



# The Value Chain and Sustainable Efficiency of Industrial Potatoes Through an Entrepreneur

Kawan SIRWAN\*, Rezhen HARUN

Department of Agribusiness and Rural Development, College of Agricultural Engineering Sciences, University of Sulaimani, Sulaimani City, 46001, Kurdistan Region, Iraq

\* Corresponding author: K.Sirwan e-mail: kawan.ismael@univsul.edu.iq

## RESEARCH ARTICLE

### Abstract

This research was driven by the need for sustainable and efficient farming, productivity, and market expansion. This study mapped the industrial potato value chain, identified key stakeholders and their responsibilities, and assessed value chain linkages. This case study employed purposive sampling. The industrial potato value chain includes input suppliers, producers, processors, traders, and consumers, according to the research. Agricultural entrepreneurs are vital to the industrial potato value chain. He chose the Sharazur Plain, Kalar City, and Penjwin districts of Sulaimani Governorate in Iraq's Kurdistan Region for industrial potato production. Additionally, the entrepreneur has entered into agreements with Green Iraq Company as a processor, input supplier, and a chain supporter of the industrial potato value chain. The company has a significant role in enhancing producers to produce industrial potatoes, Lay's Chips is manufactured by a company in Sulaimani governorate/Bazian region. The study demonstrates that the implementation of contractual agreements may lead to a win-win situation for all parties involved. This reduces the farmer's risk by promoting cultivation and guaranteeing the firm has enough raw materials for processing. According to this study, universities, research centers, and agricultural departments have no role in the industrial potato value chain.

**Keywords:** industrial efficiency, sustainable value chain, value chain mapping, entrepreneurial


Received: 08 November 2023

Accepted: 06 March 2024

Published: 15 May 2024

DOI:

10.15835/buasvmcn-hort:2023.0027

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## INTRODUCTION

The value chain is a high-level representation of the processes by which firms take in raw materials as input, add value to the raw materials through various techniques, and then sell completed goods to customers (Akyüz et al. 2023; Tadesse, and Bakala, 2018). The value chain provides comprehensive information on the production process, from the original production and producers to the final uses and consumers (Hellin and Meijer, 2006). Additionally, there are several market actors along the value chain, including input suppliers, farmers, processors, wholesalers, retailers, transporters, and customers (Jin and Gao, 2023). Due to the socioeconomic advantages they bring to individuals, agriculture and associated food items are frequently seen as a strategy to promote regional economies and economic actors (Bonadonna et al., 2022). Furthermore, agriculture is one of the most critical pillars for guaranteeing food security (Hudhud et al. 2015; Neima et al. 2021; Neima et al. 2023). The potato is the most important root and tuber crop in the world (Wubet et al. 2022; Manuela et al. 2019). The potato (*Solanum tuberosum*) originated in South America in the region surrounding Lake Titicaca, which is close to the current boundary between Bolivia and Peru (Bekele, 2017; Ugonna et al. 2013). Due to its significant relevance as a source of nutrition and income, potatoes continue to be an essential crop for the rural population's

livelihood (Taïy et al. 2016; Gildemacher et al. 2009). The majority of the world's producers and distributors of potatoes and potato-related goods now are in developing countries (Lutaladio et al. 2009). Potatoes may be used for several purposes once they are harvested, including: as a fresh vegetable for domestic cooking, as a starting point for manufacturing food products, food ingredients, starch, and alcohol, as animal feed, and as seed tubers for planting the next crop seasons. The market is constantly shifting away from fresh tubers and toward processed goods all across the world (Chancharoenchai et al. 2022). All four components of food security availability, access, utilization, and stability can be supported by the sustainable cultivation of potatoes (FAO, 2022).

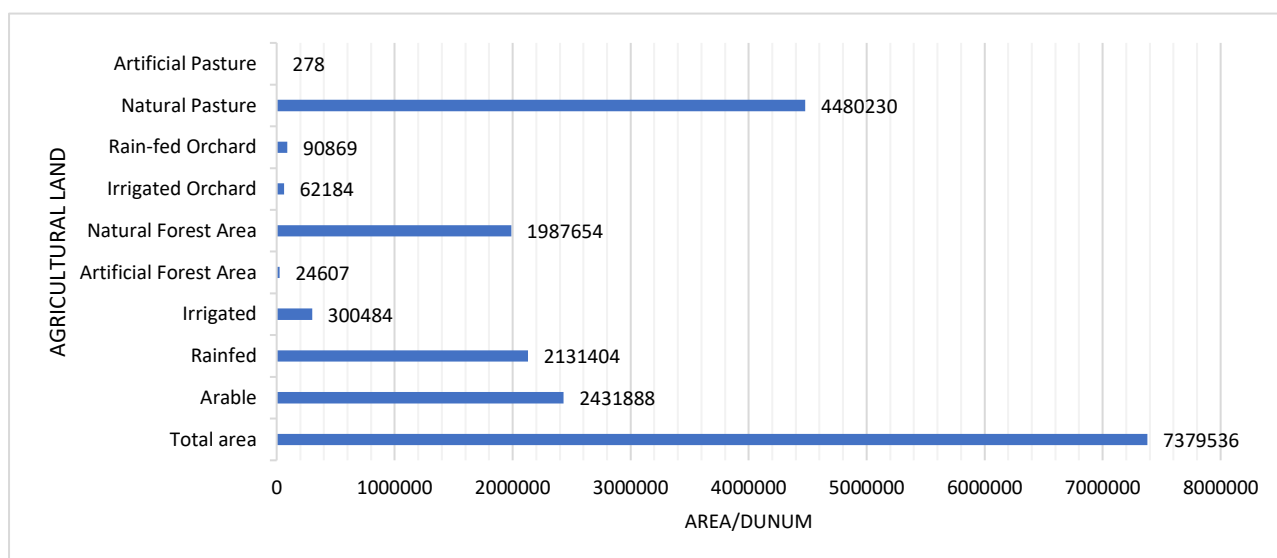
The likelihood of achieving agricultural adaptation to address the future food production problem is low without the implementation of more advanced and efficient strategies for focusing on technological and institutional interventions (Thornton et al. 2018). Therefore, potatoes can serve as a valuable indicator for assessing the possibility of sustainable rural development, particularly considering the potential for market growth and the current high prices of grains in the global market. (Yang et al. 2019).

