MINISTRY OF ECOLOGY, ENVIRONMENTAL PROTECTION AND CLIMATE CHANGE OF THE REPUBLIC OF UZBEKISTAN

GGGI

KOICA

SORGHUM VALUE CHAIN ANALYSIS

In the Republic of Karakalpakstan

GGGI Uzbekistan. Insight Brief 5. Green Rehabilitation Investment Project for Karakalpakstan Republic to Address Impacts of the Aral Sea Crisis (Aral Sea GRIP)

NOVEMBER 2022

GGGI UZBEKISTAN INSIGHT BRIEF SERIES

1. Legal & Political Framework Review for the Agriculture Sector in Uzbekistan and Karakalpakstan (2022)
2. Tomato & Cucumber Value Chain Analysis in the Republic of Karakalpakstan (2022)
3. Melon & Watermelon Value Chain Analysis in the Republic of Karakalpakstan (2022)
4. Apple, Apricot & Pear Value Chain Analysis in the Republic of Karakalpakstan (2022)
5. Sorghum Value Chain Analysis in the Republic of Karakalpakstan (2022)

Insight Briefs are based on GGGI's experience and analysis. GGGI Uzbekistan will produce additional Insight Briefs from new insights gained while working to find ways to promote green growth.

Global Green Growth Institute
7, Bunyodkor av., 100043
Tashkent
Republic of Uzbekistan

This insight brief has been produced under the 'Green Rehabilitation Investment Project for Karakalpakstan Republic to address impacts of the Aral Sea Crisis' (Aral Sea GRIP Project) funded by the Korea International Cooperation Agency (KOICA) and co-funded and implemented by the Global Green Growth Institute (GGGI).

LEAD AUTHOR: Juan Jose Robalino (GGGI)
CONTRIBUTING AUTHORS: Jack Bathe (GGGI)
EXPERT REVIEWERS: Dr. Aaron Russell (GGGI), Azat Tileumuratov (GGGI), Bakhitbay Aybergenov (GGGI), Shin Dong-Hyun (Green Asia Network), HyoSeon Yang (Green Asia Network), Jooyoung Yoo (Human Asia), Dr. Botir Khaitov (ICBA), Jakhongir Talipov (SCEEP), Bobur Makhmudov (SCEEP), Javokhir Abdukhalikov (SCEEP), Anvar Tursunaliyev (SCEEP), and the ISCAD expert group.

PHOTO CREDITS: Juan Robalino (GGGI), Nora Heinonen (GGGI) & Bakhitbay Aybergenov (GGGI).

SUGGESTED CITATION:
J.J. Robalino and J. Bathe (2022) Sorghum Value Chain Analysis in the Republic of Karakalpakstan, Global Green Growth Institute (GGGI), Seoul, South Korea.

Executive Summary

The value chain of sorghum in Karakalpakstan ends with the commercialization of sorghum grain and flour for food, and grain, stalks and leaves for livestock feed; all of these products **undergo limited value addition from the production stage**. Input providers, farmers, middlemen, millers, local retailers and wholesalers, and domestic consumers are the key stakeholders along the value chain.

The importance of sorghum in Karakalpakstan has grown recently due to its potential for supporting water-efficient, agriculture, and landscape degradation initiatives in the region. Sorghum has been part of programs in support of diversification and seed production to **enhance the productivity of salt affected lands and to increase the income of rural people**. On-farm results recommend **sorghum as a second seasonal crop** after wheat harvest, as well as into rice crop rotation, in order to fill the gap in farm productivity and crop-livestock systems. However, **opportunities for sorghum** and the development of its value chain in Karakalpakstan go beyond supporting production systems affected by heat, drought, and salinity, and include the **production of foods and beverages, as well as biofuel**. **Biofuel development does not need to compete with food production** as it makes use of excess biomass not utilized for food (i.e., leaves and stalks). In Karakalpakstan, **the development of the value chain** through innovative sorghum value-added products **requires research, marketing, political support, and strong collaboration between the private and public sector**.

