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Value Chain Analysis of Wheat, Potato and Rapeseed in Mongolia

German – Mongolian Cooperation Project Sustainable Agriculture

Dr. Erdenebolor Baast & Nyamgerel Bartseren (Short-term Experts)

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1. Introduction

1.1 Background

Mongolia's crop sector has largely recovered from the collapse during the transition period of the 1990s and the drought-affected harvest losses in the early 2000s. A major impulse for the revitalisation of the sector was provided by the government programme "Third Virgin Land Campaign" (TVLC) that was implemented between 2008 and 2010. The fundamental goals of increasing domestic production of the crops wheat and potato are already achieved, and the government is now striving to increase the competitiveness of the crop sector on both domestic and export markets. A major challenge to be addressed in this regard is the underdevelopment of crop value chains. While the TVLC and related interventions have resulted in a substantial increase of the primary production of staple crops the policy priority now is to create structures and linkages that enable delivery of value-added products at affordable prices to end customers while maximizing the profit margin of crop farmers and minimizing post-harvest losses. The intention to develop crop value chains is well recognized and addressed in the State Policy on Food and Agriculture (Paragraphs 3.1.13 and 6.1.4), the Law on Cropping (Paragraph 19.5.5) and the Law on Organic Food. Interventions for increasing the storage capacity of crops and creation of integrated storage and sale systems are also defined in the Article 8 of the Government Action Plan 2016-2020.

This study is a contribution of the German-Mongolian cooperation project "Sustainable Agriculture" to the current political dialogue on strengthening crop value chains. It was commissioned by the project within its mandate to support sustainable agriculture in Mongolia through professional dialogue and delivery of professional advice for adaptation of the legal and institutional frameworks in the agricultural sector to the sustainability needs.

1.2 Conceptual framework of value chains

A value chain is a connected series of organizations, resources and knowledge streams involved in the creation and delivery of value to the end customer. In agricultural value chains, the core processes usually include input supply, production, post-harvest processes, processing, wholesale, retailing and consumption. Accordingly, the process actors range from input supplier to producers, processors, traders and consumers. The value chain actors interact in different ways starting from local to national and international levels (Figure 1.1).

Figure 1.1: Overview of core processes in agricultural value chains

Besides the process actors, a partner network consisting of external actors or organizations (public and private) plays a critical role in the functioning and efficiency of a value chain. These external actors are not included in the core stages of a value chain but support, intervene or assist the different links of the chain and facilitate the development of the business (Figure 1.2).

In a wider vision, the dynamics of value chains and the behaviour of its actors are also influenced by the socioeconomic systems that they are part of as well as policies and institutions in a country. These larger systems can facilitate, limit or be neutral to the development of a value chain (Figure 1.3).

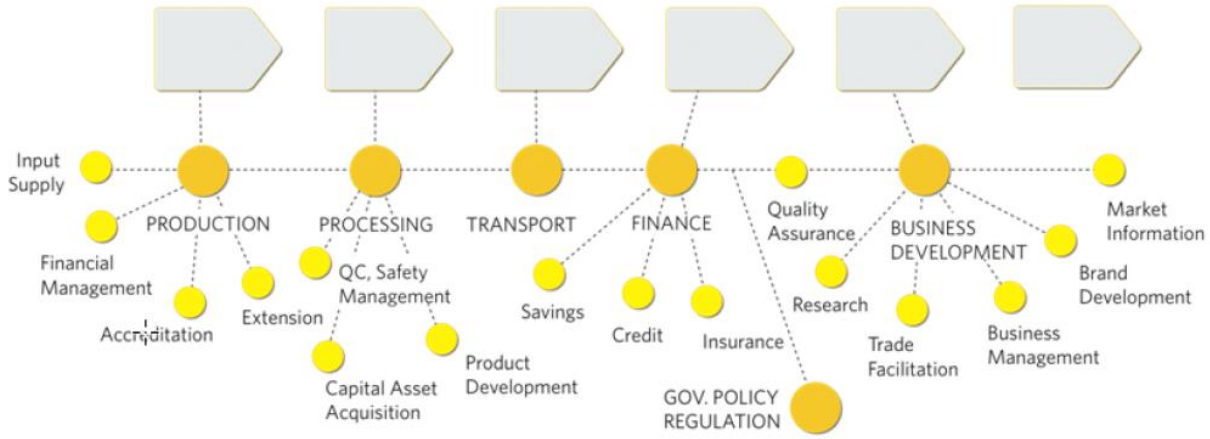

Figure 1.2: Overview of the partner network in agricultural value chains

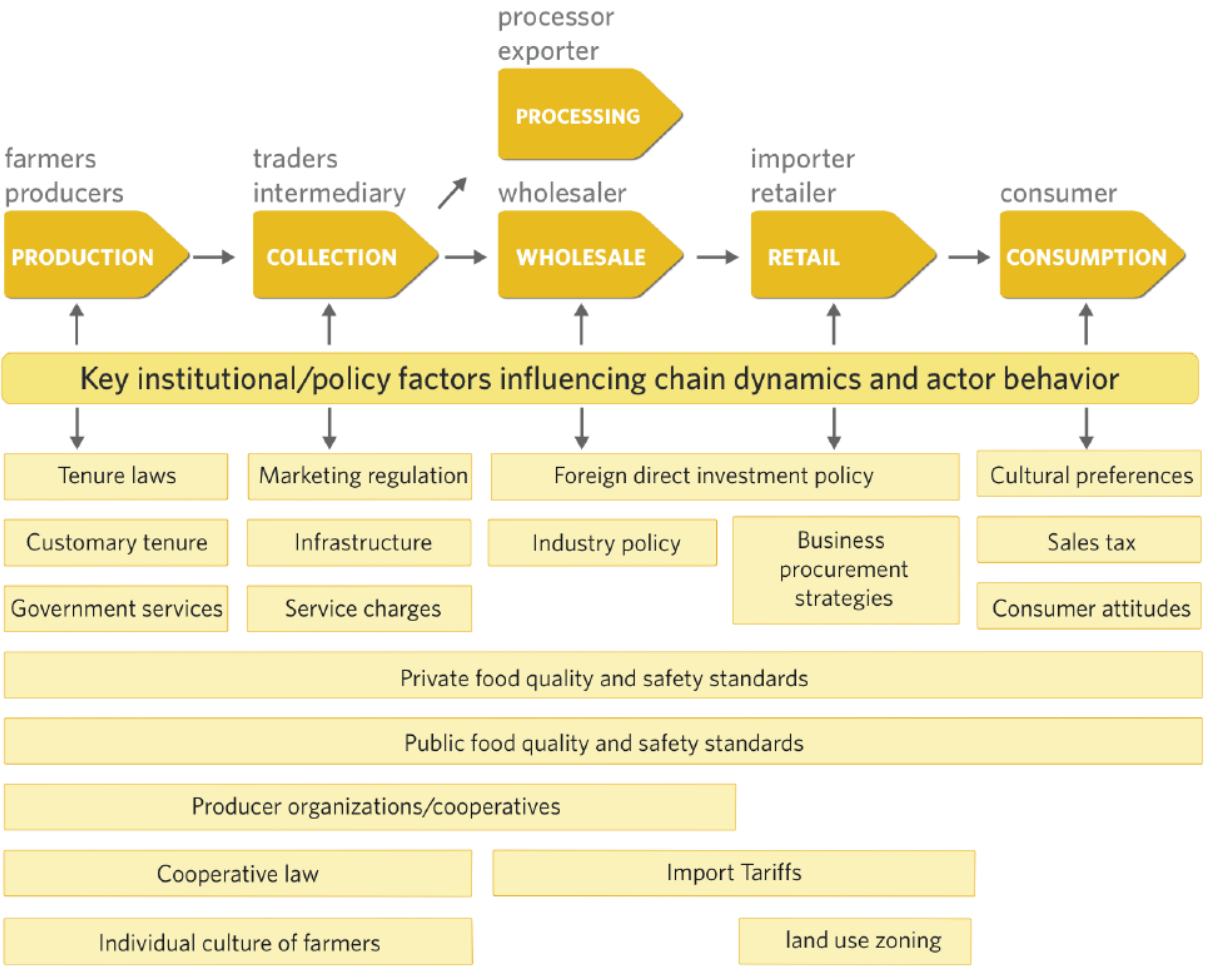

Figure 1.3: Overview of external influences in agricultural value chains

The value chain approach (VCA) is a multi-purpose analytic tool used by both private and public sector stakeholders at local, national and international levels. Private sector actors find the approach useful in improving their profitability because it focuses on creating and delivering value to consumers more efficiently and effectively (Vázquez et al., 2006; O'Keeffe & Fearne, 2009; Soosay et al., 2012). Public sector participants commonly use the VCA to identify entry points for policy interventions to improve economic viability of agri-food industries, address environmental issues and raise the living standards of rural people (Humphrey & Navas-Aleman, 2010; Rich et al., 2011; Chagomoka et al., 2014). The VCA has also been used to explore specific issues such as gender dynamics (Barrientos, 2014S; Bolwig et al., 2008), trade and poverty (Koponen et al., 2008), commodity dependence and the potential to upgrade

and differentiate products (Farfan, 2005). In summary, the VCA is one of the most useful, hence most used approaches for identifying options and formulating policies and measures to improve the sustainability of agricultural production at both industry and sector levels.

1.3 Goal and objectives of the study

This study aims to inform stakeholders in the crop sector about the economic performance of the value chains of wheat, rapeseed and potato as well as potentials, opportunities and constraints for future development of these value chains. Main objectives of the study are:

- To characterize the value chains of wheat, rapeseed and potato;
- To provide a macroeconomic assessment of the value chains;
- To identify and analyse major opportunities and constraints for strengthening these value chains; and
- To formulate policy implications.

1.4 Material and Methods

The study used a combination of quantitative and qualitative research methods. The basic quantitative methods applied were descriptive analysis of statistics and other numerical data, and calculations of the Gross Value Added of each value chain selected for analysis. The qualitative method used for data collection was semi-structured interview. Interviews were conducted with 64 persons from Ulaanbaatar and Tuv, Selenge, and Dornod aimags. The respondents consisted of crop researchers, government officials, crop farmers and processors. The research steps are outlined in Figure 1.4.

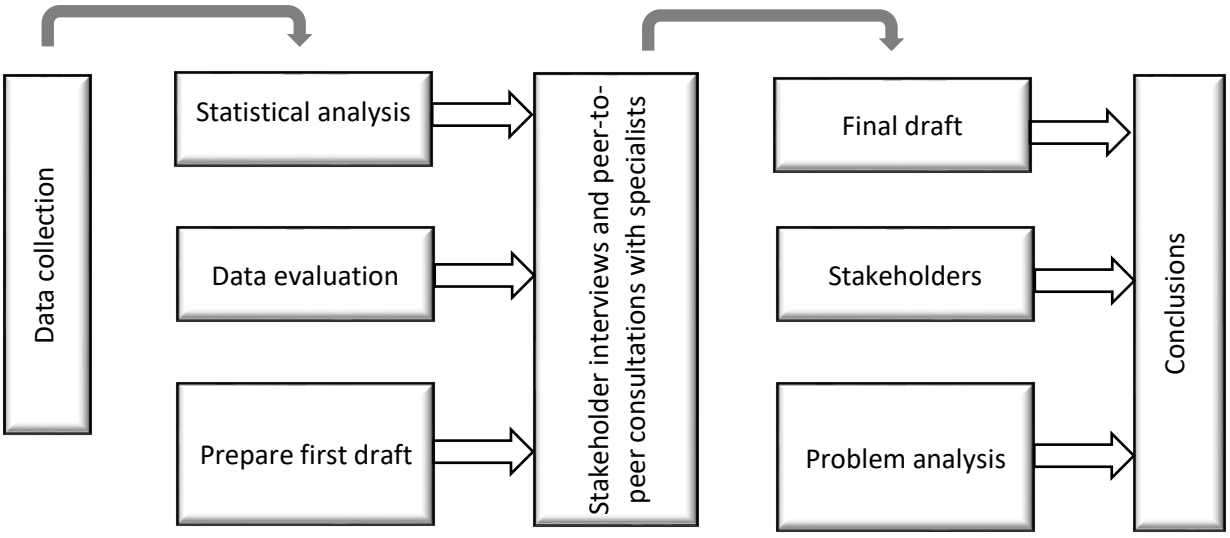

Figure 1.4: Methodical framework of the study

Sources of secondary data used in this study included agricultural and customs statistics, study reports, annual reports and presentations of MoFALI, scientific papers and presentations, laws, government resolutions and policy documents, and websites of relevant institutions in addition to technical and reference books from Mongolia and Germany.