This topic is exploratory, Nowadays, demand is steadily expanding. With the continuous increase in demand and a change in the lifestyle and food of consumers, we consider that the industrial potato planting process is taking a good direction. The objective of this study was to conduct a comprehensive analysis of the industrial potatoes value chain, with a specific focus on mapping out the major actors involved, their respective responsibilities, and the interconnections within the chain. The primary purpose was to map the value chain of industrial potatoes within the designated study area. Food and Agriculture Organization of the United Nations, 2021 conducted a value chain study on wheat, tomatoes, grapes, and dates in Iraq. However, because this is the first time the value chain of the industrial potato crop in Iraq and the Kurdistan Region of Iraq has been researched, this study is regarded as the original contribution. Although this is a new topic, we preferred this entrepreneur's work in this study to build an excellent foundation and an accurate map of the value chain for the industrial potato crop and to let farmers view their work as a large enterprise.

## MATERIALS AND METHODS

The study was carried out in the rural districts of Sulaimani Governorate, Kurdistan Regional of Iraq, in the northern part of the Republic of Iraq. The climate of the Kurdistan region is semi-arid, with very hot and dry summers and cold and rainy winters. This region's temperature ranges from (-5 to 48°C) and varies from plain south to hilly north. The average annual precipitation varied from 400 to 1000 millimeters (Amin and Amin, 2020; Tahir, and Rashid, 2023). According to weather statistics of Sulaimani governorate in 2020. The rainfall was 739.7 mm, humidity was 48.78%, and the average temperature in the Kurdistan Region was 21.16 degrees Celsius in the same year. In this research, the unit of area measurement used was the "Iraqi dunam," equivalent to 2500 square meters (0.25 hectares).

The Kurdistan Regional Government's Ministry of Agriculture and Water Resources reports that the agricultural land area in Sulaimani governorate is around 7379536 dunums, Figure 1.



**Figure 1.** Agricultural land area/ dunum in Sulaimani Governorate. Source: KRSO, 2023

Additionally, surface water, including lakes, rivers, natural springs, karez, and groundwater are the governorate's primary water resources. Internal sources of water are significantly more numerous in Sulaimani Governorate than external sources, which mostly come from Iran (Tahir and Rashid, 2023). According to the

Kurdistan Region Statistics Office, 2023, 82.67 percent of natural springs were dried for different reasons, and there were only 48 continuous springs in 2016. In 2022, out of a total of 1075 springs, 1052 springs had an uncertain present status, 14 springs were dry, and only 9 springs were classified as continuous in the Sulaimani governorate as shown in Table 1.

**Table 1.** Number and type of springs in Sulaimani governorate

Years	Number of springs	Number of dry springs	Number of continuous springs
2013	310	152	158
2016	277	229	48
2022	1075	14	9

Source: KRSO, 2023

Correspondingly, karez (subterranean aqueducts) in different places also called qanats, aflaj, foggara, khettara, and other names, it is designed to collect groundwater and direct it to surface canals that supply water to cities and agricultural areas via a subsurface tunnel with a moderate slope (Lightfoot, 2009). Table 2 shows that out of the total 1357 karez, only 235 are continuous, which accounts for a rate of 17.3%. The present status of the 815 karez is uncertain.

**Table 2.** Number and type of karez in Sulaimani governorate

Years	Number of karez	Number of dry karez	Number of continuous karez
2013	1186	241	272
2016	1241	1026	215
2022	1357	307	235

Source: KRSO, 2023

In 2021, the number of agricultural wells in Sulaimani governorate was 4138. This accounted for 36% of the governorate's total wells (11482). The number and type of wells in Sulaimani governorate are demonstrated in Table 3.

