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Second Bread: Potato Cultivation and Food Security in Kyrgyzstan

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ABSTRACT *Kyrgyzstan experienced a remarkable boom in potato production over the past thirty years, driven almost entirely by small farms. Today, potatoes are at once the backbone of national food security, a central source of income for many Kyrgyz households, and a non-trivial source of export earnings. This paper documents the central characteristics of the Kyrgyz potato economy and explains the conditions of its emergence and resilience. We show that Kyrgyzstan's potato economy is driven by three main features: land reforms that dispersed ownership of land early in the post-Soviet transition, dense social networks that connect producers to input suppliers and markets, and a match between the potato and the country's mountainous terrain and continental climate. Together, these features have given rise to a food security model that leverages the potato's well-known nutritional qualities, its cultural status as a food staple across the region, and Kyrgyzstan's geography and climate. We term this the Kyrgyz Potato Model (KPM). Unlike critics that stress the inefficiencies of Kyrgyz potato production, we highlight the model's strengths: it is extremely effective in feeding citizens, generates much-needed household incomes, and has been remarkably resilient in the face of recent global economic crises.*

KEYWORDS: food security; post-Soviet agriculture; Kyrgyzstan; potato cultivation; resilience; land reform; smallholder farming

1. Introduction: the Kyrgyz Potato Model

After the collapse of the Soviet Union in 1991, Eurasia underwent a historically unique, large-scale shift in potato production: Central Asian countries experienced a potato boom, taking over the role of potato suppliers for the Eurasian population from Russia, Belarus, and Ukraine. The unraveling of the Soviet planned economy had led to a devastating economic recession in all successor countries in the 1990s. It may therefore seem unremarkable that the potato (*solanum tuberosum*), a cheap and nutritious food, would become a popular crop during this unique moment of historical transition – when post-Soviet countries faced myriad challenges related to independent statehood, transition to a market economy, and integration into

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the global economy. What is remarkable, however, is that potato production transformed into sustained booms across all five Central Asian countries – Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan (Scott & Suarez, 2012) (Figure 1).

In this paper we examine Kyrgyzstan's post-Soviet potato boom; our main aim is to document a series of unique and beneficial attributes that have been overlooked by Kyrgyz and international policymakers. Kyrgyzstan's potato economy stands out among the group of Central Asian potato producers in that it relies on a large number of small and medium-sized producers. In 2020, the country produced approximately 1.3 million tons of potatoes – nearly all of which was grown on small, private farms. This amounts to a per capita production of 193 kg per person, approximately four times as much as in 1992, at the start of their market transition (see Figures 2 and 3; and Appendix Figure B1).[1] Potato production has increased

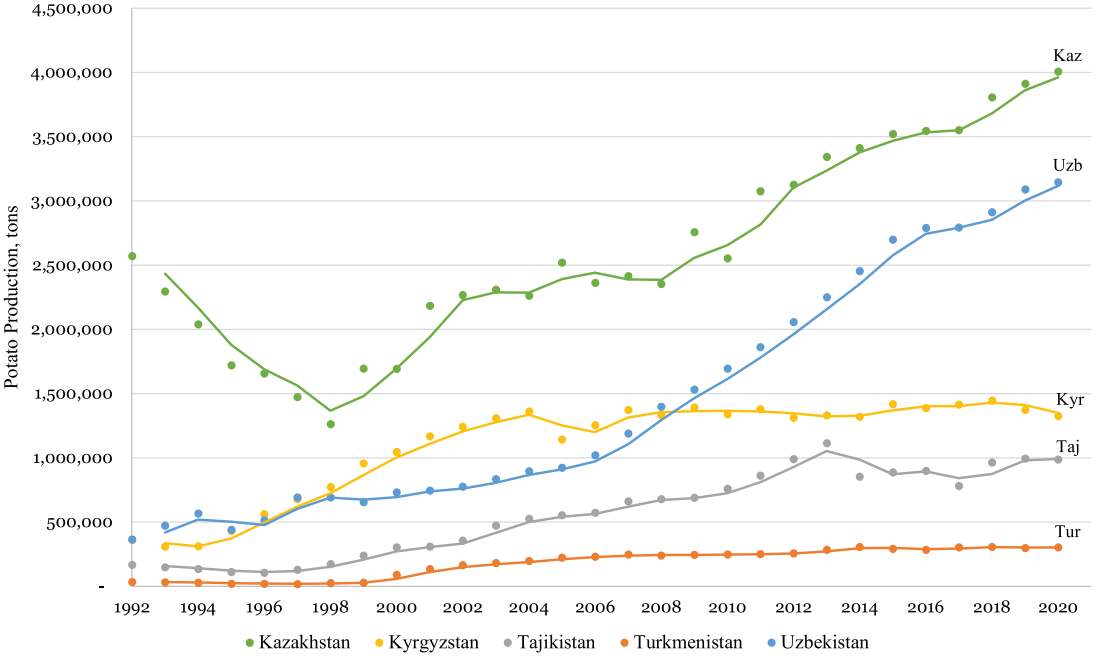

Figure 1. Potato production in Post-Soviet Central Asia, 1992–2020.
Source: FAOSTAT

	Potato production (tons)	Population	Per capita production (kg)
Kazakhstan	4,031,581	19,000,988	212
Kyrgyzstan	1,289,108	6,691,800	193
Tajikistan	903,000	9,750,064	92
Turkmenistan	572,641	6,341,855	90
Uzbekistan	3,285,646	34,915,100	94

Figure 2. Central Asia's potato boom; per capita production by country, 2021.
Source: FAOSTAT and World Bank Database

	1992	1996	2001	2006	2011	2016	2021
Kyrgyzstan	362,000	562,366	1,168,396	1,254,762	1,379,223	1,388,369	1,289,108

Figure 3. Potato production in Kyrgyzstan, 1992–2021 (tons).
Source: FAOSTAT

much faster than other crops traditionally grown in the region, with the potato becoming the leading crop for farmers and the country's top agricultural crop by value.[2] Kyrgyz citizens are also among the most avid consumers of potato, with some of the highest per capita consumption in the world.[3] A further important characteristic of Kyrgyzstan's potato production is that only 1 percent is grown for processing, a very small share relative to most other potato growing countries. What this means is that the food value chains that Kyrgyz potato growers participate in are relatively short: their product is primarily consumed as fresh food. Since unprocessed potatoes have a low value-to-weight ratio, export relationships are mostly regional.

Potatoes offer several important benefits to the country's many small growers and rural households: they are highly nutritious, adaptable to harsh climates, and a source of household earnings. The FAO holds that potatoes are "a highly recommended food security crop that can help low-income farmers and consumers ride out turmoil in the world food supply and demand" (UN FAO, 2008, p. 3). Indeed, locally grown potatoes are the backbone of national food security for Kyrgyz citizens and a valued staple of quotidian diets, holding the title of "second bread" (Abdulhamidov, Abdurakhmanov, & Monneveuxc, 2015; Caccavale, de Brouwer, & Flämig, 2013). At the same time, potatoes have also become the central source of income for many Kyrgyz households. As a daily staple for households across the former Soviet Union, they are readily sold in local and regional markets. For the national economy, they make up a significant share of export earnings, mainly through a stable relationship of potato exports to neighboring Kazakhstan (Eurasian Economic Union Statistical Service, 2019). Finally, potato production has also been quite resilient during two recent global food crises triggered by the Covid pandemic and Russia's war in Ukraine. Although these crises created some uncertainty for Kyrgyz producers, they did not fundamentally disrupt the local food supply, as they did for many poor countries in the Global South.