Objective

The main objective of this Insight Brief is to **describe the current flow of products and stakeholders involved in the sorghum value chain in Karakalpakstan**. Taking into account regional conditions, this Insight Brief **highlights the opportunities that sorghum can bring to local farmers** due to its drought tolerance and adaptability, as well as the potential products that sorghum can be processed into in order to support the development and improvement of the value chain.

This Insight Brief complements the '**Climate-Resilient Green Growth Assessment**'[1], which informs decision-makers regarding the opportunities for the development of climate resilience and green growth in Karakalpakstan.

Methodology

This Insight Brief employed a value chain analytical method framed by a functional analysis[2] to identify the physical flows and key stakeholders involved in the value chain from data mainly obtained at the production stage.

For this analysis, primary data collection was conducted in 2021 in 4 districts of the Republic of Karakalpakstan: Bozataw, Kegeyli, Chimbay, and Karauzyak (the target area for the Aral Sea GRIP). A survey developed by GGGI collected information about economic activities from a total of 1,277 stakeholders who were randomly selected within each of the following categories: homestead landowners, "*dehkan*" and "*fermer*" farmers, and other agricultural entrepreneurs. Among 887 farmers surveyed, 145 reported being involved in sorghum farming, and were able to provide detailed production statistics that form the basis of this assessment. A number of secondary information sources (ICBA, CGIAR, and others) were used to complement the primary data-based analysis of the value chain, and the opportunities for developing and improving the value chain.

---

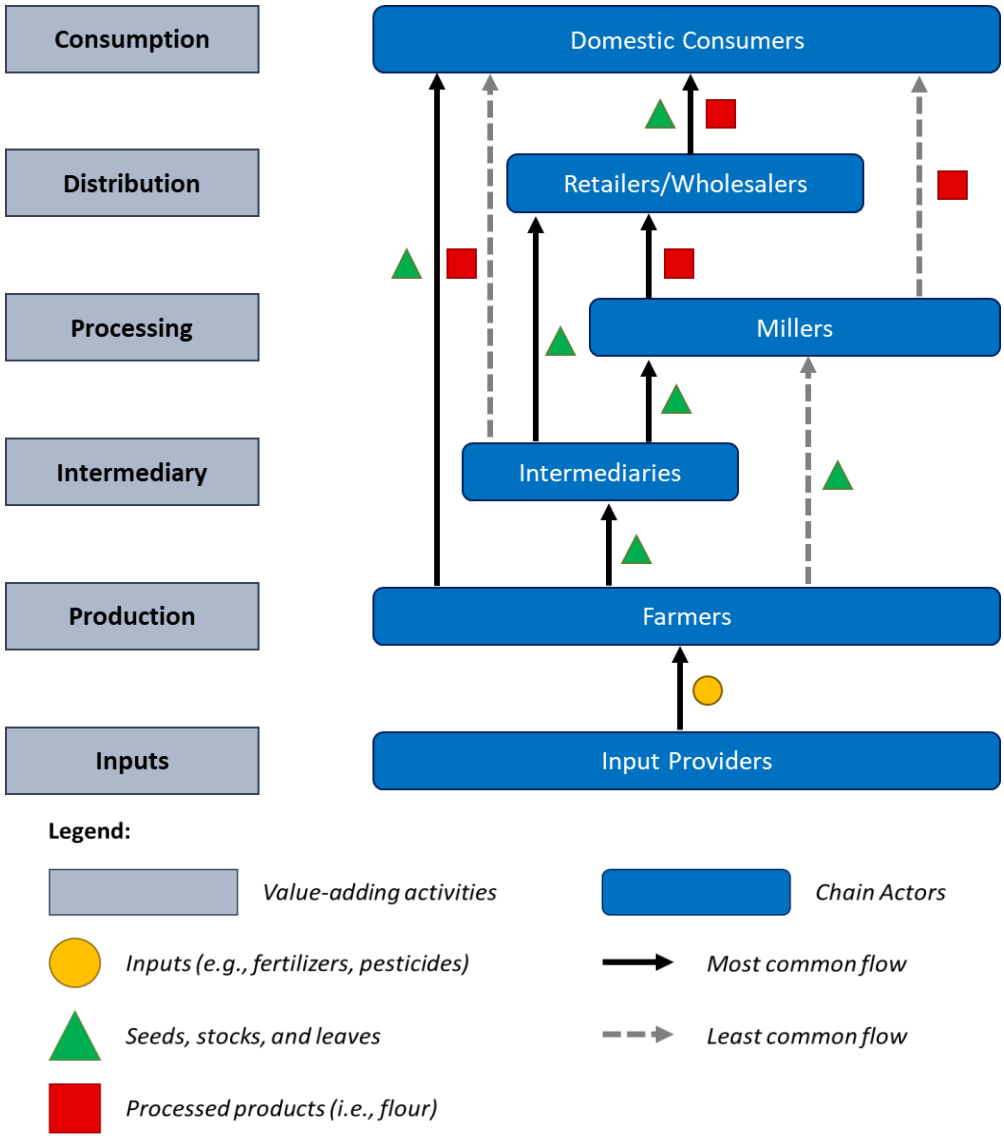
[1] J. Bathe, J.J. Robalino, R. Paik, S. Chang, & F. Song (2022) Climate-Resilient Green Growth Assessment for the Republic of Karakalpakstan, Global Green Growth Institute (GGGI), Seoul, South Korea.

