

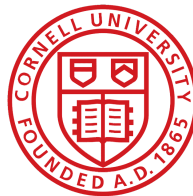
Gender and Climate Smart Agriculture: Solutions in a Rural Setting

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Introduction

The earth's surface consists of 29% land, of which 38% is used (Lipper, 2014) for agricultural purposes. Of this agricultural land, 33% is considered arable and the remainder is classified as marginal (untouched or used for livestock grazing) (Ritchie, Rosado, & Roser, 2022). This arable land currently feeds eight billion people and will be called upon to feed a global population that is predicted to peak at 10.4 billion in 2080 before beginning a slow decline (United Nations, 2024). Climate change is negatively impacting arable land and will affect aspects of agricultural production, which in turn will impact the components of food security, such as food prices, rural agricultural production, and household incomes. Many parts of the world are experiencing record temperatures, changing patterns of rainfall, more extreme weather events, along with changes in animal and insect migration patterns. These climate changes are accelerating and exacerbating competition for limited natural resources, further pressuring marginalized and rural communities.

As awareness of the inescapability of climate change is becoming a reality, adaptation has become a major focus, especially in developing nations which are more vulnerable to climate change due to limited infrastructure resilience and over-reliance on climate-sensitive sectors, including agriculture (Lee & Romero, 2023). Agriculture is a cornerstone in “eradicating hunger, poverty, and all forms of malnutrition”; and, if the global community is to meet its goal of “eradicating poverty, ending hunger, and taking urgent action to combat climate change and its impacts ... by 2030” (Lipper, McCarthy, Zilberman, Asfaw, & Branca, 2018).

Smallholder Agriculture

Smallholder farms and the farmers that manage these farms feed the world. Estimates state that there are between 500 and 510 million smallholder farmers globally (FAO, 2014; Lowder, Sánchez, & Bertini, 2021) responsible for between 30 to 35 percent of total food production on between 12 to 24 percent of gross agricultural area (Ricciardi, Ramankutty, Mehrabi, Jarvis, & Chookolingo, 2018; Lowder, Sánchez, & Bertini, 2021). Although small farms account for between 12 and 24 percent of gross agricultural area, they are responsible for feeding approximately 2 billion people worldwide, most of them located in developing countries (FAO, 2015). Smallholder farmers are defined as small-scale farmers who operate areas ranging from under one hectare to 10 hectares, family run or family focused in their operations, primarily utilizing familiar labor, and consuming part of the product (FAO, 2009). Further smallholder farm characteristics are vulnerability to supply chain disruptions, lack of resources especially when compared to large-scale farmers, participation in the informal local economy, and a heavy reliance on a single produced commodity as a main source of livelihood (Cohn, et al., 2017; WIEGO, 2024).

Smallholder farms face many barriers to economic viability along with overall relative competitiveness and productivity in comparison to large farms (Lall, Norman, & Langemeier, 2001). To remain viable, avoid consolidation, and even become competitive with larger enterprises while managing the threats encountered by climate change, smallholder farms need to adopt sustainable agricultural practices that include integrated farming systems, water and soil conservation, and fertility improvement practices (Mgomezulu, et al., 2024). Smallholder agriculture is a crucial part of any national development plan, and support of farmers to improve the viability of this venture is linked to a reduction in poverty, improved food security, and increased nutritional outcomes (Fan & Rue, 2020). To keep smallholders operational and reduce land abandonment, increased governmental supports along with increased farmer political power have shown positive results in maintaining this agrarian development tool (Falkowski, 2018; Movahedi, et al., 2021).

As essential components of a local economy, especially in developing countries, smallholder farms can play an important role in environmental preservation efforts through engagement in crop diversification, agroforestry, smart water use, and integration of crop and livestock systems among other activities (Akanmu, Akol, Ndolo, Kutu, & Babalola, 2023). Although smallholder farmers are the most climate impacted and climate dependent population, they are asked to contribute the most to global food security, while possessing the most limited ability to adjust to the impacts of climate change. CSA

practices have shown promise for smallholder farmers in not only reducing the negative impacts of climate change but to also in improving crop yields; however, despite the promise, adoption of CSA practices remains low (Mutunga, Ndungu, & Muendo, 2018; Makate, 2019; Negera, Alemu, Hagos, & Hailelassie, 2022). However, small-scale farmers, who are operating near or below the poverty line might not always have the personal assets or benefit from governmental financial help to prioritize sustainable farming approaches at the risk of their own short-term livelihood (IFAD, 2012; Jamshidi, et al., 2020). It is essential for the importance of smallholder farmers to be understood before considering technical training, financial schemes, and government interventions (Azadi, et al., 2021).

Climate Smart Agriculture

Factors impacting CSA adoption, especially amongst smallholder farmers, remain with lack of regulatory or institutional support, social and behavioral obstacles, inadequate education, and market uncertainty acting as barriers hampering adoption of environmentally conscious agricultural methods (Long, Blok, & Coninx, 2016; Jomegi, Niknami, Sabouri, & Bijani, 2024). Conversely, studies have shown that farmers who are male, trend younger, have high levels of education, own their own land or have land tenure security, have access to credit, are members of extension or farmers' organizations tend to adopt CSA practices at larger numbers (Ali & Erenstein, 2017; Khatri-Chhetri, Aggarwal, Joshi, & Vyas, 2017; Abegunde, Sibanda, & Obi, 2019; Moutouama, et al., 2022; Tione, Nampanzira, Nalule, Kashongwe, & Katengeza, 2022). Also, the number of adaptation practices utilized are positively associated with education, gender (male) of household head, amount of land owned, access to credit, use of extension services, and overall wealth (Ali & Erenstein, 2017). The role of local customs, social characteristics, past legacies, and farmer-community- policymaker interaction also play into CSA technology adaptation and stakeholder engagement (Vernooy & Bouroncle, 2019; Zougmore, et al., 2019). A shift in governmental policies and financing regimes designed to support the use of climate-smart technologies to improve weather forecasting, reduce waste in the entire farm-to-table ecosystem, and develop innovative delivery systems for these technologies has also shown promise in increasing acceptance and use of CSA (Zougmore, Läderach, & Campbell, 2021).