2. Analysis of the wheat value chain

2.1 Primary production

2.1.1 Volume and geographical distribution of wheat production

Wheat production saw a rapid expansion after cash subsidisation and other support mechanisms such as distribution of subsidised seeds, fuel and machines were introduced by the government through the TVLC in 2008. During the 10-year period 2007 to 2017, sown areas increased by 213 percent. Maximum wheat harvest since 1990 was achieved at 488.3 thousand tons in 2014. While the sown areas were stabilized around 360 thousand ha in the following years, the 2015 and 2017 droughts cost the wheat growers a half of their potential yields, which averages at 1.3 tons per ha in years without drought (Table 2.1).

Table 2.1: Overview of wheat production between 2013 and 2017

Parameters	2013	2014	2015	2016	2017
Sown area, 1000 ha	275.6	291.2	361.2	355.1	365.7
Share in total sown area	66.3%	66.1%	68.8%	70.3%	69.8%
Total harvest, 1000 t	368.5	488.3	203.9	467.1	231.4
Yield per ha, t	1.34	1.68	0.56	1.32	0.63

Source: NSO, 2018.

Wheat is grown in 15 out of 21 aimags. The main region of wheat production is the Central region and Selenge aimag is the largest wheat supplier. Selenge contributed 50.3% of total wheat production during the period 2013-2017, followed by Tuv (17%) and Bulgan (10.9%) aimags. The remaining 12 aimags contributed up to 5 percent of the total wheat production during the same period (Figure 2.1).

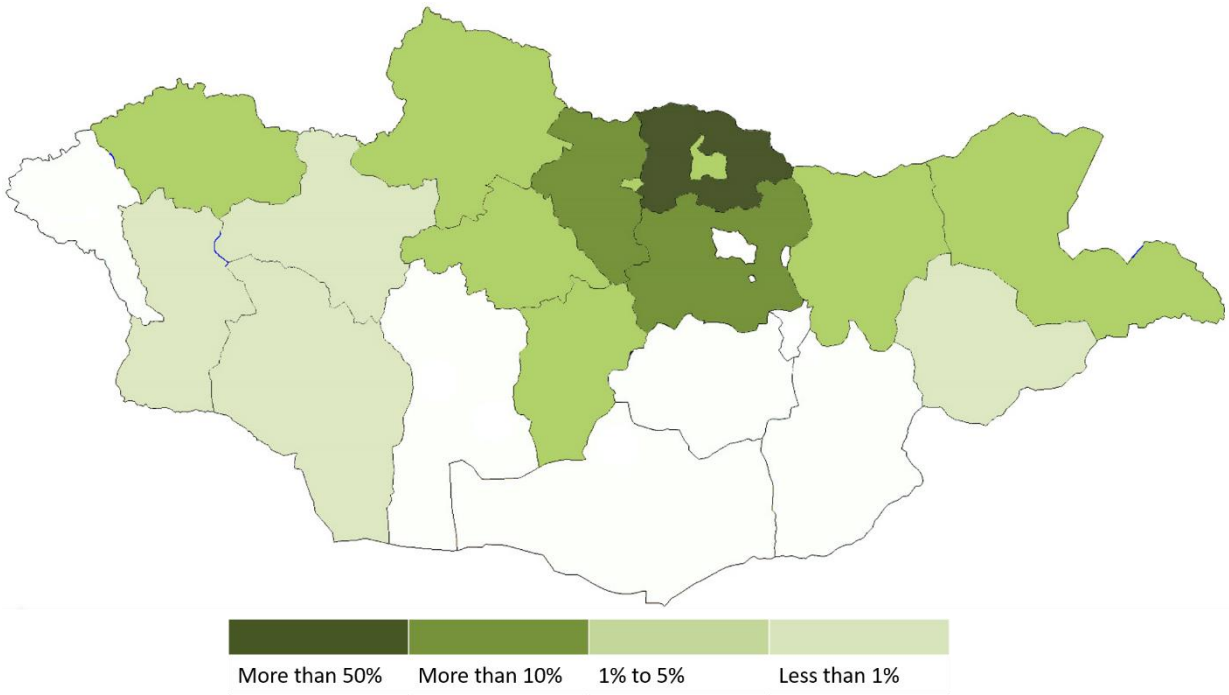

Figure 2.1: Share of each aimag in total wheat production in the period 2013 to 2017

Source: NSO, 2018.

2.1.2 Structure of wheat growers

Due to relatively low per-hectare yields as well as the commonly applied fallow-wheat rotation scheme that requires relatively large crop land and machinery, wheat production is mainly a business of firms. On average of the period 2013 to 2017, 92% of the total sown areas and 93% of the total harvest of wheat was attained by firms. The total number of wheat growers is estimated at 1100, and it consists of approx. 650 firms and approx. 450 family farms. Wheat growers cultivate approx. 531 thousand ha arable land and the average size of arable land per farm is 1701 ha. Sixty-four percent of total arable land used in wheat production is managed by crop farms with 1000 or more hectares (Table 2.2).

Table 2.2: Overview of wheat growers

Categories of wheat growers by size of arable land	Number of farms	Total arable land, 1000 ha	Average arable land per farm, ha
Less than 500 ha	811	127.8	158
501 to 999 ha	115	78.6	683
1000 to 2999 ha	130	202.3	1556
3000 ha or more	39	171.8	4405
Total/Average	**1091**	**530.9**	**1701**

Source: Ministry of Industry and Agriculture, 2013.

2.1.3 Total supply and self-sufficiency

The total supply of wheat i.e. the amount resulting from deduction of exports from and addition of imports to domestic production ranged between 225 and 625.6 thousand tons in the period 2013 to 2017. The rate of domestic supply in total supply ranged 74.7 and 103.5 percent, averaging at 91.3% (Table 2.3).

Table 2.3: Domestic and total supply of wheat between 2013 and 2017

Parameters	2013	2014	2015	2016	2017
Production, 1000 t	368.5	488.3	203.9	467.1	231.4
Exports, t	12.6	0.2	-	-	-
Imports, t	0.1	34.2	21.1	158.5	13.6
Total supply, t	356.0	522.5	225.0	625.6	245.0
Rate of domestic production in total supply	103.5%	93.5%	90.6%	74.7%	94.4%

Source: NSO, 2018.

The rate of self-sufficiency can be estimated using different methods. A comprehensive estimation would require a multi-factor and multi-period mathematic analysis along with a representative survey to be conducted in different regions. Since such an analysis was beyond the scope of this study a simpler method was chosen, and the rate of self-sufficiency is only estimated for bread wheat i.e. wheat used in flour production. The common methodology used for this purpose determines the demand for wheat on the basis of consumption norms of flour and flour products per reference person, converted into wheat amounts, and relates the domestic supply to the total demand for bread wheat. According to this method, the gross rate of self-sufficiency in bread wheat was 37% in 2016 and 99% in 2017. The projected gross rate of self-sufficiency for 2018 is 35 percent. While the calculation is quite rough and does not consider factors such as post-harvest losses and varying quality of wheat, which would influence the amount of flour production, it certainly confirms that due to the extreme vulnerability of wheat production to drought self-sufficiency in bread wheat is far from being secured (Table 2.4).

Table 2.4: Estimated gross rate of self-sufficiency in bread wheat

Parameters	2016	2017	2018
Total population	3,119.9	3,182.3	3,277.8
Total population, converted into reference persons[†]	2,523.6	2,571.4	2,620.4
Demand for flour per reference person, kg per year[‡]	36.5	36.5	36.5
Demand for flour products per reference person, converted into flour amount, kg per year[‡]	59.4	59.4	59.4
Total demand for flour per reference person, kg per year	95.9	95.9	95.9
Total demand for flour, 1000 t	242.0	246.6	251.3
Total demand for flour, converted into wheat amount, 1000 t	357.7	364.5	371.4
Amount of wheat from previous year's harvest used in flour production in the current year, 1000 t[*]	130.9	361.1	130.2
Gross rate of self-sufficiency in bread wheat	37%	99%	35%

[†] Source: MoFALI, 2018.

[‡] Source: Cabinet Secretariat of the Government of Mongolia, 2016.

[*] Source: MoFALI, 2018.

2.2 Storage

As of 2017, the total wheat storage capacity is 523 thousand tons. Nearly a half of this capacity is available at mills, most of which are located in Ulaanbaatar. The Crop Support Fund manages six grain silos with a combined capacity of 182 thousand tons on six locations in Selenge, Darkhan-Uul, Tuv, Bulgan and Uvurkhangai aimags. In addition, crop farms have silos and storage cellars with a total capacity of 110 thousand tons for wheat storage (Figure 2.2).

Mid-term policy goals for improvement in wheat storage include, in relation to the plan of increasing total sown areas, installation of silos with a total capacity of 40 thousand tons in remote regions and renewal of the storage facilities already available at crop farms.

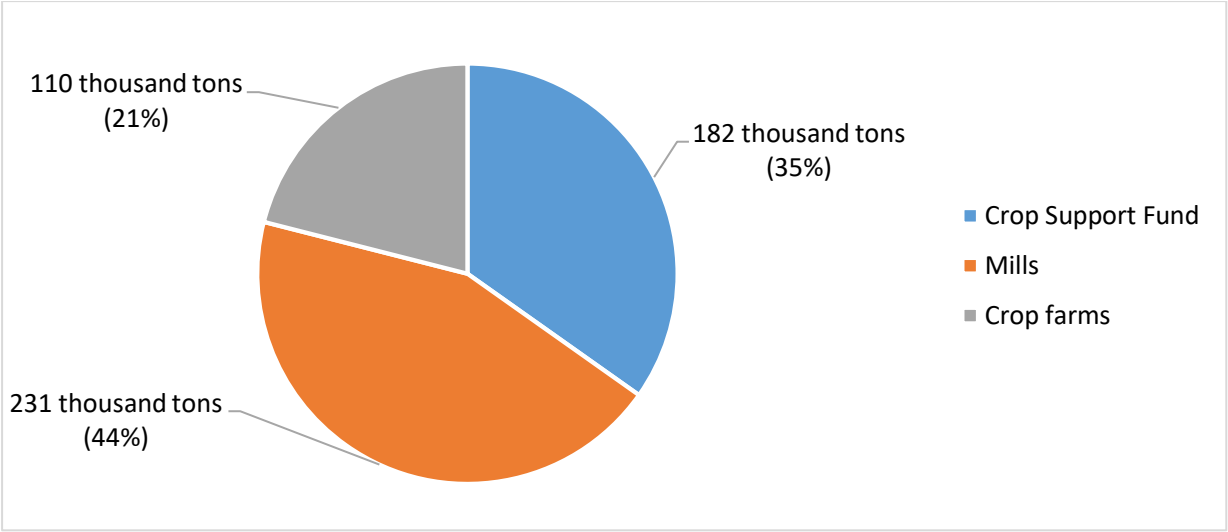

Figure 2.2: Wheat storage capacity by managing entities

Source: MoFALI, 2018.

2.3 Distribution and processing

2.3.1 Overall structure of distribution

Most of the wheat is directly supplied to mills after the harvest in autumn. In addition, a certain amount is stored at the CSF for later supply to mills. In 2016 and 2017, the share of bread wheat in total wheat supply was 84% and 62%, respectively. The CSF also stored 23 thousand tons of seed wheat in 2017. The share of farm-saved seed (wheat stored at the crop farms for next year's sowing) ranged between 10 and 13 percent in 2016 and 2017, respectively. Furthermore, a small proportion (up to 1%) of the wheat is supplied to the State Seed Reserve, which is managed by the National Emergency Management Agency. Distilleries received 3 to 4 percent of the wheat (8.4-10.8 thousand tons) for alcohol production. The remaining wheat (3% in 2016 and 10% in 2017) was used as livestock feed, either directly or as an ingredient of compound feeds (Figures 2.3 and 2.4).

