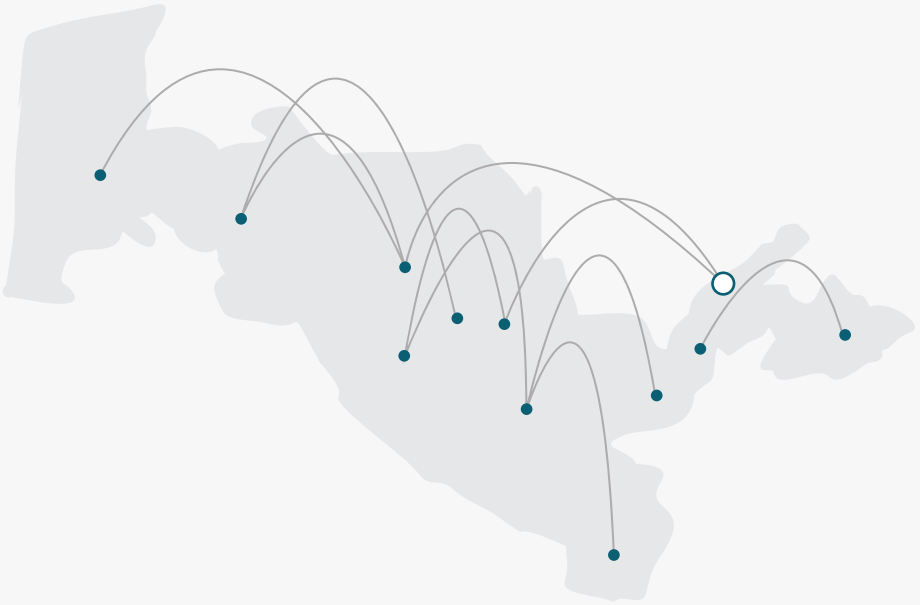
Developing agrometeorological services for climate change resilient production of fruit & vegetables in Uzbekistan

Feasibility study for a project proposal to the Green Climate Fund



Geneva • Tashkent 2019

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Draft feasibility study for a project proposal to the Green Climate Fund

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0. PROJECT IN A NUTSHELL: EXECUTIVE SUMMARY

Agriculture is an important sector of Uzbekistan's economy, providing a fifth of its GDP, employing a up to a quarter of the workforce and serving as a key source of income for half of the population. Uzbekistan's horticultural sector, a source of both rural livelihoods and high-value export, is expanding rapidly, fuelled by growing domestic demand and strong regional markets. The Government is actively supporting its expansion, seeking to transit farmers from traditional cotton and wheat production to higher-value fruit and vegetable crops.

Horticultural production and yields are strongly dependent on weather and climate impacts such as the increasing climate aridity, scarcity of water and the frequency of extreme weather events: droughts, early frosts, showers, sandstorms, cold and warm waves in all parts of Uzbekistan. According to estimates, future long-term losses of yield from climate change for, e. g., apples, tomatoes and potatoes can reach 50% – 60% depending on the region and the GHG emission scenario. Consequently, farmers, larger businesses and other players along the agricultural value chain are increasingly dependent on high-quality, tailored and timely climate and agrometeorological information to optimise their lnd-use and operations and, in the end, sustain their incomes and livelihoods.

Uzbekistan's agrometeorological network has for a long time suffered from underfunding and the lack of modernisation. The core of the network dates back to the Soviet time and can no longer provide modern services to the agricultural community. Furthermore, agrometeorological (and, at large, climate and hydrometeorological) services have traditionally been oriented towards state and regional authorities, with little experience and infrastructure to carry information down to the end users and to integrate with it directly usable agroecological and agrotechnological advice. Similarly, there has been very little experience in the country of translating and using climate-change knowledge to support long-term agricultural planning at all levels: from the central government to small and individual farms. Thus while Uzbekistan strongly promotes expanded horticulture and vegetable growing, it has so far invested little in improving the effectiveness and sustainability of its agrometeorological system. With timely external investment and expertise, not only will improved services help boost local agricultural production, but they will also catalyse institutional and cultural changes across the board, affecting the overall – beyond agrometeorology – climate and hydrometeorological services to people and economic sectors of Uzbekistan.

The project is designed to address the entire supply – demand chain for agrometeorological information: starting from the detailed understanding of user needs; to improving the analytical capacities and services of Uzhydromet as the key providers of climate and hydrometeorological information to be able to deliver to 2.5 million farmers and 3.5 million dehkans households in the project area more relevant, better-targeted and high-quality agrometeorological information and advice accessible through many forms and media; to interventions in 57 rural districts to be equipped with agrometeorological observation infrastructure by integrating the modernization of agrometeorological observation networks with building a functional set-up for a continuous flow of agrometeorological information and advice to support fruit and vegetable production.

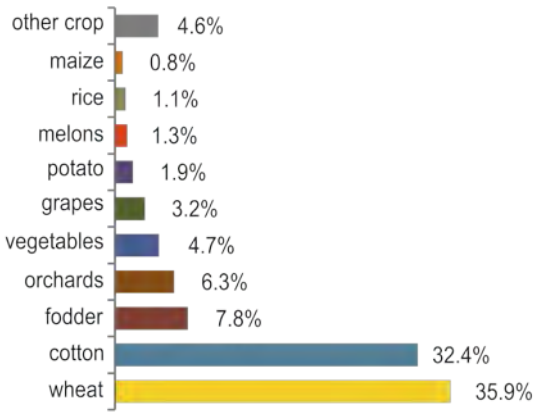
The project will help shift several prevailing paradigms by inverting the traditional supply-focussed approach to providing climate and hydrometeorological information in Uzbekistan and bringing end users to the fore; by introducing long-term climate-change knowledge into Uzbekistan's strategic agricultural planning; and by helping redesign the obsolete business and institutional models of collecting and providing agrometeorological (and eventually, climate and hydrometeorological) information. If successful, the results of the project can be expanded both geographically (to the rest of the country) and thematically beyond agrometeorology and horticulture. The requested GCF USD 10 million funding for the four-year project period will be matched through synergies with other ongoing and planned activities of Uzhydromet and international assistance partners.

1. UZBEKISTAN'S AGRICULTURE, HORTICULTURAL PRODUCTION AND TRADE

Uzbekistan is one of Central Asia's largest and fast developing economies, with GDP of USD 40.3 billion and the population of 32.9 million in 2018[1]. With the drivers of the old growth model exhausted, in 2017 Uzbekistan launched an ambitious program of market-oriented reforms that were unprecedented in the country's modern history. The Government's National Development Strategy for 2017 – 21 aims to transform the country by liberalizing its economy, reshaping the role of the state, modernizing the agriculture sector, strengthening governance, creating markets, including in financial services, enabling private sector growth, investing in human capital, and improving social protection and service delivery for all citizens. The Government has made rapid progress in implementing an impressive number of policy changes in a short period of time by initiating public service, judicial, educational, and tax systems reforms; liberalizing the foreign exchange regime followed by price liberalisation; strengthening the independence of the Central Bank of Uzbekistan; simplifying the visa regime; improving the investment climate and business environment; initiating important reforms in the agricultural sector; scaling up anticorruption efforts; and opening a dialogue between the Government and the citizens of Uzbekistan[2].

Agriculture is an important pillar of Uzbekistan's economy. As in many parts of the world, the majority of poor people live in rural areas, and the sector has a significant impact on rural livelihoods, jobs, and food security, providing livelihoods to half of the population and employing up to a quarter of the workforce[3]. In rural areas the cumulative income of people originating from agriculture exceeds 70%[4]. Although agriculture's contribution to GDP declined from 30% in 2000 to about 17% percent, farm output has doubled in real terms and continues to grow steadily[5]. Uzbekistan being the second largest cotton exporter worldwide, cotton has traditionally dominated the agricultural sector, together with wheat occupying more than 65% of cultivated land in the country (fig. 1.1).

Figure 1.1 The use of irrigated land in Uzbekistan



Source: Centre of Hydrometeorological Service 2016.

The growth of vegetables and fruit, including grapes and nuts, has always been a vital part of Uzbek agriculture, serving both domestic and – increasingly – export demand (table 1.1). Uzbekistan grows a large range of varieties of vegetables and fruit (Figure 1.2), including native species of apples, pears, almonds and pistachios.

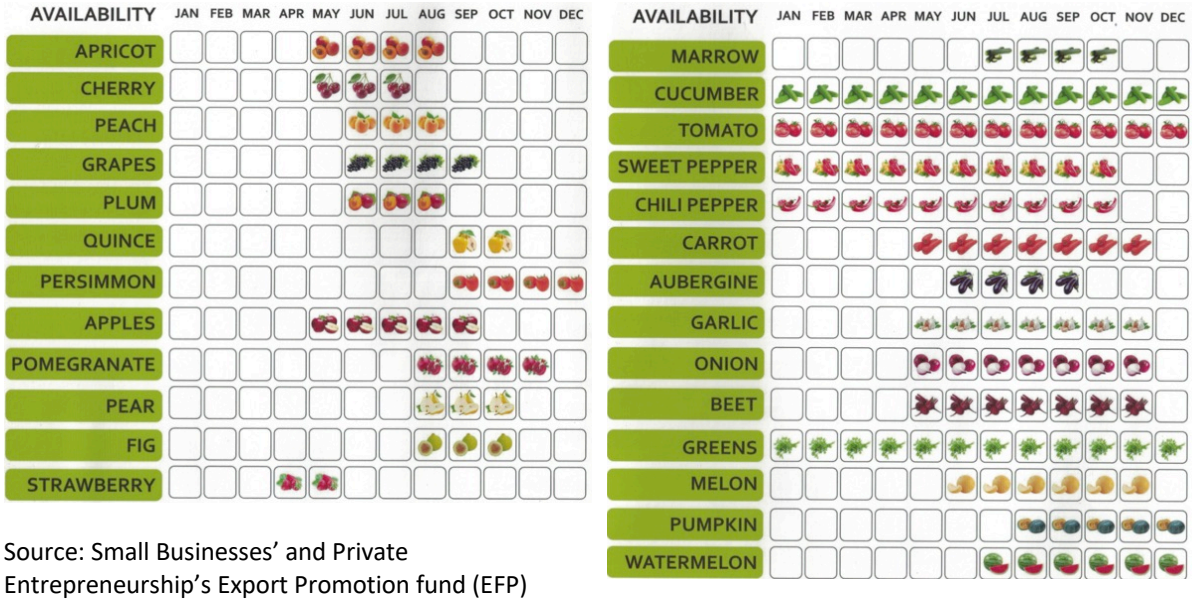
[1] https://www.worldbank.org/en/country/uzbekistan/overview
[2] Ibid.
[3] https://datacatalog.worldbank.org/dataset/world-development-indicators
[4] Centre of Hydrometeorological Service 2016.
[5] World Bank 2014; Larson et al. 2015.

Table 1.1 The use of selected horticultural crops

	Consumed fresh	Processed locally	Exported
Deciduous and stone fruits	69%	20%	11%
Vegetables	81%	4.3%	3.4%
Grapes	73%	23%	4%

Source: ADB 2018

Figure 1.2 Production and seasonality of fruits and vegetables in Uzbekistan



Source: Small Businesses' and Private Entrepreneurship's Export Promotion fund (EFP)

Orchards and vineyards occupy nearly 11% of Uzbekistan's cultivated (mostly, irrigated) land, and further 7% are used for vegetables including potatoes (fig. 1.1). While horticultural crops are widely produced by dehkan farmers[6] for own consumption, the main concentration of more commercial production of fruits and vegetables are in the Fergana Valley, Tashkent and Samarkand oblasts where soil conditions are more suitable and which are also closer to the main consumption centres. Tashkent, Samarkand and Andijan oblasts together produce almost 50% of all vegetables[7].

Most fresh vegetables are grown by private farmers and small household farms and supplied to local markets[8]. There are also larger agrobusiness firms, with both domestic and foreign capital, which grow and supply fruit and vegetables under contract to food processing companies. About 81% of Uzbekistan's vegetable crop is consumed fresh, 11.3 % is processed by the domestic food industry, 4.3% is utilized for seeds, and the remaining 3.4% is exported[9].

[6] A "dehkan farm" is a an individual or family farm in Central Asia.
[7] ADB 2018.
[8] Around 2010, Uzbekistan's horticulture subsector was an important source of income for 4.7 million households that operated dehkan farms in rural and disproportionately poor communities. Horticultural products were also grown on an additional 21 thousand larger private farms (Larson et al. 2015)
[9] ADB 2018.

The production of vegetables and fruits however still falls short of their maximum potential[10] and of targets in some of Uzbekistan's oblasts (provinces)[11], and the plans are to grow it further to meet both domestic and export demand[12]. The Government also encourages households (4.6 million families owning plots of land with the total area of 515,000 hectares) to use their plots to grow vegetables and fruit.

In recent years the Government has provided significant support to horticulture (Box 1.1), focusing on the creation of high-density orchards. Pursuant to orders from the Cabinet of Ministers, seedlings of dwarf and semi-dwarf fruit trees and drip irrigation equipment were imported from Poland, Serbia, Turkey, Ukraine, and other countries. Concurrently, measures were taken to supply seedlings of dwarf and semi-dwarf trees through local nurseries by importing rootstocks. The Government provides a number of benefits and preferences to economic entities involved in the importation and subsequent distribution of seedlings, rootstocks, as well as the necessary equipment. The big stimulus for the horticulture sector has resulted in the significantly increased areas of production already noted[13].

Box 1.1 Selected decrees by the President of the Republic of Uzbekistan on expanding and modernising the production and export of fruit and vegetables

Decree № 2505 of 5 March 2016 by the President of the Republic of Uzbekistan "On measures to further develop the raw material base, expansion in processing of horticulture, meat and dairy products, increasing foodstuffs production and export within 2016-2020".

Decree № 2515 of 7 April 2016 by the President of the Republic of Uzbekistan "On the establishment of specialised foreign trade company 'Uzagroexport' for the export of fresh and processed vegetables and fruit".

Decree № 2517 of 8 April 2016 by the President of the Republic of Uzbekistan "On creation of an association of companies active in storage and processing of horticulture products for export «Uzbekozikovkatzahira»".

Decree № 2520 of 12 April 2016 by the President of the Republic of Uzbekistan "On measures to improve the procurement and use of fruit and vegetables, potatoes and cucurbits".

Decree № 2603 of 19 September 2016 by the President of the Republic of Uzbekistan "On supplementary measures to stimulate the export of fruit and vegetables, grapes and cucurbits".

Decree № 2740 of 24 January 2017 by the President of the Republic of Uzbekistan "On the establishment of a joint-stock commercial bank 'Uzagroeksportbank'".