The harmful environmental impacts of agricultural production (GHG emissions, freshwater use, etc.) resulting from a need to feed an increasing global population could push the negative effects of food production outside of safe operating limits for humanity and beyond the planetary boundaries (Springmann, Clark, Mason-D'Croz, & al., 2018). Food production is directly responsible for about 25% of global greenhouse gases (GHG) emissions with crop production accounting for 27% of this number (Ritchie, Rosado, & Roser, 2022). One method to increase agriculture productivity while doing so in a sustainable manner while considering the realities of climate change is Climate Smart Agriculture (CSA). Climate-smart agriculture is an approach to “transform and reorient” agriculture that supports local and global sustainability efforts in the face of climate change, while also advocating for food security, equitable increases in income, and rural development (FAO, 2013; Lipper, 2014; FAO, 2021). The concepts surrounding CSA aim to advance how agricultural expansion designed to achieve food security integrates with climate awareness in response to the effects of agriculture in a changing climate. CSA works towards the sustainable increase in agricultural productivity while enhancing agricultural resilience and reducing agricultural greenhouse gases (GHGs); CSA is a synergy between these three pillars: productivity, adaptation, and mitigation (FAO, 2010). A reduction in climate and weather risks through technology while improving productivity, mitigating of harmful effects and increase in system resilience with a culturally and socially acceptable practical context are all hallmarks of CSA (Rosenstock, et al., 2016; Saja, Torquebiau, Hainzelin, Pages, & Maraux, 2017).

The term “climate smart agriculture” was first introduced to the mainstream of the global community in a 2009 Food and Agriculture Organization of the United Nations (FAO) report where a call was made to support investment in, and support for, CSA to “capture synergies between mitigation, adaptation and food security” (FAO, 2009). The notion of Climate-smart agriculture was then launched via a FAO background paper presented at the Hague Conference on Agriculture, Food Security and Climate Change, where the three main objectives of CSA were first outlined: “sustainably increase food

security by increasing agricultural productivity and incomes, build resilience and adapt to climate change, and reduce and/or remove greenhouse gas emissions where possible” (FAO, 2010). CSA is hailed as a means for encouraging local, regional, and global partnerships in evidence-based research, private and public sector investment, public policy, and culturally sensitive training towards the promotion of climate-resilient agriculture designed to decrease hunger and poverty while also reducing the agricultural related contributors to climate change (Lipper, 2014). CSA has evolved to be a solution to many of the harmful environmental impacts of agriculture while also offering solutions to the negative effects of climate change on the human population, especially those living in vulnerable locations. Table 1 offers a listing of various definitions of CSA.

Table 2- Sample Listing of Climate Action Project Sponsors		
Donor	Themes	Link
Green Climate Fund in cooperation with other donor agencies	- Community-based Agriculture Support - Building climate resilience - Green Economy Financing - Climate Adaptation and Mitigation	https://www.greenclimate.fund/countries/tajikistan
Asian Development Bank	- Agriculture Modernization and Efficiency Improvements - Hydropower Systems Rehabilitation - Enabling Climate-Responsive Business Environments - Strengthening Accountability	https://www.adb.org/projects/56299-001/main https://www.adb.org/news/videos/modernizing-irrigation-and-empowering-women-tajikistan
United Nations Development Program (UNDP)	- Support of Nationally Developed Contribution (NDC) climate action plans - Climate Change Resilience	- https://climatepromise.undp.org/what-we-do/where-we-work/tajikistan - https://open.undp.org/projects/00133016
The World Bank	- Climate Education - Strengthening Resilience of Agriculture Sector - Hydropower	https://www.worldbank.org/en/country/tajikistan
US Agency for International Development (USAID)	- Comprehensive Action for Climate Change Initiative (CACCI)	https://www.usaid.gov/tajikistan
International Food Policy Research Institute	- Agricultural Production and Productivity - Increasing Resilience of Farming Systems Under Growing Climate Challenges	https://www.ifpri.org/?s=tajikistan&post_type=project
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	- Technology-based Adaptation to Climate Change	https://www.giz.de/en/worldwide/82076.html
Food and Agriculture Organization of the United Nations (FAO)	- Enhancing compliance capacity with the Enhanced Transparency Framework under the Paris Agreement	https://www.fao.org/countryprofiles/news-archive/detail-news/en/c/1639656/
The European Bank for Reconstruction and Development (EBRD)	- Green Economy Financing Facility - Promotion of remote energy and resource efficiency technologies	https://www.ebrd.com/news/2023/ebd-pledges-new-resources-for-green-investment-in-tajikistan.html
Asian Infrastructure Investment Bank (AIIB)	- Hydropower Development	https://www.aiib.org/en/projects/details/2024/proposed/Tajikistan-Rogun-Hydropower-Development-Project-Phase-1.html
Program Green Energy Fund	- Green Energy and SME Development Project	https://www.undp.org/tajikistan/projects/undp/green-energy-and-sme-development-project
Climate Investment Funds (CIF)	- Climate Resilience	https://www.cif.org/news/apples-adaptation-and-agriculture-cif-tajikistan

Central Asia

Covering a region from the Western borders of China to the shores of the Caspian Sea, Central Asia (CA) covers a land mass of 5.9 million square kilometers (4 million square miles) with a population of more than 79 million people representing a diversity of languages and ethnic groups. The region’s longitude ranges from 4E to 90E and its latitude from 35N to 55N. The landscape of Central Asia is breathtaking, possessing two of Asia’s major mountain ranges (Pamir and Tien Shan), lush high-altitude valleys with meandering glacier-fed rivers, grassy steppes, and rugged deserts (Kyzylkum and Karakum). The region includes the countries of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, all of which were a part of the Soviet Union before its collapse in 1991. The chief ethnic and linguistic groups in Central Asia are Indo-Iranian and Turko-Mongolian with Russian, Chinese, and Korean

heritage populations comprising smaller cultural and racial groupings. The shared Soviet experience along with the predominance of Islam as the primary religion gives this region commonalities beyond their geographic proximity. It is also true that since independence, the nations of Central Asia have forged their own paths, with each following a unique trajectory as nation states.