**Table 3.** Number and type of wells in Sulaimani governorate

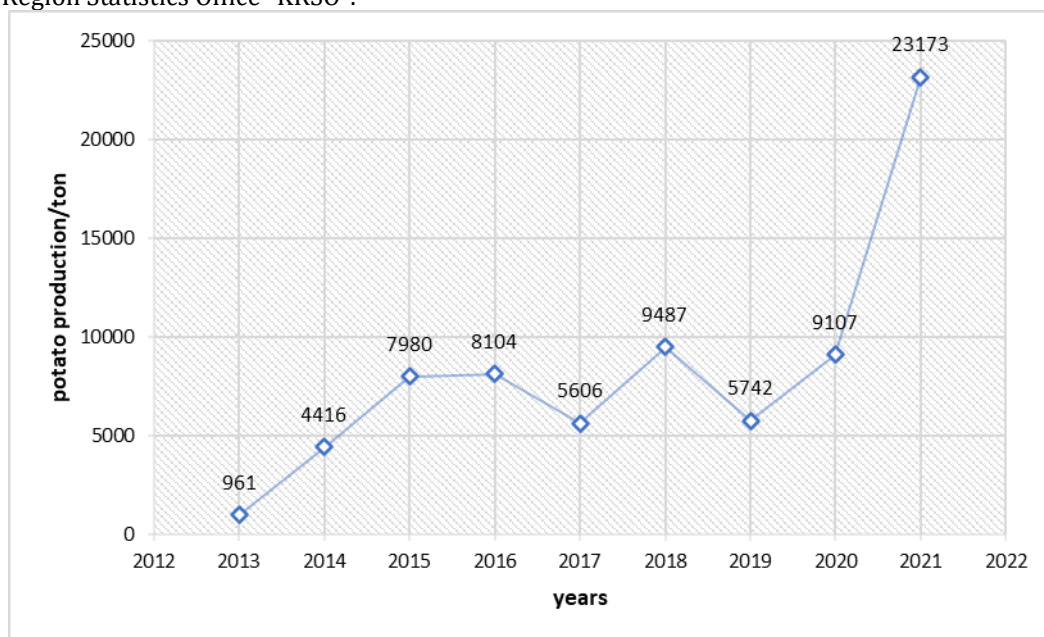
Years	Drinking water well	Agricultural well	Well of industrial projects	The total
2013	6283	3347	524	10154
2016	6566	3889	630	11085
2019	6639	4053	655	11347
2021	6677	4138	667	11482
2022	3891	4433	3713	12037

Source: KRSO, 2023

The last decade has seen spectacular growth in the production of potatoes in the Kurdistan Region of Iraq; Sulaimani governorate's contribution to this growth was swift and notable, occurring in just three years. This is due to several factors, the most significant of which are the political, economic, and social conditions following Covid 19, the Kurdistan Regional Government's policies aimed at diversifying income streams, the governorate's favorable climate for potato farming, the establishment of the Green Iraq Company, for the Lays chip production. Figure 2 illustrates the Sulaimani Governorate potato production from 2013 to 2021.

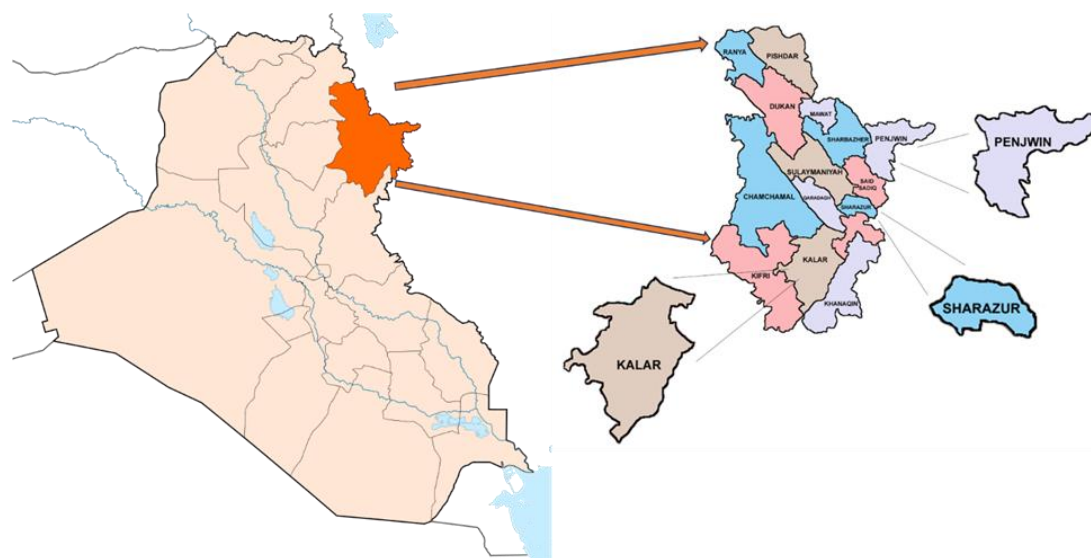
Furthermore, the Sulaimani governorate population is expected to be 2,039,685 people, while Sulaimani City's urban population was estimated to be 829,245 in 2015 (Neima et al. 2021). The study was carried out between May to December 2022 in Sulaimani governorate. Three areas were chosen based on selected areas for industrial potato

production by the agricultural entrepreneur, The areas are “Sharazur Plain, Kalar City, and Penjwin districts” as shown in Figure 3. Both qualitative and quantitative methods were used in this study. The primary data for this study were collected from the farmers, agricultural sales supervisor of Green Iraq Company, input suppliers, and wholesalers. Data were collected using face-to-face interviews (FTFI), and observation. The secondary data were collected from the Ministry of Agriculture and Water Resources of the Kurdistan Region Government, and the Kurdistan Region Statistics Office “KRSO”.



**Figure 2.** Evolution of potato production in Sulaimani Governorate from 2013 to 2021  
Source: KRSO, 2022

This study is a survey “case study”, This study employed purposive sampling techniques. Not an experiment in the laboratory, which is appropriate given the nature of the research. In this study, a single complicated case study was employed to thoroughly analyze a single topic. There is no set formula to determine the sample size for various research projects. Various researchers decide on the sample size based on the study's objectives (Wubet et al. 2022). All three types of case studies were applied in this study which are exploratory, descriptive, and explanatory. The research methodology used in this study was a mixed method. To gather primary data from a wide range of primary stakeholders, semi-structured interviews (SSIs) and key informant interviews (KIIs) were conducted.