[2] Functional analyses provide an overall description of the value chain system, identifying the main actors and stakeholders involved, and expanding on some of the main strategic development challenges faced (EU 2022).

Value Chain

It is estimated that sorghum was brought to what is now Uzbekistan more than 2.000 years ago (Ruzajon, 2019). Sorghum is a unique cereal that is drought tolerant and adaptable, making it a crop mainly utilized for subsistence farming and cash cropping in arid regions (Rooney and Serna-Saldivar 2000). Sorghum, together with corn and rice, is one of the main grain crops cultivated in Karakalpakstan, yet its importance has been emphasized in recent years due to its potential to support regional water-efficient agriculture, and landscape degradation initiatives. Dryland salinity and associated water supply and quality issues have been recognized to be among the most severe problems affecting the agriculture sector in Karakalpakstan. In this regard, sorghum has been included in programs supporting crop diversification and seed production to enhance the productivity of salt affected lands and to increase the income of rural people (CGIAR, 2015).

Currently, the value chain of sorghum in Karakalpakstan ends with the commercialization of sorghum grain and flour for food, and grain, stalks and leaves for livestock feed, with limited value addition. The figure below presents the value chain for sorghum products in the region, followed by a brief explanation of each stage.



INPUTS

The main inputs needed by farmers on an operational basis include sorghum seeds, and organic and chemical fertilizers and pesticides. In terms of fertilizers, there is no clear preference between organic and chemical materials; some farmers reported using either organic or chemical materials, while others reported using a combination of the two. For pesticides, there is a clear preference for using chemical-based products. When asked about additional **production inputs**, such as packaging materials, **51% of the farmers reported having 'no need' for them, while 44% reported lack of availability of these inputs**. Only 5% of the farmers reported the availability of additional production inputs.

Box 1. Seeds variety and research.

Targeted studies of the biology, physiology, and development of sorghum seeds began in Uzbekistan in the 1950s. In Karakalpakstan, several papers published from 1969 to 1998 were devoted to the study of sorghum. These papers made conclusions and recommendations regarding the effectiveness of different sowing schemes and the density of the standing sorghum variety known as **Chillaki variety** (Ruzajon 2019).