Though generally inhospitable to agriculture, agriculture has historically played an important role in the economies of Central Asia and is prominent in their ongoing development plans. The interconnectivity of the peoples of Central Asia dates to the Bronze Age with their agropastoral knowledge exchanges being responsible for connecting plant domestication techniques throughout the population centers of Asia and Europe shaping economies across the world (Spengler, 2015). During the Soviet Era, Central Asia was a key agricultural player providing the bulk of the empire's raw materials. The importance of agriculture in this region continues into today, as this sector is an important factor in local employment, and in international trade, as wheat and cotton production play outsized roles in the economy (Khitakhunov, 2021). A central issue facing the Central Asian agricultural sector is low productivity. Based on 2019 data, the Kazakhstan agricultural sector has a value-add per worker of \$7,643, Kyrgyzstan at \$2,246, Tajikistan at \$2,300, and Uzbekistan at \$7,807 (no data available for Turkmenistan) as compared to \$100,062 in the United States (Our World in Data, 2019). The overall Gross Domestic Product (GDP) for these countries is- Kazakhstan at \$296.74 (billion) and \$14.78 GDP per capita (thousand), Kyrgyzstan at \$13.6 (billion) and \$1.92 GDP per capita (thousand), Tajikistan at \$12.95 (billion) and \$1.27 GDP per capita (thousand), Turkmenistan at \$81.9 (billion) and \$12.41 GDP per capita (thousand), and Uzbekistan at \$97.96 (billion) and \$2.67 GDP per capita (thousand) as compared to the United States at \$28.78 (trillion) and \$85.37 GDP per capita (thousand) (International Monetary Fund, 2024).

As a predominantly mountainous region, Central Asia is one of the world's most susceptible areas to climate change, as the glaciers of the Pamir and Tien Shan mountains are a key source of water storage and their snow melt during the dry season is a main feeder of rivers that supply water for irrigation and domestic uses downstream (Kohler, et al., 2009; Xenarios, et al., 2019). Over the last 70 years, data has shown increases in greenhouse gas concentrations (GHGs) resulting in a warming of 1.2 degrees Celsius in the mountains and a resulting decrease of 20% to the snow-depth (Fallah, Didovets, Rostami, & Hamidi, 2024) posing a threat to the communities downstream as these people depend almost entirely on glacier melt for their water supply during the dry season (Pritchard, 2019). More people in Central Asia will be impacted by water scarcity resulting from the effects of climate change and exasperated by population increases and ensuing land degradation (Feng, 2013; Gosling & Arnell, 2016). Adding to the climate pressures brought on by increasing temperatures, political upheavals after independence, years of ecological mismanagement under a Soviet system that put economic growth above environmental stewardship, and inadequate investment in critical infrastructure due to a Soviet focus on agriculture have all contributed to a diminished regional climate resiliency (Lioubimtseva & Henebry, 2009; The World Bank, 2009). One stark example of Soviet area environmental legacy can be seen in the salt beds now covering what once was the Aral Sea as river basin mismanagement diverted feeder rivers to the desert for cotton, rice and fruit production for export to the Soviet states and abroad. To manage the environmental legacy of the post-Soviet area that is negatively impacting the agricultural sector, the region needs to plan for economic and cultural risks brought on by climate change while developing adaptation strategies (Khitakhunov, 2021).

The worsening environmental conditions are negatively impacting crop yields resulting in lower crop harvests and threatening food security (Qi & Kulmatov, 2008), with chronic water and soil difficulties further hampering the achievement of sustainable agricultural progress in Central Asia (Qin, He, Wei, & Du, 2022). Smallholder farms, once seen as foundational to food production in the Soviet era, are now being marginalized due to growing imports, difficulty in gaining capital, lack of technological access, and limited links to supply chains and external markets (Wegren & O'Brien, 2018). Even though individual farms are the backbone of the regional agricultural economy, the governments of Central Asia continue the Soviet period bias towards large-scale farming, ignoring data that growth is

driven by individual farms and discounting their contribution to agricultural production (Lerman & Sedik, 2018).

Women, Climate Change, and Agriculture

Women are not men, therefore the impact of feminist geographies as it relates to climate smart agriculture within the context of historical power dynamics, cultural social norms, and country-specific governance blind spots needs to be considered in the climate change mitigation debate (Arora-Jonsson, 2014; Gay-Antaki, 2020; Huyer, Loboguerrero, Chanana, & Spellman, 2024). Comprising 43% of the agricultural labor force, and nearly 50% in sub-Saharan Africa, women do the bulk of the farming in poor countries (FAO, 2009). Even with this workforce influence, women's access to credit, legal land rights or title, and policy influence are restricted by gender biases (Afolayan, 2023). According to the Food and Agriculture Organization (FAO) women are the "quiet drivers of change" and with the same resources as men, they could increase harvests on their farms by 20 percent to 30 percent resulting in 100-150 million people being lifted out of hunger (FAO, 2009). For CSA to fully meet its potential in the most at-risk regions of the globe, the concepts of unequal access to resources, unequal access to power, and unequal access to justice need to be part of any policy discussion (Nelson, Meadows, Cannon, Morton, & Martin, 2002; Chandra, McNamara, & Dargusch, 2017).

Women respond to, and are affected by, the impacts of climate change differently than men and because of their importance in communal life they can be powerful agents for climate friendly and climate adapted agriculture (FAO, 2013; WHO, 2014; Kristjanson, et al., 2017; ESCWA, 2022). Women are more impacted by the negative impacts of climate change as they are more involved in low skilled nature-based work, do not have the education or skills (usually culturally limited) to work outside the smallholder farm, take on additional work during adverse climate events (walk further for the household water during droughts, repair home and farm infrastructure during floods, etc.), and fill-in for the male head of household who migrates to an urban center for employment if the farm experiences climate related failure (Nyasimi & Huyer, 2017; IOM, 2024). The role of women as key players in addressing and reversing the impacts of climate change in all aspects daily life needs to be embraced, validated, and empowered (Huyer, Acosta, Gumucio, & Ilham, 2020; Kovaleva, Filho, Borgemeister, & Komagaeva, 2023). Empowering women to utilize their site-specific knowledge and supplementing this knowledge with access to climate related information, education, training, and mitigation solutions, along with a systematic approach to policy and governance directed at increasing female participation CSA, is essential in reducing and even reversing the climate risks they are encountering (Tsige, Synnevåg, & Aune, 2019; Glazebrook, Noll, & Opoku, 2020; Njuki, et al., 2022; Remteng, Nkem, Mofor, & Murombedzi, 2022).