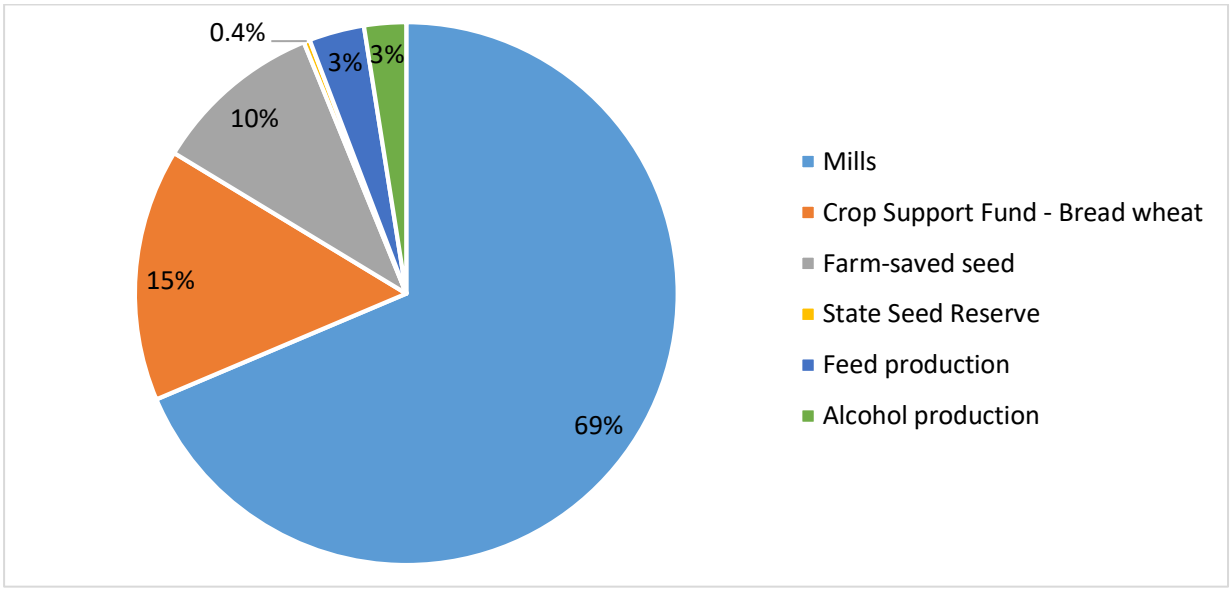

Figure 2.3: Distribution of domestically produced wheat in 2016

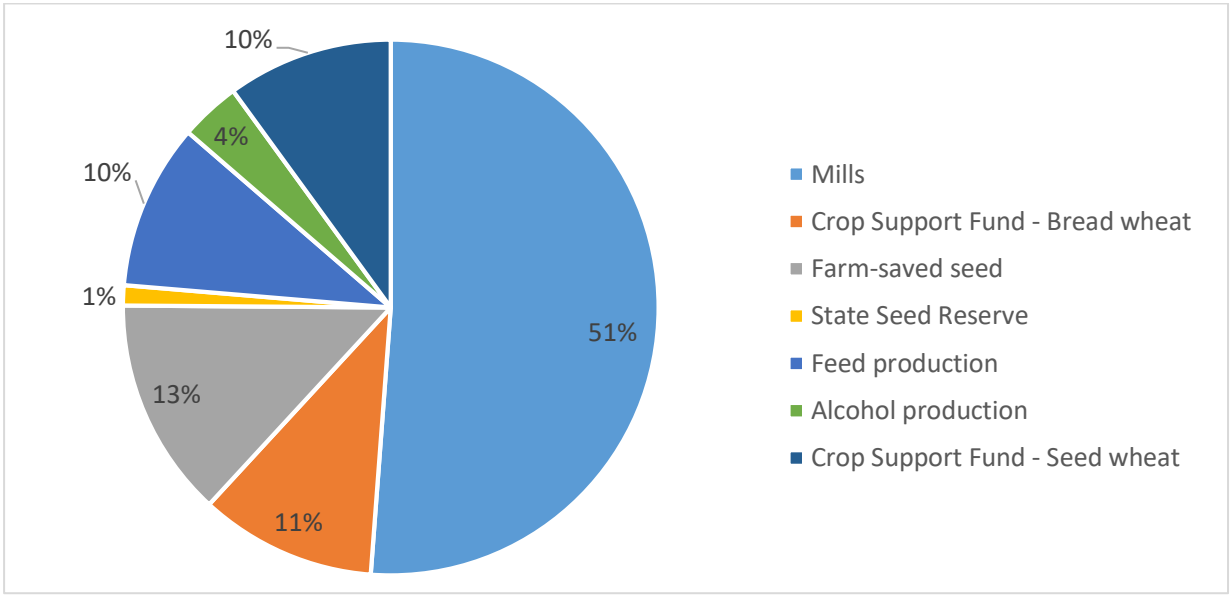

Figure 2.4: Distribution of domestically produced wheat in 2017

Source: MoFALI, 2018.

Distribution and processing across the two main value chains of wheat are described below.

2.3.2 Flour production

As explained above, wheat supply from crop farms to mills in the wheat-flour chain occurs mostly directly and, to some extent, via the CSF. The main product of milling is wheat flour and the marketable by-product is bran. Flour is sold to consumers via wholesale and/or retail as well as to bakeries, which provide the consumers with bread and other bakery products. Bran is marketed to herders and livestock farms, mostly through feed traders, but also through factory stores of larger mills (such as Altan Taria and Mill House) and their regional branches. In addition, 8approx. 5% of the bran produced is supplied to the Emergency Reserves of aimag and soum governments for delivery to herders in emergency situations (Figure 2.5).

Wheat flour is considered a strategic product since flour and products made of flour are widely consumed in Mongolia. The per-capita consumption of wheat flour is estimated at 77 kg per year, and the total demand at approx. 240 thousand tons as of 2017. Domestic production of wheat flour aims to meet the total demand but a 100% rate of domestic sufficiency in wheat flour has not been achieved since 2014. Imports of flour ranged from 16.7 to 30 thousand tons between 2014 and 2016. Interestingly, although in 2017 the domestic wheat sufficiency was 92% no flour was imported. This fact indicates a possible decrease in wheat flour consumption (Table 2.4).

In 2017, there were 63 mills countrywide with a combined processing capacity of 942.7 thousand tons. However, only 24 mills were in operation. Also, the total production of 208.6 thousand tons only required 27% of the total production capacity available. The total production included:

- 47.2 thousand tons of premium flour,
- 142.25 thousand tons of 1st grade flour and
- 19.05 thousand tons of 2nd grade flour.

Bran is used both as a standalone feed and as an ingredient of compound feeds for livestock. The total amount of bran supplied by mills in 2017 is estimated at 70 thousand tons, worth MNT 330 million. Approximately 42 percent of this amount was supplied to herders and the remaining 58 percent to semi-intensive livestock farms.

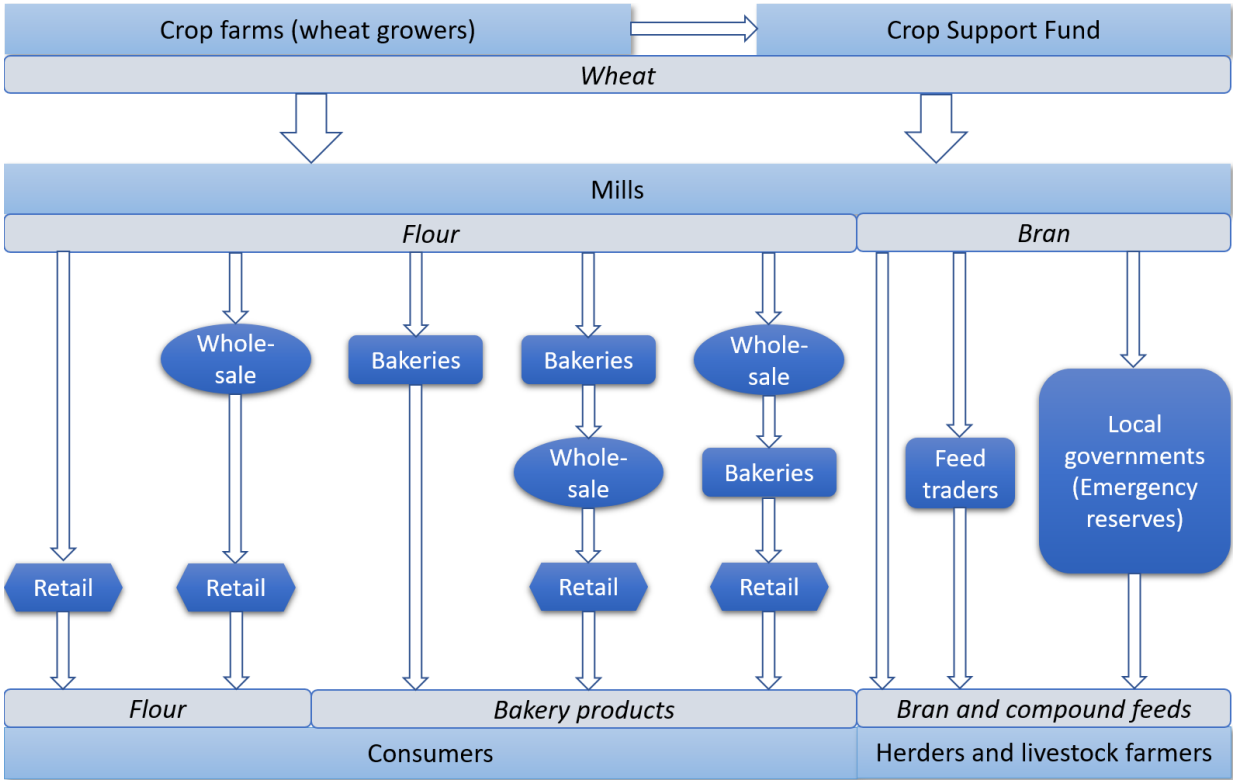

Figure 2.5: Distribution channels in the wheat-flour value chain

Table 2.5: Production and sufficiency of wheat flour between 2013 and 2017

Parameters	2013	2014	2015	2016	2017
Total demand, 1000 t	226.5	230.9	236.0	239.4	242.2
Domestic production, 1000 t	247.1	228.6	209.4	209.6	208.6
Imports, 1000 t	23.9	17.5	16.7	30.0	0
Total supply, 1000 t	271.0	246.1	226.1	239.6	208.6
Rate of total sufficiency	120%	107%	96%	100%	86%
Rate of domestic sufficiency	109%	99%	89%	88%	86%

Source: NSO, 2018.

2.3.3 Alcohol production

In the wheat-alcohol value chain, wheat is directly supplied by crop farms to distilleries for alcohol production. The latter produce 0.33 tons of raw alcohol out of one ton of wheat. The distilleries use 70 to 75 percent of the raw alcohol for vodka production in their own facilities and sell the remaining raw alcohol to vodka producers across the country. Total vodka production using domestically grown wheat was 8.75 thousand tons in 2017 (Figure 2.6).

A marketable by-product of raw alcohol production is draff, which is used by intensive livestock farms, preferably for winter feeding of dairy cattle. Unfortunately, the amount of draff sold to livestock farms is unknown.

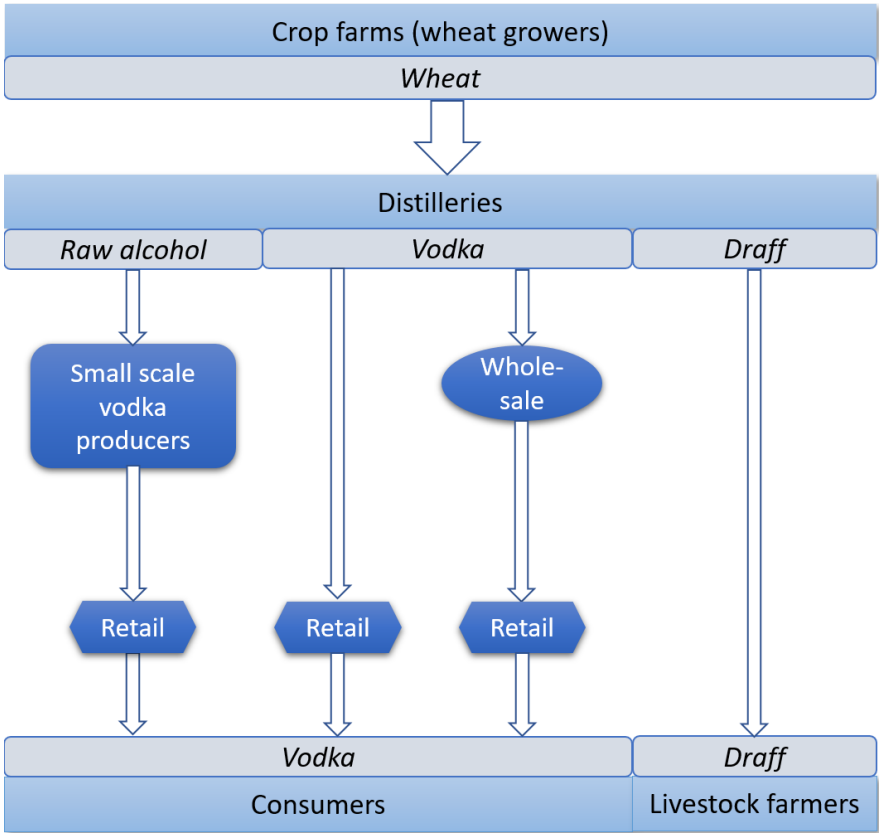

Figure 2.6: Distribution channels in the wheat-alcohol value chain

2.4 Pricing

Wheat price is negotiated between growers, mills and policy makers in the crop sector prior to the harvest every year. Since crop farms receive seeds, fuel, fertilisers and pesticides from the CSF on credit already prior to sowing early fixation of the price is required to determine the amounts of wheat the farmers have to deliver to the CSF as credit paybacks.