The Scientific Research Institute of Livestock and Poultry, under the State Committee for Veterinary and Livestock Development of the Republic of Uzbekistan, created the "**Uzbekistan-5" variety** - a hybrid of mixed and native varieties. This variety entered into the State Register in 1981. According to the Institute's description, the variety is resistant to drought, lodging, and shedding. **The protein content of the grain is 9.2% and the starch content is 80.7%** (Allashov and Jamolov 2020).

Box 1 cont.

The amount of juice in the stem of the Uzbekistan-5 variety is 72-74%. It was also reported that black moth disease affects only 0.01-0.02% of crops. Finally, the planting rate of this variety is 8-10kg/ha with a yield up to 5,000kg/ha (Allashov and Jamolov 2020).

Photo –" Uzbekistan-5" variety of sorghum, developed by the Scientific Research Institute of Livestock and Poultry (Allashov and Jamolov 2020).

PRODUCTION

Major producers of sorghum include homestead landowners, *fermers*[3], and *dehkan*[4] farmers. 97% of the producers reported to be engaged only in primary production activities, while 3% of the producers surveyed reported being engaged in processing activities in addition to primary production. Sorghum is cultivated either on dedicated land, or in combination with other grains, vegetables (e.g., tomato), seeds (e.g., sesame), and fruits. In general, sorghum production is for commercialization purposes, with some set aside for self-consumption.

In terms of production, **almost all farmers reported limited access to water**. For irrigation, farmers use small petrol pumps and fixed pumps, which bring water from collective canal networks located, on average, more than 1km from the production area. Regarding the availability of, and satisfaction

[3] An independent economic entity that conducts commercial agricultural production using land plots that are leased.

[4] Small-scale family farm that produces and sells agricultural products based on the personal labor of family members on a household plot of land granted to the head of the family for life as an inherited possession.

with additional critical production elements, most of the farmers indicated sufficient availability of productive land, and expressed medium[5] satisfaction regarding its performance (i.e., productivity). Farmers also indicated insufficient availability of basic utilities besides water resources. Finally, most of them agreed on the **lack of available production equipment and noted that additional labor is not needed**. However, 31% of the farmers interviewed reported the 'no' availability of workers when needed.

Figure 1. Sorghum production in dryland of Karakalpakstan.

According to surveyed farmers, **local (district level) intermediaries were their main customers**. This was followed by local and regional final consumers and regional intermediaries.

In terms of difficulties faced when trying to sell their products, most of the farmers reported having 'no' difficulties. However, for those who experienced difficulties, **issues with the products** (i.e., quality, quantity, and price), **transportation** (i.e., accessibility), **and finance** (i.e., lack of capital) **were the most prominent**.

Box 2. **Environmental hazards and sorghum production initiatives.**

The most important hazards faced and reported by farmers include **soil salinization, the continuous deterioration of weather conditions, and low quality of and access to water**.

Regarding fresh water scarcity, since 2006 the International Center for Biosaline Agriculture (ICBA) has been implementing research and field trials in the Kyzylkum area in Uzbekistan for introducing cold-, heat- and **drought-tolerant halophytes** (including sorghum) using mineralized artesian water. The research and trials respond to the need for identifying alternative production systems that can assist the local population in utilizing scarce available resources, especially low-quality water for irrigation (ICBA, 2018).

Regarding farmer experiences operating and managing farm activities, **basic technical and managerial skills have primarily been learned from family members and via peer learning from other farmers**. Only 1% of the farmers interviewed reported having received formal education or training to improve their technical and managerial skills.

In terms of conducting their farming activities following the regulatory framework, 70% of the farmers reported being satisfied with the public administrative permits and processes, while 30% reported being dissatisfied. In addition, and according to their perception, most of the farmers perceive a business-friendly environment in terms of conducting their business, obtaining necessary permits, and trading across districts.

[5] On a scale of low, medium, and high-performance satisfaction.