Gender shapes approach of smallholder farmers to CSA responses and their ability to execute mitigation strategies. A macro study covering Africa, Latin American, South and Southeast Asia found that acknowledging the impact of gender roles in smallholder agriculture, addressing the difficulties female farmers face in accessing the supply chain, and the need to include female voices in policy discussions cross regional boundaries (Beal, et al., 2021). Looking at Ghanaian farmers found that women are more influence by factors such as farmland tenure, income sources, and experience than their male counterparts with women who inherit farmland are more apt to adopt climate-smart agricultural techniques than men who rent farmland (Antwi & Antwi-Agyei, 2023). A recent study in Kenya emphasized the importance of including women in climate smart agriculture work as they play a major role in agriculture production, participate more in communal farming meetings, know more about farm support resources, and take-on more work during negative climate events (walk further for water or repair flash flood damage); however, these climate conversations will have little impact since women rarely hold title to the land they work and are subservient to the male head of household in agricultural-related decision making (Autio, Johansson, Motaroki, Minoia, & Pellikka, 2021). Looking at three Climate Smart Villages located in Colombia, Honduras and Guatemala, it was found that women's access to education and greater education attainment played a key role in the adoption of CSA practices and use of CSA tools (Acosta, et al., 2021). A study of Slovenian farmers found that age along with gender does

foretell used of climate smart agricultural techniques with farms managed by young women being more open to adopting climate friendly practices and implementing voluntary governmental environmental targets (Unay-Gailhard & Bojnec, 2021). In Benin, women were likely to adopt CSA techniques as they saw this as the only means to improve crop yields given that the land they farmed was often less desirable and less fertile than their male counterparts, necessity being the mother of invention (Obossou, Chah, Anugwa, & Reyes-Garcia, 2023). A study on women's empowerment in CSAs at Philippines, Myanmar, and Cambodia found societal unwillingness to support female agency and life-choice decision making compounded by the view of farming as male job (even though women are 28.5, 44, and 50 percent of the workforce, respectively), a set of gender stereotypes impacting the unwillingness of society to support female led climate friendly agricultural choices (Verzosa, et al., 2021). Looking at CSA adoption in Malawi and Zambia found that legally empowered female heads of households who were sole decision makers were more probable to adopt CSA as were women with higher education and literacy levels than other women and their male counterparts (Khoza, Niekerk, & NemaKonde, 2019). Climate change is expected to worsen global poverty, increase existing gender disparities, and add to difficulties already being experienced by women living in marginalized communities (Huyer & Partey, 2020). It is with this backdrop that emphasis must continue in increasing women's voices in the global, national, and communal climate smart agriculture debate to not only combat the negative effects of climate change in agriculture but to also attack the gender gap in agriculture.

Tajikistan

Background

After gaining independence from the Soviet Union on 9 September 1991, Tajikistan experienced a devastating civil war that began in May of 1992 and lasted five years. The civil war claimed between 35,000 and 157,000 lives, destroyed about 37,500 households, and displaced about two million people both internally and externally (Sobiri, 2017). Tajikistan has not fully recovered from the difficulties faced after independence and, as of 2021, 23.18% of the population was living below the national poverty line, making Tajikistan one of the poorest countries in the European and Central Asian region (World Bank Group, 2023). Because of the civil war, much of the population reverted to subsistence practices in the mid-1990s, a trend that further strained the fragile mountainous ecosystem (Climate Diplomacy, 2015). The long-lasting effects of the civil war can be seen most prominently on women, whose education was interrupted during the war and whose resulting wages and opportunities have yet to recover (Shimizutani & Yamada, 2024).

Government

Tajikistan contains four administrative divisions of which there are the two provinces (viloyat in Tajik) of Sughd and Khatlon, the autonomous province of Gorno-Badakhshan (GBAO), and the Region of Republican Subordination (RRP – Raiony Respublikanskogo Podchineniya transliterated from Russian or NTJ- Nohiyahoi tobei jumhurii in Tajik) which use to be known as Karotegin Province. Tajikistan has an elected president who serves as the head of state and head of the executive branch. A bicameral parliament (Majlisi Oli) is the legislative branch with members of the lower chamber (Majlisi Namoyandagon) serve a five-year elected term. In addition to the formal government structure at the village level, the Makhalla wields great informal power whose formalized structure can be seen in a forum or jamoat. Based on the Tajik Constitution a “The self-government authority of a settlement and village is jamoat” (The Constitution of the Republic of Tajikistan). Nevertheless, in administrative terms the jamoat relies on the central and regional government for policy matters such as taxation, infrastructure development, and administrative functions (Babu & Akramov, 2022). It is important to understand how the central and regional governments interact with the informal power structure at the village level, a power structure that even though it is formally recognized in the constitution, has been in place centuries before the establishment of a formal centralized power structure based in the capital city of Dushanbe.



Land Use

Tajikistan is a land-locked nation, with 93% of the country's land area being covered by mountain ranges. Due to the topography, most of the rural population live on the limited arable land and a few in the high-altitude regions. While a part of the Soviet Union, 99% of agricultural land was owned by the state via a kolkhoz or sovkhoz; farmers toiled this land, and Tajik households were given one percent for subsistence farming (Lerman & Sedik, 2008). Today, almost all the land in the country is owned by the State and given to farmers via use rights (Lerman & Sedik, 2018). Tajikistan today has four agricultural land tenure categories: -cooperatives or enterprises, individual/commercial farms (dehkan farms), presidential plots, and household plots (kitchen gardens) (ADB, 2020).