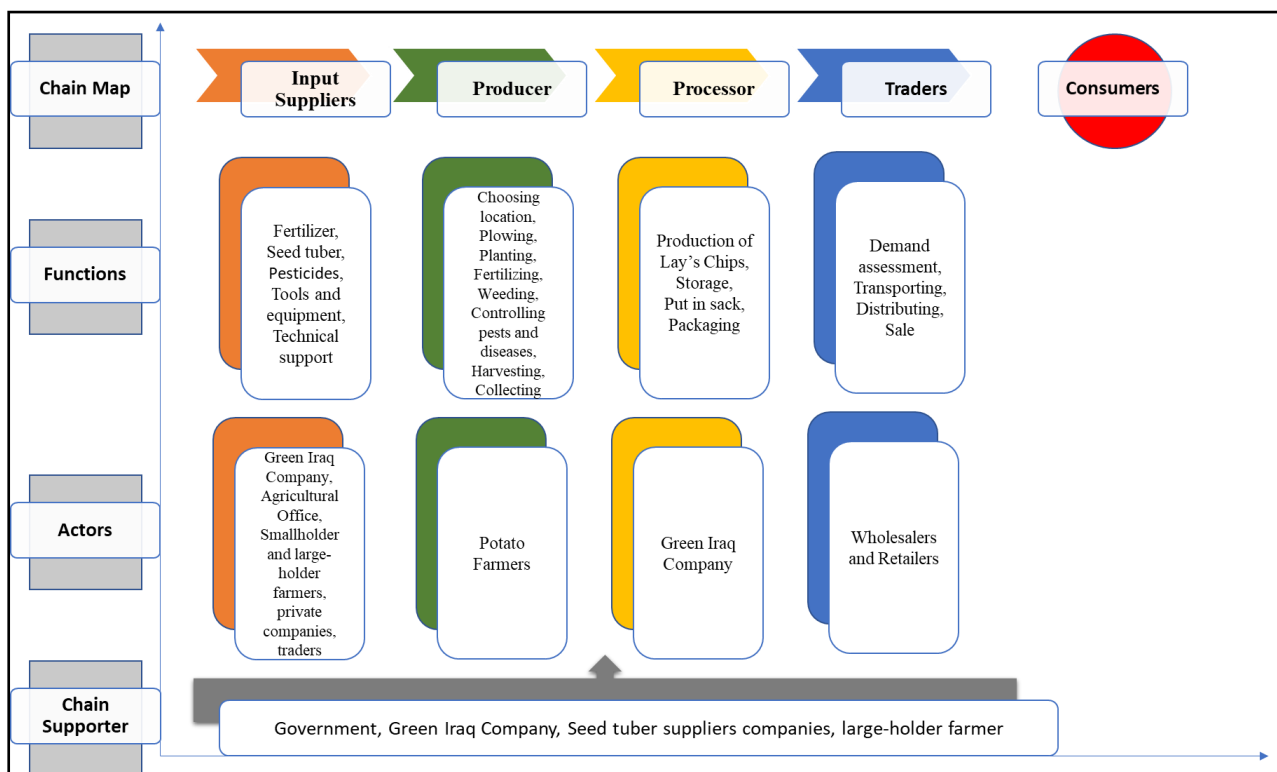
**Figure 3.** The map of study locations in the Sulaimani governorate.  
Source: Retrieved from (Fassbinder and Aşandulesei, 2016)

Data collection was conducted via in-person interviews from May 2022 to October 2023, with further follow-up visits and communication by mobile phone. The SONY ICD-PX470 Stereo digital voice recorder was used for conducting interviews with those involved. The secondary data were obtained from the Ministry of Agriculture and Water Resources of the Kurdistan Region Government, as well as the Kurdistan Region Statistics Office (KRSO). Thematic analysis was used in this research as a tool to organize, evaluate, and present qualitative data by discovering patterns and themes. It offers a systematic framework for analysis across many domains, especially in the field of social science.

## RESULTS AND DISCUSSIONS

### Value chain map

Value chain mapping is the process of illustrating the chain visually (Bekele, 2017; Daniso et al. 2021; Pisanelli et al. 2023). According to experts, the utilization of value chain mapping within the context of value chain analysis has been shown to enhance operational efficiency and reduce waste by a significant margin of 57% (Chofreh et al. 2019). Besides, when studying trade policy, it is crucial to take into account the value chain map (Giovannetti and Marvasi, 2016). Also, a value chain map for industrial potatoes was created to identify value chain actors, their connections, and the transactions that take place between each actor (Chumaidiyah, 2017; Wang et al. 2019; Hidayati et al. 2021). Accordingly, it involves several linkages between the industrial potato farmer, input suppliers, processors, logistics service providers, transporters, intermediaries, and traders. Thus, the value chain map shows the movement of industrial potatoes through the market, the tasks performed at each level of the value chain, the roles and responsibilities of those involved, and the assistance provided during the value-adding process. Figure 4 shows a map of the industrial potato value chain in the study's area.



**Figure 4.** Value chain map of the industrial potato in the study's area

### Functional role of Actors in the value chain of Industrial Potato

In the study area, the following main actors in the value chain for industrial potato production were identified: input suppliers, producers, processors, traders, and the ultimate users. The actors in the value chain map, their roles, and the connections between them in the study area are all illustrated below. The producer (potato farmer) was the focus of the study, followed by input suppliers in the backward, and processors, traders, and consumers in the forward.

#### Producer (potato farmer)

Producers were the actors who did everything from agricultural input preparation to product marketing (Awoke and

Molla, 2018). Farmers' contributions to the production of potatoes are essential in the industrial potato value chain. The agricultural producer/farmer was found to perform the most important function in the entire chain. Choosing a good location for a farm, the operation of the expert farmers, land plowing, seeding, applying fertilizer, cultivating, weeding control, chemical spraying, harvesting, and postharvest management were the primary operations in production.