Decree № 3025 of 1 June 2017 by the President of the Republic of Uzbekistan "On the establishment and activities of the Association of Walnut Producers and Exporters".

Decree № 3281 of 15 September 2017 by the President of the Republic of Uzbekistan "On measures to optimise the placement of agricultural crops and on the forecast of agricultural output in 2018".

[10] Compared to countries with similar climatic conditions, Uzbek productivity is still significantly lower and is yet to realise its full potential (ADB. Horticulture Value Chain Development Project (Additional Financing): Report and Recommendation of the President. Supplementary Document 16: Detailed Sector Assessment: Agriculture, Natural Resources, and Rural Development. Manila, 2018).

[11] https://podrobno.uz/cat/politic/prezident-snova-raskritikoval-chinovnikov-za-plokhuyu-rabotu-/

[12] Meeting with the Ministry of Agriculture, September 2018.

[13] ADB 2018.

Decree № 3893 of 1 August 2018 by the President of the Republic of Uzbekistan "On supplementary measures to optimise the structure of cultivated land, increase the production of fruit, vegetables and other agricultural crops and their export in 2018".

Decree № 3978 of 17 October 2018 by the President of the Republic of Uzbekistan "On supplementary measures to raise the effectiveness of promoting fruit and vegetables on foreign markets".

Source: https://nrm.uz/; http://lex.uz.

Following the introduction of varieties and trees from outside of the country, including the relatively new practice of intensive orchards with a high density of trees, fruit production has undergone a significant upgrading. While there are still a significant number of old varieties and traditional tree spacings in orchards, there are also many new or renovated orchards using the new varieties and intensive production practices. Many of these have yet to achieve full fruiting maturity and it remains to be seen whether they are fully suited to the local environmental conditions and if such style of production can be effectively managed by the technically less adept managers and small farmers[14].

Vegetable crops have received less direct support from the Government as part of the new policy, primarily through the Uzbek Research Institute of Vegetables, Melon Crops and Potato which is the main centre for vegetable seed development and research for vegetable, melon and potato crops. Imported hybrid vegetable seeds bring many benefits in terms of yield improvement and also, in some cases, resistance to pest and diseases, but they are also extremely expensive in comparison to locally selected varieties. For dekhan farms the choice is limited as the amounts of seed they need are small[15].

The Action Strategy in Five Priority Development Areas of the Republic of Uzbekistan in 2017 – 2021[16], defines the modernisation and intensive development of agriculture as an important element of economic development and calls for optimised land-use by gradually replacing water-intensive cotton and cereals with, i.a., potatoes, vegetables, intensive gardens, vineyards and other higher-value crops[17] – as well as for the overall adaptation of agriculture to global climate change. New intensive orchards and vegetable plantations are to be created in particular on 445,000 hectares of arable land in 66 districts and 215,000 hectares of land released from cotton and grain cultivation in 2017 – 2020[18].

Decree № 3893 of 1 August 2018 by the President of the Republic of Uzbekistan introduced 2018 area and outputs targets (Tables 1.2 – 1.3), envisaging 817,000 tonnes of extra output to be produced in areas converted from cotton and wheat, and 266,000 tonnes of fruit, vegetables and other agricultural produces additionally available for export.

[14] Ibid.
[15] Ibid.
[16] Adopted by decree № 4947 of 7 February 2017 by the President of the Republic of Uzbekistan.
[17] Important to note is that land freed from cotton production is not always in a good condition, generally suffering from poor soil structure, lack of soil organic matter, low fertility (years of cotton / wheat cropping) and also soil salinity. Vegetables and fruit crops have need of higher quality soil that is well structured and offers deep rooting potential. Organic matter content should be high and fertility at a significantly higher level than that normally required for either cotton or wheat. Both fruits and vegetables are significantly less tolerant of soil salinity than cotton, and there will be both yield and quality loss if the quality of soils freed up from cotton is not improved and maintained. Soil salinity is also prone to increase in drought-affected areas. Coupled with the changing patterns of pests and diseases likely to follow the changing climate, this will require both higher and more precise inputs of agricultural chemicals into horticulture, backed up by denser, more intense, customised and regular monitoring of soli quality in order to help farmers optimise horticultural production.
[18] https://podrobno.uz/cat/politic/prezident-snova-raskritikoval-chinovnikov-za-plokhuyu-rabotu-/

Table 1.2 Area targets for fruit and vegetable production in 2018
(thousand hectares)

	Vegetables *	New orchards		
		Intensive gardens	Vineyards	Mulberry gardens
Karakalpakstan Republic	5,5	0,1	0,4	0,3
Oblasts:				
Andijan	7,5	0,4	0,4	0,3
Bukhara	7,4	1,4	1,6	0,3
Ferghana	9,7	0,6	0,3	0,3
Jizzakh	4,9	0,4	0,3	0,3
Kashkadarya	11,5	0,4	0,4	0,3
Khorezm	6,2	0,1	0,2	0,3
Namangan	7,8	0,8	0,4	0,3
Navoi	2,8	0,2		0,2
Samarqand	17,0	0,5	0,1	0,3
Surkhandarya	10,7	3,7	0,6	0,2
Syrdarya	4,4	0,3	0,3	0,2
Tashkent	23,3	1,1	1,6	0,4
UZBEKISTAN	**118,6**	**12,1**	**6,6**	**3,7**

Table 1.3 Output targets for fruit and vegetable production in 2018
(thousand tonnes)

	Vegetables *	Fruit	Grapes
Karakalpakstan Republic	110,7	43,4	12,2
Oblasts:			
Andijan	190,2	303,3	36,6
Bukhara	166,0	98,1	79,8
Ferghana	225,0	636,6	19,2
Jizzakh	106,0	81,0	17,8
Kashkadarya	269,5	178,7	103,2
Khorezm	126,5	100,7	12,4
Namangan	187,9	301,3	109,3
Navoi	67,2	50.0	50,2
Samarqand	450,0	364,5	385,2
Surkhandarya	211,7	133,5	146,5
Syrdarya	78,7	37,0	3,8
Tashkent	602,4	320,1	141,6
UZBEKISTAN	**2791,8**	**2648,2**	**1117,8**

*Without potatoes, cucurbits, forage crops.

Source: Decree № 3893 of 1 August 2018 by the President of the Republic of Uzbekistan “On supplementary measures to optimise the structure of cultivated land, increase the production of fruit, vegetables and other agricultural crops and their export in 2018”.

Another trend have also seen a move to extend the cropping season by investment into relatively low-cost plastic greenhouses so that dehkan plots in certain areas have been largely taken up by the greenhouses, with the aim of growing "off season" vegetables to market when prices are high. The demand became so intense that the supply of natural gas for household heating was being put under pressure, and the Government took steps to control the expansion of the greenhouses and the use of gas as a fuel source. This has resulted in greatly reduced expansion, but data still indicate that, between 2009 and 2015, a total of around 11,500 greenhouses were constructed with a total area of 1,400 hectares, including more than 600 modern greenhouses with an area of 585 hectares built using advanced technology of European countries, Korea, Turkey, China and Israel, with a further 10,900 low cost lightweight design greenhouses on an area of around 1,500 hectares on dehkan plots[19].

Due to the expanding area under fruit and vegetables and yields improving over the last 25 years, the output of the sector has steadily grown too (fig. 1.3 – 1.5).

Figure 1.3 **Change in cultivated area** (thousand hectares)

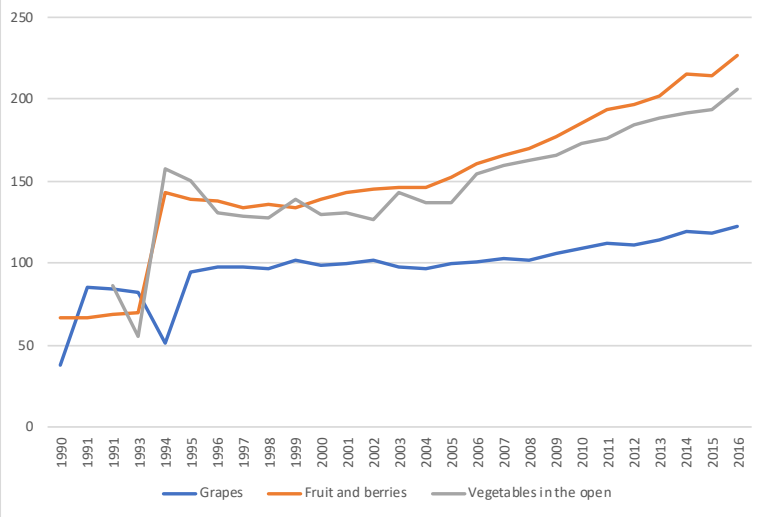
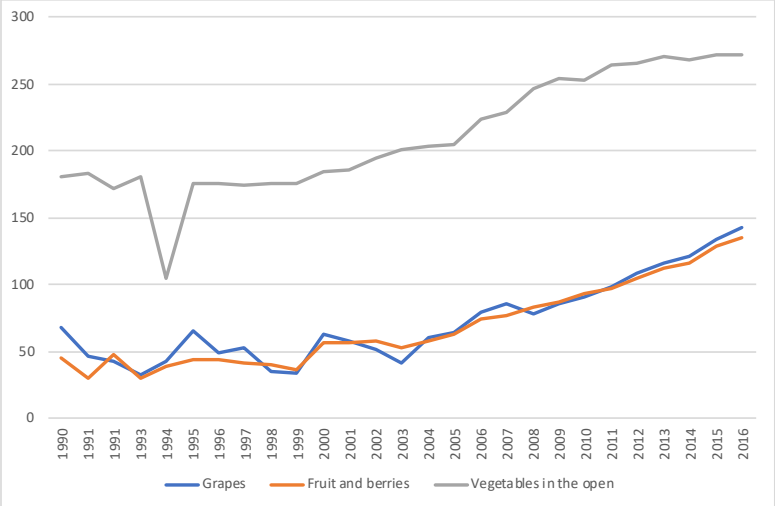
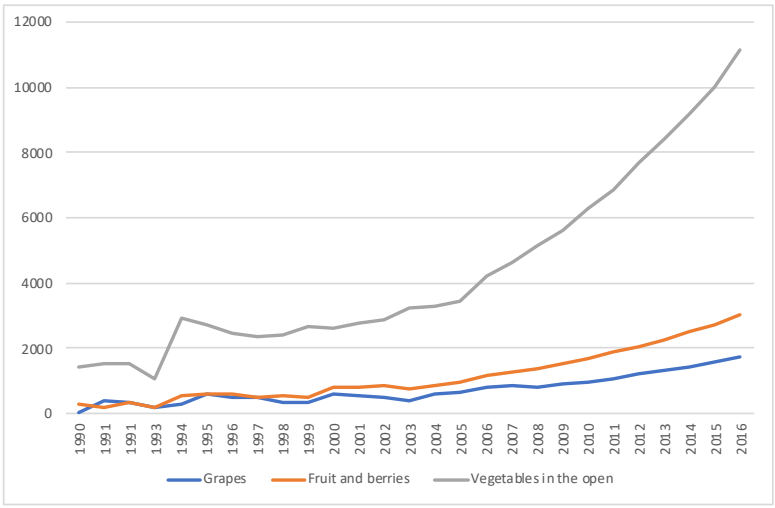


Figure 1.4 **Change in average yield** (100 kilograms per hectare)



[19] Ibid; http://ifc.uz/en/about_uzb/info_3.php.

Figure 1.5 Change in output (thousand tonnes)

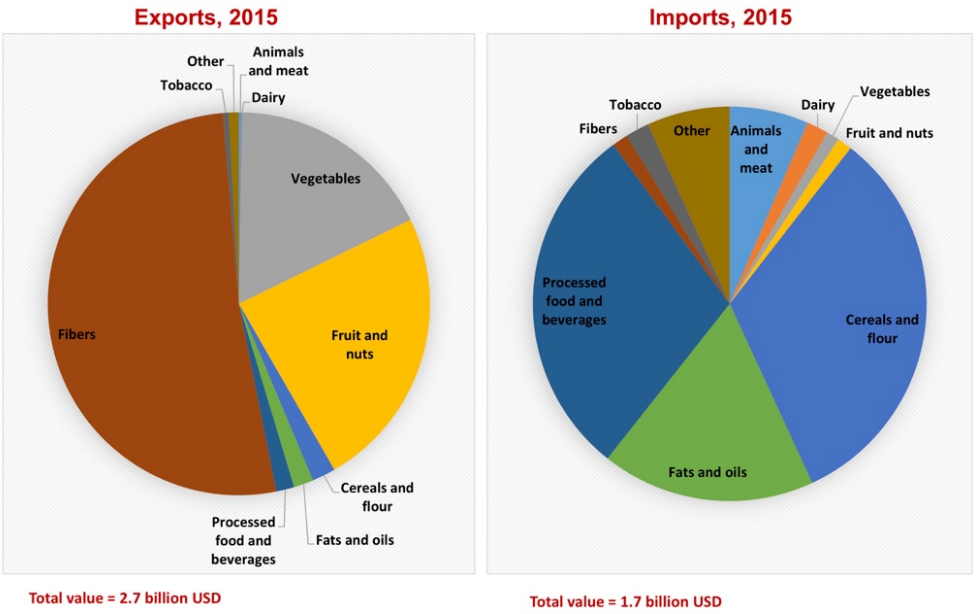


Data: State Committee for Statistics.

Uzbekistan is keen to fully utilise the export potential of its fruits and vegetables, including trade on the existing and new markets in Russia, China and Europe. Currently the export of fruit and vegetables makes about 40% of agricultural exports (Fig. 1.6), with half of this value falling on small and medium-sized enterprises. Uzbek horticultural exports that exhibit competitiveness include cherries, apricots (dry and fresh), plums (fresh), grapes (fresh) and walnuts. Fruit and vegetables are exported to over 70 countries, and markets in China and Russia have large demand for some products (i.e. cherries, plums and grapes) that Uzbekistan strives to meet (Tables 1.4 – 1.5, Box 1.2)[20].

In 2018 Uzbekistan plans to increase the volume of exports of fruits and vegetables to 1.23 million tonnes from 918,085 tonnes in 2017, and export revenues from USD 665.9 million to USD 1 billion[21].

Figure 1.6 Structure of Uzbekistan's agricultural trade



Data: FAO. Source: World Bank 2018.

[20] World Bank 2018.