In short, the Kyrgyz potato boom is more than the growth in one sector of the country's economy. The Kyrgyz potato economy, we argue, represents a remarkable model of food security, with significant economic, social, and cultural benefits. We term this the Kyrgyz Potato Model (KPM). While scholars have taken an interest in potatoes as a tool to promote global food security (Andrivon, 2017; Devaux, Kromann, & Ortiz, 2014; McNeill, 1999; Scott & Suarez, 2012; UN FAO, 2008; Wijesinha-Bettoni & Mouillé, 2019), a significant gap exists in our understanding of potato economies in Central Asia.[4] In the case of Kyrgyzstan, a general lack of interest in the Central Asian potato boom is compounded by a misrecognition of its beneficial aspects and promise. A US trade summary of Kyrgyz agriculture assesses the sector bluntly as follows: "while [agriculture] accounts for an estimated 14% of GDP, the second largest component of GDP, it is *disorganized* and *undercapitalized*, and the Kyrgyz food processing industry remains *underdeveloped*" (United States International Trade Administration, 2022).[5]

We argue that the critics of the inefficiencies of Kyrgyz potato farmers miss or undervalue a series of important aspects of this model. They mistake dense social networks for disorganization, and devalue knowledge acquired through these networks as unscientific. Likewise, they do not recognize that the consumption of potatoes as fresh produce, rather than as processed, has public health benefits. Short value chains should be seen as a Central Asian farm-to-table model, rather than as a deficiency in the value-adding processing industry. Most importantly, policymakers intent on upgrading and higher yields fail to recognize the role of the Kyrgyz potato economy in promoting food security and generating household incomes in the absence

of supportive rural state institutions, and within a context of very limited capital availability. Taking these considerations into account, we suggest that the Kyrgyz potato economy represents a type of "bottom-up" development and food security model in which small-scale potato production has emerged through the use of available (and relatively low-cost) technologies by smallholder farmers who have capitalized on cultural and material aspects of potatoes. Interestingly, this mirrors the experience of Kyrgyzstan's craft-based apparel producers, who have been similarly characterized by development officials as "stagnant, weak, and under-performing," an assessment that ignores the successes of small-scale and local producers who have reoriented their skills and discovered new market niches (Botoeva & Spector, 2013).

This type of misrecognition and criticism precludes an understanding of how the Kyrgyz model of potato production benefits citizens. The empirical study we present below should be seen as an effort to highlight the value of elements of potato farming that are explicitly or implicitly de-valued by the development policy experts who ignore what we see as distinctive benefits of the extant model of potato production: it feeds the country's citizens while generating household incomes and displaying resilience in the face of major global shocks to food supply chains. Although we present a largely empirical study of a single country, we hope this will serve as a case study of a unique food security model that deserves recognition.

We highlight three important pillars of the Kyrgyz Potato Model: land reforms that dispersed ownership of land early in the post-Soviet transition, dense social networks that connect producers to input suppliers and markets, and a match between the potato and the country's mountainous terrain and continental climate. The most important initial condition for the emergence of the potato boom was that Kyrgyzstan has successfully distributed ownership of land to households across the country. Land reforms initiated in 1993 gave nearly all rural families access to land plots early in the post-Soviet period, a time of acute economic crisis. Subsistence production was a matter of survival for many citizens at the time. Unlike in many other post-Soviet countries, where rural outmigration led to abandoned farmland in less productive regions, rural plots in Kyrgyzstan were claimed and farmed.[6] Potato consumption increased sharply during this difficult decade. In the years that followed, potato production has proven highly conducive to the emerging structural conditions of Kyrgyz farms, in particular the small size of landholdings (less than 0.5 hectares, or approximately 1.2 acres on average). Secondly, we stress the importance of the dense social networks that allow farmers to acquire inputs and sell potatoes at relatively competitive prices. Farmers can purchase inputs (primarily seed potatoes) from cooperatives, re-sellers, or larger producers. They also rely on social media networks to share information about production practices and market conditions. Cooperatives are part of these social networks that facilitate the Kyrgyz potato economies, leasing machinery, re-selling seeds, and facilitating access to credit. These networks act as a partial substitute for the services that are elsewhere provided by the state. Finally, potato production is aided by its adaptability to Kyrgyzstan's uniquely mountainous terrain, continental climate, and abundant water resources. These geographic features are highly favorable to potatoes relative to other crops.

Our findings are based on fieldwork conducted in the Issyk-Kul and Naryn regions of Kyrgyzstan, during May–June 2022 and December 2022–January 2023. The data were collected through semi-structured interviews with farmers, public officials, and agribusiness leaders selected for their expertise in some dimension of potato production, sales, or regulation. We conducted a total of fifteen interviews with respondents selected using a snowball sampling method (see Appendix A). We also rely on a large range of statistical data of regional, national and international potato production provided by the National Statistical Committee of the Kyrgyz Republic, the Eurasian Economic Union Statistical Service, the Food and Agriculture Organization (FAO) and the World Bank. Finally, the author team brings extensive previous knowledge to this paper: it is based on a decade of research on post-Soviet agriculture by one of the co-authors (Wengle, 2018, 2020, 2022; Wengle, Mamonova, & Dankevych, 2024), and on the insights and observations by a second co-author, who, as a Kyrgyz citizen, has participated

in the Kyrgyz potato boom since its inception. Although we are not able to make statistically relevant inferences, our interview subjects were carefully selected based on their substantive involvement in the potato economy. The insights they shared in open-ended conversations provided us access to a rich and reliable set of information, which was then triangulated and confirmed with published data and prior research on post-Soviet rural economies.

The narrative in this paper proceeds as follows: Section two introduces the pessimistic assessment of Kyrgyz farming in international and domestic development reports. While the main contribution of our work is an empirical description of the Kyrgyz Potato Model, we draw on established debates in critical agrarian studies to make the case that the merits of small-scale potato production deserve more attention than they have received. Section three documents the defining characteristics of the KPM, while section four explains its emergence and central pillars. Section five concludes with reflections on the Kyrgyz Potato Model and its relevance within larger debates regarding global food security.

2. Misrecognition of a hybrid model

Agricultural consultants and policy advisors have often emphasized the deficiencies of Kyrgyz potato production, particularly those stemming from what they see as farmers' unwillingness or inability to modernize their farms.[7] A recent World Bank policy note argues that, "[T]he Kyrgyz farm structure itself, with its dominance of small farmers, is one of the main constraints for the effective functioning of modern value chains, preventing them from delivering high incomes and improved livelihoods for smallholders" (World Bank, 2018b). This critical assessment of small farm production is echoed by domestic development consultants and policy advisors who tend to emphasize the deficiencies of the Kyrgyz Potato Model. A report by the Kyrgyz government, for example, states that farmers lack "sophisticated technology and modern storing facilities." The report specifically singles out small plots as undesirable: "[the] division of land into small plots does not allow for efficient use of crop rotation, which leads to irrational use of irrigation water, equipment, and financial resources." (Ministry of Justice of the Kyrgyz Republic, 2017). Tatiana S., an agricultural consultant whom we interviewed, provided a similar assessment of small farming as lacking skills to attain higher yields: "There is a need for education and training of farmers. They lack basic skills. What they usually do is listen to their neighbor farmers and usually do not cross check [information ….]. […] it is necessary to create platforms for the transfer of knowledge and technologies for farmers."