The selection of an appropriate location for a farm is a fundamental responsibility of the entrepreneur. The individual in question is an entrepreneurial farmer hailing from the Penjwin district, engaged in agricultural pursuits. Due to his contractual agreement with Green Iraq Company, he does not solely depend on cultivating industrial potatoes in the Penjwin district. Consequently, he engages in the practice of leasing agricultural lands in many geographical areas, such as the city of Kalar and the Sharazur Plain. Hence, he can experience agro-climatic zoning due to the diverse climatic conditions prevalent in the aforementioned zones, as seen in Table 4. According to the producer, an additional factor contributing to the selection of diverse places is the fatigue experienced by Penjwin, which is accompanied by limited land, insufficient water resources, low agricultural productivity, and a prevalence of weeds.

The entrepreneur supervises around 3,000 dunums of land dedicated to industrial potato production. This land is distributed among three distinct regions, namely Kalar City, the Sharazur Plain, and the Penjwin District, with areas of 175, 2000, and 750 donums respectively. The planting density of industrial potato seed tubers varies between 700 kg and 1 ton per dunum of land area, dependent on factors such as tuber size, environmental conditions, and soil type. In the Kalar City, the Sharazur Plain, and the Penjwin area, the quantities of crops planted were recorded as 185, 1750, and 535 tons, respectively. Conversely, the quantities of crops harvested in these regions were documented as 950, 13,000, and 7,000 tons, respectively. Furthermore, the industrial potato output in the region of Kalar City was adversely affected by inclement weather conditions, particularly excessive rainfall. The output levels in Sharazur Plain and Penjwin District were quite satisfactory. The entrepreneur states that a total of 2,500 tons of Penjwin District output is used to replant the Sharazur plain. As illustrated in Table 4.

Relying on professional farmers to cultivate their fields is an additional strategic approach employed by this entrepreneur. The entrepreneur is compelled to depend on contractual farmers due to the inherent limitation of being physically present in all of his fields simultaneously. Currently, potato crops are being planted on his behalf in the Gokhlan/Penjwin district. The entrepreneur expressed concerns over the possible adverse effects on his firm that may arise from the recruitment of persons who lack specialized expertise. He has effectively contributed to the expansion of employment opportunities within the regions where his operations are conducted. Consequently, the labor force engaged in various agricultural activities, including soil preparation, sowing, fertilizer application, spraying, and machinery operation, predominantly comprises male workers. Conversely, in the specific context of potato gathering and packing within agricultural fields, the majority of workers involved are women. According to the (World Bank, 2023), the agricultural sector has a higher efficacy, ranging from two to four times, in boosting the income levels of the poorest people when compared to other sectors.

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**Table 4.** Locations and areas that the entrepreneur planted in. **Planting (Green color)** and **harvesting (Brown color)** dates according to the cultivated areas. planted amount and harvested amount/tones of industrial potato by an entrepreneur

Districts	Planted Areas/donum	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Planted amount/Ton	Harvested amount/Ton
Kalar city	175					15-20 May to Jun							Dec	185	950
Sharazur Plain	2000	15 Jan – 15 Mar.					15-20 Jun. to Aug.							1750	13000
Penjwin district	750						15-20			Sep. to Nov.				535	7000

Source: Face-to-face interview with the entrepreneur

Plowing is another agricultural activity undertaken by farmers, wherein the entrepreneur in this designated study engages in plowing the ground during the autumn season in preparation for subsequent rainfall and subsequent weed control throughout the chilly winter period. The entrepreneur employed certain varieties of industrial potato seed, such as commercial name LADY ROSETTA, COROZO, and HERMES. LADY ROSETTA proved to be the cultivar that exhibited the highest productivity and resistance to diseases. The cultivar known as LADY ROSETTA has greater adaptability to cold semi-arid regions. The entrepreneur strategically cultivates it in the Penjwin district and Sharazur Plain. COROZO and HERMES tuber seeds are a variety known for their higher heat tolerance. The farmer often cultivates all three potato varieties throughout all locations, focusing on the distinctive features and ripeness of each variety. Moreover, Lady Rosetta is a cultivar that exhibits moderate earliness and high productivity, particularly in terms of its crisping characteristics. This particular cultivar exhibits elevated amounts of dry matter and reduced sugar content throughout the early stages of the growing season. Lady Rosetta cultivates tubers that exhibit a high degree of uniformity in their round shape with the red color skin, the Netherlands is the country of origin. While the HERMES cultivar is characterized by its intermediate maturation period and good crispness. The cultivar in question has a high production potential and demonstrates strength against scab, heath, and drought, has yellow-colored skin, and the country of origin is Austria.

As demonstrated in Table 4. The cultivation periods of industrial potatoes exhibit variations, with the Sharazur Plain area seeing a distinct growing season that does not extend to the Penjwin district. The process of sowing seeds in Kalar City typically starts in December, with the subsequent harvesting of industrial potatoes taking place in the middle of May. Moreover, the planting dates in Sharazur Plain may vary between the 15th of January and the 15th of March, contingent upon prevailing weather patterns. The harvesting of industrial potatoes is scheduled to take place between June 15th to 20th through August. On the other hand, planting activities for industrial potatoes are conducted inside the Penjwin district from June 15th to 20th. The harvesting dates took place between September and November according to the climate conditions. Penjwin district is designated as a mother by the farmer to carry and replant the industrial potato seeds in Sharazur plain. Thus, the entrepreneur can supply the processor with industrial potatoes over the period spanning from mid-May to November.