[21] http://uzagroexport.uz/en/2018/02/28/uzbekistan-intends-to-export-1-2m-tonnes-of-fruits-vegetables-in-2018/

Table 1.4 Central Asian fruit with high export potential to China and Russia *

Kazakhstan	Uzbekistan	Kyrgyzstan	Tajikistan
	Grapes		
	Apricots (fresh)		
	Apricots (dry)		
	Plums and sloes		
	Plums (dry)		
	Watermelons		
	Cherries		
	Walnuts, with shell		
	Grape juice		
Peas (dry)			

TO CHINA →

Kazakhstan**	Uzbekistan	Kyrgyzstan	Tajikistan
Grapes			
Apricots (fresh)			
Apricots (dry)			
Plums (dry)			
Cherries			Cherries
Watermelons			
Plums			
Strawberries			
	Walnuts, with shell		
Peaches			

TO RUSSIA →

* Products for which China and Russia are net importers and Central Asian countries are net exporters (2013 estimate based on FAOSTAT data). Most of Kazakhstan's exports to Russia are re-exports from other countries.

Source: adapted from World Bank 2018.

Table 1.5 Uzbekistan's horticultural export [a]

Product	Uzbek net exports (2012-2017 average) USD	Revealed Comparative Advantage index (2012-2016 average)	Domestic Resource Cost (2017)	Chinese net imports (2015-2017 average) USD	Russian net imports (2015-2017 average) USD
Cherries	44,733,333	172.0	0.20	903,424,257	179,307,051
Apricots (fresh)	20,396,311	109.1	0.17	496,490 [b]	66,240,193
Apricots (dry)	9,594,508	57.1	0.17 [c]	-665,132 [d]	26,998,989
Walnuts	39,208,645	37.5	0.20	25,300,000	18,326,576
Plums (fresh)	10,665,391	28.6	0.41	99,008,118	102,209,431
Grapes	78,195,406	22.1	0.22 (table) 0.65 (wine)	532,000,000	573,936,999
Plums (dried)	11,261,431	7.3	0.41 [c]	7,557,770	50,631,719

a Data: UN Comtrade, mirror trade statistics; World Bank's own calculations

b Net imports of fresh apricots increased from - USD 1.5 million ln 2015 to USD 4.2 million in 2017

c DRCs for fresh fruits are used to approximate the DRCs for the corresponding dry fruits

d Chinese net imports of dry apricots increased from - USD 3.5 million in 2015 to USD 2.6 million in 2017

Source: World Bank 2018.

Box 1.2 Export potential of selected Uzbekistani fruit

Uzbekistan has strong pre-conditions for the production of cherries due to its good climatic conditions, early crop maturing and inexpensive labour. Upgrading cherry production technologies have potential to further boost cherry yields. For example, there are opportunities to further extend the cherry season to allow for larger harvests. Kazakhstan and Russia are the main destination of cherry exports, however, Uzbekistan is also exploring new markets, including recent exports to South Korea. Starting in 2018, Uzbek cherries are also allowed into China (previously held quarantine restrictions have been lifted).

Table grapes are the number one product from the fresh produce category exported from Uzbekistan. Thanks to its climatic conditions, Uzbekistan can export table grapes almost all year round. Their production has been steadily increasing since 2008, primarily driven by improved yields. Key destinations for table grapes exports include Kazakhstan and Russia.

The production of apricots has drastically increased since 2000, reaching over 660,000 million tonnes in 2016 from 68,000 in 2000. In the last 17 years, Uzbekistan has been among the top three world producers of fresh apricots, behind Turkey and Iran. Fresh apricots are mainly exported to Kazakhstan and Russia. Geography of dry apricots is much more diversified – in 2017, Uzbekistan exported them to 26 countries

Similarly to other horticultural products, production of plums has been increasing in recent years. Exports of fresh plums, however, remained rather limited. Exports of prunes saw a sharp increase in 2017, reaching USD 16.9 million comparing to 8 million in 2016 and 2015. Fresh plums are mainly exported to Kazakhstan and Russia. Geography of prunes is much more diversified – in 2017, Uzbekistan exported prunes to 15 countries.

Uzbekistan has a strong potential to increase both production and exports of walnuts. The production of walnuts has been increasing since 2012 due to increases in both area and yields. In 2017 the newly-created Association of Producers and Exporters of Walnuts was allocated additional USD 50 million and 10,000 hectares for new walnut plantations.

Source: World Bank 2018.

Uzagroexport is one of the major players on the agricultural export market, holding 12% of fruit and vegetable trade and entirely covering some of export streams (e.g. for sweet cherries, pomegranates, date plums)[22]. Besides Uzagroexport, the following organizations are involved in horticultural export too[23]:

- Uzagrozahira (Uzbekistan Agricultural Resources Agency);
- Uzmevasanoatholding (Uzbekistan Horticultural and Vegetable Industry Holding Company);
- Uzavtosanoat (Uzbekistan Automobile Industry Company);
- Uztadbirkor (Enterpreneurs Organization under the Ministry of Foreign Trade);
- Large-scale farmers, who can also export directly.

To assist sales by private producers, the Association of Fruit and Vegetable Exporters is expected to be established in the near future too. The governmental responsibilities for overseeing and facilitating

[22] Meeting with Uzagroexport, September 2018; http://uzagroexport.uz/en/category/news/.
[23] ADB 2018

the export of fruit and vegetables have been recently handed over to the Ministry of Foreign Trade which is to look for new buyers, to facilitate entry to new markets, and to support export contracts[24].

National agricultural policies and strategies are formulated and overseen by the Ministry of Agriculture, which has in its structure the Department of Vegetables, Potatoes and Cucurbits and the Department of Gardening and Viticulture[25]. The Ministry's regional branches work in close contact with regional / oblast authorities (Khokimiyats) and supervise district-level agricultural departments, which in their turn directly interact with agricultural enterprises and individual farmers.

The Ministry of Agriculture with its regional departments take major part in strategic decisions about allocating land, its use and crops to be cultivated on it. However unlike with land designated for cotton or cereal production, areas not under requirements to produce cotton have greater independence to choose their own cropping, and subsequently often focus on fruits and vegetables. In these "non-cotton" areas it is common to see vegetables being produced as second crop after winter wheat, with farmers cultivating vegetable, beans and potato or melon crops. Some dehkan farms are the main grape and fruits producers in these areas[26]. Individual horticultural farmers do not own agricultural land, but are able to lend it for 49 years with the possibility of extending the lease and passing it on through heritage rights.

In order to further increase yields[27] and, at the same time, to respond to the already noticeable changes in climate (see Chapter 2), agricultural authorities and producers increasingly turn to new technologies such as drip irrigation and other water-saving techniques, and to the use of new crop varieties, in the search and development of which a major role is played by Uzbekistan's research community (see below). Efforts are also being made to encourage organic agriculture[28] and other modern forms of agricultural production, including adherence to global standards of agricultural product safety, farm assurance and good agricultural practices[29].

The principal agricultural research and development agency is the Uzbek Agricultural Research and Production Centre. Most research is carried out by the Centre's 45 research institutes and research stations, and research laboratories at universities. Research centres also provide advisory services based on extension principles, and assist the national government in formulating agriculture policies. The presence of two CGIAR centres in Tashkent – the International Centre for Agricultural Research in the Dry Areas (ICARDA) and Bioversity International - is an advantage, supporting and promoting research in the framework of the Eco-Regional Collaborative Research Programme for Sustainable Agriculture Development in Central Asia and the Caucasus. The M. Mirzaev`s (formerly, Schröder) Research Institute of Horticulture, Viticulture, with 17 subsidiary research centres located in the regions, is the main centre for research and development of tree and other fruit crops (including nuts) as well as grapes. The Uzbek Research Institute of Vegetables, Melon Crops and Potato is the main centre for vegetable seed development and research for vegetable, melon and potato crops[30].

Agricultural advisory and consultative services are provided primarily by governmental institutions, coordinated by the Ministry of Agriculture, which also provides advice and recommendations for

[24] https://podrobno.uz/cat/economic/zelenaya-revol/
[25] http://www.agro.uz/ru/about/ministry/
[26] ADB 2018.
[27] Which are still well below those in other countries with similar climate: e.g., potatoes in Turkey under irrigated conditions (as per Uzbekistan) would be achieving 30 – 32 tonnes / hectare on average, while apples would be around 40 tonnes /hectare compared to Uzbekistan's average 15–25 tonnes /hectare (Ibid).
[28] Meetings with the Ministry of Agriculture and M. Mirzayev (Schröder) Research Institute of Gardening, Viticulture and Winemaking, September 2018; Nurbekov et al. 2018.
[29] E.g., GLOBALG.A.P. https://www.globalgap.org/
[30] ADB 2018.

farmers on its website[31]. An overall positive development is the increase in online advice for farmers. For instance, Tashkent State Agrarian University hosts two informational portals that are linked to Information and Consultation Centres of the university. The websites[32] compile scientific research, contact information for agricultural and other organisations, recommendations for farmers and events announcements.

Extension service providers include councils of farmers, agro-firms, water users' associations, vocational and research institutes and others[33]. In parallel, several international development organisations arrange training for farmers, usually led by local experts. Yet despite the range of services and training courses, farmers' needs are still not met, and there is particularly high demand for extension services among farmers who produce fruit and vegetables (in contrast to those who are involved in the production of state-ordered crops who have fewer incentives to adapt new practices and technologies)[34] . At present, for the farmers involved in fruits and vegetables production, only informal extension services are available in practice, primarily provided through the international input suppliers (e.g. Syngenta, Agrico, Enza Zaden, etc.) or in conjunction with foreign aid programs[35]. This support is generally well received and in high demand, but is not coordinated and therefore is less effective in having a sustained impact. There is a significant need for capacity development of practically trained horticulturalists who have experience of modern practices and methods and who can provide real practical management support and technical advice to developing agrobusinesses that are starting to invest in the horticulture sector[36].

Thus the development of agricultural extension services in Uzbekistan is becoming a matter of national importance, particularly in respect of the stated aim of significant development for the horticultural sector and high-quality exports. The new Agri-food development strategy 2019 to 2030 puts particular emphasis on the dissemination of agricultural knowledge and innovations, as well as relevant business related information by the establishment of adequate infrastructure and the development of an effective and pluralistic advisory / extension services network, in which sufficient public and private resources are allocated to support its development[37]. Consequently, the Ministry of Agriculture has developed a road map for coordinating foreign assistance to help roll out the system of extension centres in Uzbekistan's regions throughout 2019 – 2020[38] .

[31] http://www.agro.uz/ru/services/recommendations/.
[32] http://www.agrowebcee.net/awuz/home/ (in Russian and English); http://www.agriculture.uz (in Uzbek, Russian and English).
[33] Kazbekov and Qureshi 2011.
[34] Ibid.
[35] ADB 2018.
[36] Ibid.
[37] [Government of Uzbekistan] 2019.
[38] Ўзбекистон Ркспубликаси Қишлок хўжалиги вазири 2019.

2. CLIMATE CHANGE AND IMPACTS ON UZBEKISTAN'S AGRICULTURE

As it is in the rest of Central Asia, climate change is evident in Uzbekistan, where average annual temperature has been increasing since 1950s by 0.27°C every 10 years (Fig. 2.1), higher than average global rate. In 2007 – 2016 mean annual temperature was 0.6 – 2°C higher than in 1961 – 1990.

Figure 2.1 Mean annual air temperature in Tashkent: 1887 – 2016

Source: Uzhydromet.

Precipitation has gradually decreased throughout 1950 – 2013, with the strongest changes observed in the south of Uzbekistan. Heat waves have been registered in all parts of the country, with the highest growing numbers of affected days in the delta of the Amu Darya[39]. Throughout 2011 – 2016 droughts of heat waves were registered every year[40].

The impact of a changing climate on Uzbekistan's agriculture, including on the production of fruit and vegetables, is well documented. Specific impacts are manifested through short-term or long-lasting severe weather (frost, warm / cold winters, heat waves, persistent droughts) as well as through more fundamental shifts of seasons, phenology, productivity, and agroecological conditions. Reduced water availability and drought have underscored these risks, as has the presence of agricultural pests that may not have previously been found in Uzbekistan[41].

Considerable increase in number of days per year with such temperature above 35°C, harmful to agricultural crops, has been observed in Uzbekistan during the last 70 years. Today the number of such days per year is on average about 80 in the south, 60 in the north and more than 40 in the central and the piedmont areas (Fig. 2.2). Compared to 1950s, the growing season currently starts earlier and ends later, its duration increasing by 3 days every 10 years (Fig. 2.3). The sums of effective temperatures[42] above 5°C, 10°C and 15°C have been increasing too, respectively, by 68°C, 53°C and 38°C every 10 years. As a result, in 1994 – 2013 the sums of effective temperatures above 5°C and 15°C have been 4-6% higher than in 1980 – 1999 (Fig. 2.4)[43].

[39] Centre of Hydrometeorological Service 2016.
[40] FAO et al. 2018.
[41] Ibid; Sutton et al. 2013
[42] The notion related to though different in detail from the concept of "degree-days".
[43] Centre of Hydrometeorological Service 2016.