The negative assessments of potato farming in Kyrgyzstan, and in particular the emphasis on "upgrading," conveys an unreflecting comparison of Kyrgyz potato production with an export-oriented agricultural model, while missing that the KPM is essentially a hybrid model. The underlying logic of the market-oriented model of agriculture holds that for farming to be an effective tool for development and income generation, farmers must shift production to crops where they hold a comparative advantage. To be competitive in regional and global markets, farmers are encouraged to adopt agricultural technological inputs – particularly high yielding seeds, fertilizers, chemicals, and mechanization – that improve farm output and efficiency. As we will detail below, we do indeed observe elements of this model among Kyrgyz potato farmers: a significant share of Kyrgyz potatoes is marketed and exported, and producers utilize imported seed potatoes and agricultural machinery (to various degrees), to increase yields and generate incomes. Yet, at the same time, many Kyrgyz potato farmers simultaneously operate within what is often called a peasant model of production.

This kind of characterization could be seen as a relatively straightforward case of mis-representation of local context and processes by a development policy orthodoxy, well theorized by critical development scholarship.[8] James Ferguson and the scholarship that furthered his work, however, have primarily focused on the 'apparatus that is to do the "developing"' rather than the 'people to be "developed"' (1994; 20). Our main concern in this study is to reveal aspects of Kyrgyzstan's rural economy that are misrepresented or ignored by the development

community. Before we proceed to the empirical study, we bring rural sociologists associated with the work of Teodor Shanin (1973) to this discussion. We draw on these studies to support our claim that some of the perceived shortcomings of Kyrgyz potato production are in fact well-recognized strategies by peasant farmers.[9]

Specifically, we draw on two essential insights in critical agrarian studies. A central claim is that 21st century peasant farmers are often characterized by partial integration with markets, and that they utilize a mix of strategies including farm diversification, co-production, and pluriactivity. These are strategies devised in continuous processes of adaptation that allow them to persist as rural producers and preserve their autonomy while participating in volatile markets (McMichael, 2009; van der Ploeg, 2008, 2010). If we apply this lens to Kyrgyzstan, we see that the strategies used by Kyrgyzstan's smallholder potato farmers are indeed deliberate and valuable means to leverage the value of the potato in local and regional markets, while advancing household food security and resilience.

A second way in which our research relates to extant studies is that the Kyrgyz case allows us to highlight the material quality of crops, something that has been emphasized by James Scott (2009) and Klara Fischer and co-authors (Fischer et al., 2022). Scott has argued that potatoes can facilitate "escape agriculture" and evasion from the state because they can be hidden underground. Although Kyrgyz potato farmers are not primarily concerned about evading the state, which only has a weak presence in the countryside, other material elements of the potato are important to understand its popularity and prevalence. These include the crop's nutritional value as a food staple that can be consumed as well as traded, and its adaptability to mountainous ecosystems. The potato's weight/value ratio makes it unattractive as a globally traded commodity. However, it can be transported over relatively short distances and sold within regional markets. In other words, the Kyrgyz Potato Model leverages the unique features of the potato – its material and cultural value – to promote food security and generate household incomes.

Taken together, these insights suggest that the benefits and proliferation of potato cultivation in Kyrgyzstan are in fact attributable to an agri-food model that relies on a particular commodity, and combines market and subsistence production in a particular way. The material and cultural properties of the potato underpin its dual rule as both a consumable "second bread" and as a cash crop that generates household incomes. Potato production is "monetized" beyond what would be predicted under the peasant or subsistence model, as well as "insured" by its widespread consumption.

3. The Kyrgyz Potato Model; defining characteristics

The Kyrgyz Republic is a small, lower middle-income country; with a per capita GDP of $1,276 in 2021, it trails behind most other post-Soviet countries. Its economy depends on mineral extraction, remittances from labor migration and agriculture; the latter accounts for roughly 20 percent of Kyrgyz national income (The World Bank Data, 2024). Agriculture is central in Kyrgyz economic life: it is by far the largest sector in terms of employment with approximately 40 percent of the labor force engaged in farming (United States International Trade Administration, 2022). Furthermore, two thirds of the country's 6.7 million citizens live in rural areas (World Bank, 2018a). Aside from potatoes, Kyrgyzstan also grows wheat, cotton and tobacco. Unlike potatoes, however, these commodities have not experienced a boom in the post-Soviet period: cotton and tobacco have declined after the end of Soviet-era planning, while wheat production has stagnated.[10]

3.1. Nearly all farms grow potatoes, the country's second bread

Potatoes are commonly called "second bread" for their role within the daily diet, and in many poorer households, they serve as "first bread" for their role in providing calories, fiber, and

nutrients (see Image 1). This is also observed across other areas in the Central Asia/post-Soviet region (Maxaeva, 2021). Although wheat provides the most important caloric contribution to the Kyrgyz diet, accounting for an estimated 38 percent of energy intake, potatoes are a cheaper source of calories than bread. They are also an important source of vitamins, micro-nutrients, and fiber. In terms of their caloric share of the average diet, potatoes and meat both make up around 8 percent, but potatoes only account for 3–4 percent of the monthly costs of food, whereas bread products and meat each account for approximately 30 percent of food budgets.[11] Potatoes are therefore the most affordable components of the Kyrgyz diet.

Image 1. Kuurdak, Kyrgyz traditional dish.
Source: Author image.

Roughly a quarter of Kyrgyz farmers grow potatoes as their primary crop – though virtually all farms and rural households grow at least some potatoes – and they are grown on 7 percent of the country's cultivated agricultural land (Kyrgyz National Statistics Committee; Abdulhamidov et al., 2015, p. 56). Kyrgyz farms are typically very small – household plots are around 0.5 hectares and mid-sized family farms are between 1 and 10 hectares, although some farmers also rent land from neighbors and farm larger plots. Overall, the country has produced between 1.3 and 1.45 million tons of potatoes per year over the last few years, or 180–200 kg per capita per year. Farmers in all of Kyrgyzstan's seven regions grow potatoes (see Appendix Figure C1). Potato yields are highest in the Issyk-Kul region, followed by Talas, and Chuy. Jalal-Abad, Osh, and Batken in the southwest specialize in early varieties, while the northern regions, Talas, Chuy, and Issyk-Kul, cultivate late varieties. Issyk-Kul, located in the country's northeast, is Kyrgyzstan's largest potato growing region (see Image 2). With fertile land and favorable climate, it produced over 464 thousand tons in 2021, nearly a third of the country's overall potato production (see Appendix B).