Since independence the government has passed presidential decrees to promote private land ownership, though this amount remains small. The 1996 Land Code gave each Tajik family permanent, generational, right to a small garden plot (between 0.15 and 0.4 hectare) adjacent to their home, the Presidential Decrees of 1995, 1996, and 1997 distributed an additional 75,000 hectares of government owned land in the form of garden plots to lessen rural poverty resulting from the effects of the Civil War, and the 2016 Land Code increased the private ownership of these garden plots (Shapiro, Cahill, Haidarovich, & Dilbar, 2017; Hierman & Nekbakhtshoev, 2018; USAID, 2021).

In addition to family garden plots, the 1992 law on dehgan (peasant) farms provided means for Tajiks to obtain inheritable land use rights from the Soviet era collective, with the 1994 Constitution affirming state ownership over all land and the Land Code of 1996 establishing the legal framework for recognizing land use rights and the ability to transfer these rights (USAID, 2021). Tajik laws allow former workers of the collectives the right to a share of the entity via a petition to the local state-run District Land Committee, a group that is also responsible for issuing the legal certification of recognition for these plots of land (Hierman & Nekbakhtshoev, 2018; Hayward, Hofman, & Gillin, 2022). These dehgan farms can range from 0.01 to over 30,000 hectares, averaging in size at seven hectares, are estimated at 172,668 (IFAID, 2020), and are run by either private individuals, families or collectives, with the larger farms resembling their Soviet era predecessors in terms of ownership structure and operating philosophy (USAID, 2021). Deghan farms can be held under three forms of usage rights: 1- perpetual use

with no fixed term (usually for state agricultural use), 2- fixed term use, and life-long heritable tenure that must be re-registered at transition (usually individuals or collectives) (Bann, Shukurov, Boziev, & Rakhmatova, 2012; Mandler, 2019). The prime beneficiaries of the deghan farm system have been the Soviet era rural elites who held collective farm chairmanships or other high posts as these individuals and their families, utilizing their governance knowledge and government connections, rose to the leadership ranks while the shareholders remained as laborers receiving negligible payment or in-kind transactions for their farm work on the deghan (Nekbakhtshoev, 2021). These ruling elites have been reluctant to give control of these large deghan, share fairly the annual profits, or even allow shareholders their legal right to sell their portion of the collective's shares (Nekbakhtshoev, 2016; Hierman & Nekbakhtshoev, 2018). See Appendix XX for a timeline of land reforms.

Agriculture

Agriculture is the main economic activity in Tajikistan. Of the country's total 141,380 square kilometer area, less than seven percent is arable, with agriculture accounting for approximately 23% of gross domestic product (GDP) and employing 51% of the country's workers (The World Bank, n.d.). About 34% of the country's total land area is agricultural, with 77% being pastureland and the rest cropland; of the cropland, 70% is irrigated (USAID, 2021). The main agricultural products include cotton, wheat, barley, corn, potatoes and, as with most former Soviet republics, there is little freedom for farmers to veer from governmental directives on production mix (FAO, 2023; USDA, 2024). Tajikistan has the lowest ratio of irrigated land to population in Central Asia, and is considered food insecure (Mustaeva, Wyes, Mohr, & Kayumov, 2015; Organization for Security and Co-operation in Europe, 2017; Khakimov, Aliev, Thomas, Ilyasov, & Dunston, 2020; USAID, 2024).

While a part of the Soviet Union, Tajikistan was a major cotton producer. The 1992 – 1997 civil war negatively impacted this industry. After the war, Tajikistan made a concerted effort to diversify away from cotton, with wheat moving into a secondary production role and the growing of legumes, cereals, oil seeds, and a variety of fruits and vegetables following. This diversification was a result of the government's desire to achieve food security, a goal that is still elusive as Tajikistan greatly relies on imports of essential foods such as grain, flour, meat, rice, buckwheat, vegetable oil, and sugar. The lack of arable land is a crucial constraint in increasing agricultural production. Even with this constraint, most of the rural population relies greatly on agriculture, second to labor remittances, for their livelihood (Hegland, 2010; Mustaeva, Wyes, Mohr, & Kayumov, 2015).

As a part of the Agrarian Reform Program (2012-2022), agricultural cooperatives were identified as a key component in accelerating sustainable development goals along with being a key driver in rural economy (FAO, 2024). As a nation counting on the agricultural sector for rural economic growth, Tajikistan's agricultural exports are the lowest in Central Asia. Further, Tajikistan is a substantial net importer of agricultural goods and has an overall trade deficit that has expanded over the past few years (Khitakhunov, 2021; The World Bank, 2023). Agriculture in Tajikistan faces many challenges. An obstacle facing the reform movement is that many rural farmers do not understand the cooperative business model, nor do they possess the skills to navigate the legal and governance landscape to fully take advantage of the newly given rights (FAO, 2024). Another challenge is the absence of investment in smallholder value chains, hampering the upgrading of small-scale farms by younger farms as seen in other former Soviet states (Burkitbayeva & Swinnen, 2018). Farmers also lack adequate education, both agriculturally and managerially, to implement the reforms pushed forward by Western developmental entities, especially as the Tajik system operates within remnants of the Soviet agricultural and educational machine that is infrequently in sync with Western suggestions (Shtaltovna, 2015). Also, the need to engage farmers in related policy discussions, improved land tenure rights, provide crop insurance, build agricultural extensions, and support further country-specific agricultural research can all support the growth of this sector (Babu & Akramov, 2022). Lastly, in the Government's own development strategic report the following additional challenges were listed: weak mechanisms for public support of agricultural enterprise, obstacles to consolidation of land impeding growth of agribusiness, outdated material and technical know-how, flawed regulatory mechanisms, unequal access for women to land, poor irrigation

systems, outmoded water management and irrigation systems, and nominal sustainable agriculture practices leading to land degradation (Government of Tajikistan, 2016).