The trend of the last five years shows a gradual increase in wheat price. Between 2013 and 2017, the price increased by 67 percent (Table 2.6).

Table 2.6: Average price of wheat between 2013 and 2017

Parameter	2013	2014	2015	2016	2017
Wheat price, MNT per kg	360	460	550	440	600

Source: MoFALI, 2018.

Flour price depends on the quality grade (premium, 1st grade or 2nd grade). The average price of one kg wheat flour is between approx. 1100 in cropping regions and approx. 1350 in the remote Western region in 2017. The average prices of the period 2016-2017 in the 4 regions are by 19.1 to 22.7 percent higher than the average prices of the period 2012-2016. Adjusted to inflation, however, the differences are insignificant. In conclusion, the wheat price has been relatively stable since 2012 (Table 2.7).

Table 2.7: Price of wheat flour between 2012 and 2017

Regions	2012-2016	2016	2017
Western region	1,044	1,168	1,354
Khangai region	995	1,206	1,236
Central region	938	1,138	1,123
Eastern region	936	1,100	1,131

Source: NSO, 2018.

Flour price has also been relatively stable in Ulaanbaatar in 2017. The average price of 1st grade flour, for example, in the range between MNT 1000 and MNT 1100 per kg, with a maximum deviation of MNT 98 between the months (Figure 2.7).

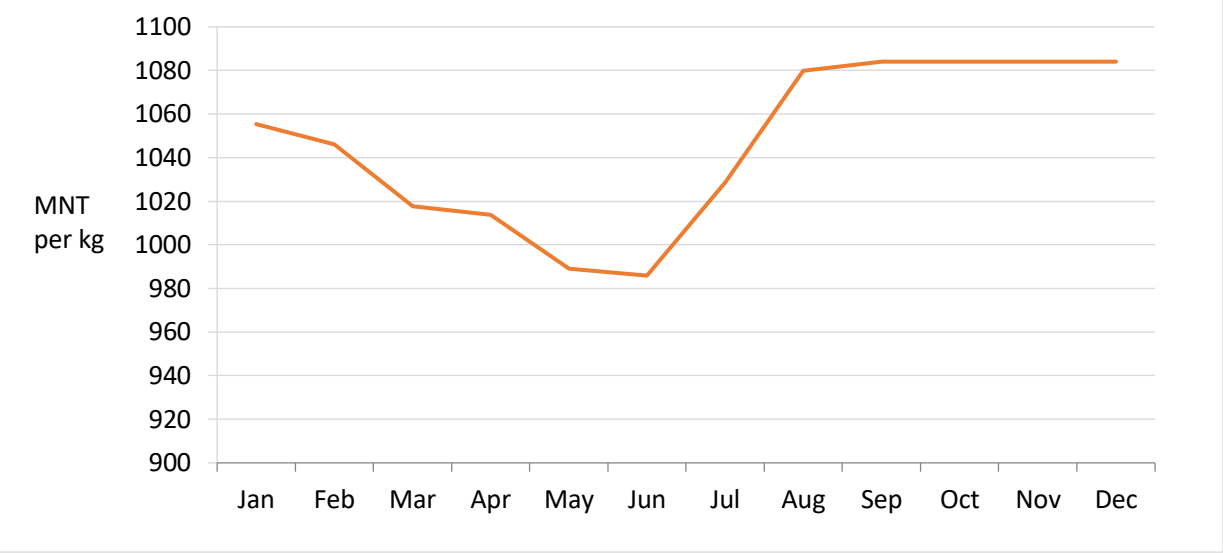

Figure 2.7: Average price of 1st grade wheat flour in Ulaanbaatar in 2017

Source: NSO, 2018.

2.5 Gross Value Added of the main wheat value chains

2.5.1 Gross Value Added in the Wheat-Flour value chain 2017

The GVA analysis in this study refers to the performance of selected value chains in year 2017, which used the 2016 harvest of the crops. Accordingly, production costs and crop prices are estimated for autumn 2016 while prices of processed products are estimated for 2017.

The production costs of wheat were estimated, using reference materials and interviews with crop farms, at MNT 385 per kg. The farm gate price for bread wheat was MNT 440 per kg but the price paid by mills was MNT 500 per kg, considering that transports of wheat to mills were made by farmers themselves. The mills produced 208.6 thousand tons of flour and 70 thousand tons of barn, which they sold at MNT 883 per kg and MNT 380 per kg, respectively. The traders' margin was estimated at approx. 24.6% for flour and 31.6% for bran, resulting in consumer prices of MNT 1100 per kg of flour and MNT 500 per kg of bran.

According to the above calculation, the wheat-flour value chain in 2017 turned an initial input of MNT 139 billion into a final gross output of MNT 264.5 billion, hence resulting in a GVA of MNT 125.4 billion. The growers' share in the wheat-flour value chain was 33% and those of mills and traders were 24 and 43 percent, respectively (Figure 2.8).

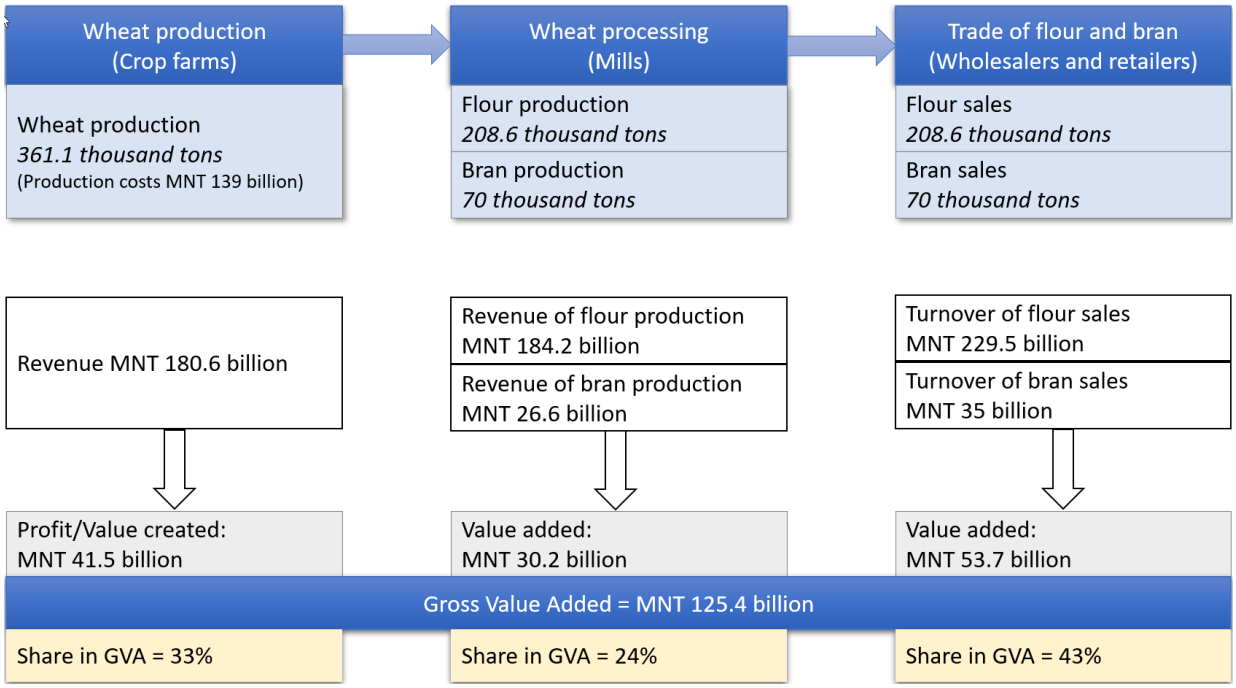

Figure 2.8: Gross Value Added in the wheat-flour value chain 2017

The values added in the core processes of the value chain are more clearly illustrated at a scale of MNT 100. At this scale, a MNT 100 input in wheat production 2016 was turned into a MNT 130 output after the harvest, a MNT 152 output after milling and, eventually, a MNT 190 final output after retail trade. In other words, out of every MNT 100 invested in wheat production wheat growers, mills and traders earned MNT 30, MNT 22 and MNT 38, respectively (Figure 2.9).

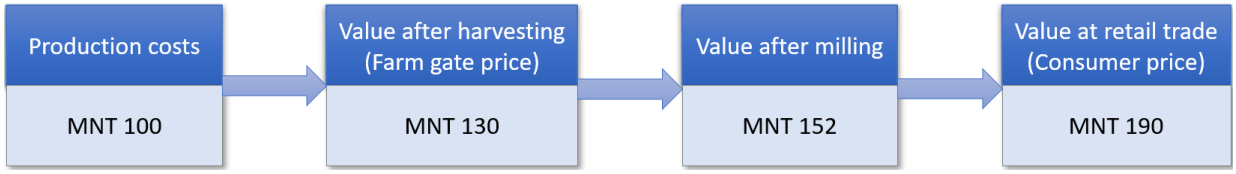

Figure 2.9: Value adding in the core processes of the wheat-flour value chain 2017

2.5.2 Gross Value Added in the Wheat-Alcohol value chain 2017

The production costs of wheat were MNT 385 per kg in 2016. The average price of wheat to distilleries for alcohol was MNT 450 per kg, slightly lower than the price of bread wheat due to quality difference. The distilleries produced 3.5 thousand tons of raw alcohol out of 10.8 thousand tons wheat supplied, and the raw alcohol was used in the production of 8.75 thousand tons of vodka. The average price of wholesale price of vodka was MNT 15 thousand per kg and at retail trade a margin of 10% was added, resulting in consumer price of MNT 16.5 thousand per kg.

According to the above calculation, the wheat-alcohol value chain in 2017 turned an initial input of MNT 4.2 billion into a final gross output of MNT 144.4 billion and resulted in a GVA of MNT 140.2 billion. The shares of crop farms, processors and traders in the GVA were 0.5%, 90.1% and 9.4%, respectively (Figure 2.10).

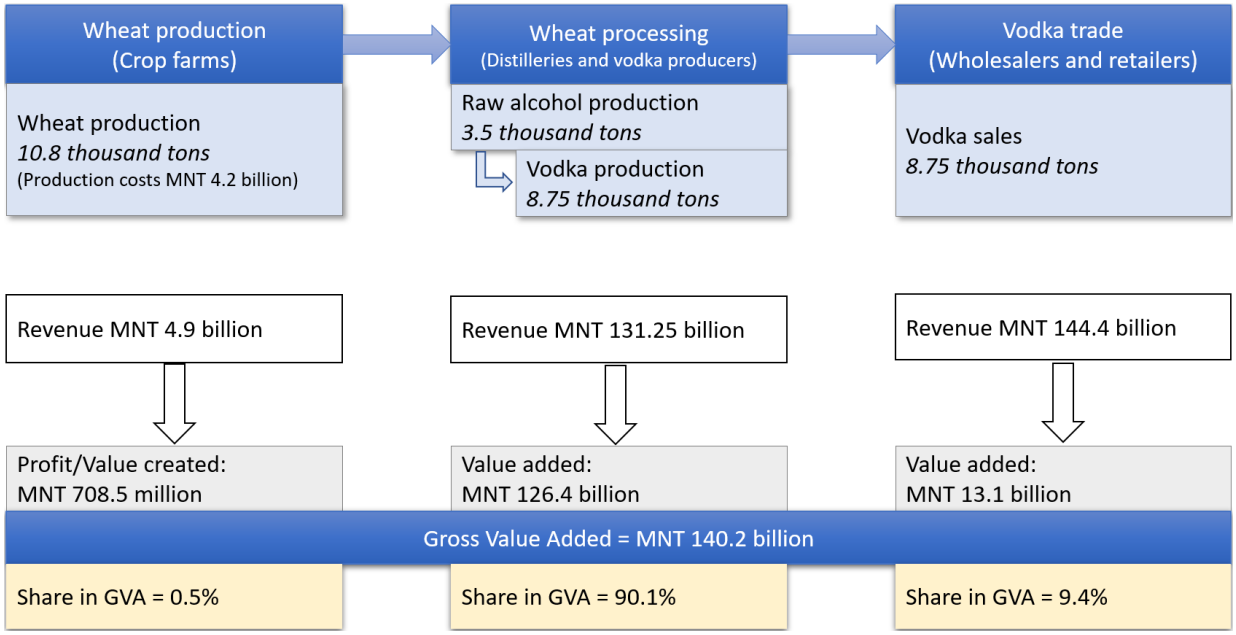

Figure 2.10: Gross Value Added in the wheat-alcohol value chain 2017

This means that out of every MNT 100 invested in wheat production crop farms, processors and retail traders earned MNT 17, MNT 3011 and MNT 312, respectively (Figure 2.11).