In our interviews, nearly all farmers report that they grow for both subsistence and for income. In general, we find that families save a small fraction of what they produce, and sell the majority of their harvest:

> *"We are a family of four and we eat five sacks of potatoes in one season. I personally like noodles, but we also consume potatoes because it is like second bread. During Soviet times, when we would have no food, if you walked into any house in the Issyk-Kul region, you would*

Image 2. Potatoes bagged on farm in Jeti Oguz district, Issyk-Kul region, September, 2022. *Source*: Author image.

see potatoes on the table. I think potatoes saved us. Earning from potato sales represents 30 percent of my income." Interview with Beksultan U., December 2022.

"I have a family of four: three adults and one child. Yearly, we use 10–12 sacks of potatoes. I also provide potatoes to my extended family, including in-laws. According to my calculations, out of 10–15 tons of potatoes I grow, we consume around 1 ton ourselves. If people know your potatoes are good, they will ask for it. […] Although in my family we do not have people who love potatoes, we still use them in our meals up to four times per week." Interview with Erlan B., December 2022.

Most farmers have access to basic machinery used for tilling, planting and harvesting. Capital requirements are manageable for many small farmers because they can use affordable and at times worn-out equipment, and generally do not require costly digital/GPS tools that large scale crop farmers rely on (see Image 3). Smaller household-farms lease equipment from larger farms, co-ops, or district administration, which offer low rents and typically utilize older equipment. Nearly all Kyrgyz potato growers have access to storage infrastructure. Households rely on simple basement storage or separate rooms in rural dwellings (see Images 4a & b). Larger and more commercially oriented farmers have dedicated storage buildings or they lease storage space in purpose-built and climate-controlled storage facilities that are common in the larger towns and cities.

The Kyrgyz Potato Model also features hybridity in terms of farm *inputs*. On the one hand, small producers store potatoes in basements of residential homes, exploit family labor, and avoid the use of fertilizers and other costly inputs. At the same time, most of the farmers use imported certified seed potatoes mostly from the Netherlands and Germany. (Although sometimes, farmers also pragmatically save and re-use some tubers for future growing seasons). Most farmers use a version of furrow irrigation, a traditional and affordable irrigation method that does not require infrastructural investments. Larger coops maintain drip irrigation and sprinkler systems for member owners. Some of the larger, commercially-oriented farms do use fertilizers, capital-intensive machinery and purpose-built storage rooms. The variability of inputs highlights the adaptability of potato – it is adaptive not only to varied terrains across the mountainous country, but also to different social conditions and market orientations.

Image 3. Amanat Duishon uulu, Jeti Oguz district, Issyk-Kul region, September, 2022.
Source: Author image.

Image 4. a: Full potato storage; Jeti Oguz district, Issyk-Kul region, December, 2022. b: Empty potato storage; Jeti Oguz district, Issyk-Kul region, June, 2022.
Source: Author image.

3.2. Potato incomes, marketing and export

While many Kyrgyz potato farmers grow potatoes for subsistence and for their extended family's dietary needs, they often have other primary employment. At the same time, most potato producers sell a share of their harvest to traders or local markets, without requiring costly capital investments. Farmers can count on a stable income from the potato because it is an established dietary staple across the region. While there are some price swings in response to regional supply and demand, discussed below, in its raw unprocessed form it is not a globally traded commodity and is therefore less vulnerable to the volatility of global food commodity markets. The share of subsistence vs. marketed potatoes depends on the size of the harvest each

year, and varies greatly across Kyrgyz households and farms. The farmers and stakeholders we interviewed reported that income generated from potatoes accounts for 30 to as much as 80 percent of household income. Although our sample was limited, and the share of potato incomes likely varies across regions, by all accounts, potato income is very important for many rural Kyrgyz households:

> *"We are a family of eight, including five grandchildren. We eat 5 kg of potatoes every day. We also rely on a lot of meat, flour, and vegetables in our daily diet. We earn good money from potato selling. I can say that it is a very important part of our income. On the scale, we spend 30% [of potato earnings] on production costs and make 70% profit. We also raise and sell cattle." Interview with Turatbek A., December 2022.*

> *"In my opinion, a family in the Issyk-Kul region consumes on average 5–10 kg every day. […] Potatoes are second bread, […] and we add potatoes to almost every meal. [….] My income does not only consist of earnings from potatoes. I also have other business, […] I work in cargo transportation, I drive trucks. But the profit we earn from potatoes is very important." Interview with Talantbek A., December 2022.*

Some of Kyrgyzstan's potato farmers maintain larger land plots and grow potatoes primarily to market them. This type of farmer tends to have more experience, devotes more time to farming and owns more capital-intensive farming equipment, including tractors, potato planters, or diggers. Since potato production is labor intensive, this type of farm hires additional labor for planting, harvesting and sorting. Though potatoes are brought to market in every region, the larger and more commercially-oriented growers are most common in Issyk-Kul. Some of these medium-sized rural producers also grow industrial crops destined for regional and global markets. Sugar beet, for example, is an important cash crop in the Chuy region, and the Fergana valley is known for commercially oriented vegetable production, often practiced by ethnic Uzbeks of the Fergana (Abdulhamidov et al., 2015).

Kyrgyzstan potato exports are primarily directed to neighboring countries (see Images 5a & b). Potato producers export between 20–30 percent of the total national production, depending on total harvest and domestic needs each year. Figure 4 shows that Kazakhstan is by far the most significant export destination for Kyrgyz potatoes, accounting for nearly 80% of Kyrgyz exports, followed by Turkmenistan, the Russian Federation, Uzbekistan and Turkey.[12]

Image 5. (a & b) Potatoes prepared for export, Jeti Oguz district, Issyk-Kul region, Nov & Dec 2022.

	Exports (1000 US$ equivalent)	% of exports (value based)	Metric tons
Kazakhstan	3,048	79.1	16,587
Turkmenistan	265	6.9	748
Russian Federation	164	4.3	841
Uzbekistan	156	4	1,183
Turkey	87	2.3	683

Figure 4. Export destination for Kyrgyz potatoes (2019).
Source: Eurasian Economic Union Statistical Service

3.3. Resilience

Kyrgyz potato farming and consumption have historically served as a kind of "insurance" staple that guarantees food security during times of crises. During the 20th century, the Soviet planned economy was plagued by periodic shortages that had become chronic by the 1980s. Central planning also distributed goods according to political hierarchies, whereby political elites and workers of privileged industries received far better access to the most desirable goods. Soviet citizens who were not proximate to these areas of privilege resorted to subsistence production, and potatoes were the good that was most widely self-provisioned (Wengle, 2022). Central Asian Soviet Socialist Republics were generally less well provisioned with processed goods and disproportionately affected by chronic shortages, which meant that subsistence production was quite common in Central Asia in the late Soviet period. Potatoes became increasingly important during the post-Soviet period, initially as a reaction to widespread economic dislocation in the 1990s. Nancy Ries' ethnography of potato practices in central Russia showed not only that many citizens survived by means of potatoes – "if not for our potato plots, I do not know how we would survive" – but that they carried symbolic weight, denoting a type of resilience that "no matter what" was in store, potatoes were the basis of "the population's ability to feed itself autonomously" (Ries, 2009, p.183).