Figure 2.2 Change in the number of days with air temperature above 35°C

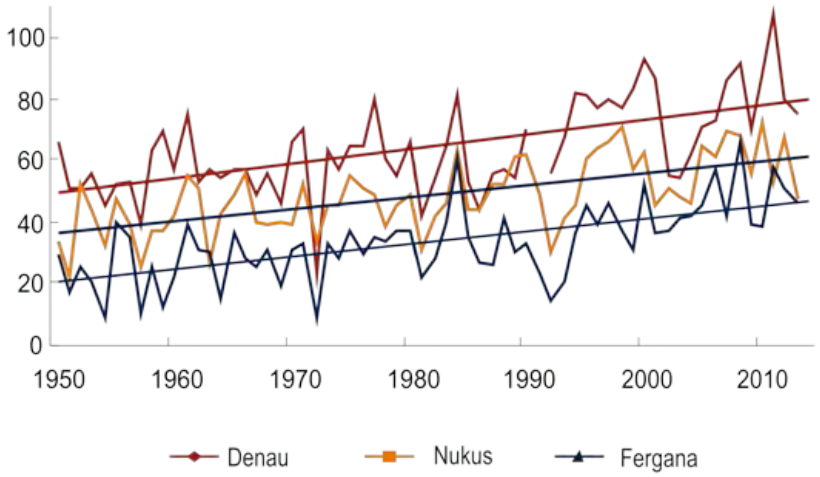


Figure 2.3 Change in the duration of the growing season

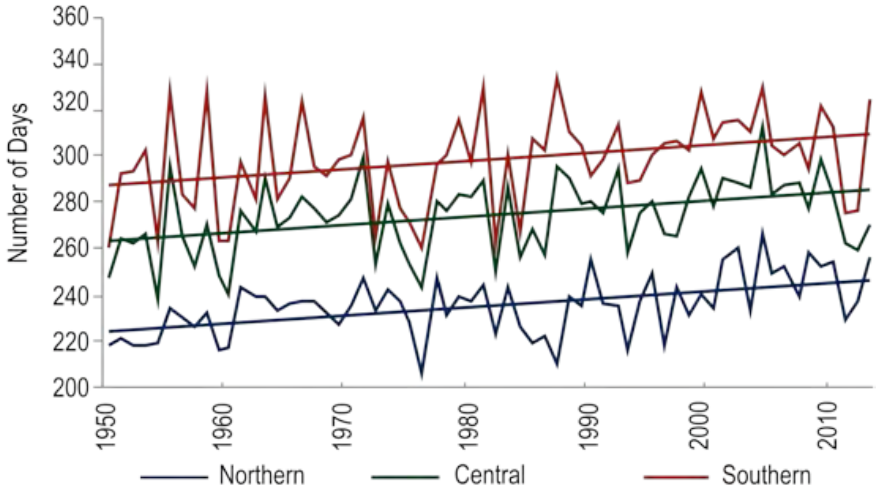
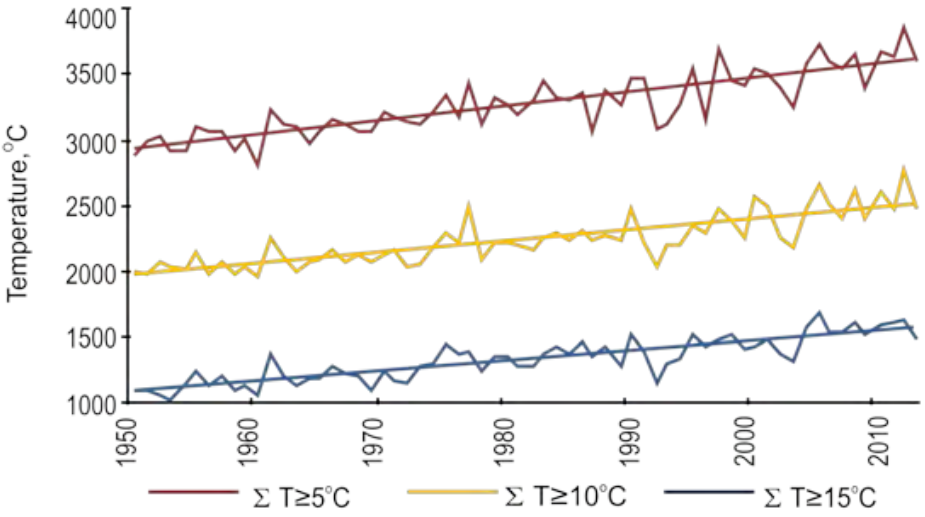


Figure 2.4 Change in the sums of effective temperatures in northern Uzbekistan



Source: Centre of Hydrometeorological Service 2016.

Table 2.1 Damage to fruit and vegetables from extreme weather events in 2005 – 2016

	KAR	AND	BUK	FER	JIZ	KAS	KHO	NAM	NAV	SAM	SUR	SYR	TAS
2005													
March-April, snow and frost: blooming trees, grapes, mulberries 20-30% to 60-100%	•	•	•		•	•	•	•	•	•	•	•	•
2006													
February-March, frost: buds of apricots / almonds 20-30%, cherries / peaches 10-15%						•					•		
April, frost: leaves of grapes and mulberries up to 70%						•							
April-May, hail (13-14 mm): general damage, leaves / flowers on fruit trees 80-100%				•							•		
2007													
March-April, excessive precipitation (140 mm): buds / flowers on fruit trees up to 50%												•	
April, hail (20-50 mm): 1500 ha under fruit, 183 ha under cucurbits and vegetables									•				
October, frost (-1…-6°C: unharvested vegetables 40-60%	•				•					•		•	•
2008													
January, frost (-26…-30°C): buds of peaches, grapes, mulberries 25-60%	•	•	•			•	•		•	•		•	•
January, frost (-1…-2°C): grape ovaries and leaves 20-30%	•											•	•
May, hail (20-50 mm): fruit, grapes, cucurbits, vegetables 20- 70%					•					•		•	•
October, frost (0…-5°C: unharvested vegetables 10-90%			•		•				•	•			•
2009													
March, frost (-1…-4°C): buds, flowers of apricots, almonds, cherry plums 15-30%		•					•	•	•	•			
April, frost (-1…-4°C): buds, leaves, ovaries of fruit trees 20-70%, grapes, mulberries	•					•	•						•
April-May, hail (4-30 mm): fruit to 40%, grapes, vegetables		•			•	•			•				
2010													
March, frost (-1…-4°C): fruit trees to 40-70%, mulberries to 20%, potatoes 15-100%												•	•
April, hail (10-40 mm): fruits and leaves to 100%					•								
May, heavy rain (93 mm): fruit trees 10-15%													•
June, strong wind (19 m/sec): fruit trees 10-15%													•
2011													
Febr-April, frost (-1…-7°C): buds, flowers of apricots, cherry plums, almonds 10-70%	•		•			•	•				•		•
April, heavy rain (15-28 mm in 24 hours): fruit ovaries cast	•						•						
May, hail (5-10 mm): fruits, leaves of fruit trees, grapes (to 10%), vegetables						•				•			
May, heavy rain (16-35 mm in 24 hours): fruit cast						•		•			•		•

	KAR	AND	BUK	FER	JIZ	KAS	KHO	NAM	NAV	SAM	SUR	SYR	TAS
2012													
Mar, frost (0…-3°C) and snow: buds of apricots, almonds 10-20%						•					•		
Jun, heavy rain (15-28 mm in 24 hours) and hail (3-5 mm): grape leaves													•
2013													
Mar, frost (-2…-14°C): fruit buds and flowers 5-30%, grapes and mulberries to 10-15%		•	•	•	•	•		•	•	•	•	•	•
Apr-May, rain and hail: fruits and leaves of fruit trees, grape ovaries (to 20%)					•			•					
Apr, Jun, strong wind (to 28 m/sec): fruits, leaves, branches of mulberries, grapes 5-20%					•	•							•
2014													
Mar-Apr, heavy rain (24-30 mm in 24 hours) and hail (4-12 mm): flowers of blooming almonds and apricots up to 20-90%, cherry plums to 20%					•								
Apr, frost (0…-2°C): flowers of blooming almonds, apricots, peaches up to 20%													•
May, heavy rain (16-46 mm in 24 hours): fruits and branches of fruit trees					•	•					•		•
2015													
Feb, rain and snow (15-13 mm in 24 hours): fruit buds 10-20%						•							
Mar, frost: fruit, grapes, mulberries, almonds 10-90%, vegetables to 85-90%, potatoes 30-45%		•	•	•	•	•	•	•	•	•		•	•
Apr, heavy rain and strong wind: fruit cast, fruit and grape flowers, leaves, branches 20-30%	•				•					•			•
June, strong wind (15-20 m/sec): fruit cast, leaves and branches 15-20%		•											
2016													
Feb, frost (-3…-7°C), rain and snow: fruit buds 10-25%						•							
Apr, heavy rain, hail (2-15 mm): fruit leaves, flowers, ovaries 5%, grape leaves, flowers 25-60%					•								•
May, rain and strong wind (15-20 m/sec): fruit cast, branches to 10%	•	•	•	•	•	•	•	•	•	•	•	•	•
2017													
Apr, hail (10 mm): cast of fruit leaves, buds, flowers, ovaries to 3%								•					
Jun, heavy rain and hail (12 mm): cast of fruit leaves, fruits / berries to 25%								•					

Data: Uzhydromet / Ministry of Emergencies. Percent figures typically show damage per average sample / tree / bush in the assessed area.

KAR – Republic of Karakalpakstan
AND – Andijan oblast
BUK – Bukhara oblast
FER – Ferghana oblast
JIZ – Jizzakh oblast
KAS – Kashkadarya oblast
KHO – Khorezm oblast
NAM – Namangan oblast
NAV – Navoi oblast
SAM – Samarqand oblast
SUR – Surkhandarya oblast
SYR – Syrdarya oblast
TAS – Tashkent oblast

During the last two decades, Uzbekistan has experienced several periods of drought, during which the affected areas lost 50% to 75% of agricultural harvest. During the 2000 – 2001 droughts the harvest of cereals dropped by 10%, cotton by 17% and rice by 60%, with the total loss of USD 40 to 130 million according to different estimates[44]. According to polls among farmers, 94% of them have experienced drought-related damage[45].

Like with high temperatures, also cold waves have caused significant damage, in particular to horticulture. During the famous wave of November 1954, when the temperature dropped from 6°C to -20°C over two days, fruit trees died over most of the country. In recent years, 15 – 30% yield losses have resulted from night frost and early flowering of fruit trees followed by snowfall. Records of damage to fruit and vegetable plantations from extreme weather during the last decade (Table 2.1) indicate that the largest number of cases has been registered in the Tashkent, the Jizzakh and the Kashkadarya oblasts, which reflects regional variations in the overall vulnerability to climate change (Fig. 2.5 – 2.6) as well as the prevalence of horticulture in particular regions (see Chapter 1).

Figure 2.5 Impacts of climate change in Uzbekistan

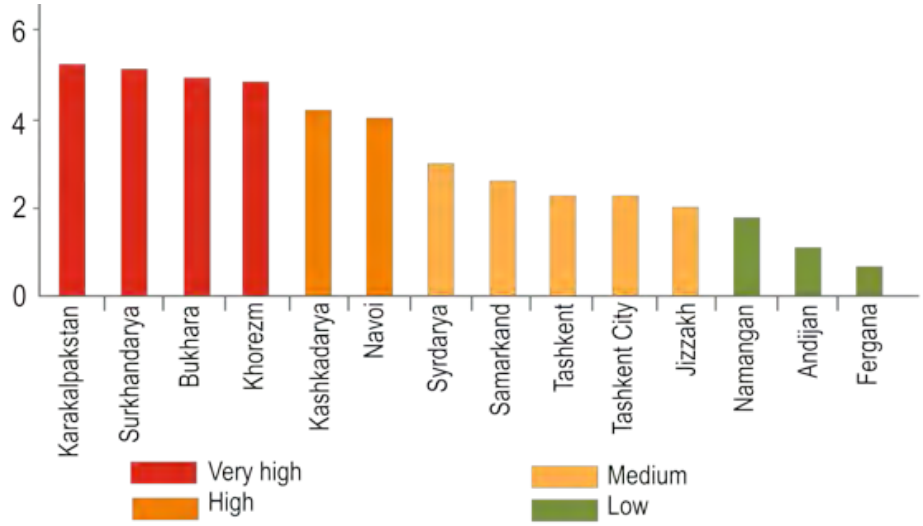
Impacts of climate change

- Rivers with intense water use and increased stress from climatic and hydrological changes
- Densely populated and agriculturally important areas with increased environmental stress and projected impacts of climate change
- Impact of regional climate change and dust storms due to shrinkage of the Aral Sea
- Reduction of ice cover and risk of glacial lakes outburst floods
- Increased risk of climate-related hazards in the mountains and impacts on populated areas and infrastructure

Source: Zoï Environment Network 2015.

[44] FAO 2017.
[45] Uzhydromet.

Figure 2.6 Vulnerability of Uzbekistan's regions to climate change

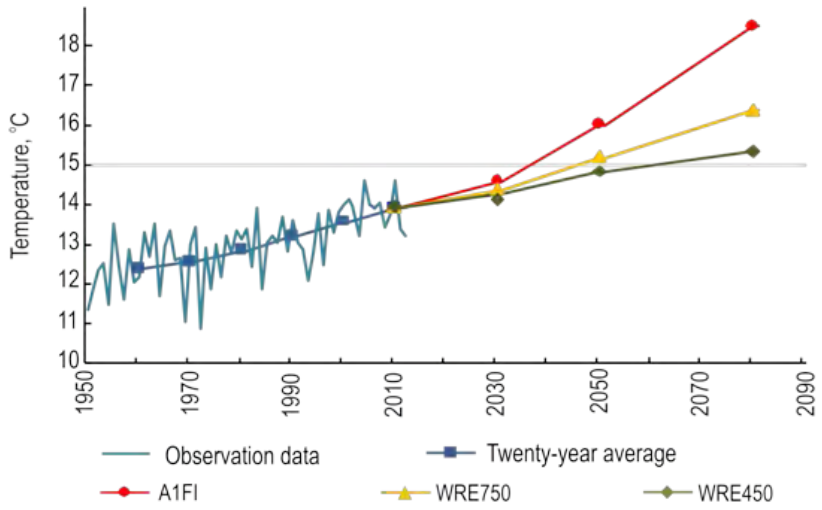


Data and production: Царев, Меркушкин 2016

Source: Centre of Hydrometeorological Service 2016.

Uzbekistan's climate projections with the range of global GHG emission scenarios roughly corresponding to RCP2.6, RCP6 and RCP8.5 Representative Concentration Pathways[46] indicate that the growth of average air temperature will continue (Fig. 2.7) and by 2030 may reach 1 – 1.4°C. The frequency of heat and cold waves is also to increase. Under the soft scenario, the number of days with high temperature will grow by 2050 by the factor of 1.5 – 2 compared to the base period. The temperature variability is expected to increase too, which will affect the start, the end and the duration of the growing season as well as growing conditions.

Figure 2.7 Projected increase of the annual air temperature



Source: Centre of Hydrometeorological Service 2016.

[46] IPCC 2014.

Similarly, these scenarios point to lower precipitation to be expected in the future. Even the soft GHG emission scenario by 2050 may lead to a 17% increase in water deficit, while under the extreme scenario it can reach 30%[47].

Research by the World Bank confirms that, as a result of climate change, temperature will continue to grow. It however projects that precipitation on average is likely to increase, but will become more variable, However climate change will worsen current competition over water resources because irrigation water demands will increase with higher temperature[48].