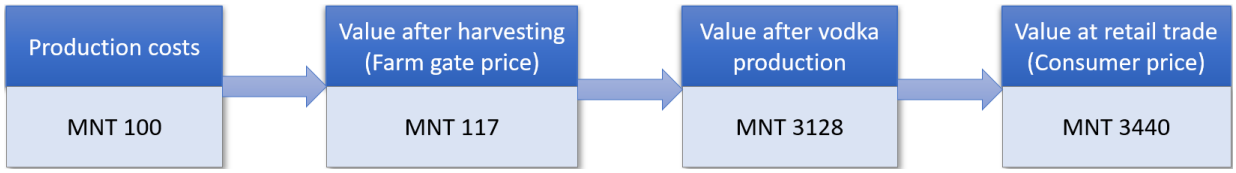

Figure 2.11: Value adding in the core processes of the wheat-alcohol value chain 2017

3. Analysis of the rapeseed value chain

3.1 Primary production

3.1.1 Volume and geographical distribution of rapeseed production

Rapeseed is considered as a major alternative to wheat as a crop for large scale production due to limited export opportunities of wheat in contrast to almost unstoppable Chinese demand for oil and energy crops. Rapeseed was grown on 83.9 thousand ha in 2013 and 86.5 thousand ha in 2014 in comparison with only 32.5 thousand ha in 2012. The year 2015, however, exposed the vulnerability of imported rapeseed varieties to Mongolian drought. The average rapeseed yield per ha in 2015 was less than a half of the 2014 yields. Consequently, sown areas of rapeseed dropped to 66.1 thousand ha in 2016 but increased again to 79 thousand ha in 2017, reaching 15.1% of total sown areas. The total production of rapeseed ranged between 13.5 thousand tons in 2017 to 51.9 thousand tons in 2014 (Table 3.1).

Table 3.1: Overview of rapeseed production between 2013 and 2017

Parameters	2013	2014	2015	2016	2017
Sown area, 1000 ha	83.9	86.5	83.0	66.1	79.0
Share in total sown area	20.2%	19.6%	15.8%	13.1%	15.1%
Total harvest, 1000 t	41.7	51.9	23.1	21.4	13.5
Yield per ha, t	0.5	0.6	0.28	0.32	0.17

Source: NSO, 2017.

Rapeseed is grown in 13 out of 21 aimags. The main region of rapeseed production is the Central region, with Selenge and Tuv aimags taking a combined share of 57.9% in the total production during the period 2013 to 2017. Next to these aimags, Dornod and Sukhbaatar in the Eastern region contributed 14 and 9.8 percent of the production, respectively. The remaining 12.4% of the production was distributed across 9 aimags in all 4 regions, with Darkhan-Uul, Bulgan and Khentii having a slightly dominating role. Rapeseed is not grown in aimags in the Gobi and Altai mountain sub-regions yet (Figure 3.1).

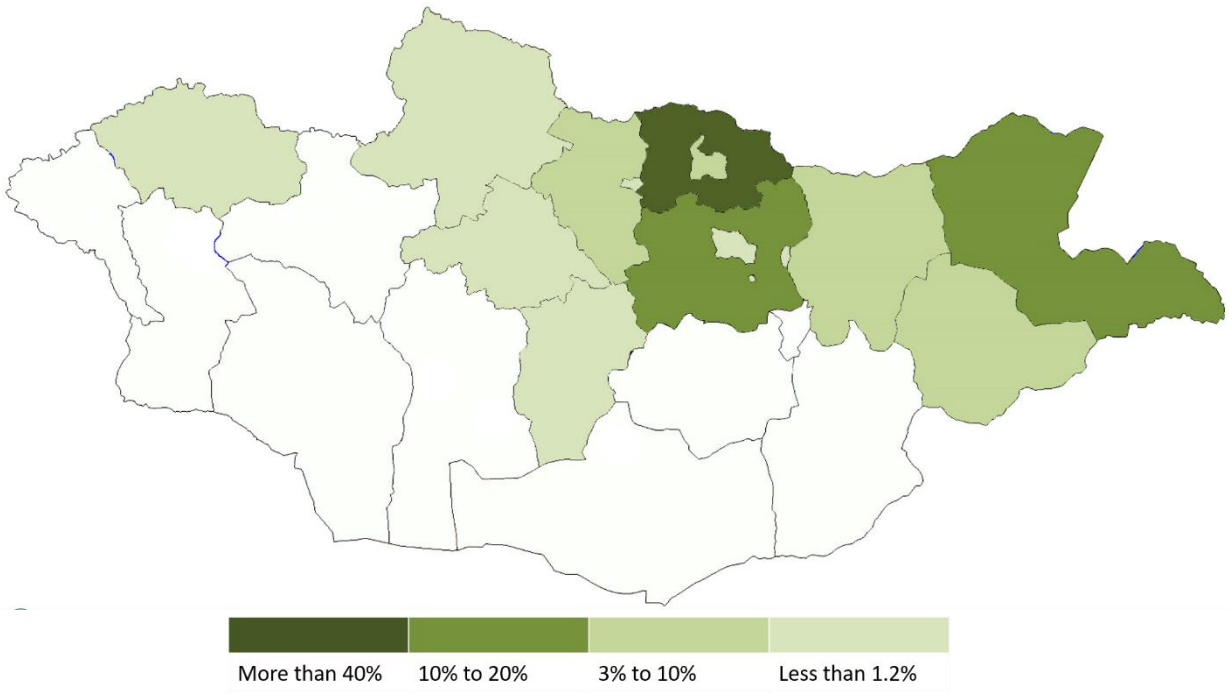

Figure 3.1: Share of each aimag in total rapeseed production in the period 2013 to 2017

Source: NSO, 2018.

3.1.2 Structure of rapeseed growers

On average of the period 2013 to 2017, 87% of the total sown areas and 90% of the total harvest of raoeseed was attained by enterprises and the remaining 13% of the sown areas and 10% of the harvest by family farms. The structure of rapeseed growers resembles that of wheat growers: in fact, most rapeseed growers also grow wheat, partly in rotation with rapeseed. Hence, the typical rapeseed grower is a mechanized farm with more than 500 ha, or rather more than 1000 ha, arable land. The exact number rapeseed growers is unknown (Table 3.2).

Table 3.2: Structure of rapeseed growers

Parameters	2013	2014	2015	2016	2017
Sown area, 1000 ha					
Enterprises	73.2	78.2	68.8	56.6	70.9
Family farms	10.7	8.3	14.2	9.5	8.1
Harvest, 1000 t					
Enterprises	37.7	47.2	20.7	18.5	12.9
Family farms	4.0	4.7	2.4	2.9	0.6

Source: NSO, 2018.

3.1.3 Total supply and exports

For unknown reasons, rapeseed exports and imports are not captured in customs statistics that are accessible for the public. Imports of rapeseed are rather unlikely since the rapeseed industry in Mongolia is limited to two processors and only one of them (Mind Tech) is in operation. That very processor confirmed no imports of rapeseed. Exports on the other hand, are well known. According to Mind Tech, approx. 15 to 20 of total rapeseed harvest is delivered for domestic processing and the remaining 80 to 85% is exported to China. In 2017, for example, the company was only able to secure 2000 tons of rapeseed from domestic growers for processing. The remaining 11.5 thousand tons of rapeseed were exported to China.

The domestic demand for vegetable oil is estimated at 10.95 kg per capita (at an average daily ration of 30 g) and 31.2 thousand tons in total per year. For the production of 1 kg rapeseed oil 2.36 kg rapeseed is required. Hence, the total domestic demand for rapeseed is approx. 73.63 tons. The 2017 harvest of rapeseed equalled 18% of the required amount. Since only 2000 t of rapeseed were left after exports, however, the rate of domestic sufficiency only reached 2.7 percent.

3.2 Distribution and processing

As also confirmed by rapeseed growers interviewed in this study, 80 to 85 percent of the rapeseed harvest is exported to China through intermediary traders and the remaining 15 to 20 percent is delivered to Mind Tech for processing. The main product of rapeseed processing is rapeseed oil and the marketable by-product is expeller. Rapeseed oil is marketed via wholesale and/or retail while expeller is sold to livestock farms, mostly through feed traders (Figures 3.2 and 3.3).

Mind Tech has a capacity of producing 100 tons of vegetable oil per day and 33 thousand tons per year. The production facility in Selenge aimag commenced its operation in 2012 and has been processing sunflower, soy and rapeseed for vegetable oil production. While the company's production capacity is sufficient to cover the domestic demand for vegetable oil undersupply of rapeseed forces the company to only use 6% of its capacity. Furthermore, the company imports premium quality rapeseed seeds from Germany and distributes to crop farms on the condition to purchase the harvest back. Unfortunately, many crop farms do not comply with their agreement and sell their harvest to China instead.

Figure 3.2: “Orgikh” vegetable oil and expeller produced from Mongolian-grown rapeseed

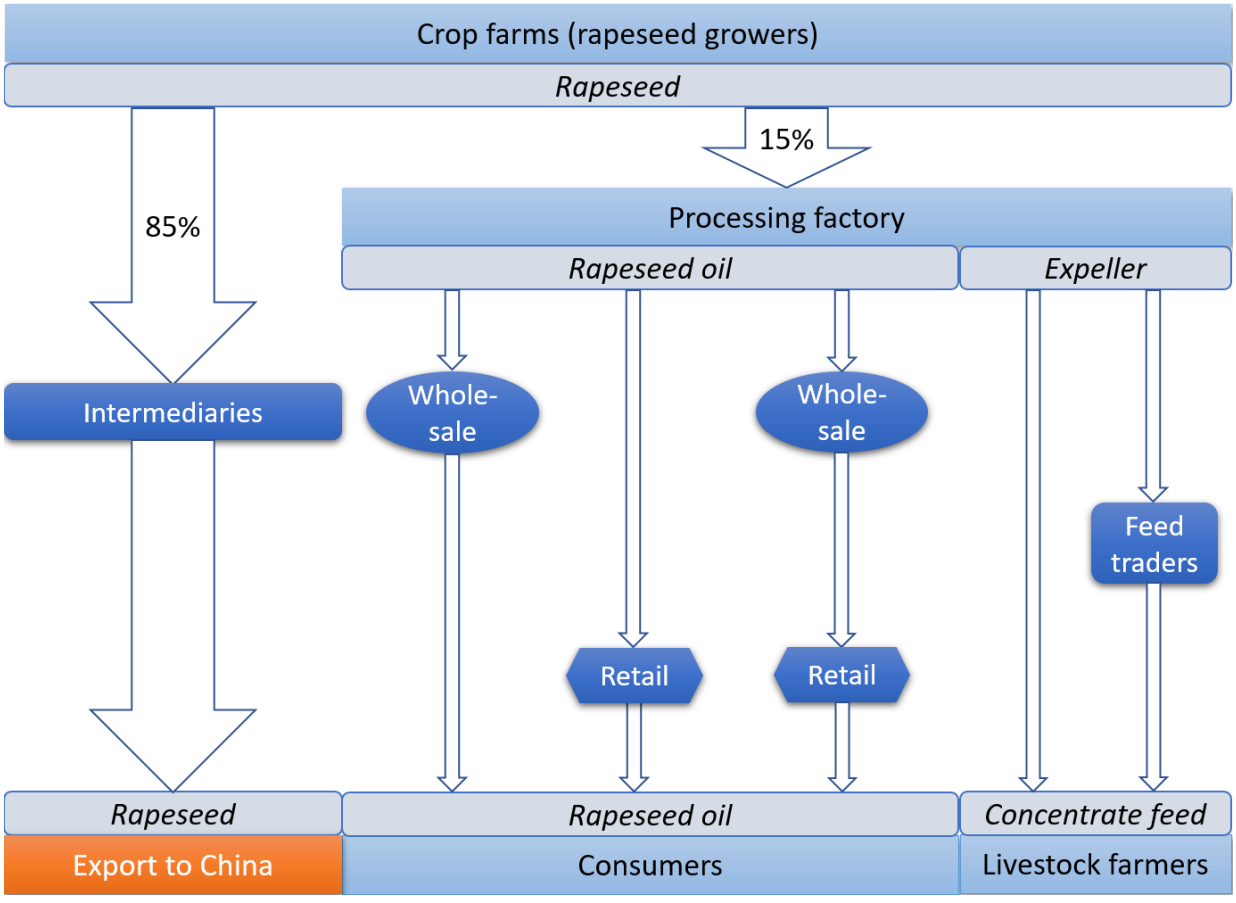

Figure 3.3: Distribution channels of rapeseed

3.3 Gross Value Added of the rapeseed value chain

3.3.1 Gross Value Added in the Wheat-Flour value chain 2017

The market price of rapeseed in late 2016 and 2017 ranged between MNT 900 and MNT 1000 per kg. In the GVA calculation, we used the lower price MNT 900 thousand per t. The production costs of rapeseed were estimated through interviews with crop farmers at MNT 295 thousand per t. The processing of 2000 t rapeseed delivered to Mind Tech resulted in the production of 982 t rapeseed oil and 1684 t expeller, which were sold at wholesale prices of MNT 2500 per kg rapeseed oil and MNT 888 per kg expeller. At retail trade, an average margin of 10% was added to the prices of each product.