Two recent global economic crises have caused widespread disruptions of global food systems, one related to the Covid-19 pandemic and another related to Russia's war in Ukraine. It is well documented that these two overlapping crises produced sharp increases in food prices and food insecurity (Clapp, 2022). Kyrgyz potato growers were affected by both, particularly through rising fuel costs and shipment delays. Our interviews suggest, however, that these disruptions were largely perceived as relatively minor and manageable. The Covid-19 pandemic also led to a very notable increase of potato prices: data from the Kyrgyz National Statistics Committee show that potato prices nearly doubled between 2019 and 2021 (see Figure 5; Kudryatseva, 2021). Since most potato farmers produce both for subsistence and for sale to market, this was an enormous boost to farm incomes. It was also a welcome reversal of a sharp drop in potato prices that occurred in 2019, which had been caused by a glut of domestic production and greatly reduced potato incomes (RadioFreeEurope, 2019). On balance, while farmers were affected by global crises and mentioned ensuing uncertainties, those who we interviewed emphasized the positive effects of price increases:

> *"I think the Covid pandemic positively affected all farmers. During the lockdown, people stayed home and had to eat locally. So, the price of potatoes and other produce went up. Moreover, people would buy groceries, including potatoes and flour in bulk. I think that was an advantage for us." Interview with Talantbek A., December 2022.*

> *"The Covid pandemic only slightly affected my business. I think [the effect] depended on the region, variety of potatoes, and the size of a farmer. It was more beneficial for bigger farmers, unlike myself." Interview with Emil T., December 2022.*

	2019	2020	2021
Potatoes	13,451	20,705	26,495
Wheat	14,670	17,253	26,134

Figure 5. Prices for potatoes and wheat, 2019–2021 (Kyrgyz som/ton).
Source: National Statistical Committee of the Kyrgyz Republic

Russia's war in Ukraine that started in February 2022 disrupted wheat and corn exports from the Black Earth region to countries in Africa, the Middle East and Asia that rely on grain imports, creating concerns about hunger in these countries. Higher prices of fuel and fertilizer affected farmers across the world. Kyrgyzstan potato exports are primarily destined for Kazakhstan and these regional and relatively short supply chains were not affected by the war. Indeed, Kyrgyz potato growers were seen as a reliable source of potato, while growers in other Eurasian countries struggled (Potato Business, 2021). That said, the supply of seed potatoes was delayed, and fertilizer and fuel prices increased, creating uncertainty among Kyrgyz producers:

> "*Those of us who buy the Elite potatoes from Europe made the payments to the bank in January. However, at the end of February and beginning of March [2022], we started to get worried because the trucks with potatoes [….] were stuck at the Belarusian border. At the end of March, some farmers withdrew their money because they did not want to risk losing it. […]. [Importers …] assured their customers that the potatoes would arrive. […] one month before the start of the cropping season, we got our seeds in full. Even though we got our seeds a few weeks later than planned, to be honest, at some point we did start panicking. According to our contract, we were supposed to get them at the end of February, but we got them at the end of March. Some farmers had to wait for even longer." Interview with Erlan B., December 2022.*

4. The central pillars of the Kyrgyz Potato Model

So far, we have presented empirical evidence suggesting that potato production makes critical contributions to Kyrgyz food security and household earnings, while displaying a remarkable resilience with respect to recent global shocks. In what follows, we outline the underlying pillars that have generated this unique economy, and arguably will be key to its future sustainability and resilience. We argue that the Kyrgyz potato economy rests on three main pillars: first, a large share of Kyrgyz households have access to land – a land holding pattern that stems from post-Soviet land reforms that aimed to distribute land to families threatened by poverty. Second, dense social networks that allow Kyrgyz citizens to source inputs, borrow tools, locate storage space and obtain market information. These networks are dispersed and rely on a variety of intermediary organizations and businesses. Third, potatoes are a highly adaptable crop that is uniquely well-suited for Kyrgyzstan's mountainous terrain and ample water resources. Although Kyrgyz farms share features with potato producers in neighboring Central Asia, the combination of these pillars distinguishes the Kyrgyz Potato Model from those of its neighbors, as sections 4.1–4.3 will detail.

4.1. Dispersed access to land

With the collapse of the Soviet planned economy, Kyrgyz industrial sectors suffered from the disruption of supply chains and faced foreign competition. Industrial labor and government employment declined in the nineties, which led to a sharp drop in GDP between 1990 and 1995,

and rising poverty rates each year between 1993 and 2000 (World Bank, 2001). It also precipitated a shift to rural production.

Perhaps the single most important factor that gave rise to Kyrgyz potato economies was land reform initiated by the government in the early post-Soviet period. Land reforms were initiated in response to the economic collapse of the nineties, but by dispersing land ownership broadly they also created the basis for the emergence of the food security model that we see today. Kyrgyz land privatization started early compared to other post-Soviet countries that delayed meaningful land reform into the early 2000s, or even later. Privatization gave use-rights to small plots of land to all households, rural and urban, although land-ownership was initially only transferred as notional rights to state- and collective-farm workers. In the decade that followed, a land-registry was developed and it became possible to turn use-rights into permanent land titles that could be transferred and sold. This registration process was widely considered a success: by 2012, more than 92 percent of land parcels were legally registered.[13]

Kyrgyzstan's land reforms dissolved the previous landholding structure dominated by about 500 large state farms (*sovkhozes*) and collective farms (*kolkhozes*), which together accounted for 97% of the arable land (USAID., 2011). Lands were redistributed in the form of approximately 900,000 household plots (0.1 hectares on average) and 300,000 peasant farms (3 hectares on average).[14] Household plots are large enough for families to grow potatoes for subsistence (and in some cases for market), and peasant farms are large enough to produce at a commercial scale for local and regional markets, where demand for potato is robust. At the same time, peasant farms are generally not large enough to capture gains from the adoption of industrial agriculture, and the capital limitations of most farmers prevent them from moving in that direction. While Kyrgyz farms vary in the size, the most important feature is that they represent a landholding structure of predominately smallholder farming, which has proven remarkably conducive to potato cultivation.[15] In this way, we suggest that the widely dispersed ownership of land in relatively small plots helped establish a rural economy in which smallholder potato production has proven remarkably successful.

Note that the creation of small, private farms is a central difference between Kyrgyzstan and its post-Soviet neighbors: Tajikistan, Turkmenistan, Uzbekistan have not privatized farm land. In Kazakhstan, individual citizens received the legal right to own land in 2005, but the state has retained de facto ownership of the vast majority of arable land; by 2019, a mere 1.4 percent of agricultural land was privately owned (Kvartiuk & Petrick, 2021, p. 3). In Kyrgyzstan, by contrast, household plots and peasant farms account for approximately 94.5% of arable lands (Mogilevskii et al., 2017). What is more, the prevalence of small farms in Kyrgyzstan distinguished the country's rural economy from the post-Soviet countries that did pursue extensive privatization. Russia and Ukraine, for example, two agricultural giants in the post-Soviet region, have seen the consolidation of land in the hands of large, vertically integrated agricultural corporations. Agricultural companies (known as agroholdings), have come to dominate agricultural production and land-ownership in Russia and Ukraine, thriving due to state support, and oligarchic and foreign investment. Agroholdings were the main driver of technological and infrastructural updates, which in turn has changed production methods and led to higher yields and exports (Wengle, 2021). In Kyrgyzstan's potato sector, by contrast, only one large, vertically integrated agricultural corporation is active, a company by the name of Kirbi.[16]

4.2. Lack of top-down state support; dense social networks & infrastructure

Historically, potato production has often been boosted by state-led campaigns, with governments promoting potatoes as a low-cost source of energy to feed the poor. This was the case in 18th and 19th century potato campaigns across Western Europe that fed the working class and underpinned the Industrial Revolution, as well as in ongoing Chinese campaigns meant to satisfy a tremendous national demand for food (Earle, 2020; Klein 2020). States have also turned

to potatoes in times of war. As historian William McNeil has argued, "every military campaign on European soil after about 1560 resulted in an increase in potato acreage, down to and including World War II." In post-Soviet Kyrgyzstan, however, this kind of state support campaign has been largely absent.