Figure 2.8 Projected distribution of the sums of effective temperatures above 10°C

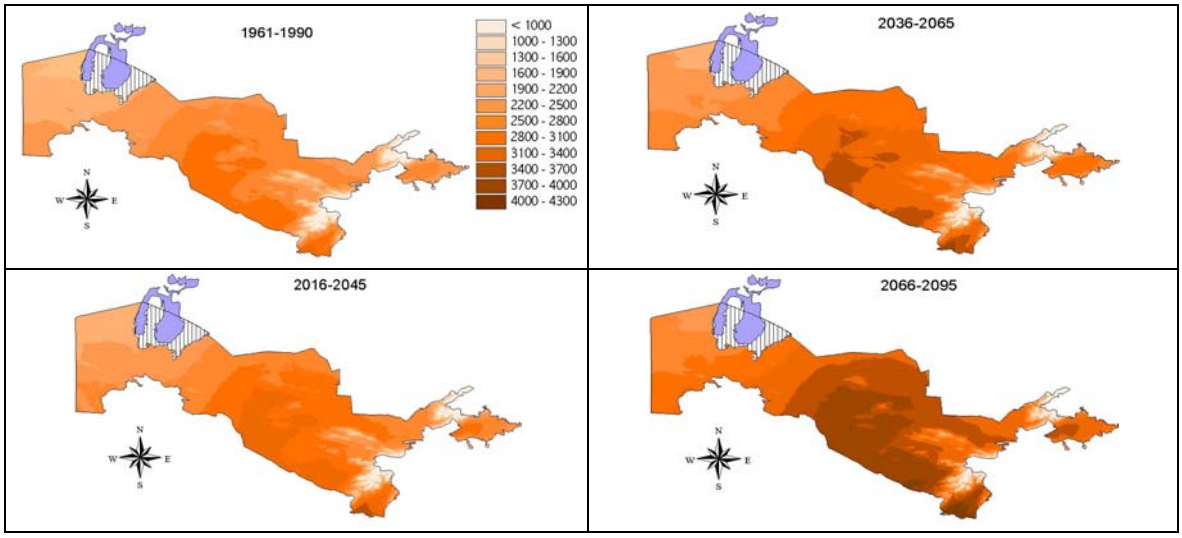
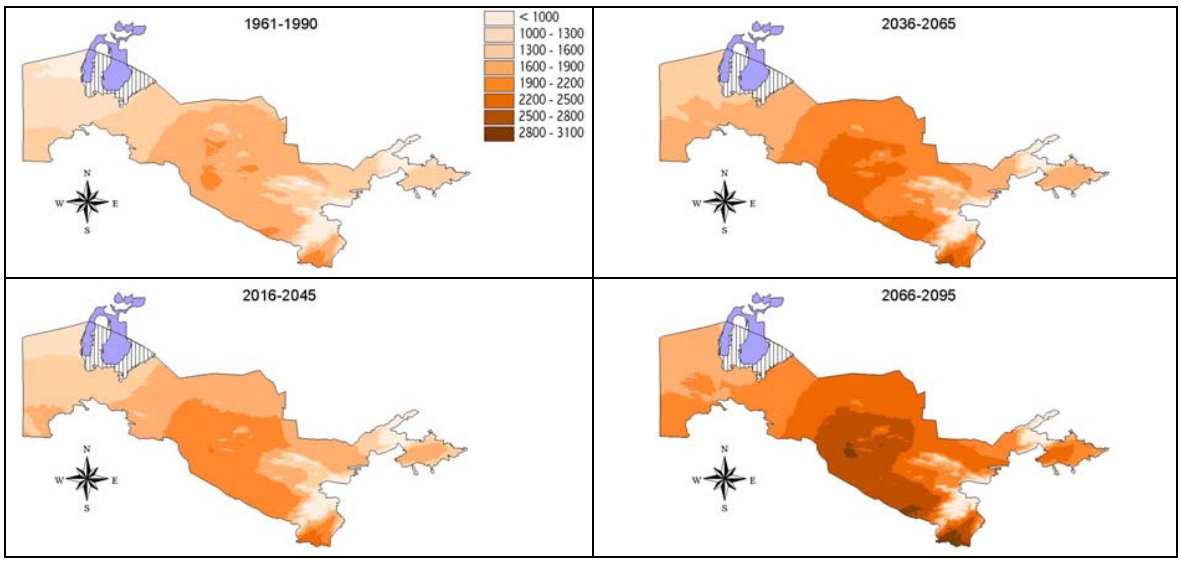


Figure 2.9 Projected distribution of the sums of effective temperatures above 15°C

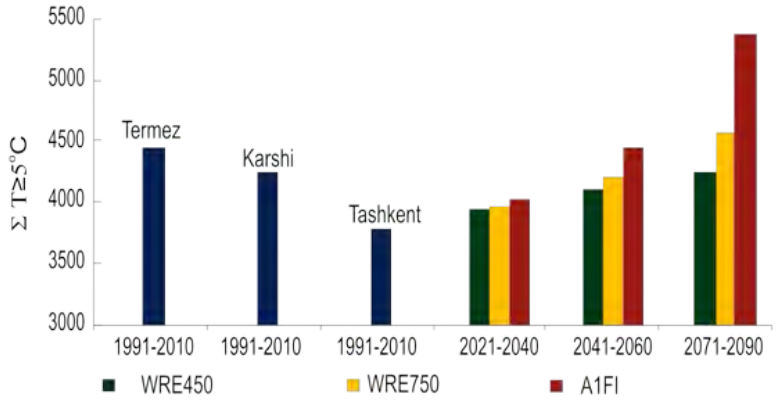


Data and production: Спектрман, Петрова 2007. Global GHG emission scenario: IPCC SRES A2.
Source: Чуб 2007.

[47] Centre of Hydrometeorological Service 2016.
[48] Sutton et al. 2013.

The current spatial distribution of the availability of heat during the growing season will change too: with time, the Tashkent oblast can gradually reach the conditions of the Kashkadarya and later of the Surkhandarya oblasts, while conditions in mountainous areas will come close to those currently typical of Uzbekistan's plainland (Fig. 2.8 – 2.9). By 2021 – 2040 the increase of the sum of effective temperatures is expected to exceed their natural variability by the factor of 1.5 – 2. Under the extreme GHG emission scenario, by 2050 the sum of effective temperatures above 5°C may increase by 21% (Fig. 2.10)[49], and above 15°C – by 34% compared to the base period.

Figure 2.10 Past and projected sums of effective temperatures above 5°C in southern Uzbekistan



* Past data: Termez, Karshi, Tashkent meteorological stations. Projections: Tashkent meteorological station.
Source: Centre of Hydrometeorological Service 2016.

Table 2.2 Number of days per year with air temperature above 39°C

Regions	1980 – 1999	2021 – 2040 projec-tion	2041-2060 projections*			2071-2090 projections*		
			Soft	*Mode-rate*	*Extreme*	*Soft*	*Mode-rate*	*Extreme*
Ferghana valley	3	5-7	9	12	17	14	20	34
Central piedmont	7	14-17	18	21	27	22	29	43
Lower Amudarya, Karakalpakstan	10	16-18	19	22	26	22	28	41
Khorezm oblast	10	19-21	22	25	29	25	32	45
Kashkadarya river valley	17	25-27	29	31	37	32	39	54
Surkhandarya river valley	25	33-25	35	39	45	40	49	62
Kyzylkum desert	29	36-38	39	42	46	42	50	64

* Soft scenario WRE 450, moderate scenario WRE 750, extreme scenario SRES A1FI.
Source: adapted from Centre of Hydrometeorological Service 2016.

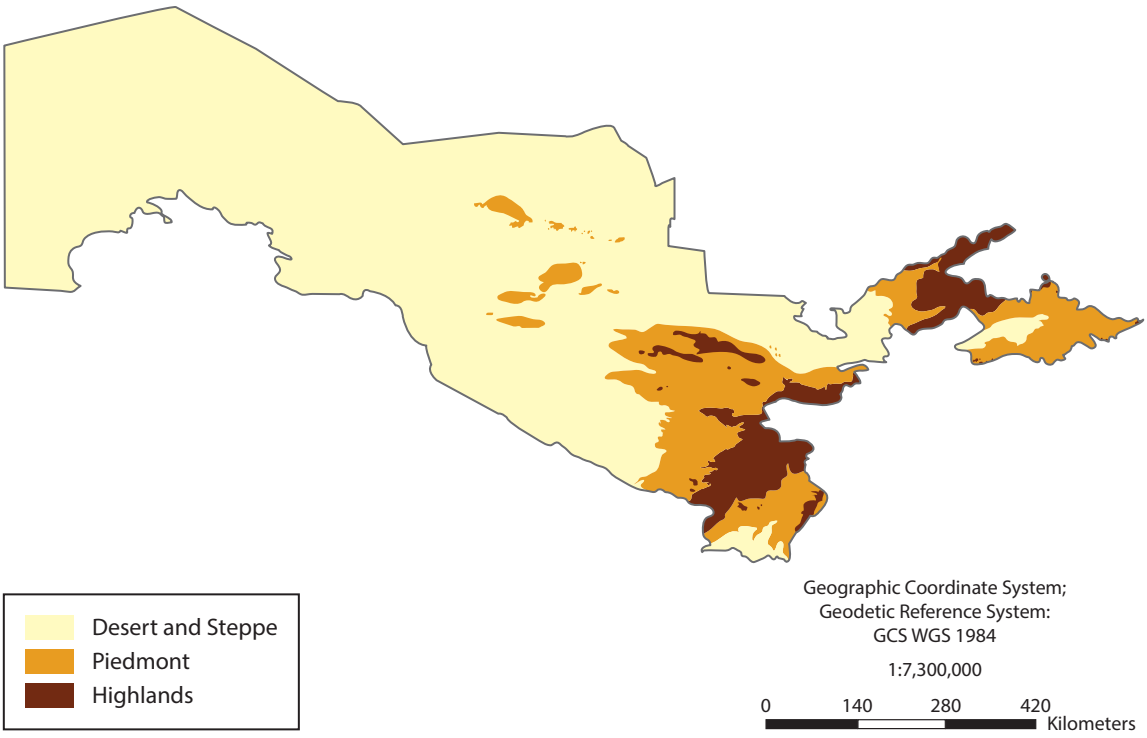
[49] Centre of Hydrometeorological Service 2016.

Climate modelling further suggests the steady and significant increase in the number of days with air temperature above 39°C, which is the least favourable for plant development: up to 2 to 10 times by 2071 – 2090 compared to 1980 – 1999 (Table 2.2), that is from 3 – 7 to 14 – 43 days in the Ferghana valley and the central piedmont areas; from 10 to 20 – 45 days in the lower Amudarya, Karakaplakstan and the Khorezm oblast; from 17 to 32 – 54 days in the Kashkadarya valley; and from 25 – 29 to 40 – 64 days in the Kyzylkum desert and the Surkhandarya valley. Already by 2030 in many regions, especially in the south of Uzbekistan, climate conditions may reach critical level for the currently grown crops, which will experience thermal stress from extremely high temperatures exacerbated by the increasing moisture deficit.

One can also expect the gradual shifting, towards earlier parts of the spring and later parts of the autumn, of dates when average daily air temperature passes 5°C, 10°C and 15°C. However, within Uzbekistan's plainland up to 2041 – 2060, the length of the growing season may stay within the range of its current natural variability. Overall the soft scenario suggests that the current conditions will not change up to 2071 – 2090, however already under the moderate scenario by 2050s the change in the duration of the growing season will exceed its current variability.

Moisture deficit (the difference between evaporation / evapotranspiration and precipitation) is expected to increase throughout the country under all GHG emission scenarios, and a 11-14% increase is expected against the base period by 2021 – 2040. By 2041 – 2060, it is expected to stay within 17% according to the soft scenario, but may exceed 30% under the extreme scenario, pointing to the likely aridisation of climate. (These projections probably overestimate moisture deficit on irrigated lands.)[50]

Figure 2.11 Agroecological zones of Uzbekistan



Data and production: Industrial Economics. Reuse allowed via Creative Commons Attribution 3.0 Unported license (CC BY 3.0). Agroecological zones: CGIAR.

Source: Sutton et al. 2013.

[50] Centre of Hydrometeorological Service 2016.

Even without climate change, increases in non-agricultural demands for water will cause shortages in the next decades. With climate change, certain areas, particularly basins in the western part of the country, will face severe water shortages. In agriculture too the increasing moisture deficit will lead to increased demand for irrigation, while the actual shortage of water may cause water stress among crops and therefore decrease yield. Three climate change stressors will thus combine to yield an overall negative impact on crop yields throughout Uzbekistan: the direct effect of temperature and precipitation changes on crops; the increased irrigation demand required to maintain even reduced yields; and the decline in water supply associated with higher evaporation and lower rainfall.

Modelling suggests that, under the medium-impact GHG emission scenario used by the World Bank (SRES B1), the direct effect of climate changes – not considering water availability – will be a reduction by 2050 in yields of irrigated crops, including cotton, wheat, apples, tomatoes, and potatoes, by about 1 – 13% across all agroecological zones of Uzbekistan (Fig. 2.11). By 2050 climate change can also improve yields of grasslands (by 12 – 43%) and alfalfa provided that sufficient irrigation water is available. However water shortages could severely limit the availability irrigation water: when their effects are taken into account, climate change has a much greater negative effect on almost all crops in almost all river basins, with yield reduction of 10 – 25% through 2050[51].

Table 2.3 Ranges of projected yield decrease through 2040s across three climate scenarios without effects of reduced water availability

Crop	Eastern desert and steppe	Western desert and steppe	Southern highlands	Eastern piedmont	Southwestern piedmont
Apples	4 – 22%	6 – 14%	2 – 19%	-2* – 24%	3 – 19%
Potatoes	2 – 10%	5 – 11%	3 – 13%	-2* – 12%	1 – 11%
Tomatoes	0 – 16%	4 – 12%	0%	0 – 10%	-4* – 15%

* negative decrease corresponds to yield growth.

Source: adapted from Sutton et al. 2013.

Table 2.4 Ranges of projected yield decrease through 2040s across three climate scenarios including effects of reduced water availability

Crop	Eastern desert and steppe	Western desert and steppe	Southern highlands	Eastern piedmont	Southwestern piedmont
Apples	12 – 49%	22 – 39%	19 – 43%	0 – 63%	20 – 42%
Potatoes	10 – 41%	21 – 37%	20 – 38%	0 – 57%	19 – 37%
Tomatoes	8 – 45%	21 – 38%	18 – 29%	2 – 56%	14 – 40%

Source: adapted from Sutton et al. 2013.

For fruit and vegetables included in the World Bank's study (apples, potatoes and tomatoes), even assuming no shortage of irrigation water, yields are forecast to decline about 1% – 9% under the

[51] Sutton et al. 2013.

medium scenario. Under the high-impact SRES A1B scenario[52] which forecasts higher temperature, lower precipitation and soil moisture in virtually all regions of Uzbekistan, yields could be reduced much more severely: to 15% across all agroecological zones (except for no change for tomatoes in the Southern highlands, but up to 24% for apples in the Eastern piedmont; Tables 2.3 – 2.4). If the availability of irrigation water is taken into account, yield losses expected under the high-impact scenario is even is 2.5 – 4 higher: up to 35 – 45% in most agroecological zones and up to 56 – 64% in the Eastern piedmont[53].