In accordance with the above calculations, the rapeseed value chain 2017 turned an input of MNT 0.6 billion into a gross output of MNT 4.4 billion and resulted in a GVA of MNT 3.8 billion. The growers' share in the GVA was 32%, that of the processor 57% and the share of retail trade 11%, respectively (Figure 3.4).

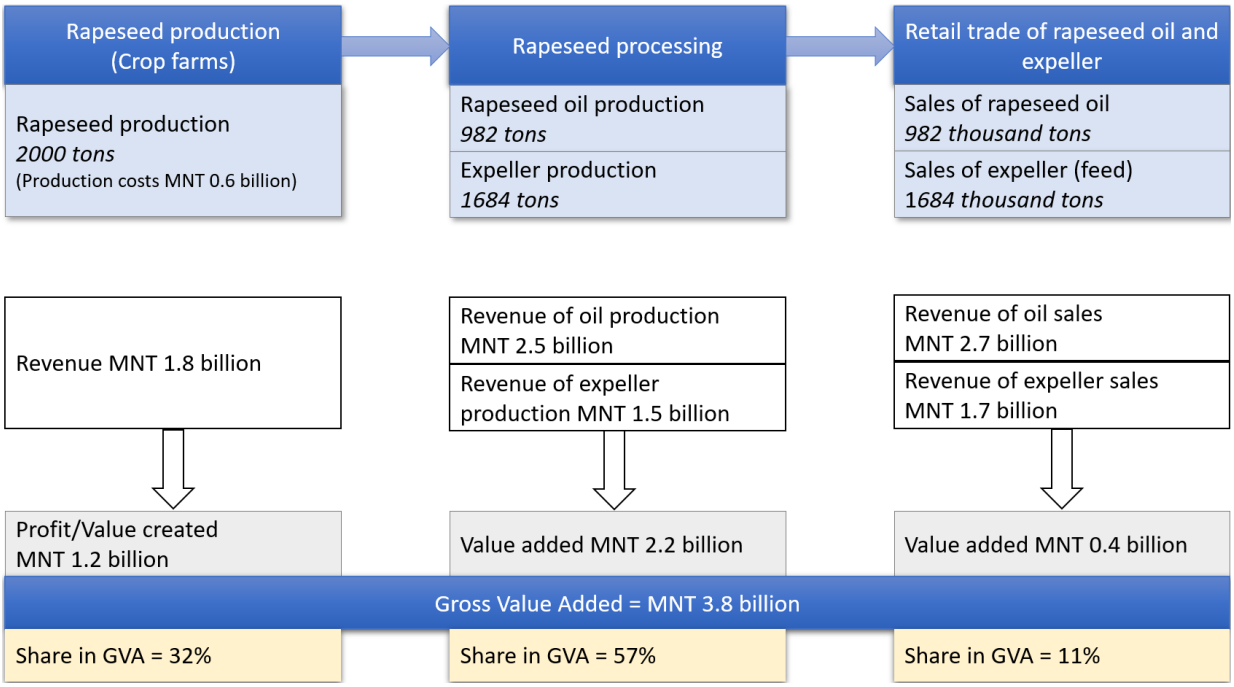

Figure 3.4: Gross Value Added in the rapeseed value chain 2017

This means that out of every MNT 100 invested in rapeseed production crop farms, processors and traders earned MNT 205, MNT 365 and MNT 67, respectively (Figure 3.5).

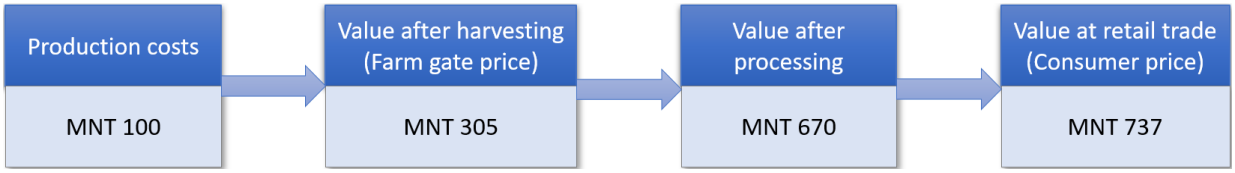

Figure 3.5: Value adding in the core processes of the rapeseed value chain 2017

4. Analysis of the potato value chain

4.1 Primary production

4.1.1 Volume and geographical distribution of potato production

Due to the satisfaction of the domestic demand potato production has stabilised around 15 thousand ha of sown areas during the last 2 years. The hectare yields greatly vary, not only depending on the weather but also on the availability of irrigation at each farm, but average at approx. 12 tons. The total production during the last five years reached a maximum of 191.6 thousand tons in 2013 and a minimum of 121.8 thousand tons in 2017 (Table 4.1).

Table 4.1: Overview of potato production between 2013 and 2017

Parameters	2013	2014	2015	2016	2017
Sown area, 1000 ha	15.5	13.2	12.8	15.0	15.1
Share in total sown area	3.7%	3%	2.4%	3%	2.9%
Total harvest, 1000 t	191.6	161.5	163.8	165.3	121.8
Yield per ha, t	12.4	12.2	12.8	11.0	8.0

Source: NSO, 2017.

Potato is grown in all 21 aimags and in Ulaanbaatar. The main region of potato production is the Central region, with Selenge and Tuv aimags contributing 37.9 and 26.2 percent of the total production, respectively, on the average of the period 2013 to 2017. Next, Darkhan-Uul aimag in the Central region, Khovd in the Western region and Bulgan in the Khanghai region contributed 6.1%, 4.3% and 3.7%, respectively, during the same period. In all other aimags, potato production was below 3% of the total or below 5000 tons, with some aimags in the Southern region only producing 60 to 200 tons per year (Figure 4.1).

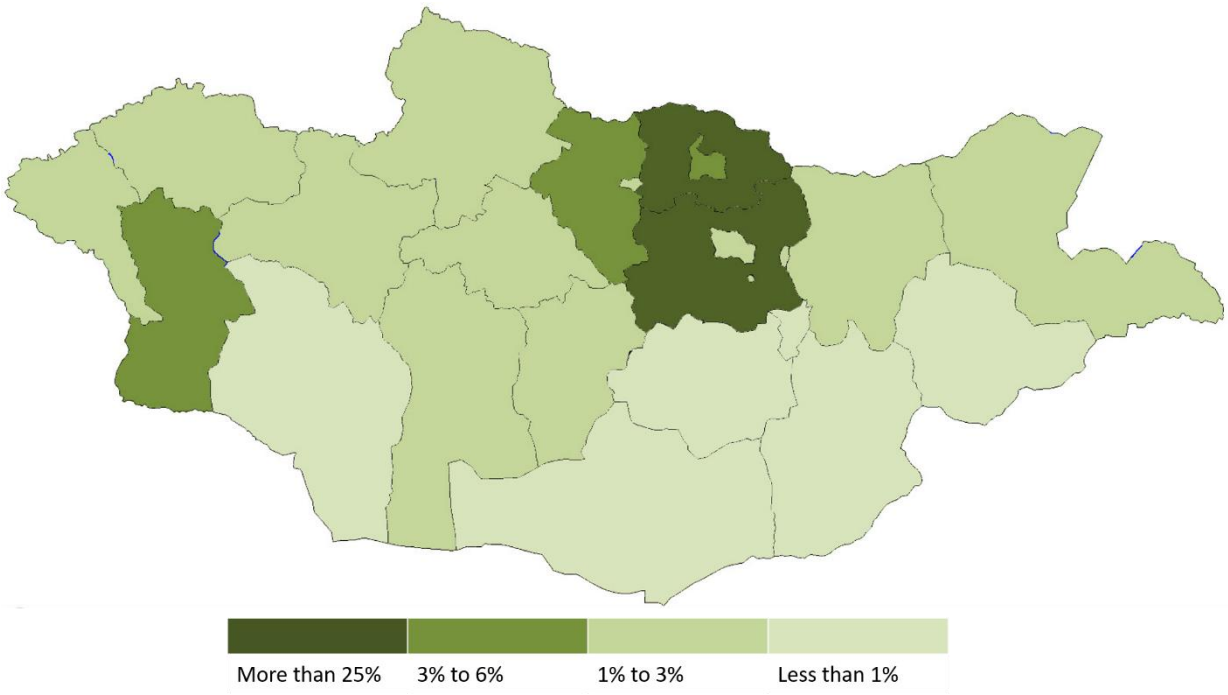

Figure 4.1: Share of each aimag in total potato production in the period 2013 to 2017

Source: NSO, 2018.

4.1.2 Structure of potato growers

On average of the period 2013 to 2017, 27% of the total sown areas and 29% of the total harvest of potato was attained by firms and the remaining 73% of the sown areas and 71% of the harvest by family farms. The trend confirms that potato farming is mainly a family business, run by small- and medium-scale farms (Table 4.2).

Table 4.2: Structure of potato growers

Parameters	2013	2014	2015	2016	2017
Sown area, 1000 ha					
Enterprises[1]	4.2	3.2	3.3	4.1	4.8
Family farms	11.3	10.0	9.5	11.0	10.3
Harvest, 1000 t					
Enterprises	55.4	47.7	45.9	46.3	39.4
Family farms	136.2	113.8	117.9	119.1	82.4

Source: NSO, 2018.

Unfortunately, no reliable statistics on the number of potato growers are available. In the latest agricultural census from 2011 the NSO counted 33461 family farms, most of which are supposed to engage in potato and vegetable production (NSO, 2011). The MIA estimated the number of family farms at 63 thousand as of 2013 (MIA, 2013). More recently, the MFARD determined 35,242 potato and vegetable producers in total and estimated that 95% of them or approx. 33,500 producers are family farms (MFARD, 2016). This figure, however, is not confirmed by the NSO, according to which there were only 15,985 family-run crop farms in 2017. Yet, we must accept the fact that none of these figures promise 100% certainty because many "family farms" are members of cooperatives, which are registered as crop farming enterprises, at the same time, and extended families i.e. families with two or more generations of crop farmers are counted as one farm in some cases and several in other cases. For the purpose of this study, we are left to assume that there are approx. 30 thousand family farms that engage in potato production on a regular or non-regular basis.

4.1.3 Total supply and self-sufficiency

Imports of potato, including seed potatoes, ranged between 32 and 17,059 tons during the last five years. Potato exports were irregular but reached 4.5 thousand tons in 2014. The total supply of potato ranged between 121.6 thousand tons in 2017 and 221.1 thousand tons in 2013. The rate of domestic production in total supply averaged 95.3%, peaking at 100.2% in 2017 (Table 4.3).

Table 4.3: Total supply of potato between 2013 and 2017

Parameters	2013	2014	2015	2016	2017
Production, 1000 t	191.6	161.5	163.8	165.3	121.8
Exports, 1000 t	2.5	4.5	-	-	0.6
Imports, 1000 t	32.0	5.4	17.1	0.7	0.4
Total supply, 1000 t	221.1	162.4	180.9	166.0	121.6
Rate of domestic production in total supply	86.7%	99.4%	90.5%	99.6%	100.2%

Source: NSO, 2018.

[1] Firms and cooperatives.

The level of self-sufficiency in potato was estimated by MFARD (2016) using a relatively sophisticated calculation, in which variables such as the share of seed potatoes in total harvest, post-harvest and pre-consumption losses and the limited purchasing power of rural and low-income households were embedded. According to this calculation, the total demand for potato was 115 thousand tons and the rate of self-sufficiency was 88% on the average of the period 2013-2015 (Table 4.4).