The producer uses appropriate agricultural processes, ensuring the application of pesticides and the feeding of plants are conducted with precision in terms of farming techniques, dosage, and concentration. Chemical fertilizers are utilized when necessary. The potatoes undergo inspection by the firm on the farm. If the item successfully undergoes inspection, it will be thereafter conveyed to the designated facility. Conversely, if the item fails to meet the inspection criteria, the entrepreneur will proceed to transport it to the wholesale market or explore alternative avenues for its sale. Hence, the utilization of contractual agreements would be beneficial for the farmer, provided that there is a minimal presence of inferior commodities and a low discount rate (Huang et al., 2019).

### Input suppliers

From this case study, we were able to confirm that, Agricultural Office, Smallholder and large-holder farmers,

private companies, and traders are considered as input suppliers. They functioned as input providers for the production of industrial potatoes. There are local largeholder companies that have contracts with international companies to supply raw materials such as potato seeds, fertilizers, and pesticides. They are agents of global companies, which in turn supply raw materials to agricultural offices or directly to farmers.

The entrepreneur in this case is a large holding farmer who owns a huge amount of land in different areas of Sulaimani, hence he has established an agricultural office. He meets almost all of his requirements at his agricultural office, and he employs many other farmers, some of whom he has given land in shares and others whom he hires. The farmer owns a plant in Penjwin that makes plastic boxes, as well as a factory that makes pipes and T-tapes used to construct irrigation systems in the fields.

There exist several obstacles to the importation of potato seeds since the authorization to import such seeds is exclusively granted to certain local large-scale agricultural enterprises. The Green Iraq Company is partly dependent on a contractual entrepreneur, who was the primary subject of this study, for the provision of industrial potato seeds to smallholder farmers. These seeds are produced on the entrepreneur's farms located in the Penjwin district. Moreover, the entrepreneur stated that the seeds sowed in the Sharazur Plain, totaling 1750 tons, were successfully harvested in the Penjwin area. To facilitate the transportation and subsequent transplantation of seeds to Sharazur Plain, we designate Penjwin as a mother. The remaining industrial potato seeds of the entrepreneur were acquired by the Green Iraq company and afterward transported to Erbil. Approximately 750 tons of these seeds were then transferred to Duhok, where the firm collaborates with local farmers. This entrepreneur plants Dutch industrial potato seeds, every year he buys about 200-300 tons of industrial potato seed, some of this amount from the large holder company (Nahar Al Awrad Company) that is authorized to import HERMES seeds in the Erbil governorate. Furthermore, the seeds that are not registered under the names of seed supplier firms in the Kurdistan Region are procured directly by the entrepreneur from sources in Germany and Egypt (LADY ROSETTA from Egypt and COROZO from Germany). These seeds are then transported back to the entrepreneur via established transport companies.

The agricultural product purchasing department is one of the Green Iraq company's departments. This section is in charge of supplying agricultural raw resources to the corporation, such as industrial potatoes and vegetable oils. 20-25% of firm output comes from domestic sources of peasant produce of industrial potatoes across Iraq. One impediment is the government's prohibition on importing potatoes from April 15 to November 15. The company is arguing with the government to make it obvious to him that the potatoes he uses are industrial, not consumer potatoes, beginning in 2020. Although the government is aware of the problem, its stringent processes are seen as an important obstacle to importing potatoes during the aforementioned months.

### **Processor**

Processing potatoes primarily for consumer use and making money via marketing are their two major tasks. This study primarily focuses on the Green Iraq company as the main processor. Green Iraq company is a prominent entity in the food production and commerce industry in Iraq, serving as a subsidiary of the international corporation PepsiCo. A plant was created in the Bazian district of Sulaimani governorate in Iraq for the production of Lay's Chips and Cheetos popcorn, adhering to globally recognized standards and quality. Skilled quality control personnel supervise all manufacturing divisions, ensuring adherence to PepsiCo standards. To perform the requisite examinations, it is important to gather periodic samples of the items over 24 hours. Before launching a product into the market, it is imperative to conduct thorough testing and verification procedures to ensure its quality. The Green Iraq Company has established a contractual agreement with farmers, ensuring the purchase of their whole agricultural yield for each production season. This would serve as a substantial motivation for industrial potato farmers to maximize their efficiency in production. The firm conducts tests on potatoes to ensure that the sugar level does not surpass 15%. If the potatoes are above this threshold, they are considered unacceptable by the company. The corporation sent a fully equipped car to the farm to inspect the potatoes. If the item is successfully through the inspection process, it will be thereafter transported to the company. Conversely, if the item fails to meet the inspection criteria, it will be declined.

Before 2016, Lay's products were imported into Iraq from Saudi Arabia and neighboring nations. The plant began operations in 2014, and it has been producing since 2016. Since that time, Lay's Chips have been manufactured in Iraq's Sulaimani Governorate. A local product with a global brand is created for the local market at the lowest possible cost, with the highest possible quality, and free of any international logistical constraints that ensure the product reaches the customer in a safe and healthy condition.