Climate Change

As with many low-income developing nations, the data from Tajikistan suggest that urban areas are less vulnerable to the impacts of climate change, while the mountain zones face the bulk of the coping challenges such as water scarcity in prime agricultural valleys (Heltberg & Bonch-Osmolovskiy, 2011). The central and southern regions of Tajikistan are repeatedly experiencing hotter than usual weather as well as increased flooding and flash floods due to heavy rain and snow melt, ultimately destroying agricultural infrastructure and farms, which in turn adds to the nation-wide social and economic stressors brought on by crop loss, extreme weather events, and loss of income (Organization for Security and Co-operation in Europe, 2017). With an average temperature increase of 0.7–1.2°C in the valleys, 0.1–0.7°C in mountains and highlands, and 1.2–1.9°C in cities the vulnerability and low adaptive capacity of Tajikistan is expected to see decreased yields of wheat, barley, maize, fruit, and vegetable production resulting higher prices to a consumer population that is already one of the poorest in the region (Khakimov, Aliev, Thomas, Ilyasov, & Dunston, 2020). The negative impacts of climate change are considered a major obstacle to the achievement of the government's National Development Strategy for 2016–2030 objectives of improving living standards, increasing access to quality nutrition, and achieving food security by 2030 (Government of Tajikistan, 2016).

Through the introduction of laws, international cooperation, and strategies, the government of Tajikistan has been working towards climate change mitigation, risk reduction, and resiliency. See Table 2 for a sample listing of climate action sponsored projects. Refer to Appendix 1 for a listing of Tajik government actions in support of climate change mitigation. With regards to the agricultural sector, technological programs to improve irrigation, crop varieties, and weather forecasting along with economic provisions such as crop insurance and income support have been recognized as key contributors in support of adaption to climate change (Manandhar, Xenarios, Schmidt-Vogt, Hergarten, & Foggin, 2019). In addition, programs are being implemented to train vulnerable farming households on how to understand and use climate data to make informed planting and livestock decisions as well as use of efficient irrigation and drainage methods and conservation farming practices to promote soil protection (Green Climate Fund, 2022). Tajikistan, through national projects, government actions, and partnerships with international organizations, has adopted climate change mitigation strategies (See Table 2 for a listing of such activities. Due to lack of knowledge on the effects of glacier melt on hydrological cycles of Tajikistan's major rivers, the microclimatic nuances of the Pamir and Tien Shan mountainous regions, and the preexisting socioeconomic deprivations of the region, it is difficult to understand the impact and progress of climate change adaption and prevention initiatives (Manandhar, Xenarios, Schmidt-Vogt, Hergarten, & Foggin, 2019).

Table 2- Sample Listing of Climate Action Project Sponsors		
Donor	Themes	Link
Green Climate Fund in cooperation with other donor agencies	- Community-based Agriculture Support - Building climate resilience - Green Economy Financing - Climate Adaptation and Mitigation	https://www.greenclimate.fund/countries/tajikistan
Asian Development Bank	- Integrated Care - Hydropower Plant Rehabilitation - Enabling Climate-Responsive Business Environments - Strengthening Accountability	https://www.adb.org/projects/56299-001/main
United Nations Development Program (UNDP)	- Support of Nationally Developed Contribution (NDC) climate action plans - Climate Change Resilience	- https://climatepromise.undp.org/what-we-do/where-we-work/tajikistan - https://open.undp.org/projects/00133016
The World Bank	- Climate Education - Strengthening Resilience of Agriculture Sector - Hydropower	https://www.worldbank.org/en/country/tajikistan
US Agency for International Development (USAID)	- Comprehensive Action for Climate Change Initiative (CACCI)	https://www.usaid.gov/tajikistan
International Food Policy Research Institute	- Agricultural Production and Productivity - Increasing Resilience of Farming Systems Under Growing Climate Challenges	https://www.ifpri.org/?s=tajikistan&post_type=project
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	- Technology-based Adaptation to Climate Change	https://www.giz.de/en/worldwide/82076.html
Food and Agriculture Organization of the United Nations (FAO)	- Enhancing compliance capacity with the Enhanced Transparency Framework under the Paris Agreement	https://www.fao.org/countryprofiles/news-archive/detail-news/en/c/1639656/
The European Bank for Reconstruction and Development (EBRD)	- Green Economy Financing Facility - Promotion of remote energy and resource efficiency technologies	https://www.ebrd.com/news/2023/ebird-pledges-new-resources-for-green-investment-in-tajikistan.html
Asian Infrastructure Investment Bank (AIIB)	- Hydropower Development	https://www.aiib.org/en/projects/details/2024/proposed/Tajikistan-Rogun-Hydropower-Development-Project-Phase-1.html
Program Green Energy Fund	- Green Energy and SME Development Project	https://www.undp.org/tajikistan/projects/undp/green-energy-and-sme-development-project
Climate Investment Funds (CIF)	- Climate Resilience	https://www.cif.org/news/apples-adaptation-and-agriculture-cif-tajikistan

Women in Agriculture

During the Soviet era, the Kolkhoz and Sovkhoz farms espoused the communist perspectives on gender role, having men and women take on equal responsibility for farm management. The Soviet gender norms conflicted with the preexisting Islamic and rural Tajik customs, which assign all formal authority to men; the introduction of the Tajik constitution affording men and women equal rights did not change Tajik gender customs. Building on these informal structures, male and female roles in Tajikistan are highly defined, women are in a subordinated position to men, lack household power, and on the farm, women are mostly responsible the manual work and men taking on the mechanized work (Hofman, 2018). Based on a ADB survey, found that rural women perform approximately 74% of unpaid care and domestic work (at about eight hours a day compared to two for men) and about 20% of agricultural work, putting most of the daily household burden on women who work and leaving them little time for other pursuits (ADB, 2020). These gendered norms can be seen in the gender gap with Tajikistan ranking 111th out of 146 countries included in the 2023 Global Gender Gap rankings with a score of 67% as compared to the Nordic countries, which all rank in the top 10 with scores between 82 and 91 percent (The World Economic Forum, 2023). With the economic challenges facing Tajikistan, many families have had to rely on male out migration for supplemental income. Approximately 95% of these male laborers are coming from rural areas, resulting in majority female regions that in turn push women to take on traditional male roles, especially in the agriculture sector, changing the traditional male dominated social norms

(Mukhamedova & Wegerich, 2018). One such change can be seen in the role women play as workers outside the home as a *Kolkhozchi* (collective farm worker) or a *Mardikor* (day laborer or helper) working in jobs that are considered predominantly agricultural. The outmigration of males has resulted in a feminization of agriculture, with women becoming the dominant participants, increasing the percent of women who are economically active outside the home (ADB, 2020). Despite the increased participation in agriculture, female management of farms, ownership of farmland, and influence on farming decisions remain secondary to men, leaving women in a subservient position despite their increased labor participation (Lambrecht & Mahrt, 2022).