The Kyrgyz government is rhetorically in favor of rural economies and did enact the land reforms that have been foundational for the emergence of the Kyrgyz potato economy. However, with the exception of (underused and underfunded) agricultural loan programs for technological updating, state intervention in agricultural markets has been minimal and has had difficulty reaching farmers (Azernews, 2015). Although the government has helped extend access to loans via major Kyrgyz banks and micro-credit institutions, interest rates have been criticized for being excessively high, and repayment periods too short to be of assistance for small farmers.[17] Subsequent programs have tried to address this through subsidized interest rates and shorter repayment periods, but these loans have primarily been directed to livestock producers who have used them to update facilities.[18] Further, many obstacles constrain farmers' ability to participate in these programs: many do not have bank accounts, and some do not have the necessary paperwork to prove that they have formal title to their land. Together, these features lead us to characterize rural Kyrgyz farmers as operating in the context of a weak or "absent state," with very limited access to state resources and agricultural assistance programs. This contrasts with other post-Soviet neighbors, such as Russia and Uzbekistan, where respective governments have enacted sustained and generous campaigns to promote domestic agriculture (Lombardozzi, 2021; Wengle, 2022).

Instead of relying on state support, Kyrgyz potato farms operate in a dense social network that makes inputs readily available and facilitates market access for even the smallest farmers. Farmers who do not have their own machinery and storage space can easily lease and rent these through these networks. For many farmers, the most important inputs are seed potatoes – potatoes that are used strictly for planting – which they obtain from private distributors, co-ops or local markets.

While farmers can save their own potatoes for use in subsequent harvests, many farmers opt to purchase seed potatoes from specialized distributors.[19] Since Kyrgyzstan does not have its own varieties of potatoes, many farmers rely on imported seed potatoes from Europe, mainly Germany and the Netherlands, through Kyrgyz distributors that work directly with European suppliers.[20] Agroway, for example, a licensed distributor of Dutch seed potatoes, is cited as a source of seed potatoes by a number of farmers that we interviewed. Agroway and other distributors of imported seed potatoes guarantee the quality of their product and work with farmers to find potatoes that are most suitable to the soil conditions on their farms, providing a range of seeds and fertilizer for experimental plantings, and assisting farmers in analyzing soil quality and yields. They also supply seed material certificates (see Image 6) that allow farmers to negotiate higher prices with traders (the "perekupshiki," see below). Some farmers buy seed potatoes from local markets, but our interview partners convey that they perceive them to be of lower quality and less reliable.

Potato growers rely on local social networks for critical knowledge about production practices and market information. Experienced farmers support those who joined the ranks of potato growers more recently with advice and connections. Local growers maintain group chats on social media, including WhatsApp and Facebook, to request help and share useful tips. Social media chats are also used to advertise, sell, and purchase inputs and harvested crops.

> *"There is a WhatsApp group called 'Ton Potatoes' with 129 participants. The group started out small, but then got bigger. People share different useful information with each other, including training and/or their experiences with growing potatoes and best practices. Usually, the group is very active during the cultivation season. People would send pictures of their production and ask questions regarding pests and diseases. People would also advertise to sell/buy their production in the group. There are three or four very experienced agronomists and farmers who always support [the group] with consultations and advice." Interview with Erlan B., June 2022.*

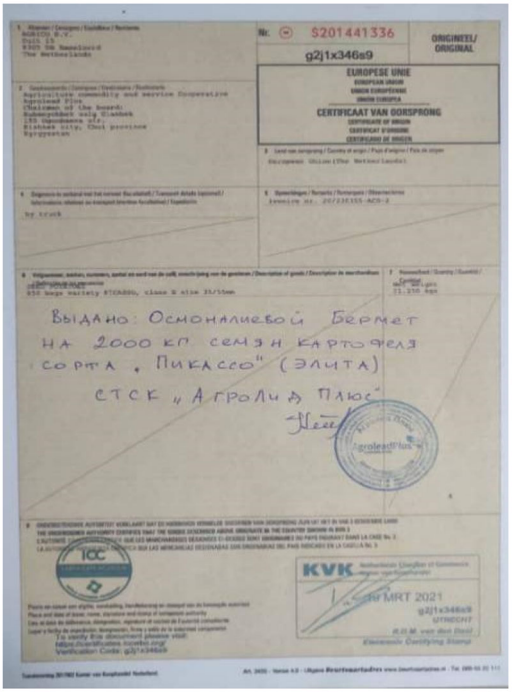

Image 6. Seed material certificate.
Source: Author image.

> *"We started to work with local and Russian seeds. Now we also use European seeds, from Germany. Since everything is getting much more expensive, it is so hard to harvest potatoes ourselves, so we need to hire people and we find people through networks. I am a founder and a member of an agricultural commercial cooperative that consists of eight people. One of the advantages of being in a co-ops is that we coordinate crop rotation and can improve export volumes." Interview with Beksultan U., December 2022.*

A further notable actor in the Kyrgyz potato economy are the cooperatives formed following land privatization. Cooperatives pool land of their member owners and offer a number of services in exchange for an annual fee. Some Kyrgyz co-ops are quite large – one well-known co-op has 267 members, farming 180 hectares—but others are quite small, pooling the land of around twenty farms. Co-ops help farmers procure foreign seed potatoes, and offer preferential loans, skills training, and access to more advanced machinery for their members. Some of the larger co-ops also maintain drip irrigation and sprinkler systems for land farmed by member owners. A union of co-ops, the UCK (Union of Cooperatives of Kyrgyzstan) brings together 250 independent cooperatives from across Kyrgyzstan. UCK functions as a member-financed non-profit that assists potato grower cooperatives and lobbies for their needs at regional and national levels. UCK provides consultancy services and education workshops, often in collaboration with international donors, as co-ops are often the preferred partner organization for international development projects. While co-ops fulfill important functions and provide valuable services to members, only a relatively small share of Kyrgyz potato farmers are co-op members. Nurlan U., for example, says he is not a member of any cooperative because he believes that membership holds few advantages for him, an experienced farmer:

> *"I know how to plant potatoes and collect the harvest, cure diseases, and use fertilizers. Members are taught exactly what I already know. Moreover, there is a fee of 2,000 soms*

(USD$25) that one has to pay. However, it can be very beneficial and useful for newcomers [to the potato business]." Interview with Nurlan U., June 27, 2022.