The company's annual consumption of industrial potatoes amounts to 100,000 tons. The typical duration for potato storage is four months. Potatoes that are locally sourced are subjected to storage within the refrigeration facilities of the firm throughout the period spanning from June to July. This potato will last for around 2-3 months. Subsequently, the shortfall is addressed by sourcing industrial potatoes from Turkey, Egypt, India, Russia, and Ukraine throughout their respective production seasons. Within the context of the firm, it is possible to identify two distinct categories of domestic markets, namely the contractual market and the spot market. The contractual market involves a pre-planting phase when both parties engage in discussions on many specific aspects and afterward reach



a mutual agreement on the price. Both parties are in consensus that any fluctuations in the market do not have an impact on their stance towards the contractual agreement. In this study, an entrepreneur has a contractual agreement with the firm.

### **Trader**

The role of the trader is crucial in facilitating the movement of goods or services from the producer to the ultimate consumer within a value chain framework. Traders serve as intermediaries who enable the transfer of products between different participants within the value chain. The Green Iraq Company has granted authorization to many contractors for the wholesale distribution of its products across all governorates in Iraq. The distribution channels for Lay's Chips encompass a wide range of retail establishments, such as hypermarkets, supermarkets, markets, shops, palaces, and vendors, which are present in all governorates, cities, towns, and villages within the Kurdistan Region and Iraq.

### **Consumer**

The consumer is seen as a crucial element inside the realm of supply and value chain operations, exhibiting diverse behaviors that need careful study and comprehension (Neima et al. 2023). The value chain map illustrates the multitude of activities involved in the creation and delivery of a product or service to end-users. Consumers, often seen as the ultimate destination of the value chain, have a significant impact that surpasses the act of acquiring the final product. Consumers exhibit a lack of familiarity with the acquisition of this particular kind of potato in its raw form for domestic use. Instead, their preference is in its utilization as processed Lay's chips or as fries at restaurants. In addition, the Lay's Chips factory in Sulaimani governorate/ Kurdistan Region of Iraq has demonstrated a proactive approach by incorporating consumer preferences and input into their product offerings. This includes accommodating specific flavor preferences, such as less spicy options, as well as considering size preferences. In a similar vein, (Neima et al. 2021) discovered that broiler chicken farmers have demonstrated a conscientiousness toward accommodating consumers' demands regarding chicken size. According to the company's evaluation of consumer preferences, Forno Authentic Cheese, Gourmet Vintage Cheddar, Flamin Hot, Flamin Hot Lime, and Caramelized Onion are among the Lay's varieties that are manufactured in Saudi Arabia but not in the Kurdistan Region of Iraq (Iraq).

### **Chain Supporter/ Enablers**

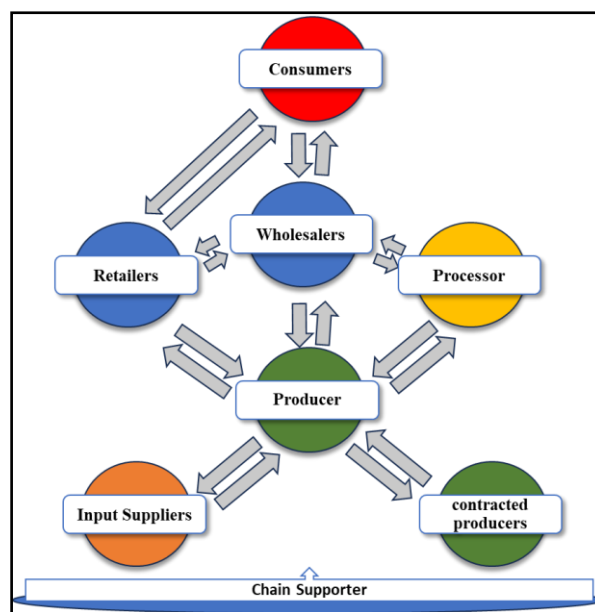
The chain supporter's role is to assist with essential value chain activities. To increase industrial potato production and farmer income, state governments, research institutions, commercial seed firms, public policy organizations, and other potato stakeholders should encourage the spread and acceptance of better varieties and other enhanced potato technologies (Kharumnuid et al. 2023). Supportive services, such as training and advising, information, financial, and research, are provided by such actors. The main supporters of the industrial potatoes value chain in this study are the Kurdistan Region Government, Green Iraq Company, and Seed tuber suppliers' companies.

The level of assistance provided by the government in terms of policies and regulations for agricultural producers and investors is inadequate. The government's jurisdiction in restricting imports is confined to the specific period of crop production. Illicit entry of imported goods through border points occasionally occurs, posing a challenge for government authorities in terms of effective control. The government's restriction on importing potatoes from April 15 to November 15 supports potato producers and prevents factories from importing industrial potatoes from outside countries. Whereas, Green Iraq company has a local product development program that involves importing industrial potato seed authorized by the International Chips Corporation of Lay's distributing them to farmers, and monitoring their progress on a daily and weekly basis. The company has farmers all over Iraq. In recent years, the company has distributed 100% of the local industrial potato seeds it has given to farmers from large-holder farmers. Additionally, the company offers logistical assistance to farmers by dispatching trucks accompanied by technical personnel to examine and transport the potatoes to the company's processing facilities. Moreover, the primary responsibility of seed tuber suppliers is to provide farmers with current seed kinds. Furthermore, they frequently provide advice on production techniques, in addition to offering fertilizers and pesticides. They provide loans for seeds till the harvest season. Nevertheless, purchasing with cash incurs lower costs. These firms also engage in the provision of a training program designed for the farmers they collaborate with. According to the results of the Ismaeel et al, 2019 study, training courses provide additional options to achieve increased productivity and profit due to a substantial association between production and training courses. Moreover, training has an excellent impact on job knowledge, developing skills, boosting work motivation, raising job satisfaction, and producing high-quality work (Hameed and Sirwan, 2019). The additional function of Green Iraq Company and the input suppliers is to provide training courses to farmers with whom they have contracts. The courses were of moderate quality. According to the results of this study, universities, research centers, and agricultural departments have no role in the industrial potato value chain. The primary value chain participants ascribed this lack

of participation to these institutions' failure to update to what is going on in the reality of the agricultural sector.