Agriculture employs 60% of the Tajik population but 80% of agricultural land is owned by men, with the same percentage leading local 'dekhans' or farms (United Nations, 2024). Governmental and non-governmental organizations have been working with the Tajik government to educate women on their legal rights to property and collective action on the farm. Working with women's groups in 78 villages, Oxfam launched a program to create female led producer groups and to educate them on how to lobby the government for farm land access; to date this program has established female-led agriculture cooperatives and increased female awareness of their political land use rights (Oxfam, 2015; Oxfam, 2017). USAID has launched programs educating women in how to keep their land rights, get access to the farm land that is legally their rights, and fight in court for farm land illegally taken from them. The USAID led program helped increase women-led family farm by three-fold from 87 to 240 in 2013 with this program continuing via the US Government's "Feed the Future" initiative (Blau, 2013). The United Nation's International Fund for Agricultural Development (UNIFED) in cooperation with the Tajik government is working to provide women financial and managerial training to manage their own agriculture-related businesses. This UNIFED project has, as of June 2023, has worked with between 50 and 60,000 households in about 180 villages to reach approximately 300,000 people in promoting rural female equality in farming (IFAD, 2024).

Theory (For Discussion)

Numerous theories have been developed to identify the role of women in their own empowerment, such as feminist theory, equity approach, empowerment approach, and gender and development approach. A listing of possible theories has been researched. I will choose a theory after further research and guidance.

- Feminist theory- This theory is based on the belief that women's inferior status is due to societal inequality, and that women should have equal access to power. Central to feminist theory is the belief that the inferior status delegated to women is due to societal inequality, that the personal status of women is shaped by political, economic and social power relations and that women should have equal access to all forms of power.
- Equity approach- This approach aims to promote women's status, power, and control so that they can be equal with men.
- Empowerment approach- This approach focuses on women seeking to empower themselves through greater self-reliance and influence their own change. Feminists seek to empower themselves through greater self-reliance. Women seek to influence their own change and the right to determine their own choices in life.
- Gender and development approach- This approach recognizes women's active involvement in development by utilizing their capacity to the fullest. It recognizes the active involvement of women in development by utilizing the capacity of women at the optimum level and can be achieved by planning and implementation of the programs.

Other theories on women's empowerment include:

- Individualistic perspective- This perspective focuses on women's individual capacities and free exercise of personal choice.
- Collectivistic perspective- This perspective focuses on collective behavior and adherence to cultural norms that emphasize collective growth.

- Social Identity Theory- This theory emphasizes the fundamental need to be a part of social groups.
- Kabeer's empowerment framework- This framework explores empowerment through three interconnected dimensions: resources, agency, and achievement.
- Liberal feminist theory- This theory focuses on patriarchy as a system of power that organizes society based on the assumption that "male supremacy oppresses women". It's relevant to the agricultural sector because women in rural areas may not have the same access to rights as men, such as land, education, and economic rights.
- Gender egalitarianism- This theory supports equal rights, roles, and responsibilities for men and women, and doesn't support gender-specific roles in business and the home.

Feminist agrifood systems theory (FAST):

- This theory suggests that women farmers can create a more feminist agriculture by:
 - Creating gender equality on farms
 - Establishing a farmer identity
 - Accessing more resources
 - Shaping new food and farming systems
 - Negotiating roles in agricultural organizations

Technology acceptance model:

- The technology acceptance model (TAM) is an information systems theory that models how users come to accept and use a technology. Behavioral intention is a factor that leads people to use the technology.

Resilience theory:

- Explores the process of navigating challenges and thriving. It takes a strengths-based approach, emphasizing the inner resources and external supports that help individuals bounce back from adversity.
- Resilience has gained considerable attention in recent years, particularly in the context of climate change.

Methodology (For Discussion)

Study areas

The proposed study area will be region or village in Tajikistan. Details will be finalized based on research interview permissions granted by the Tajik government.

Please note that I will need help in how to go about securing these permissions.

Research design

The initial approach will be either a mixed methods research design where both qualitative and quantitative data were collected sequentially within the same study or a qualitative study based on interview data. The approach chosen will be guided by "Research Design" written by John W. Creswell.

Data collection and instrumentation

Once a research location has been approved, data collection will be conducted by the author and enlisted help from trained local researchers. Qualitative data will be collected from a set of key informants at the approved site.

Initial steps will be to capture descriptive data on all participants (age, education, family size, region, land size, farming assets, etc.). Also, investigation of CSA techniques awareness and adoption of CSA techniques will be conducted via the questionnaire. Road blocks to adoption along with other factors will be a part of the questionnaire.