As is recognised by the Government (Box 2.1), the projected impacts will require revisions and corrections to the current cropping and cultivation patterns and technologies in order to minimise risks and to get maximum benefits from the change and to avoid severe consequences for vulnerable groups of population which are dependent on agriculture for their livelihoods. They are similarly needed to maintain food security and the economic potential of Uzbekistan's high-value horticulture. However a detailed planning of adapting Uzbekistan's horticulture - and agriculture at large – is yet to commence, and improved agrometeorological information has its role to play to effectively guide and support it.

Box 2.1 Extract from Uzbekistan's Intended Nationally Determined Contribution to combatting global climate change

The global climate change is recognized as an unquestionable fact, and changes in the Earth climate system, observed from the 1950s, are unprecedented. A considerable warming of the atmosphere and ocean has occurred, world snow and ice storage has decreased, and average global sea level has increased. The main reason for climate change is the anthropogenic increase in greenhouse gases (GHGs) concentration in the Earth surface layer of atmosphere. The analysis of observation data collected under the World Meteorological Organization's Global Atmospheric Watch Program shows that the averaged carbon dioxide and other greenhouse gases concentrations in atmosphere reaches their new maximum each year.

Uzbekistan is one of the countries most vulnerable to climate change. Without additional resource saving measures, the country may face deficiency of water resources, growth in land desertification and degradation, increase in occurrence of droughts and other dangerous phenomena, leading to instability of agricultural production and threatening to the country's food security.

…

Adaptation to climate change is the priority direction in Uzbekistan's activities aimed at decrease in vulnerability and ensuring the country's sustainability to climate change. Adaptation measures cover a wide scope of actions for protecting the communities from adverse impacts of climate change such as extreme droughts and dangerous hydrometeorological phenomena, associated with the global change in air temperature; increasing the sustainability of strategic infrastructure and ecosystems for conservation of agro- and biodiversity; diminishing harmful impact of the Aral Sea disaster on the environment and life of millions of people living in Priaralie, through, inter alia, implementation of well conceived targeted projects and programs supported by proper financing sources. This will require substantial assistance from the United Nations institutions, other international organizations and partner countries in development.

[52] In fact, the high-impact global GHG emission scenario (SRES A1B) in the World Bank study (Sutton et al. 2013) is more moderate than the extreme scenario (SRES A1IF) used for projections in Uzbekistan's Third national communication to UNFCCC (Centre of Hydrometeorological Service 2016). Were A1IF to unfold, the negative impact on agricultural output might therefore exceed that projected under A1B. Other GHG emission scenarios used in the World Bank study are the low-impact SRES A2 and the medium-impact SRES B1.

[53] Sutton et al. 2013.

Adaptation of agriculture and water management sector

- Improvement of climate resilience of agriculture through diversification of food crops production pattern; conservation of germplasm and indigenous plant species and agricultural crops resistant to droughts, pests and diseases; development of biotechnologies and breeding new crop varieties adopted to conditions of changing climate;
- Improvement of irrigated lands affected by desertification, soil degradation and drought, increase in soil fertility of irrigated and rainfed lands;
- Further improvement of water management practice in irrigated agriculture with wide use of integrated water resources management approaches and innovative technologies for water saving, including broad introduction of drip irrigation systems;
- Improvement of pasture productivity and fodder production in desert and piedmont areas.

Adaptation of social sector to climate change

- Raising of awareness and improvement of access to information about climate change for all groups of population;
- Development of early warning systems about dangerous hydro- meteorological phenomena and climate risk management;
- Prevention of diseases onset and aggravation caused by climate change;
- Widening the participation of the public, scientific institutions, women and local communities in planning and management, taking into account approaches and methods of gender equity.

…

Source: Intended Nationally Determined Contributions of the Republic of Uzbekistan, 2017

3. AGROMETEOROLOGICAL NETWORK AND SERVICES

The Centre of Hydrometeorological Service under the Cabinet of Ministers of the Republic of Uzbekistan (Uzhydromet) is the state agency for hydrometeorological services. The current legal basis for Uzhydromet's operations is defined in Annex № 2 to the Decree № 606 of 9 August 2017 by the Cabinet of Ministers of the Republic of Uzbekistan. Uzbekistan's first Law on Hydrometeorology is currently under preparation [54].

Uzhydromet is tasked with the management, development and improvement of the state system of hydrometeorological observations; analysis, forecast and other hydrometeorological services for economic sectors and other users; and research in the field. Uzhydromet's observation network[55] includes more than 400 stations and posts (Fig. 3.1). A small part of the network has been automated with international support[56], automatic weather stations also operate at major airports.

Agricultural meteorology is part of Uzhydromet's mandate which, in this field, is to maintain and develop the network of agrometeorological observations and to provide information about current and future agrometeorological conditions, including weather-related risks, to Uzbekistan's agricultural sector, authorities and organisations. Uzhydromet is tasked to monitor the state of agricultural crops and pastures, observe agriculture-relevant weather events, and conduct agrometeorological research.

Table 3.1 Number of locations with agrometeorological observations of vegetables and fruit

Regions	Vegetables				Fruit														
	tomatoes	cabbage	potatoes	cucumbers	almonds	apricots	plums	peaches	cherry plums	apples	pears	sour cherries	sweet cherries	quinces	figs	pomegranates	walnuts	persimmons	grapes
Karakalpakstan Republic	1	1				11				11	1	2						1	12
Oblasts:																			
Andijan			1			3		1		3		2	1						2
Bukhara						2	1			2		2							2
Ferghana	2	3			2	3		2		4		3		2	1		2		4
Jizzakh	2	1	1	1	1	3	2	1	1	5	1	4		2					4
Kashkadarya					1	5		2		5	1	3							2
Khorezm	1	1		1		4				4	1	3		1					4
Namangan	1				1	3		1		3	1	3							4
Navoi	1					2	2			2		2							1
Samarqand	2	1	2			6	1	1		6	2	4	1	1		1			6
Surkhandarya	2				4	4	2	2	2	5		3		2		3	1	1	5
Syrdarya	1	2						1		2		2							2
Tashkent	4	2	4		2	5	1	5	1	10	1	8	2	1			6		9
UZBEKISTAN	**17**	**11**	**8**	**2**	**11**	**51**	**9**	**16**	**4**	**62**	**8**	**41**	**4**	**9**	**1**	**4**	**9**	**2**	**57**

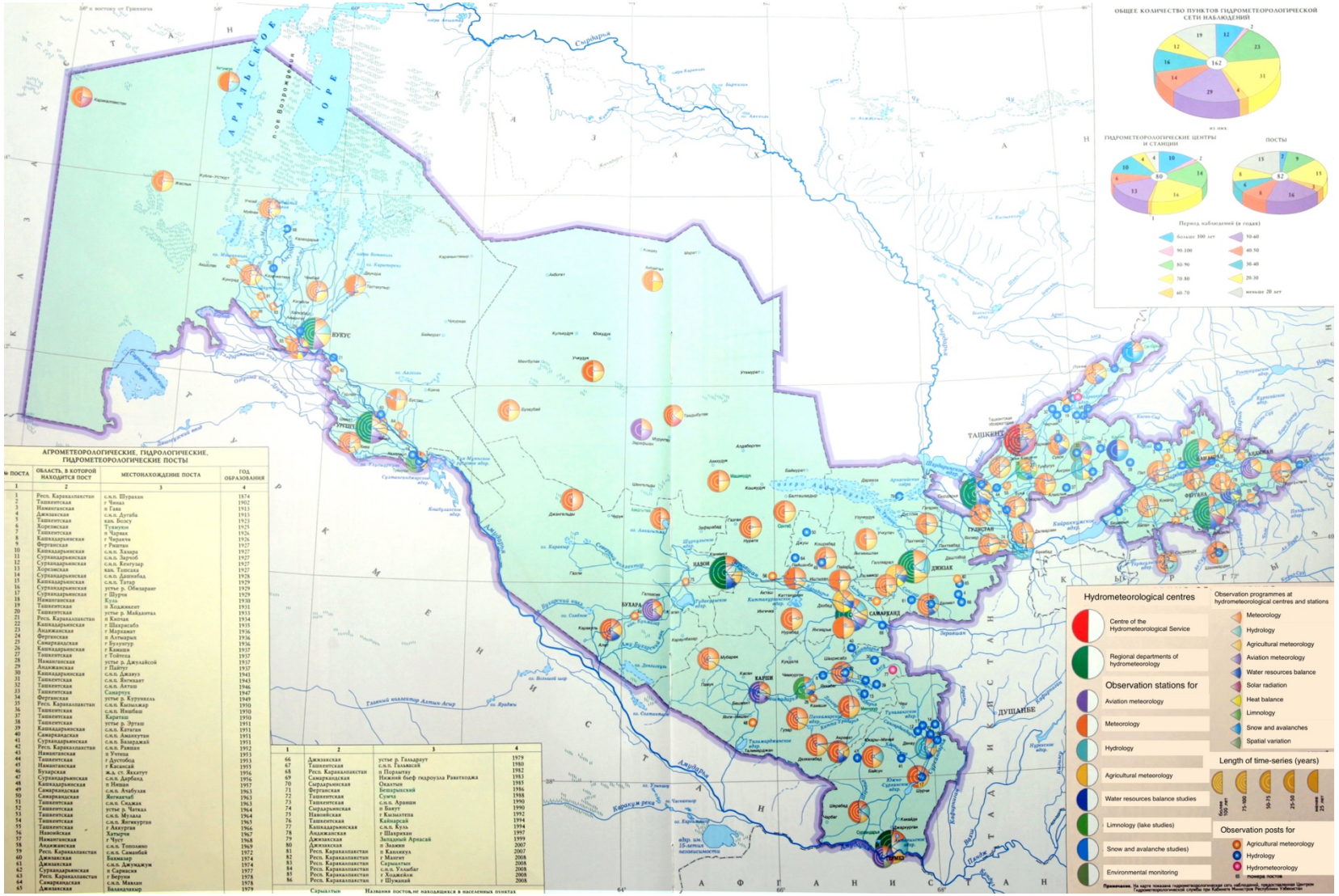
Source: Uzhydromet.

[54] Uzbekistan's first ever Law on Hydrometeorology is currently under preparation: https://regulation.gov.uz/ru/document/588.

[55] https://www.meteo.uz/#/ru/about

[56] http://www.uz.undp.org/content/uzbekistan/en/home/operations/projects/environment_and_energy/developing-climate-resilience-of-farming-communities-in-the-drou.html

Figure 3.1 Hydrometeorological observation network of Uzbekistan



Source: Государственный комитет Республики Узбекистан по земельным ресурсам, геодезии, картографии и государственному кадастру 2012.

Agrometeorological observations are carried out at 61 of Uzbekistan's meteorological and hydrological observation stations (with specialised staff of 3-5 persons) and at 33 smaller agrometeorological observation posts (with staff of 1-2 persons; see Fig. 3.1). A large part of the network supports horticulture (tables 3.1 – 3.2)[57].

Table 3.2 Stations and posts performing agrometeorological observations of vegetables and fruit

Stations, posts	Vegetables				Fruit														
	tomatoes	cabbage	potatoes	cucumbers	almonds	apricots	plums	peaches	cherry plums	apples	pears	sour cherries	sweet cherries	quinces	figs	pomegranates	walnuts	persimmons	grapes
Karakalpakstan Republic																			
Nukus						•				•									•
Chimbay	•	•				•				•	•							•	•
Kungrad						•				•									•
Takhiatash										•		•							•
Buston						•				•									•
Kanlykkol						•				•									•
Khojeyli						•				•									•
Shorakhan						•													•
Mangit						•				•									•
Saryaltan						•				•									•
Shumanay						•				•									•
Ulygbakh						•				•		•							•
Andijan oblast																			
Andijan						•				•		•	•						•
Boz										•									•
Kurgantepa			•			•		•		•		•							
Ulugnar						•													
Bukhara oblast																			
Bukhara						•				•		•							•
Karakul						•	•			•		•							•
Jizzakh oblast																			
Jizzakh						•		•		•		•		•					•
Dustlik	•																		
Yangikishlak										•									•
Lyalmikor			•			•	•			•		•							•
Gallyaaral	•	•		•	•	•	•		•	•		•		•					•
Bakhmal										•	•	•							
Ferghana oblast																			
Ferghana	•	•				•		•		•		•							•
Kuva	•	•			•	•				•		•		•	•		•		•
Rishtan					•			•		•				•			•		•
Kokand		•				•				•		•							•
Kashkadarya oblast																			
Karshi						•		•		•		•							

[57] Uzhydromet

Guzar						•				•									•
Dehkanabad						•				•									
Shakhrisyabz						•		•	•	•	•	•							•
Mubarek					•	•				•		•							
Khorezm oblast																			
Urgench	•	•		•		•				•		•							•
Khiva						•				•		•							•
Tuyamuyun						•				•		•		•					•
Gurlen						•				•	•								•
Namangan oblast																			
Namangan						•				•		•							•
Pap						•													•
Chust										•		•							•
Kasansay	•				•	•		•		•	•	•							•
Navoi oblast																			
Navoi	•					•	•			•		•							
Nurata						•	•			•		•							•
Samarqand oblast																			
Samarqand						•				•	•	•	•						•
Payshanba	•		•			•										•			•
Payaryk						•				•									
Kushrabad																			•
Nurabad						•				•		•							•
Dagbit	•	•	•							•		•							
Yangiaryk						•	•	•		•	•	•	•	•					•
Bulungur						•				•									•
Surkhandarya oblast																			
Termez					•	•		•	•	•		•		•		•			•
Sherabad	•					•				•									•
Baysun					•	•	•		•	•		•		•			•		•
Denau	•				•					•		•				•		•	•
Shurchi					•	•	•	•		•						•			•
Syrdarya oblsat																			
Syrdarya	•	•								•		•							•
Yangier								•				•							
Akaltyn										•									•
Tashkent oblast																			
Kokaral								•		•		•							•
Angren	•	•				•		•		•		•	•						
Yangiyul						•		•		•		•					•		•
Pskem										•							•		
Dalverzin	•	•	•							•		•							•
Tuyabuguz			•																
Almalyk	•		•					•		•		•					•		•
Sukok					•	•		•					•				•		•
Chinaz										•		•							
Kuchlik																			•
Charvak					•	•	•			•	•	•		•			•		•
Bozsu						•				•							•		•
Toytepa	•		•						•	•		•							•

Source: Uzhydromet

Being part of the regular programme of agrometeorological observations (Table 3.3), observations of fruit and vegetables include crop development phases, the state and productivity of crops, damage from bad weather, pests and deceases, and the proceeding and the flow and quality of field work. Gardens surveys are organised in spring, and the ripening of fruit trees is assessed every autumn. The germinative faculty of fruit-tree branches and vines is surveyed in winter.