Table 4.4: Total supply of potato between 2013 and 2017

Regions	Number of population, thousand	Intake requirement, thousand tonne	Number of persons that are possible to consume potato thousand*	Real demand, thousand tonne	Three-year average, thousand ton		Supply of real demand, %
					Total harvested	Total consumed **	
Western	354.8	18.1	269.2	13.7	17.4	11.1	88.1
Khangai	525.5	26.8	398.7	30.8	30.8	13.6	62.4
Central	437.6	22.3	366.4	18.7	109.2	70.2	375.4
Capital city	1233.0	63.0	1175.6	60.0	3.6	2.0	3.4
Eastern	190.0	9.7	146.3	7.4	7.1	4.38	59.2
National total	2740	140.0	2360.7	115.0	168.1	101.3	88.0

Source: MFARD, 2016.

While a replication of this calculation or a more sophisticated calculation for 2017 is beyond the scope of this study we may assume that, given the fact that only 400 kg potatoes were imported in 2017, the 2016 harvest minus seed potatoes and losses nearly equalled the domestic demand in 2017. The required amount of seed potatoes was approx. 45 thousand tons, and post-harvest and pre-consumption losses are estimated at 15% in total (cf. MFARD, 2016). Accordingly, the net amount of potatoes consumed from the 2016 harvest in 2017 was approx. 102 thousand tons, and the rate of self-sufficiency approx. 89 percent. We may conclude that while the demand for potatoes is approx. of 110 to 120 thousand tons the consumption is in the range of 100 thousand tons per year. An addition supply of 10 to 20 thousand tons of potatoes is required for full self-sufficiency.

4.2 Storage

According to MFARD, the storage capacity that was known at the end of 2015 was able to cover 69.7% of the 2016 potato and vegetable harvest. The rate of sufficiency ranged from 24.4% in the Khangai region to 725.6% in Ulaanbaatar. Apparently, 35% of the total storage capacity is available in Ulaanbaatar and this results in unbalanced geographic distribution of storage facilities for potato and vegetable. Hence, the 69.7% rate of total sufficiency in storage capacity is only hypothetical; in most potato and vegetable producing areas the rate of sufficiency is far below it. In the major potato producing aimags Selenge and Tuv, for instance, the rates of sufficiency were 50.6 and 63.3 percent, respectively. In summary, there is overall shortage of storage capacity for potato and this is most critical in the major regions production, in contrast to the overcapacity of storage facilities concentrated in the capital Ulaanbaatar (Table 4.5).

Table 4.5: Capacity of potato and vegetable storage

Parameters	Potato and vegetable harvest in 2016, t			Storage capacity, as of 2015	Sufficiency of storage, %
	Potato	Vegetables	Total (P+V)		
Western region	**17,660**	**15,190**	**32,850**	**13,278**	**40.4**
Zavkhan	2,320	1,260	3,580	4,540	126.8
Uws	3,220	3,400	6,620	2,880	43.5

Bayan-Ulgii	2,720	1,130	3,850	1,250	32.5
Khovd	8,690	8,900	17,590	2,780	15.8
Gobi-Altai	710	500	1,210	1,828	151.0
Khangai region	**49,360**	**14,160**	**63,520**	**15,510**	**24.4**
Khuvsgul	3,410	2,070	5,480	4,900	89.4
Bulgan	5,240	2,100	7,520	1,200	159.6
Orkhon	3,870	4,100	7,970	2,600	36.2
Bayankhongor	2,900	2,100	5,000	2,170	43.4
Arkhangai	3,530	1,190	4,720	955	20.2
Uvurkhangai	4,310	2,600	6,910	3,685	53.3
Central region	**102,014**	**54,780**	**156,794**	**87,025**	**55.5**
Selenge	40,690	31,300	71,990	36,400	50.6
Darkhan-Uul	6,830	15,500	22,330	9,720	43.5
Tuv	54,310	6,900	61,210	38,740	63.3
Gobi-Sumber	97	100	197	350	222.9
Dornogobi	210	280	490	620	126.5
Dundgobi	120	60	180	470	261.1
Umnugobi	540	64	604	725	120.0
Eastern region	**6,670**	**3,640**	**10,310**	**6,868**	**66.6**
Khentii	3,820	2,500	5,320	2,100	39.5
Sukhbaatar	510	240	750	850	113.3
Dornod	2,340	900	3,240	3,918	120.9
Ulaanbaatar	**3,510**	**5,800**	**9,310**	**67,366**	**725.6**
Total	**179,210**	**93,530**	**272,740**	**190,047**	**69.7**

Source: MFARD, 2016.

According to MoFALI, the total storage capacity of potato and vegetables increased to 200.2 thousand tons by the end of 2017. The number of storage facilities is estimated at approx. 9700. The government is aiming to increase the total capacity to 297.5 thousand tons by 2020. Besides the overall shortage in storage capacity a matter of concern is the quality of storage. According to MoFALI, approx. 60 percent of storage facilities do not meet the quality standards, and this increases the post-harvest losses of potato and vegetables up to 35 percent. Major elements increasing losses during storage that were identified through the assessment include wooden walls, bulk storage of different vegetables, non-regulation of the micro climate and lack of plant protection measures (MoFALI, 2018).

4.3 Distribution and processing

Due to lack of processing potato is delivered in unprocessed form to consumers. Potato growers sell 10% of their harvest directly or through retail trade, 50% to intermediaries, 10% to wholesalers after the autumn harvest and store the remaining 30% for winter and spring sales through retail trade and food markets, which offer wholesale and retail trade at the same time. The intermediaries, who own approx. 50% of total storage facilities for potato and vegetables, sell approx. 40% of the potato that they bought from farmers at food markets, 30% through retail trade and the remaining 30% to individual buyers such as restaurants, hospitals, holiday resorts and canteens (cf. MFARD, 2016). Overall, the potato value chain is relatively simple, with its core processes only including primary production and trade (Figure 4.2).

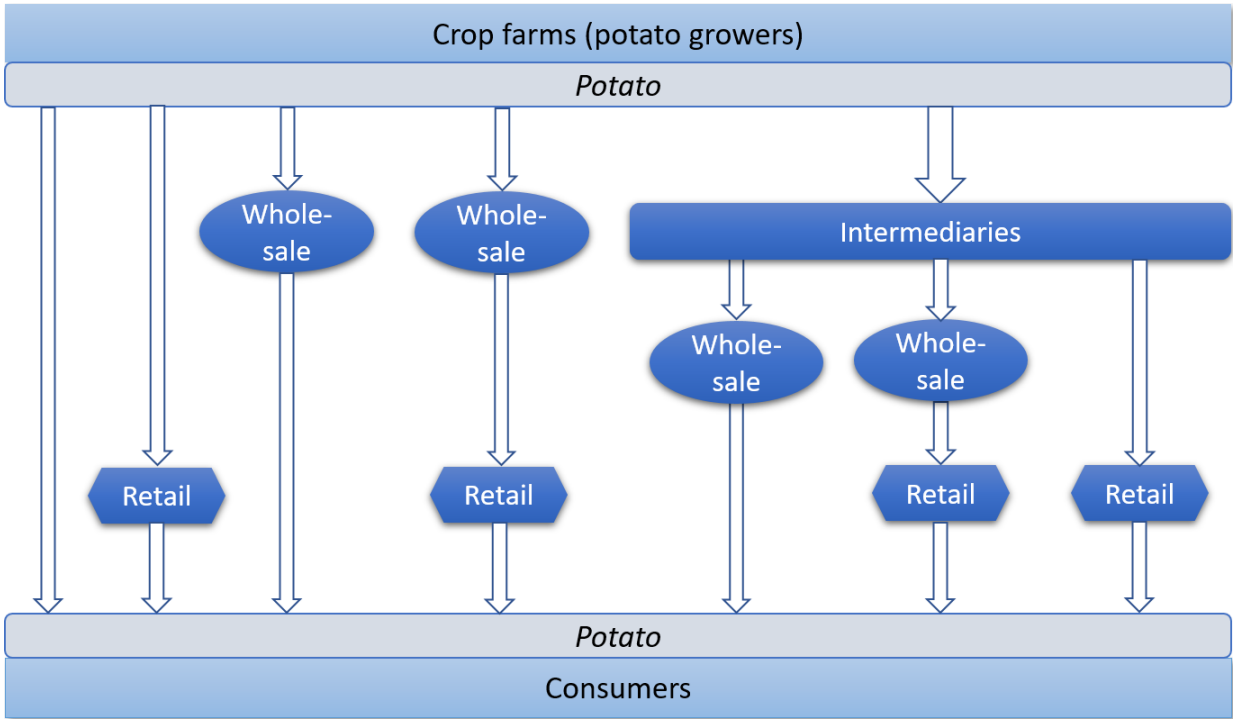

Figure 4.2: Distribution channels of potato

Processing of fresh potatoes is uncommon. Instead, several plants producing French fries and chips in Ulaanbaatar use imported potato starch or frozen French fries. In 2017, for instance, 44.3 tons of potato starch were imported. The reasons for not using domestically grown potatoes in processing include lack of the specific varieties for either French fries or chips production, and the investments and maintenance costs required for storage and processing of fresh potatoes. The Elite Seed LLC in Selenge aimag is growing the Shepodi variety along with its plan of producing French fries using Mongolian grown potatoes. But this operation is still in its experimental stage, hence insignificant for the potato value chain yet.

4.4 Pricing

Potato price is not regulated but freely negotiated between sellers and buyers. During the last five years shows there has not been any significant change in potato price although production costs have increased, primarily due to increased fuel price and labour costs. Hence, the relatively stable price trend indicates stagnating to decreasing profitability of potato cropping (Table 4.6).

Table 4.6: Average price of potato between 2013 and 2017

Parameter	2013	2014	2015	2016	2017
Potato price, MNT per kg	938	988	1263	969	884

Source: NSO, 2018.

The farm gate price of potato rarely exceeds MNT 300 while the retail price is usually above MNT 1200. On food markets, potato prices are relatively similar, but differences arise upon the location of each market. At markets in downtown Ulaanbaatar the price is by MNT 100 to 200 higher than the price offered at food markets in the suburbs. Seasonal fluctuations are not typical for retail prices but substantial on food markets. The price peaks around the end of July when fresh early ripening potatoes are offered. During the first week or so, the price climbs up to MNT 1500 to 2000 per kg but it gradually drops to the normal level of MNT 800 to MNT 1000 (Figure 4.3).

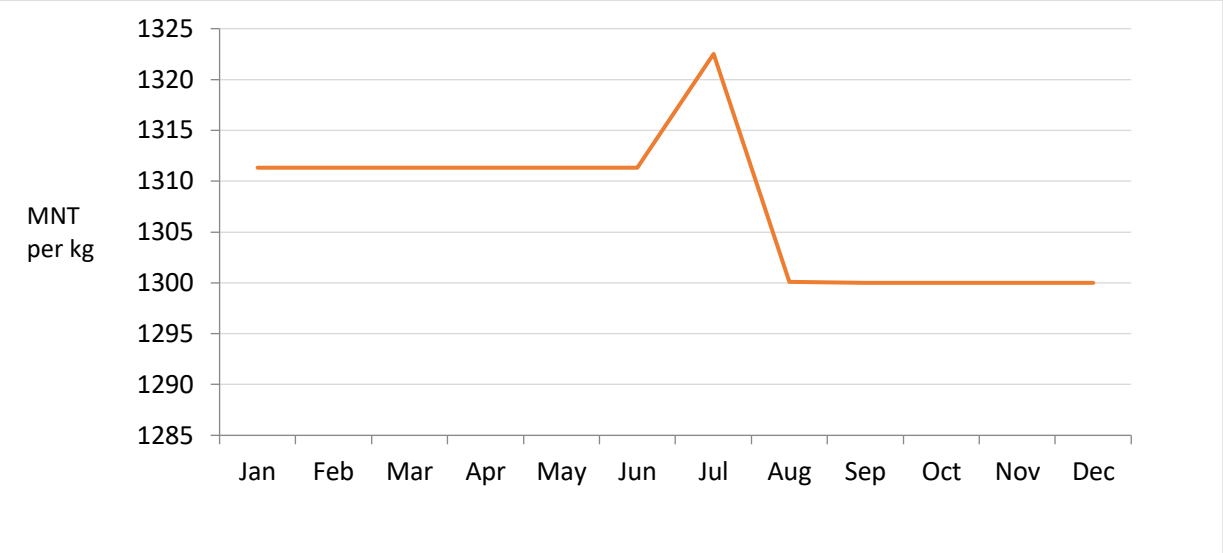

Figure 4.3: Average retail price of potato in Ulaanbaatar in 2016

Source: NSO, 2018.