In terms of market access for the share of the harvest that is sold for income, small-scale farmers have several options. They typically sell potatoes to middlemen, known as "perekupshiki," literally re-sellers. These intermediaries have established partnerships and well-developed networks within the Kyrgyz countryside as well as with buyers abroad. Perekupshiki send trucks to the more remote rural areas to collect potatoes directly from farmers (Maxaeva, 2021). Farmers can also deliver their potatoes to regional wholesale markets that exist across many smaller towns and larger cities in Kyrgyzstan, where they either sell them to local business, such as local retail markets, stores or restaurants, or to larger perekupshiki for export.

4.3. Climate-crop pairing

A final aspect of Kyrgyzstan's potato economy that has contributed to the post-Soviet boom relates to a particular crop-climate pairing. Potatoes perform well in high-altitudes, but are generally a thirsty crop. Kyrgyzstan's climate and terrain provides for both these particularities. The country is landlocked and marked by a continental climate, heavy rainfall, and high mountain ranges: the Tien Shan and Alay ranges in the south, the Fergana range in the west, and the Alatau range in the north. Together, these mountain ranges cover over 90 percent of the country's land surface, making Kyrgyzstan one of the highest countries in the world, with an average elevation of 2,750 meters (approximately 9,000 feet) above sea level. High-altitude terrain generally creates challenges for crop cultivation, as many crops are rendered unproductive by high altitude. Potatoes, however, originated in the Peruvian Andes, and thrive in Kyrgyzstan' climate and mountainous terrain. Kyrgyzstan's continental climate provides an abundance of sunlight during the days and cool temperatures during the nights, ideal conditions for potato growth. This climate also produces long growing seasons, typically lasting from May through September. Some farmers are able to take advantage of two growing seasons for potatoes during these long summers. Others take advantage of distinct microclimates created by weather, soil, and altitude, to produce particular varieties of potatoes.

Potatoes are also a water-intensive crop and thrive in environments with a consistent and reliable water supply. Kyrgyzstan and Tajikistan control 90 percent of the region's water resources (Karaev, 2005). Kazakhstan and Uzbekistan are located downstream in the region's main river valleys; they are Central Asia's largest agricultural producers and water consumers. While Kyrgyzstan, Kazakhstan and Uzbekistan have all significantly scaled up potato production in the post-Soviet period, cultivation in the latter two countries depends heavily on capital-intensive irrigation infrastructure fed by water resources that originate outside their borders during most of the growing season. Kyrgyzstan's control of water resources in the region has thus placed it at a distinctive advantage, as producers generally have access to ample water on or near their farms and can use traditional and low-cost irrigation methods.

Finally, while Kyrgyzstan's terrain and climatic conditions have helped the emergence of the current model and remain a central pillar, the country's mountainous and continental terrain also make it particularly vulnerable to changes in weather patterns and water availability.[21] Concerns over water will very likely become more salient, as climate scientists predict that average temperatures in Kyrgyzstan will rise at rates significantly higher than the global average (World Bank/Asian Development Bank, 2021).

5. Conclusion: what do we learn from Kyrgyzstan's model of food security?

Potato cultivation in Kyrgyzstan increased significantly during the early post-Soviet era and came to occupy a central role in both the daily lives of Kyrgyz citizens and the national economy. Mountainous and marginal terrain, farms with capital limitations, and weak state support

are generally difficult conditions for agricultural production. Despite these limitations, potatoes have thrived: Kyrgyz potato growers have been able to use small plots and capitalize on the potato's dual role as both a food staple and cash crop. Potatoes are Kyrgyzstan's "second bread" – a cheap source of energy that is rich in vitamins, micro-nutrients, and fibers that cover subsistence needs. For many Kyrgyz households the sale of potatoes is also an important source of income, making the potato the nation's top agricultural crop by value.

While many policy advisors urge Kyrgyz farmers to upgrade production technologies and acquire new skills to improve yields, we find that potato production in the country has a number of distinct benefits for farmers, and deserves recognition as a remarkable and innovative food security model. We draw on established insights in agrarian studies that have demonstrated the value of hybrid rural production and drawn attention to the materiality of crops. That said, the central contribution in this paper is empirical: we described key characteristics of the Kyrgyz potato economy and identified the main pillars that support this model of potato production. We emphasized the importance of smallholder farmers and of a number of distinct social, cultural and material aspects of potato farming as central drivers of the potato boom. During the country's early market transition, land reforms dissolved large Soviet-era state and collective farms, and redistributed arable lands to citizens in the form of household plots and peasant farms. Our interviews suggest that Kyrgyzstan's smallholder farmers overcame capital limitations by developing social networks that allowed them, for example, to borrow tools and obtain technical advice and market information. The widespread cultural familiarity of potatoes made it an easily traded commodity that can be brought to local and regional markets. Material qualities of the potato – including its nutritional value, its weight-to-value ratio and the fact that it can be stored for months – have also played a role in making it such a successful crop.

Whether or not the Kyrgyz model of potato production can serve as a model for rural producers facing different conditions needs to be examined in future studies. While potato production in Europe and North America has decreased throughout the 20th century, production in Asia, Africa, and Latin America has increased more than six-fold over the past sixty years. The potato is increasingly viewed as a desirable crop for developing countries because it is an adaptable crop that holds a high degree of drought resistance, and does not directly compete with other major food staples for soil nutrients. Potatoes are also viewed as a type of crop for which production can be scaled-up. In fact, UN FAO Director General, Qu Dongyu, argued in May 2022 that global potato production has the potential to double over the next ten years.[22]

The boosters of the potato model should consider the various ways in which production can be scaled up. Rather than assuming that scaling up necessarily entails investment in capital-intensive technological improvements, the case of Kyrgyzstan suggests that a reliance on small-scale and relatively "low-tech" production, and a partial integration into local and regional markets, may be a viable pathway to food security and income generation in financially-constrained countries and challenging climatic conditions. Although we are cautious about advancing policy recommendations based on our study alone, these findings suggest that policymakers should look to preserve and strengthen pillars that sustain the KPM – by fostering social networks, or by helping local actors develop locally-adapted, drought resistant potato varieties, for example – rather than apply one-size-fits-all recommendations that aim to upgrade and scale-up production.

Notes

1. Measured in per capita terms, Kyrgyz farmers produce nearly twice as much as their Central Asian neighbors in Tajikistan, Uzbekistan, and Turkmenistan, where farms remain state-owned. Kazakh farms produce a sizable potato harvest, comparable to Kyrgyzstan in per capita terms, though wheat remains a more important commodity for Kazakh farms, which are large and mostly state-owned. Note that the land reform trajectory in post-Soviet countries varied greatly and have influenced how rural sectors developed. Section 4.1 returns to these aspects of Kyrgyzstan's land reforms and how they differ from those of its neighbors. However, a detailed comparison of land reform trajectories across the five Central Asian countries and how they shaped potato economies is outside the purview of this paper.