INTERMEDIARY & PROCESSING

Processor and farmer group aggregators are weakly integrated into the value chain, while intermediaries are the best integrated. Only 5% of the farmers reported being connected with local (district) processors, and only 2% with farmer group aggregators. Meanwhile, local (district level) and regional intermediaries are key actors in the value chain, with more than half of the farmers reporting being connected to them. In terms of availability of intermediary services (i.e., transportation, storage), only 10% of interviewees reported them as being available. For those who had access to these services, a low[6] level of satisfaction with their current performance was reported.

Millers also play a key role in sorghum processing and are mostly connected with intermediaries. According to Resolution of the President of the Republic of Uzbekistan No. 2731 on the development of the Aral Sea region for 2017-2021, the development and support of grain processing facilities is key to regional development of this industry. Following this priority, two projects with an investment size of UZS 51 billion are being implemented in Chimbay district for processing grain products. A capacity of 20.000 tons of flour products is estimated after completion (On the state program for the development of the Aral Sea Region for 2017 - 2021 n.d.).

DISTRIBUTION & CONSUMPTION

Sorghum grain and flour are the most common food products traded and distributed to final consumers in Karakalpakstan. For livestock feed, sorghum grain, stalks and leaves are the most common commercialized products. In terms of distribution, exchange of these products occurs at local level (district or village) between families, at district traditional markets (bazaars), and neighborhood stores. At the end of July 2022, sorghum grain was priced at UZS 6,000 per kilogram (Data collected by GGGI Team).

Figure 2. Sorghum grain at a Nukus bazaar.

Box 3. **Sorghum exports.**

According to primary and secondary information, **no exports** of sorghum products were reported from Karakalpakstan.

This might be because, according to Decree of the President No. 5286 (2017) "About additional measures to ensure competitiveness of local products in foreign markets and encourage export - Appendix 1" , sorghum is not part of the list of cereals approved for export purposes.

[6] On a scale of low, medium, and high service satisfaction.

Value Chain Development

According to CGIAR (2015), on-farm results demonstrate that sorghum was recommended as a second crop (mid-June to early July) after wheat harvest, as well as into rice crop rotation, in order to fill the gap in farm productivity and crop-livestock systems in rural communities in saline desert environments. However, opportunities for sorghum and the development of its value chain in Karakalpakstan go beyond supporting production systems affected by heat, drought, and salinity, and include the production of foods and beverages (which already occurs in developed markets outside of Uzbekistan), as well as biofuels. Critically, biofuel development does not compete with food production as it makes use of excess biomass not utilized for food (i.e., leaves and stalks).

In terms of food, sorghum is a key ingredient in Karakalpak cuisine (See Figure 3). **Yet, its nutritional and health-related properties are not widely acknowledged, nor properly exploited**. Sorghum grain presents excellent properties in healthy diets including its gluten-free status, the functionality of the slowly digested starch, and the health benefits of its phenolic compounds. Studies have shown that sorghum compounds have potent antioxidant activity, and consumption of sorghum whole grain may improve gut health and reduce the risks of chronic diseases (Khoddami, et al. 2021). Moreover, its compounds can be isolated and used as promising natural multifunctional additives for broad food applications, improving food quality and safety, and health (Khoddami, et al. 2021).

For sorghum **to become more widely accessible and utilized as a food in Karakalpakstan and Uzbekistan, processing, packaging, and marketing activities need to be carefully assessed and improved**. Sorghum's beneficial characteristics, such as its powerful antioxidant properties and it being gluten-free, can be emphasized in order to increase its popularity. Meanwhile, **further research and development efforts are needed to determine the structural and functional properties of the local varieties of sorghum grain**, which can enable sorghum to be used as food additive.

Figure 3. Karakalpak sorghum dishes.