Table 3.3 Parameters and methods of agrometeorological observations

Type of observation	Frequency	Method
Warm season		
Precipitation, temperature, wind	Twice a day	Instrumental
Temperature of arable soil layer	Every 2 days	Instrumental
Crops, grass, trees, shrubs development phases	Every 2 days	Manual, visual
Pest / decease damage to crops	Every 2 days	Visual
Crop conditions: standing density, height, infestation, damage, overall visual assessment	Every 2 days / twice every 10 days	Manual, visual
Humidity of root soil layer	Every 10 days	Instrumental
Field surveys	Seasonal	Visual
Survey of field crops and gardens	Each spring, 10 days after renewal of vegetation	Visual
Plant formation, mass, yield structure	Once a year	Manual
Cold season		
Vitality of wintering field crops and fruit trees	5-7 days after temperature drops to -10°C	Manual, visual
Soil temperature at tillering nodes of winter crops, root collars of perennial grasses, roots of fruit trees	Every 5 days in winter	Instrumental
Snow cover on fields with wintering crops and in fruit gardens	Every 5 days in winter	Instrumental
Depth of soil freezing and thawing	Every 10 days	Instrumental
Survey of wintering field crops	Each year at the end of autumn	Visual

Source: adapted from WeatherPia 2016

Agrometeorological observations also include taking soil samples for chemical analysis. Since fruit and vegetable plantations are always irrigated, hydrological and water resource data and forecast are also regularly used for providing information to horticulture.

The currently performed observations are considered sufficient for the agrometeorological assessment of large (stone and pomiferous) fruit plantations, but not for subtropical crops such as pomegranates or figs. The latter observations are in particular lacking in the Kashkadarya, Bukhara, Samarqand and Tashkent oblasts as well as in the Ferghana valley. Similarly insufficient (not fully

representative) are observations on vegetables, which are required virtually everywhere but in particular in the Andijan, Jizzakh and Kashkadarya oblasts.

In order to strengthen the network, plans exist to expand it with 13 additional agrometeorological posts and several new stations[58]. In the long-term perspective however no systematic analysis has yet been carried out as to what changes in the system of agrometeorological observations may be needed due to climatic changes (Chapter 2) and the evolving conditions and needs in Uzbekistan's agriculture (cf. Chapter 1).

Only four stations with agrometeorological observation programmes have so far been automated (three of which in September 2018). Over most of the network observation and laboratory equipment is obsolete and aging, which reduces the reliability of measurements and makes it impossible to collect and share data in the real time.

Presently, once collected, agrometeorological data are sent through radio channels to Uzhydromet's regional offices and the headquarters. Based on the collected data, the Department of Agricultural Meteorology in Tashkent produces medium-range forecasts, which for fruit and vegetables include[59]:

- warming conditions during the growing season;
- flowering of almonds, apricots, peaches, cherries and apples;
- opening of vineyards and grape fruiting;
- opening of leaves of mulberry trees;
- fruition of tomatoes.

Agrometeorological information and forecast are regularly published in various formats (Table 3.4), some of which are available on-line[60].

Table 3.4 Selected agrometeorological information products

Type	Content
Periodical / ten-day agrometeorological bulletins	Meteorological and agrometeorological conditions
Seasonal agrometeorological information	Seasonal agrometeorological statistics and forecast Crop growth and development data Cultivation / agrotechnological data
Annual reviews of agrometeorological conditions	Reviews of conditions for cotton, cereals, fruit, grape, mulberry, grasslands
Annual forecast of agrometeorological conditions and yield	Analytical notes on expected heat supply, cotton yield
Ad-hoc briefings	Damage from extreme weather (frost, rain-showers etc.) Agrotechnological recommendations (e.g., dates for cotton sowing and defoliation)

Source: Uzhydromet; WeatherPia 2016

[58] Uzhydromet.
[59] Uzhydromet; WeatherPia 2016
[60] See e.g. agrometeorological bulletins at https://www.meteo.uz/users/meteoagro/agro_uz.pdf.

There are certain limitations on the current capacities for, and practices of, the production and publication of analytical agrometeorological information:

- at the moment, agrometeorological forecast are produced manually, with no use of modern automated analytical systems or software[61];
- pest and decease development forecasts are not produced at all;
- information and forecasts are not sufficiently localised, at best being provided at the regional / oblast levels;
- a large array of retroactive agrometeorological data which could be used to calibrate models, improve forecasting techniques and analyse longer-term trends are still stored on paper and are at risk at eventually being lost.

According to legislation and Uzbekistan's practice, agrometeorological publications, like other weather-related and hydrological information and forecasts, are routinely provided to the President's Administration, the Cabinet of Ministers, the Prosecutor-General's Office and central governmental agencies. The are also sent to regional administrations (Khokimiyats) and the regional branches of central authorities (e.g. regional agricultural departments). Both paper and electronic copies are distributed, the latter by electronic mail.

Agricultural producers including small-scale farmers are keen to use meteorological and agrometeorological information too, and do so to the possible extent. Yet the local reach of such information is at present very limited. As most information products from Uzhydromet are intended for higher management levels, quite often end users do not get the information contained in there at all, although some of it is available on-line or is made available in other ways by regional and district authorities[62]. And even if they do, they do not necessarily have sufficient knowledge of how to effectively use it.

A study by the World Bank[63] concluded: "The ability to collect, generate, and provide meteorological data to farmers appears to be high, but the provision of those data to farmers for decision-making appears mixed. Uzhydromet appears to have good infrastructure and well-trained staff able to collect and provide agriculturally relevant meteorological data to farmers. During the farmer consultations, however, farmers noted that the agricultural extension service is not oriented toward ameliorating risks from climate, and could provide better integration with hydrometeorological data provision, particularly related to short-term precipitation forecasts and seasonal water availability for irrigation. The extension service could expand its capacity to advise on adapting agricultural systems to the climate risks outlined in this study."

As the network of local-level integrated agricultural advisory or extension centres envisaged by the Government in order to help farmers with a range of issues is yet to be established (see Chapter 1), it will hardly be immediately qualified to handle agrometeorological information and support. First cases to specifically provide farmers with local-scale meteorological and hydrological data are being tested by UNDP in Karakalpakstan, where three extension centres are set up through arrangements with a regional university (Nukus), an agricultural college (Kegeyli) and a private company (Kanlykol)[64].

[61] See e.g. WMO 2012.
[62] Including through regular (weekly) district-level voice conferences with agricultural enterprises and farmers: meeting with with EcoAgroProduct horticultural farm, Tashkent oblast, September 2018.
[63] World Bank 2013.
[64] http://www.uz.undp.org/content/uzbekistan/en/home/operations/projects/environment_and_energy/developing-climate-resilience-of-farming-communities-in-the-drou.html; meeting with UNDP project office, September 2018.

Interviewed agriculturalists[65] confirm strong demand for timely and localised agrometeorological information to help optimise their operations, including phenological forecasts, pest and decease analysis, soil humidity and water chemistry data. Yet apart from the study quoted above, there has been little interaction between the producers and the users of agrometeorological data that would help get a clear idea of what information is needed and in what form.

Meanwhile, farmers and businesses increasingly equipped with modern communication tools search and get meteorological information directly from the internet (e.g. Russia's Gismeteo) or various mobile phone applications. Some international agencies operating in Uzbekistan start producing mobile applications for farmers[66], although not yet including there meteorological information. The above-mentioned UNDP project in Karakalpakstan is developing a multi-purpose platform for communicating hydrometeorological information thought different electronic channels too[67].

Small privately-owned weather stations for real-time monitoring of local meteorological conditions gradually become reality as well. Some are being set up through international technical assistance[68], others are a result of private investments[69]. At the moment there is no formal interaction between the owners and operators of such private installations on one side, and Uzhydromet on the other side. However the fact that there exists tangible demand for such information and its analysis points to new economic opportunities for providers of weather and agrometeorological information and very targeted services – and to the need to strengthen coordination of data flows and, eventually, the exchange of data.

Remotely sensed / space data derived from e.g. the Copernicus programme of the EU[70], IBM Weather[71] or observations by the Russian Space Agency programmes[72] may in the long run be a useful supplement (or, indeed, a competitor) to the ground network of Uzhydromet.

Despite acknowledged agricultural impacts of future climate change, circulation and practical use of related information remains limited: while farmers and authorities are generally aware of the changes and the related issues with water, temperature, extreme weather events etc.[73], there is little actual use of such information for long-term planning. So far little analysis has been made available to explain the projected changes in terms that would be well understood by agriculturalists, and an overall dialogue and understanding between the climate and the agricultural communities has so far been scarce especially on the local and the regional levels.

At the same time, in line with Uzbekistan's INDC (see Box 2.1), the recent decree № 3281 of September 2017 by the President of the Republic of Uzbekistan requests the optimised placement of agricultural crops, in particular intensive cucurbit plantations, gardens and vineyards, accounting for soil and climate conditions, the availability of water, regional specialisation, yields and other factors; thus confirming the need and demand for systematically integrating climate-change information in long-

[65] E. g., meeting with EcoAgroProduct horticultural farm in Tashkent oblast, September 2018.
[66] https://dai-global-digital.com/horticulturalist-chat-groups-and-youtube-q-and-as-an-uzbek-ict4ag-case-study.html?utm_source=daidotcom; meeting with USAID and DAI, September 2018.
[67] Meeting with UNDP project office, September 2018.
[68] "Business Forum for Uzbekistan" project of UNDP and the Chamber of Commerce of Uzbekistan http://www.uz.undp.org/content/uzbekistan/en/home/presscenter/articles/2017/10/27/meteorological-stations-installed-to-help-farmers-in-the-tashken.html
[69] For instance, private horticultural enterprise 'Leo Garden' https://www.facebook.com/pg/OOO-Leo-garden--578072395704831/posts/?ref=page_internal in the Tashkent oblast operates a set of small weather stations which generate data then processed and analysed in France to produce recommendations: Meeting with Mirzayev (Schröder) Research Institute of Gardening, Viticulture and Winemaking, September 2018.
[70] https://www.copernicus.eu/en
[71] https://www.ibm.com/weather
[72] https://www.roscosmos.ru/25638/
[73] E. g., surveys among farmers by UNDP (UNDP 2016) and the World Bank (Sutton et al. 2015).

term agricultural planning. Similarly, climate information increasingly interests investors in agricultural business[74]. This highlights the potential for bringing climate knowledge into business planning, and may in turn bring new economic opportunities to Uzbekistan's agrometeorological network and services.

[74] Cf. recent request for information to Uzhydromet from an Uzbek trade company with investment partner in the US considering agricultural development in the Jizzakh oblast: meeting with Uzhydromet, September 2017.

4. THE WAY FORWARD: ELEMENTS OF THE PROJECT CONCEPT

Project history

The idea of the GCF project to support Uzbekistan's horticulture through improved agrometeorological services was initially developed by Uzhydromet and UNDP, and consequently endorsed by the Uzbekistan's interagency task force comprised of the representatives of relevant governmental agencies in June 2017. Following the endorsement, the concept was further elaborated by UNEP and UNDP with the strong engagement of Uzhydromet and its experts who provided guidance, substantive support and expertise.

In September 2018, the international fact-finding mission comprised of UNEP, UNDP, international and local consultants, discussed the concept with a wide range of national and international stakeholders including:

- the Ministries of Economy and Agriculture,
- business organisers the Chamber of Commerce and Industry and JSC Uzagroexport,
- agricultural research and consultancy organisations M. Mirzayev (former Schröder) Institute of Gardening, Viticulture and Winemaking and Development Alternatives, Inc. (US),
- small-scale horticultural farmer EcoAgroProduct (Tashkent oblast),
- and selected international organisations including the World Bank, FAO and USAID.

Consultations about possible synergies were also held with the Water and Climate Department and the Global Framework for Climate Services Office of WMO in Geneva.

The project concept, presented and discussed in detail, received unanimous support from all stakeholders and was further refined following the mission. UNEP, UNDP and Uzhydromet have all committed resources for the further development of a full funding proposal once the project concept has been accepted by the GCF, and for being part of project implementation once GCF resources have become available.

Further to that and following the discussion of the project concept with the GCF secretariat in early 2019, a multi-stakeholder round-table was held in Tashkent in June 2019 (Annex I), coupled with bilateral meetings with the World Bank, the OSCE and the Ministry of Agriculture. The project proposal was also discussed from a regional perspective with stakeholders in the Samarqand oblast (Annex II).

Project logic and interventions

On the overall level, the project is expected to help improve the resilience of climate-sensitive horticultural production in Uzbekistan and to strengthen the livelihoods of climate-affected rural communities. With the help of improved agrometeorological services, the targeted farms and households, agricultural businesses and authorities will be able to improve their land-use planning and the selection of crops, optimise their daily field operations such as the use of water and fertilisers, plant protection, pest and decease control, and other agrotechnological and protective measures.

In more concrete terms the project will bring economic and social benefits such as lower costs of production, improved agrotechnological skills and practices, increased yield and quality of the output and reduced harvest losses, and, eventually higher sales revenues, in the end contributing to reduced poverty and a more climate-resilient, sustainable, efficient, diverse and competitive agricultural sector in Uzbekistan.

The project will contribute to improved resilience of climate-sensitive production of fruit and vegetables by improving the accessibility and use of high-quality, targeted, timely and understandable agrometeorological information and advice. In doing so it will address several challenges facing today Uzbekistan's agriculture and hydrometeorology, which all have been presented and discussed in the preceding chapters and are summarised in Box 4.1.

Box 4.1 Challenges facing Uzbekistan's horticulture and agrometeorology

NATURE: aggravating conditions for horticultural production due to the already observed and projected climate change, thus requiring more precise, timely, relevant and usable information.

CULTURE: the prevailing "supply" perspective among the providers of agrometeorological information and advice, not sufficiently oriented towards agricultural end users.

INFRASTRUCTURE: insufficient / outdated physical and institutional infrastructure of Uzhydromet as the main provider of agrometeorological services in Uzbekistan.

CAPACITIES: low capacities of Uzhydromet to produce and communicate agrometeorological information relevant to the needs of farmers and agricultural enterprises, as well as insufficient capacities of end users to understand, accommodate and use the available agrometeorological information in their daily life.

INTEGRATION: weak inter-sectoral linkages between hydrometeorology, agricultural policies and practices, resulting in limited cooperation to e.g. provide extension services to agricultural users and to integrate climate information into agricultural planning;

RESOURCES FOR CHANGE: Insufficient own expertise and the systematic lack of own or external financial resources to address all the above challenges.