4.5 Gross Value Added of the potato value chain 2017

Production costs of one kg potato in the vegetation season 2016 were estimated at MNT 282.1 on non-irrigated fields, MNT 306.7 on irrigated fields and MNT 205 on average (MFARD, 2016). The farm gate price of potato in autumn 2016 averaged MNT 384 per kg. This is also the price attained by direct sales of growers. Intermediaries sold potatoes at MNT 575 per kg, and the wholesale and retail prices in 2017 averaged at MNT 696 and MNT 759, respectively. The total amount of potato sold by farmers was approx. 103.7 thousand t, which is determined by deducting 10% post-harvest loss and 45 thousand t of seed potatoes from the total 2016 production (165.2 thousand t). As described in section 4.3, 10% of the 2016 potato harvest was sold directly by farmers, 50% by intermediaries, 30% by wholesalers and the remaining 10% through retail trade (cf. MFARD, 2016).

According to the above calculation, the potato value chain in 2017 attained a GVA of MNT 26.1 billion, hence turning the initial input of MNT 30.6 into a gross output of MNT 56.7 billion. The growers' contributed 35% of the GVA, intermediaries 38%, wholesalers 5% and retail traders 22%, respectively. The relatively little share of the wholesalers in the total GVA is explained by the fact that only 10% of the total harvest is channelled through wholesale (Figure 4.4).

The value of potato grown on a MNT 100 investment became MNT 130 when it was sold by growers themselves. It became MNT 195, MNT 236 and MNT 257 when the potato was bought by intermediaries and sold directly, via wholesale and via retail, respectively. The highest value of MNT 157 was added to a MNT 100 investment in potato production in the case that the potato was sold by the grower to an intermediary trader, who then sold it via retail (Figure 4.5).

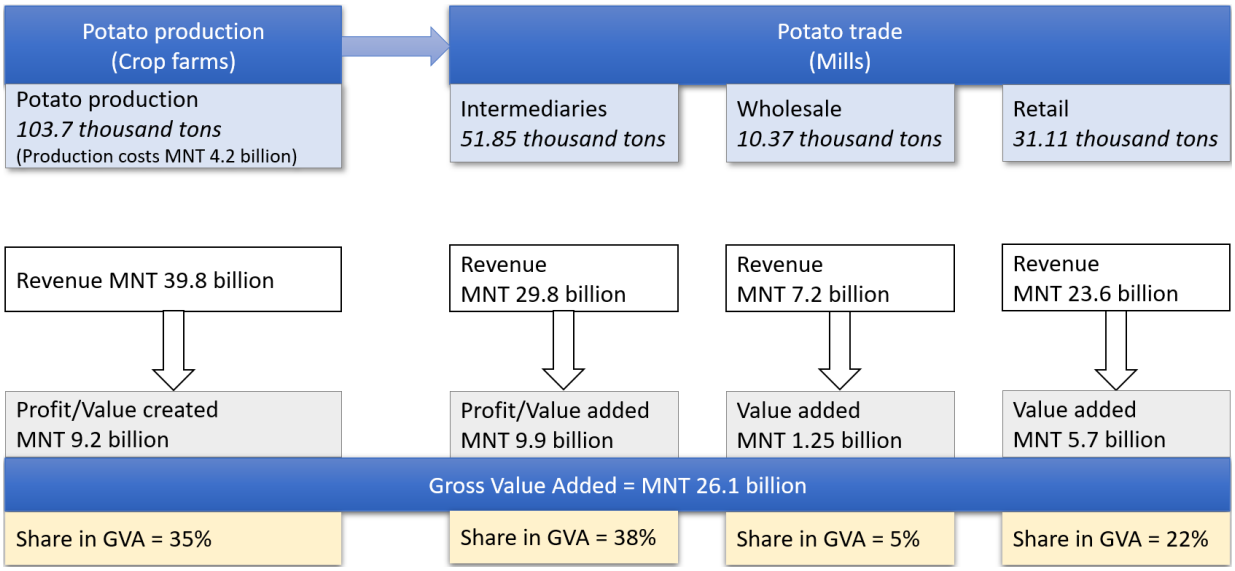

Figure 4.4: Gross Value Added in the potato value chain 2017

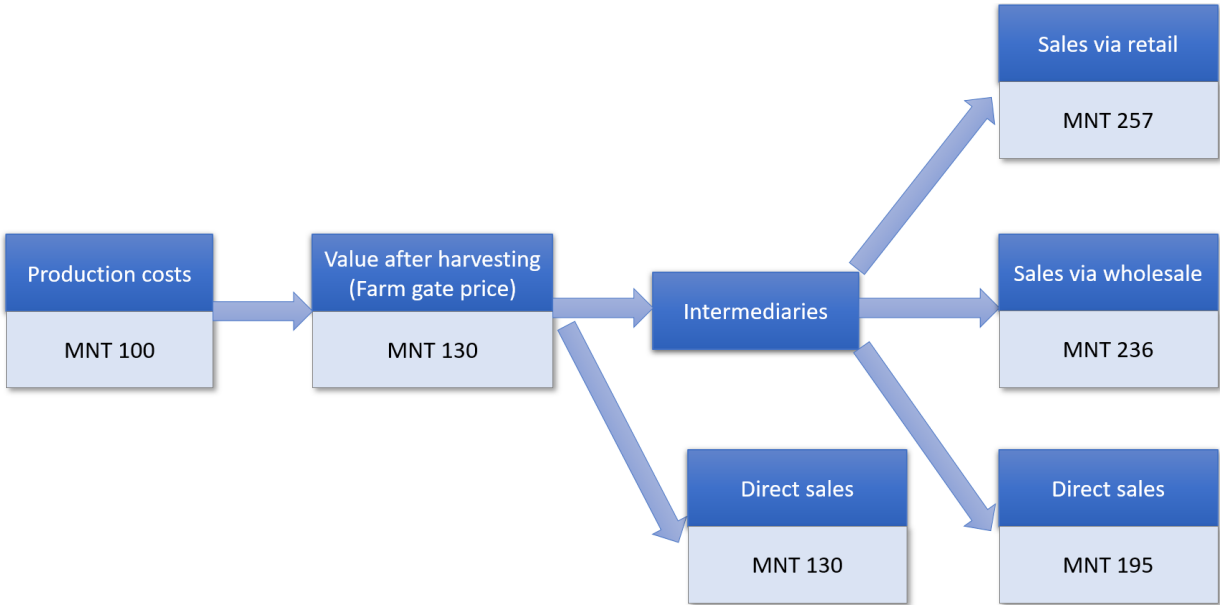

Figure 4.5: Value adding in the core processes of the potato value chain 2017

5. Conclusions

This study identified the following major weaknesses in the value chains of wheat, rapeseed and potato:

- Cropping is extremely vulnerable to climate risks, and this not only threatens the economic viability of the cropping sector but also results in strong fluctuations of the domestic supply, which in turn, threatens stable operation of the processing sector.
- Due to the vulnerability of cropping to climate risks self-sufficiency of the strategic crop wheat is seriously endangered and there is no guarantee for securing it even in the event of upscaling production. As already experienced during the 2008 food crisis, which raised the price of bread by 60% within a few months despite preventive measures of the government, dependency on wheat and flour imports is a time bomb that only awaits its explosion.
- In the case of potato, the economic viability of cropping is additionally threatened by persisting price stagnation in relation to increased production costs. The price stagnation, in turn, is the result of the lack of fresh potato processing. The market for potato is relatively satisfied, and the only opportunity for extending the market capacity lies in the use of fresh potatoes instead of imported starch and frozen potatoes by the processing industry.
- Also, the wheat-flour value chain and the rapeseed value chain are characterised by underutilisation of the processing capacity i.e. undersupply of crops in relation to the processing capacity available. The extreme case is the rapeseed processing facility of Mind Tech, which only utilises 6% of its capacity.
- Due to its relatively high profitability rapeseed production can be expected to increase in the near future. However, the fact that up to 85% of domestically grown rapeseed is exported to China presents a serious concern that urgently needs to be addressed. Not only does this trend conflict with the policy goal of developing domestic value chains but also endangers an exemplary model of value chain development, introduced by Mind Tech at its own risk, to collapse. This pilot “contract farmer” model deserves dedicated policy attention and support as to stimulate introduction of similar value chain models.
- There is overall shortage of storage capacity for potato and this is most critical in the major regions production, in contrast to the overcapacity of storage facilities concentrated in the capital Ulaanbaatar. In addition, poor design and maintenance of storage facilities causes up to 35% post-harvest losses of potato.
- Although reliable benchmarks are not available this study found the growers’ shares in the GVA of the to be relatively insufficient. In the extreme case of the wheat-alcohol value chain it is only 0.5 percent.
- The most imbalanced pricing pattern was found in the potato value chain: the consumer price is more than double the producer (farm gate) price for the same unprocessed crop. This is not to neglect the burden of storage costs and losses that is carried by intermediary traders. In fact, it is not possible to identify a winner in this value chain. At present, all key actors of this value chain are trapped in a losing situation with no clear way forward. Most critical are the growers, who have to keep up with increasing production costs with no realistic perspective of getting better prices for their potatoes.

6. References

AGRIDEA (2016). Wertschöpfung der Produkte der Freiburger Landwirtschaft.

Arneiter, M. (2016). Risiken in der Wertschöpfungskette und deren Management in der österreichischen Getreidewirtschaft. Masterarbeit der Universität für Bodenkultur, Wien.

Bakey, A. et al. (2018). Mongolian agriculture: Development perspectives. Ulaanbaatar: Mongolian University of Life Sciences.

Byambadorj, Ch. and Mungun, J. (2015). German design of wheat machinery, specialties of usage. Ulaanbaatar: Mongolian University of Life Sciences.

Choijamts, A. Odgerel, B., Amarsanaa, B., Tuul. D. (2015). State of soil fertility of crop land in Mongolia, options for improvement and requirements for fertilization. Unpublished Power point presentation.

Department of Statistics, Information and Research of the Capital City (2004): Ulaanbaatar in the 20th century. Ulaanbaatar.

Department of Statistics, Information and Research of the Capital City (2015): Economic and social indicators of the capital 2014. Ulaanbaatar.

Department of Statistics, Information and Research of the Capital City (2016): Statistics. Ulaanbaatar.

Holstein, A. (2000). Mengenströme und Wertschöpfung im Deutschen Getreidesektor.

Ministry of Environment and Tourism (2017). Report on the environment.

Ministry of Food, Agriculture and Light Industry (2013). Current situation of the food, agriculture and light industry sector. Unpublished Power point presentation.

Ministry of Food, Agriculture and Light Industry (2018). Evaluation report of the activities of the Ministry of Food, Agriculture and Light Industry.

Ministry of Food, Agriculture and Light Industry (2016). Monitoring report on the status of implementation of the objectives and measures in food and agriculture sector for the period 2012 to 2016.

Ministry of Food, Agriculture and Light Industry (2018). Current situation of the food, agriculture and light industry sector. Retrieved on 12 November from http://mofa.gov.mn/exp/blog/8/70

Mongolian customs (2018). Customs statistics 2017. Retrieved on 14 November from http://customs.gov.mn/statistics/index.php?module=users&cmd=info_full&cid=590&st=1.

Mongolian Farmers' Association for Rural Development (MFARD) (2016). Study on Mongolian vegetable sector and value chain situation. Commissioned by the "Support to Employment Policy for promoting job creation in Mongolia (SECiM)" project, Component 2: Piloting quality private sector work in selected livestock and vegetable value chains.

Namjim T. (2004). Economy of Mongolia. Vol. 1. Ulaanbaatar: Mongolian Academy of Sciences.

National Statistical Office (2018). Agricultural sector 2017. Ulaanbaatar: National Statistical Office (NSO).

National Statistical Office (2000, 2001, 2011, 2013, 2016, 2017). Statistical yearbook 1999, 2000, 2010, 2012, 2015, 2016. Ulaanbaatar: National Statistical Office (NSO).

Neil, A.C. (1993). Wheat production in Mongolia: An economic analysis.

Nyamdavaa, B. (2014). Results of the investigation of the production costs of bread wheat.

Odonkhuu, B. (2014). Current situation and future goals of grain production.

Laws and policy documents used:

Law on Cropping (2015)

State Policy on Food and Agriculture (2015)

Mongolian Livestock Program (2010)

Action Plan for Implementation of the Government Program 2016 to 2020 (2016)

Action plan for Implementation of the State Policy on Food and Agriculture (2016)

Resolutions of the Secretary of State of the Ministry of Food, Agriculture and Light Industry: A-281 (2014), A-03 (2015), A-298 (2015) and A-141 (2016).