A working summary of the data Collection are listed-

- Face-to-face interviews- structured and semi-structured
- Snowballing
- Desk review
- Ethnographic observation
- Focus group discussions (FGD)
- Key informant interviews (KIIs)
- Survey questions based on:
 - The three pillars of CSA- productivity, adaptation, and mitigation
 - Farmers' Perception of Climate Change and Climate-Smart Agriculture in Northern Benin, West Africa (Moutouama, et al., 2022)
 - Abbreviated Women's Empowerment in Agriculture Index (A-WEAI) domains of empowerment as the framework
 - Pathways to Women's Empowerment in the Promotion of Climate Smart Agriculture in the Philippines, Myanmar, and Cambodia (Verzosa, et al., 2021)

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Appendix XX- Timeline of Land Reforms

Period	References to Legislation	Institutional Characteristics	Characteristics of Reform	Employment and Gender Related Changes
1930–1987	- Soviet law and legislation specific to Tajik SSR	Establishment of kolkhoz/sovkhoz collective farms	State owned collective farms, subsidized by the state, with a state monopoly on cotton crop	- Establishment of positions: rais (leader), brigadirs (foremen), members/workers - Men and women are members and workers of collective farms, entitled to salaries based on the common Soviet labor code
1987–1990	- Law “On Leasing in Tajikistan”	Kolkhoz/sovkhoz farms allowed to function as lease enterprises (podryad/pudrat)	Law “On Leasing in Tajikistan” 2–3 ha of land to increase productivity and motivation	- Members become individual or group tenants (hektarchi)
1991–1993	- Law No. 544 of the Republic of Tajikistan “On Dekhkan Farms” - Law No. 604 of the Republic of Tajikistan “On the Land Reform”	Division of kolkhoz/sovkhoz into dekhkan farms (DFs), lease share enterprises, agricultural cooperatives Every member entitled to a land share (sahim)	Restructuring formalized but not implemented Members entitled to land shares, but do not always receive them (often because of kolkhoz/sovkhoz debts)	- Rais, brigadirs, members/workers positions maintained and individual dekhkan farmers appeared - Establishment of Women's and Family Issues Committee - Tajikistan becomes a member of the Convention on the Elimination of All Forms of Discrimination against Women CEDAW
1995	- Presidential Decree No. 342, “On the Assignment of 50 Thousand Hectares of Lands for Personal Husbandry of the Citizens” - Decree No. 621 “On the Structural Reorganization of Kolkhoz/Sovkhoz Farms and Other Agricultural Enterprises”	50,000 ha. allocated to household plots (presidential lands) Land continues to be allocated to DFs in 1997 Unprofitable farms reorganized into lease share enterprises Profitable farms reorganized into collective farms	Presidential lands allow only crops to be planted and are allocated from poorly irrigated lands Land share size and locations not defined Management of reorganized farms follows old state order style	- Establishment of collective enterprises, new dekhkan farms, presidential land owners, sahimdors, and hektarchi
1996	- Presidential Decree No. 522 “On the Reorganization of the Agricultural Enterprises and Organizations”	Reorganization into collective/ corporate farms Distribution of land certificates to all ex-kolkhoz members	Ad-hoc issuance of land use certificates and uneven implementation caused by unclear rules, water availability, enforcement of rights by members, collective farm leaders unwilling to comply and dependence on government authorities	- No significant change
1998–2000	- Presidential Decree No. 1021 of the President of the RT “About Ensuring the Right to Land Plots” - Resolution No. 244 on “Measures for Implementation of the Decree “On Realization of the Right to Land Use”	Farms scheduled for restructuring determined and land use certificates issued within collective enterprises, dekhkan farms, joint ventures, cooperatives, joint-stock companies, associations	Sahim (share)owner, however, is not entitled to make cropping or production decisions Intra-farm and government intervention in farm planning dominates	- In 1998 the Government of the Republic of Tajikistan approves a national action plan for increasing the status and role of women 1998–2005 - In 2000 the country ratified the CEDAW Protocol
2002– ongoing	- Law “On Dekhkan Farms” (replacing the 1992 law)	Establishment of individual farms, family farms, associations and dekhkan farms (partnerships) mardikors, land use owners and tenants, farm mirobs.	Reforms trigger the need for additional workers in areas of marketable vegetables and crops such as rice, onions, and potatoes	- Implementation of the state policy for Ensuring Equal Rights and Opportunities of Men and Women in Tajikistan for 2001–2010 - Law On Reproductive Health and Reproductive Rights (December 2002)

Adapted from: The feminization of agriculture in post-Soviet Tajikistan, Nozilakhon Mukhamedova and Kai Wegerich

Appendix XX- Listing of Government Supported Climate Change Mitigation Efforts

Government strategies, programs, plans and documents	Climate Change Adaptation (CCA)
	- 1st National communication to the UNFCCC (2002) - 2nd National communication to the UNFCCC (2008) - Pilot programme on adaptation to climate change (2010) - National report on human development: Tajikistan-poverty in the context of climate change (2012) - 3rd National communication to the UNFCCC (2014) - National strategy of the Tajikistan on CCA (in development process)
	Climate change mitigation
	- National action plan for climate change mitigation (2003) - Intended Nationally Determined Contributions (INDCs)- Tajikistan (2015)
	Disaster Risk Reduction
	- National action plan (2008) - Statement of common understanding: rapid emergency assessment and coordination team (2008) - Tajikistan: National disaster risk management strategy (2010) - National strategy on the management of hazards risk from 2010 to 2015 (2010)
	Environment/Nature protection and others
	- State program on environmental awareness-raising and education of the population of Tajikistan until 2000 and 2010 (1996) - National action plan for hygiene of the environment (2000) - National action program to combat desertification (2001) - State program on development of forestry and hunting for 2006-2015 (2005) - National action plan for environmental protection (2006) - National development strategy of the Republic of Tajikistan for the period to 2015 (2007) - Complex program on use of the renewable energy sources in Tajikistan for 2007-2015 (2007) - Issues of climate change risks incorporated in third poverty reduction strategy (PRS) 2010-2012 - Living standards improvement strategy for 2013-2015 - National report on implementation of the Aarhus Convention (2013)
Relevant Laws	- Law on nature protection (1994) - Law on atmospheric air protection (1996) - Law of the Republic of Tajikistan on protection of atmosphere (1996) - Law of the Republic of Tajikistan on energy (2000) - Law of the Republic of Tajikistan on transport (2000) - Law of the Republic of Tajikistan on environmental education (2010) - Law of the Republic of Tajikistan on the use of renewable energy sources (2010) - Law of the Republic of Tajikistan on environmental protection (2011) - Law of the Republic of Tajikistan on environmental information (2011) - Law of the Republic of Tajikistan on ecological expertise (2012) - Law of the Republic of Tajikistan on energy saving and energy efficiency (2013)

Adapted from: Climate Vulnerability & Adaptive Capacity of Mountain Societies in Central Asia, Sujata Manandhar, et al.