stage. The necessary support provided by the government through incentives, funding, and other supplies of resources will encourage them to be innovative in successfully dealing with a multitude of the issues entrenched in modern agriculture. In a country like Nepal with a scattered small-holder farming population, Agritech can play a crucial role in input and information flow among the farmers and also play an essential role in bypassing intermediaries and providing fair remuneration to the deserving farmers. Agritech startups have been playing a decisive role in educating the farmers and supporting their decision-support systems through curated information flow. Quality management and quality assurance for consumers have been properly handled with the use of advanced technologies like block chain technologies. With the Agritech sector being a new entry in the agribusiness ecosystem, it has tremendous potential to prosper alongside the individual farm businesses of the farming communities in the country through innovative business models.

Similarly, the penetration of the internet in Nepal is gradually in the phase of digitization, and prime moves in the development of policies to facilitate the growth of Agritech sectors need to be instigated as soon as possible. The fragmented and distorted agricultural value chain, beginning with production until the marketing and supply chain, can be made seamless, benefiting all related stakeholders, if guidelines and policy directives are drafted and implemented in the country. Nepal carries immense possibilities to revitalize its economy through advancement in the agricultural system; however, the impetus for successful amelioration is only within achievable limits in cases where policy execution and an enabling environment are regarded as vital attributes. Therefore, it becomes paramount for policymakers to consider this situation and work on documenting an effective policy that would be inclusive in order to incubate the growth of the Agritech players in the country, creating an atmosphere where the country's agriculture economy, aided by digitization, can propel to endless limits.

## References


Adhya, P. S., & Sahoo, S. K. (2022). Agritech Startups in India: A Revolutionary Idea Giving Birth to Agripreneurs. *INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN TECHNOLOGY, 9*(5), 687-702.

Assem, M. (2020). Agritech - towards transforming Indian Agriculture. *Ernst and Young LLP*, 2-53. Retrieved from assets.ey.com/content/dam/ey-sites/ey-com/en_in/topics/...

Basnet, K. (2017). *Middlemen hike veggies prices, not farmers: Market observers*. myRepublica. Retrieved from https://myrepublica.nagariknetwork.com/news/middlemen-hike-veggies-prices-not-farmers-market-observers/

Bhattarai DR (2018) Postharvest horticulture in Nepal. Hortic Int J 2(6):458–460

Central Bureau of Statistics. (2013). National sample census of agriculture Nepal 2011/12

Dhital PR. (2017). Agriculture extention in nepal: Experience and issues. Journal of Advances in Agriculture 7:1071–1082. doi: 10.24297/jaa.v7i3.6287.

Gauchan, D. (2018). Agricultural Development in Nepal: Emerging Challenges and Opportunities. *Discourse in Nepal's Development*, 212-240.

Gautam DM, Bhattarai DR, Acharya UK (2021) Postharvest management of horticultural crops in Nepal. Paper presented in national horticulture workshop. 6th Feb 2019. Kirtipur, Kathmandu, Nepal

Gautam, N. (2020). *New Opportunities in Agriculture*. New Business Age. Retrieved from https://www.newbusinessage.com/MagazineArticles/view/2674

GC, R. K., & Hall, R. P. (2020). The Commercialization of Smallholder Farming—A Case Study from the Rural Western Middle Hills of Nepal. *Agriculture-MDPI, 10*(5), 1-16.

Gyawali, P., & Khanal, S. (2021). Overview of Agriculture in Nepal: Issues and future Strategies. *Fundamental and Applied Agriculture, 6*(3), 323-335.

ILO. (2019). *EIGHT WAYS TO GROW NEPAL'S AGRICULTURAL SECTOR.* International Labour Organization.

K.C, S. K., & Timalsina, A. K. (2016). Challenges for Adopting E-Commerce in Agriculture in Nepalese Context: a case Study of Kathmandu Valley. *Proceedings of IOE Graduate Conference*, 305-312.

Kaiser, H. M. (1991). Climate Change and Agriculture. *Northeastern Journal of Agricultural and Resource Economics, 20*(2).

Krishna, H.S. (2018). Entrepreneurial learning and Indian tech startup survival: An empirical investigation. Asian Journal of Innovation and Policy, 7(1), pp.55-78.; https://doi.org/10.7545/ajip.2018.7.1.055

Lamichanne, R. (2020, September 28). Why the agriculture supply chain couldn't be saved https://tkpo.st/3jb8Nwj. Kathmandu.

McKinsey and Company. (2022). *Global Farmer Insights 2022*. Retrieved from https://globalfarmerinsights2022.mckinsey.com

Mishra, R. P., & Paudel, I. H. (2023). Agribusiness and Supply Chain Development Policies in Nepal: A review from Temporal Dyanimcs. *Nepal Public Policy Review, 3*(1), 141-168.

MOF (2022) Economic Survey 2021.

Moharekar, T. T. (2022). ROLE OF AGRITECH START-UPS IN INDIA. *Journal of the Maharaja Sayajirao University of Baroda*, *56*(1), 23-29.

National Planning Commission. (2013). *Collection of Nepal Agriculture Policies Nepali*. Government of Nepal.

National Statistics Office. (2023). *National Sample Census of Agriculture*. Kathmandu: National Statistics Office.

Nepal Rastra Bank. (2022). *Current Macroeconomic and Financial Situation in Nepal*. Kathmandu: Nepal Rastra Bank.

Pokhrel, D. M., & Thapa, G. B. (2007). Are marketing intermediaries exploiting mountain farmers in Nepal? A study based on market price, marketing margin and income distribution analyses. *Agricultural Systems, 94*(2), 151-164.

Sharma, Y. S. (2023, April 20). *NITI Aayog suggests states to formulate specific AgriTech policy to promote start-ups* . Retrieved from https://economictimes.indiatimes.com/news/economy/agriculture/niti-aayog-suggests-states-to-formulate-specific-agritech-policy-to-promote-start-ups/articleshow/99642164.cms

Siwakoti, S. (2023, August 4). *Imperative of E-Commerce Legislation in Nepal*. Retrieved from https://myrepublica.nagariknetwork.com/news/imperative-of-e-commerce-legislation-in-nepal/

Štefan, S., & Richard, B. (2014). Analysis of Business Model. *Journal of Competitiveness, 6*(4), 19-40.

The Insight Partners. (2021, Feburary). Retrieved from https://www.theinsightpartners.com/reports/agritech-market

The Kathmandu Post. (2020). *Structural Bottlenecks*. The Kathmandu Post. Retrieved from https://kathmandupost.com/editorial/2021/01/04/structural-bottleneck

Times of India. (2023, January 28). *Union Budget: Agritech industry seeks Centre's support through newer policies* . Retrieved from https://timesofindia.indiatimes.com/business/budget/union-budget-agritech-industry-seeks-centres-support-through-newer-policies/articleshow/97401268.cms?from=mdr

TrackXn. (2023, June 23). *AgriTech Startups in Nepal*. Retrieved from https://tracxn.com/d/explore/agritech-startups-in-nepal/__vVR-XvgpyN7GOCc3u4u6Xi6nuo4mM8Sq2i2Ty193KdU/companies

UNCDF. (2021, Janurary 29). *Improving Smallholder Farmer's Productivity and Income with Digital Innovations*. Retrieved from https://www.uncdf.org/article/6470/improving-smallholder-farmers-productivity-and-income-with-digital-innovations