Zhueri zharma
(sorghum soup)

Zagara
(sorghum bread)

Zhueri gurtik
(sorghum pasta)

In terms of biofuel potential, sorghum already plays an important role in the development and evolution of bioenergy crops globally (W. L. Rooney 2014). Bioenergy crops provide an opportunity for agriculture to be part of the solution for global energy demand and the mitigation of climate change. With regards to the role of sorghum, different types of biofuels can be produced from sorghum-based biomass such as stalks, leaves and grains. This biomass can be converted into liquid biofuel (i.e., bioethanol, biodiesel, and bio-oil), gas biofuel (i.e., biohydrogen, biogas, and syngas), and solid biofuel (i.e., biochar) (Stamenković, et al. 2020). Which conversion takes place depends on the fermentable carbohydrates of the specific sorghum variety, further reinforcing the need to conduct research to identify the properties of local varieties (W. L. Rooney 2014).

As sorghum produces a large quantity of biomass and has multiple potential conversions, it is a key biofuel crop. However, to realize its biofuel potential, the most efficient and cost-effective methods for pre-treatment, processing, and production need to be identified to ensure that the biofuel is valued competitively. In this process, strong collaboration between the private and public sector is highly recommended and encouraged in order to develop a profitable biorefinery and inclusive production models (Stamenković, et al. 2020).

KEY TAKEAWAYS

- The value chain of sorghum in Karakalpakstan ends with the commercialization of sorghum grain and flour for food, and grain, stalks and leaves for livestock feed, with limited value addition in the Republic of Karakalpakstan.
- In Karakalpakstan, sorghum has been part of programs in support of diversification and seed production to enhance the productivity of salt affected lands and to increase the income of rural people due to its resilience to heat drought and salt salinity.
- Issues with the product (i.e., quality, quantity, and price), transportation (i.e., accessibility), and finance (i.e., lack of capital) are key barriers to the production and sale of sorghum products.
- Only 1% of the farmers interviewed reported having received formal education or training to improve their farming technical and managerial skills.
- Opportunities for sorghum and the development of its value chain include the production of foods and beverages (which already occurs in developed markets outside of Uzbekistan), as well as biofuels. Critically, biofuel development does not compete with food production as it makes use of excess biomass not utilized for food (i.e., leaves and stalks).
- To realize its biofuel potential, the most efficient and cost-effective methods for pre-treatment, processing, and production need to be identified to ensure that the biofuel is valued competitively. Strong collaboration between the private and public sector is highly recommended and encouraged.

References

*Allashov, B.D., and S.G. Jamolov. 2020. "Uzbekistan-5" variety of Sorghum. -, Tashkent: Scientific Research Institute of Livestock and Poultry.

*CGIAR. 2015. MEL CGIAR. https://mel.cgiar.org/overview/cluster/id/1.

*EU. 2022. Value Chain Analysis for Development. Public Document, -: European Union.

*ICBA. 2018. Farming in Uzbek desert. December. https://www.biosaline.org/news/2018-12-27-6712.

*ISCAD. 2022. Uzbekistan Agri-Food Facts & Trends 2020/2021. Public, Tashkent: International Strategic Center for Agri-Food Development.

*Khoddami, Ali, and et al. 2021. Sorghum in foods: Functionality and potential in innovative products. -: Food Science and Nutrition.

*MoA. 2020. Invest in the Agri-food sector of Uzbekistan. Tashkent: Main Department of Strategic Development and Investment.

*Rooney, Lloyd, and et al. 2000. "Sorghum." In Handbook of Cereal Science and Technology, 27. Food Science & Technology.

*Rooney, William. 2014. "Sorghum." In Cellulosic Energy Cropping Systems, -. -.

*Ruzajon, Latipova. 2019. A brief history of the cultivation of sorghum in Uzbekistan. -: International Journal of Student Research.

*Stamenkovic, Olivera, and et al. 2020. Production of biofuels from sorghum. -: ELSEVIER.

*UNECE. 2020. Environmental Performance Reviews - Uzbekistan - Third Review. Geneva: United Nations.

The Global Green Growth Institute

19F Jeongdong Building, 21-15, Jeongdong-gil,
Jung-gu, Seoul, Korea 04518

Follow our activities on Facebook, X, LinkedIn, YouTube and Instagram.

www.GGGI.org