2. In this paper, we rely on FAOSTAT 2003 well as on statistics by the National Statistical Committee of the Kyrgyz Republic; https://www.fao.org/faostat/en/#home and https://www.stat.kg/en/statistics/selskoe-hozyajstvo/.
3. The leading potato consumers are Belarus, Ukraine and Kyrgyzstan, according to FAOSTAT.
4. The exception is Abdulhamidov, Abdurakhmanov, & Monneveuxc (2015), but even this analysis is primarily limited to a description of the current system of production, rather than an analysis of its origins and mechanisms.
5. Note: italics added.
6. See Prishchepov, Müller, Dubinin, Baumann, and Radeloff (2013) and Vorbrugg (2019) on the abandonment of farmland in other post-Soviet countries.
7. These critics include domestic agencies, such as the Ministry of Justice of the Kyrgyz Republic (2017) as well as international observers, such as the United States International Trade Association 2022), quoted in the introduction.
8. This is a thriving and ongoing research area, based on the landmark work by Ferguson (1994), Escobar (2011); Vunibola (2023) and many others. Botoeva and Spector (2013) apply this lens to show that dominant narratives about the Kyrgyz economy by international actors obscures the experience of thriving, small scale textile producers.
9. The question of market integration is central to agrarian studies, where scholars have been particularly concerned about the penetration of capitalism within agrarian societies. Although some scholarship suggests that the "peasant" category is no longer useful (Bernstein 2006), debates about the role and adaptation of peasant farms continue to generate useful conceptual tools (Van der Ploeg 2018). See also Mamonova (2023) on the resilience of small-scale Ukrainian farms during the ongoing war with Russia.
10. Wheat cultivation is the largest crop in terms of total cultivated area, although Kyrgyzstan also imports significant quantities of wheat. While wheat production in the country has fluctuated over the last thirty years, Kyrgyz wheat is unable to compete with rapidly growing wheat production in Russia.
11. This is based on a World Food program report, which utilizes FAO data from 2009. See also Caccavale et al. (2013).
12. Note that while we see a general eastward shift of potato production and new concomitant trade patterns, potatoes are still grown as subsistence crops and in the informal economy across the post-Soviet region; see for example, Ries (2009) and Wengle (2022).
13. Legal restrictions prevent rural land-ownership by non-villagers, foreigners, and companies that are not primarily engaged in agriculture from purchasing land. Ownership of agricultural land may be transferred only to residents of the same rural area, and only to Kyrgyz citizens, not to legal entities such as banks or foreigners.
14. Some collective farms continued to exist alongside household plots and peasant farms; they account for 5.5% of total arable lands (Mogilevskii et al., 2017).
15. The Kyrgyz government classifies 97% of potato farmers as smallholders (Abdulhamidov et al., 2015; p. 57).
16. Founded in 1997, Kirbi is Kyrgyzstan's largest potato grower and processor, with land plots in Chui and Issyk-Kul regions, 70–100 ha and 35–40 ha, respectively, relying on advanced irrigation systems. Kirbi is mostly known for its branded chips, but it also grows other industrial crops and supplies potatoes for the Kyrgyz fast food industry. Kirbi relies on imported agro-technology, including John Deere potato cultivators, Grimme potato planters, single-row and double-row trailed harvesters. The company has purpose-built storage facilities with dedicated, imported equipment (PIR Chips, 2022; Viklenko, 2021).
17. The FAO and other publications confirm that farmers "have limited financial management skills and unstable incomes" as reasons why these loans were not successful (FAO 2019, p. 24); this assessment seems to belie the fact that they were just too expensive to be attractive.
18. Efforts to make preferential loans accessible to farms have been made again under a new program, "Financing of Agriculture," passed in November 2022, which subsidized loans from the largest commercial banks. The Cabinet of Ministers allocated 520m som for the initiative (Ministry of Agriculture of the Kyrgyz Republic, 2022).
19. Among larger farmers, this is often preferable because seed potatoes are typically certified as disease-free, and can be used to ensure stable yields. Smaller farmers will also choose to save and re-use their potatoes; without proper management, this typically leads to the gradual accumulation of potato viruses and eventual declines in yield.
20. Some domestic seed farms grow seed potatoes based on imported seed material.
21. Climate change in Kyrgyzstan is projected to be significantly higher than global averages and will increase average temperatures by 5.6 C in the 2090s relative to the 1986-2005 baseline under the under the high emissions modeling scenario, or 2.7 C under the most likely scenario (World Bank 2022/Asian Development Bank, 2021).
22. Remarks during the May 2022 World Potato Congress (FAO 2022). See also Altieri (2002).

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Appendix A. List of interviews

1. Muktar Ch., Elena T., Bishkek city, May 19, 2022
2. Tatiana S., Bishkek city, May 20, 2022
3. Ivan Ch., Ak Suu district, Issyk-Kul region, May 20, 2022
4. Makhabat K., Jalal-Abad city, Jalal-Abad region, May 27, 2022
5. Kaiyrkul K., Bishkek city, May 31, 2022
6. Erlan B., Tup district, Issyk-Kul region, June 15, 2022
7. Emil T., Ak Suu district, Issyk-Kul region, June 16, 2022
8. Nurlan U., Tup district, Issyk-Kul region l, June 27, 2022
9. Turatbek A., Tup district, Issyk-Kul region, January 8, 2023
10. Beksultan U., Tup district, Issyk-Kul region, January 8, 2023
11. Talantbek A., Ak Suu district, Issyk-Kul region, January 8, 2023
12. Rahmat O., Kochkor district, Naryn region, January 8, 2023
13. Amanat D., Tup district, Issyk-Kul region, January 8, 2023
14. Erlan B., Tup district, Issyk-Kul region, January 15, 2022
15. Emil T., Ak Suu district, Issyk-Kul region, January 15, 2022

Appendix B.

Rank	Total Soviet Production	74,501
1	Russian SSR	37,137
2	Ukrainian SSR	18,273
3	Belarussian SSR	10,994
4	**Kazakh SSR**	**2,061**
5	Lithuanian SSR	1,872
6	Latvian SSR	1,281
7	Estonian SSR	8,64
8	Moldovan SSR	379
9	Georgian SSR	346
10	**Kyrgyz SSR**	**318**
11	**Uzbek SSR**	**301**
12	Armenian SSR	259
13	**Tajik SSR**	**198**
14	Azeri SSR	185
15	**Turkmen SSR**	**33**

Figure B1. Late Soviet potato production, 1986–1989 (three-year average, thousand tons).
Source: Narodnoe Khoziastvoe SSR v 1989g.
Notes: Central Asian Soviet Republics appear in bold.

Appendix C.

	2016	2017	2018	2019	2020	2021
Batken	36.4	37.5	38.2	39.3	36.4	37.4
Jalal-Abad	137.4	136.3	134.5	138.0	132,0	123.2
Issyk-Kul	487.4	503.3	521.8	477.3	453.9	464.1
Naryn	85.7	90.6	100.0	95.7	95.1	94.6
Osh	199.7	202.3	204.4	206.2	204.9	207.4
Talas	239.7	238.3	234.0	215.1	203.9	185.4
Chui	199.5	204.7	210.5	199.3	197.6	173.7
Bishkek City	0.1	0.1	0.1	0.1	0.1	0.1
Osh City	2.5	2.9	3.0	2.6	3.2	3.3
Total	***1385.9***	***1413.1***	***1443.5***	***1371.0***	***1191.9***	***1285.9***

Figure C1. Kyrgyz potato production by regions, 2016–2021 (thousand tons).
Source: National Statistical Committee of the Kyrgyz Republic 2023 "Potato production by regions."