### The interconnection of value chain actors

As illustrated in Figure 5, industrial potato value chain participants in the study's area were linked backward and forwards, vertically and horizontally. The producer was the center of this study, he was an entrepreneur and had a link with the majority of the actors in this chain. Since the producer had a vast space of land in the locations mentioned above, he was not able to do all the work on their own, so he contracted producers who were experts in producing industrial potatoes. He gave them 20-30% of the shares so that they would lead the work pleasantly and satisfyingly as if they were working for themselves rather than if they worked on a wage, they would not give their best to work. Additionally, the entrepreneur assumes the responsibility of overseeing all operational aspects and allocating necessary resources for production. Due to the inherent weaknesses in the banking system of Iraq and the Kurdistan region, the procurement of supplies is predominantly facilitated through loan arrangements. Specifically, at the onset of the planting season, agricultural producers acquire the necessary supplies through loans. then, with the commencement of the cultivation season, these producers get the corresponding money and then repay the loans obtained.



**Figure 5.** Interconnection of value chain actors in industrial potato value chain. Source: Self-drawn diagram based on a survey, 2023. Linkages that go up, down, or both in the vertical and horizontal directions.

The contractual agreement between the producer and the processor, which is the Green Iraq Company, is established at the commencement of the planting season. This agreement entails the mutual consent of both sides about the price of the crop. As part of the agreement, the farmer is obligated to surrender all of their agricultural output to the company and ensure that, even if the crop is bought at a more favorable price by another entity, it is still relinquished to the company. Likewise, the corporation assures the farmer that irrespective of the magnitude of their harvest, the acquisition of their product is ensured before its production, contingent upon its adherence to the company's predetermined quality standards. In certain instances, a limited proportion of produce from farms may not match the established standards of quality. Consequently, such products are returned to the original farmer, who has the discretion to sell them to either a wholesaler or a retailer.

The processor accumulates the potatoes obtained from farmers and utilizes them in the production of Lays chips, which are offered in a variety of sizes and flavors. The available sizes for the products are categorized as small, medium, and large. The flavors offered include original (salt), French cheese, tomato ketchup, salt & vinegar, and yogurt & herbs. Additionally, there are "max" chips available in several flavors such as creamy cheddar cheese, yogurt & herbs, Mexican chili, and BBQ. The facility operates continuously, operating round the clock throughout the week, using three different work schedules, and has a daily production capacity of 300 tons of industrial potatoes. The distribution of this facility's products spans all governorates of Iraq through a well-established network of agents, often known as wholesalers. These wholesalers are responsible for the following sale of the items to retail outlets, ultimately reaching the end customers.

## CONCLUSIONS

The main actors in the industrial potato value chain were input suppliers, producers, processors, traders, chain supporters/enablers, and final consumers. The suitability of the region for industrial potato production, availability of continuous market demand due to the existing Green Iraq Company and its daily need for industrial potatoes, increased product value, and availability of improved seed, were the main opportunities. By contrast, high market pricing for production resources, company terms on the product, natural factors, unavailability of banking service, and the market not being familiar with this kind of potato were the main constraints in the value chain of industrial potato. Value chain actors establish powerful connections to create a sustainable industrial potato value chain. The government emphasizes stabilizing production resource prices and increasing farmers' market share. The government and other responsible authorities must expand information and communication technologies. Farmers' agricultural experience should be enhanced to improve productivity and promote market involvement. Input suppliers will be encouraged to provide farmers with suitable supplies in terms of quality and price competitiveness. Private seed producers, research centers, non-governmental organizations (NGOs), and other institutions should introduce new/improved seed types. Negotiating pricing before the production season and creating a post-harvest management method is equally critical for having a significant impact on the competitiveness of the industrial potato value chain. Finally, by looking at the value chain of industrial potatoes, we find that this chain has generated numerous job opportunities for those residing in rural and district areas, both in the form of seasonal jobs in the production fields during the potato season of cultivation and as permanent employment at Green Iraq Company. The workforce is mostly female, which is a positive development. To ultimate this investigation regarding the value chain and sustainable efficiency of industrial potatoes through an entrepreneur, the recommendation stated the following:

- Establishing a manufacturing facility dedicated to the manufacture of fries, alongside the production of potato chips, would significantly bolster the industrial potato value chain.
- Facilitate the process of exporting industrial potatoes cultivated by farmers to multinational fast-food chains in the Gulf nations and the surrounding countries, to enhance accessibility for all agricultural stakeholders, by involving private agricultural export enterprises in this industry.
- The proposed strategy involves establishing factories for processing other agricultural products into agrifood, aiming to establish a sustainable and permanent market for farmers.

**Author Contributions:** K.S. analyzed the collected data and wrote the draft of the manuscript, performed an interview with an entrepreneur and gathered the data, reviewed the manuscript. R.H. idealized the work and reviewed the manuscript.

**Funding Source:** This study did not get funding.

## Acknowledgements

All appreciation to our colleague “Khansa Hameed Hama Faraj” for her valuable assistance in all stages of conducting this study. The assistance provided by entrepreneur “Bilal Mahmood Marf” throughout the process of data collecting is greatly valued.

## Conflicts of Interest

The researchers of this study affirm that they have no conflicts of interest.

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