The project is designed to address these challenges along the entire supply – demand chain for agrometeorological information:

- starting with the detailed understanding of users' needs by entering in a systematic dialogue with them;
- to improving the analytical capacities and services of Uzhydromet as the key providers of climate and hydrometeorological information, for it to be able to deliver more relevant, better-targeted and high-quality agrometeorological information and advice in many forms and through various media;
- to interventions in 57 rural districts adjacent to the locations to be equipped with new agrometeorological infrastructure by integrating the modernization of observation networks with building functional set-ups for continuous flows of localised agrometeorological information and advice to support fruit and vegetable production in direct cooperation with regional and agricultural authorities, advisory services, farmers and dehkans;
- to ensuring long-term climate-change information to be available and integrated into strategic planning of agricultural / fruit and vegetable production.

The specific rural areas chosen for field interventions (Fig. 4.1) are rural districts within 50 – 60 kilometre distance of each of the 57 project locations where agrometeorological observations are to be modernised represent about 80% of Uzbekistan's territory and rural population. The choice of locations is guided by the areas' importance for horticultural production together with the feasibility

of automating observations at the respective hydrometeorological stations by making use of GCF and / or matching partners' financial resources (Table 4.1). Activities built around four project components are described below, while linkages between the outputs of these activities, the resulting outcomes of project components, the overall project outcome and the higher-end impact are explained in Table 4.2 and Figure 4.2.

Table 4.1 Hydrometeorological stations and posts included in project design

Region	Station / area	GCF [a]	GEF – FAO [b]	UNDP – AF [c]	Other
Karakalpakstan Republic	Nukus			•	
	Chimbay			•	
	Kungrad			•	
	Takhiatash			•	
	Buston			•	
Andijan oblast	Andijan				• [d]
	Boz	•			
	Kurgantepa	•			
	Ulugnar	•			
	Pakhtaobod	•			
Bukhara oblast	Karakul	•			
	Shafrikon	•			
Jizzakh oblast	Jizzakh	•			
	Dustlik		•		
	Yangikishlak		•		
	Lyalmikor		•		
	Gallyaaral		•		
	Bakhmal		•		
	Mirzachul	•			
Ferghana oblast	Ferghana	•			
	Kuva	•			
	Kokand	•			
Kashkadarya oblast	Guzar		•		
	Dehkanabad		•		
	Shakhrisyabz		•		
	Mubarek		•		
	Mirishkor	•			
Khorezm oblast	Khiva	•			
	Tuyamuyun	•			
	Shavat	•			
Namangan oblast	Pap	•			
	Yangikurgan	•			
Navoi oblast	Navoi	•			
	Nurata	•			
	Khatirchi	•			
Samarqand oblast	Samarqand				• [d]
	Nurabad				• [d]
	Payshanba	•			
	Dagbit	•			
	Pastdargom	•			
Surkhandarya oblast	Sherabad	•			
	Baysun	•			
	Denau	•			
	Shurchi	•			
	Kyzyryk	•			

	Muzrabod	•			
Syrdarya oblsat	Syrdarya	•			
	Yangier	•			
	Sardoba	•			
Tashkent oblast	Kokaral	•			
	Angren	•			
	Yangiyul	•			
	Pskem				• e
	Dalverzin	•			
	Almalyk	•			
	Sukok	•			
	Kuyi Chirchik	•			

• Stations with agrometeorological observations • Agrometeorological posts

a, b, c To be automated through the current project

a with GCF support;

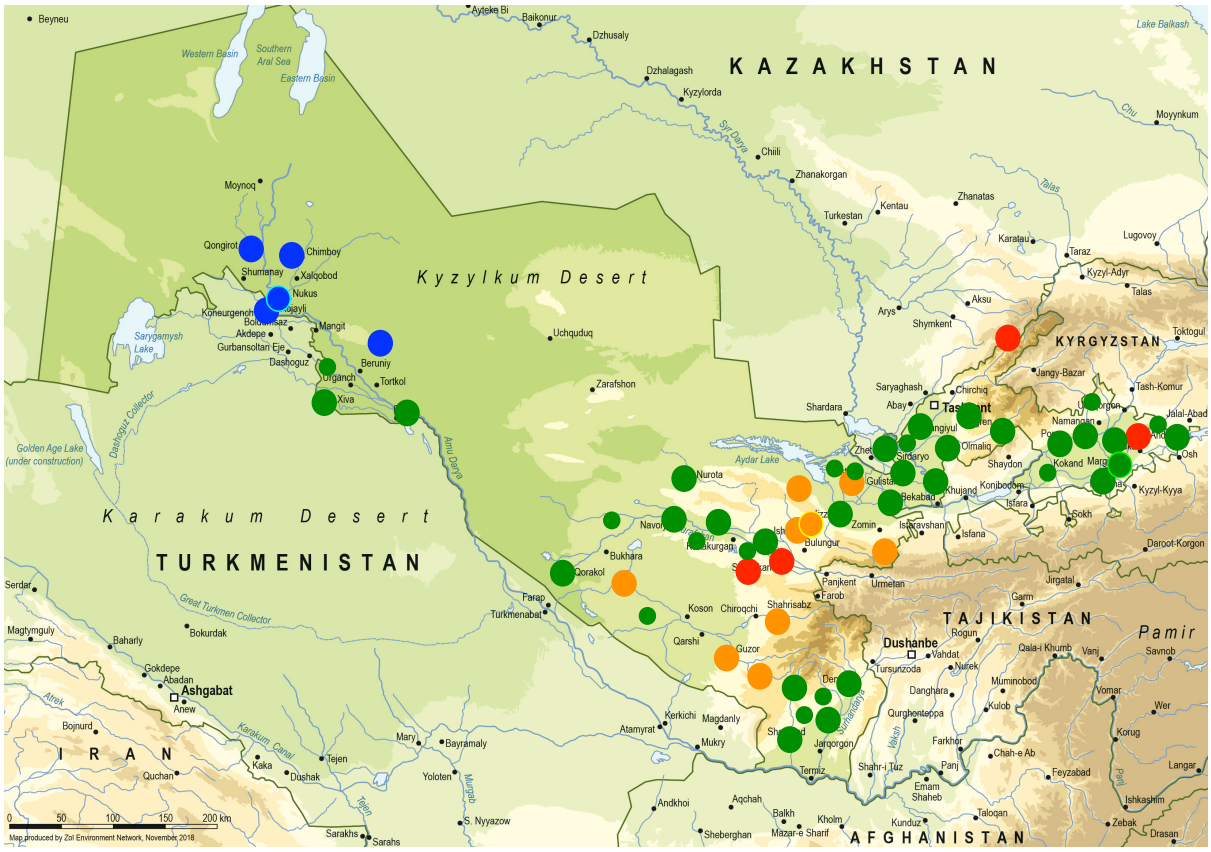
b through the matching UNDP – Adaptation Fund project “Developing climate resilience of farming communities in the drought prone parts of Uzbekistan”;

c through the matching GEF – FAO project “Integrated Natural Resources Management in Drought-prone and Salt-affected Agricultural Production Landscapes in Central Asia and Turkey (CACILM2)”.

d Automated by China Huayun Meteorological Technology Group (September 2018).

e Automated with USAID support.

Figure 4.1 Hydrometeorological stations and posts included in project design



Stations with agrometeorological observations

- **26 sites** to be automated with GCF funds through the project
- 9 sites to be automated under the parallel GEF-funded FAO project "Central Asian Initiative for Land Management II"[75]
- 5 sites automated by UNDP under the parallel Adaptation Fund project "Climate resilience of farming communities (Karakalpakstan)"[76]
- 4 sites automated through other parallel contributions (China, USAID)

Agrometeorological posts

- **13 sites** to be automated with GCF funds through the project

NB: locations of soli quality laboratories are not indicated

Project components and design

COMPONENT/OUTCOME I: User-driven and climate-responsive agrometeorological services in Uzbekistan

Output 1.1: Agrometeorological information user interface platform

Development of agrometeorological information user interface platform aimed at strengthening dialogue/interactions with end users of agrometeorological information in fruit- and vegetable-growing areas of Uzbekistan. This platform will enable regular and increased understanding of the views, perspectives and needs of end users of agrometeorological information at district-level, as well as effective and regular collection of information demands/requests in fruit- and vegetable-growing areas. The user interface platform will regularly inform the establishment of functional mechanisms for a systematic dialogue with agrometeorological information users and regular collection and addressing of user feedback and demand.

Output 1.2: Long-term vision for agrometeorological information services for fruit and vegetable production in Uzbekistan

Development and adoption of a long-term vision for agrometeorological information services in support of fruit and vegetable production under anticipated climate change and evolving economic and market conditions. The development of this new vision will be built upon the results of the in-depth assessment of the views, perspectives and needs of end users of agrometeorological information, take into account climate change scenarios and expected impacts on fruit and vegetable production, and market prospects for economic growth of the sector. The new long-term vision will divert from the prevailing paradigms by inverting the traditional supply-focussed approach to providing climate and hydrometeorological information in Uzbekistan by bringing long-term climate-change knowledge directly into Uzbekistan's strategic agricultural planning and by integrating modern principles of public access to information in the way that agrometeorological information is made available to end users.

Output 1.3: Legal, institutional and operational strengthening of agrometeorological information services in Uzbekistan

[75] https://www.thegef.org/project/integrated-natural-resources-management-drought-prone-and-salt-affected-agricultural
[76] https://www.adaptation-fund.org/project/developing-climate-resilience-of-farming-communities-in-the-drought-prone-parts-of-uzbekistan/

Development of the strategy plan and business model for the progressive introduction of legal, institutional and operational changes for modernising agrometeorological information services in Uzbekistan. The strategy plan will comprise recommendations for action and a suggested schedule for their progressive implementation for addressing the insufficient / outdated physical and institutional infrastructure of Uzhydromet as the main provider of agrometeorological information services in Uzbekistan. It will also include recommendations to strengthen linkages between hydrometeorology and agricultural policies and practices, and inter-sectoral cooperation. Since Uzhydromet operates under only partially realistic assumption of cost-recovery from the market which is neither well developed, nor is capable to ensure the recovery of the costs of hydrometeorological and climate services, a new business model of cost-recovery will be proposed to support a more reliable foundation to the sustainability of agrometeorological information services for end users.

COMPONENT/OUTCOME II: Modernized collection of agrometeorological data in 57 fruit- and vegetable-growing districts of Uzbekistan

Output 2.1: Automated agrometeorological observations and data transfer and modernized soil-quality analytical laboratories

Automating agrometeorological observations and real-time data transfer at 39 locations in 12 administrative regions in Uzbekistan and modernising equipment for soil-quality analysis (salinity, humus content, agrochemicals) at 23 local, regional and central laboratories. The automating of agrometeorological observations and real-time data transfer will imply project interventions in 39 rural districts adjacent to the locations to be equipped with new automated equipment measuring weather parameters including air and soli temperature, precipitation, snow depth, solar radiation, humidity, wind speed, soil pH and other parameters; and by integrating the modernization of observation networks with building functional set-ups for a continuous flows of localised agrometeorological information and advice to support fruit and vegetable production in direct cooperation with regional and agricultural authorities, advisory services, farmers and dehkans. The specific rural areas chosen for field interventions where agrometeorological observations are to be modernised are rural districts within 50–60 kilometer distance of each of the 39 project locations. At further 18 sites which are to be covered by project activities observations will be or have already been automated through parallel activities of UNDP, FAO, USAID and China (Fig. B.3.1). The choice of locations to be covered by project activities has been guided by the district's importance for horticultural production, the vulnerability the latter to climate change (cf. Section B.1 above) together with the feasibility of automating observations at the respective hydrometeorological stations by making use of GCF and matching financial resources.

Output 2.2: Agrometeorological observation network staff trained in operating and maintaining new equipment

Training the staff of the respective agrometeorological stations and analytical laboratories in operating and maintaining new automated and laboratory equipment. A training programme will be rolled out for staff of the respective agrometeorological stations and analytical laboratories to improve the analytical capacities and services of Uzhydromet as the key providers of climate and hydrometeorological information, for it to be able to deliver more relevant, better-targeted and high-quality agrometeorological information and advice in many forms and through various media. Training will include capacity building activities in operating and maintaining new stations and laboratory equipment.

Output 2.3: Innovative technologies for using and exchanging data piloted

Modalities for using and exchanging data with small / portable automatic weather stations will be tested during the project with the aim to establish the potential of using data collected by external providers (for developing information and communication infrastructure and services of the agrometeorological network) as well as climate and agricultural research centres (for improving the analysis and delivery of climate-change information in support of horticultural planning at national and local levels through innovative and cost-effective methods).

COMPONENT/OUTCOME III: Improved processing, delivery and increased use of agrometeorological information in fruit and vegetables production in Uzbekistan

Output 3.1: Upgraded and modernized IT capacities and expertise of Uzhydromet

IT capacities and expertise of Uzhydromet will be upgraded and modernized for agrometeorological data processing and forecasting (including phenological, pest and plant disease forecasting adapted to local conditions).

Output 3.2: Modern communication channels for delivering agrometeorological information

Communication channels for delivering agrometeorological information will be modernized through designing and operationalising new formats, including visualizations and the use of i.a. web-based, mobile applications, media and social networks for improved delivery of and access to agrometeorological information for climate-resilient fruit and vegetable production.

Output 3.3: Improved capacity for agrotechnological, agroecological and agro-climatic issues

In-service / vocational training of the staff of the agrometeorological observational network will be carried out with the aim of improving their understanding on agrotechnological, agroecological and agro-climatic issues and their capacity to relate observed data with the needs of end-users as related to improving resilience of fruit and vegetable production to climate change.

Output 3.4: Capable extension services developed in target districts

Capability of extension services in target districts will be developed through targeted training in cooperation with local authorities, academia and the private sector to enable extension centres/facilities to foster improved access of agricultural end-users (fruit and vegetable producers) to agrotechnological advice based on effective agrometeorological information. By building their capacity, these extension centres/facilities will also be able to further train agricultural end-users (fruit and vegetable producers) in the understanding and use of that information for improving resilience of their production to climate change.

COMPONENT/OUTCOME IV: Climate-informed planning of agricultural land-use, crop selection and agrotechnology for fruit and vegetable production in Uzbekistan

Output 4.1: Electronic archive of agrometeorological time-series

Agrometeorological information archives will be safeguarded electronically through the creation of an electronic archive capable of supporting long-term analysis and forecasting / projections of changes

in agroecological conditions. The archive will further enable the regular production and sharing of climate-change information and analyses for strategic horticultural planning.

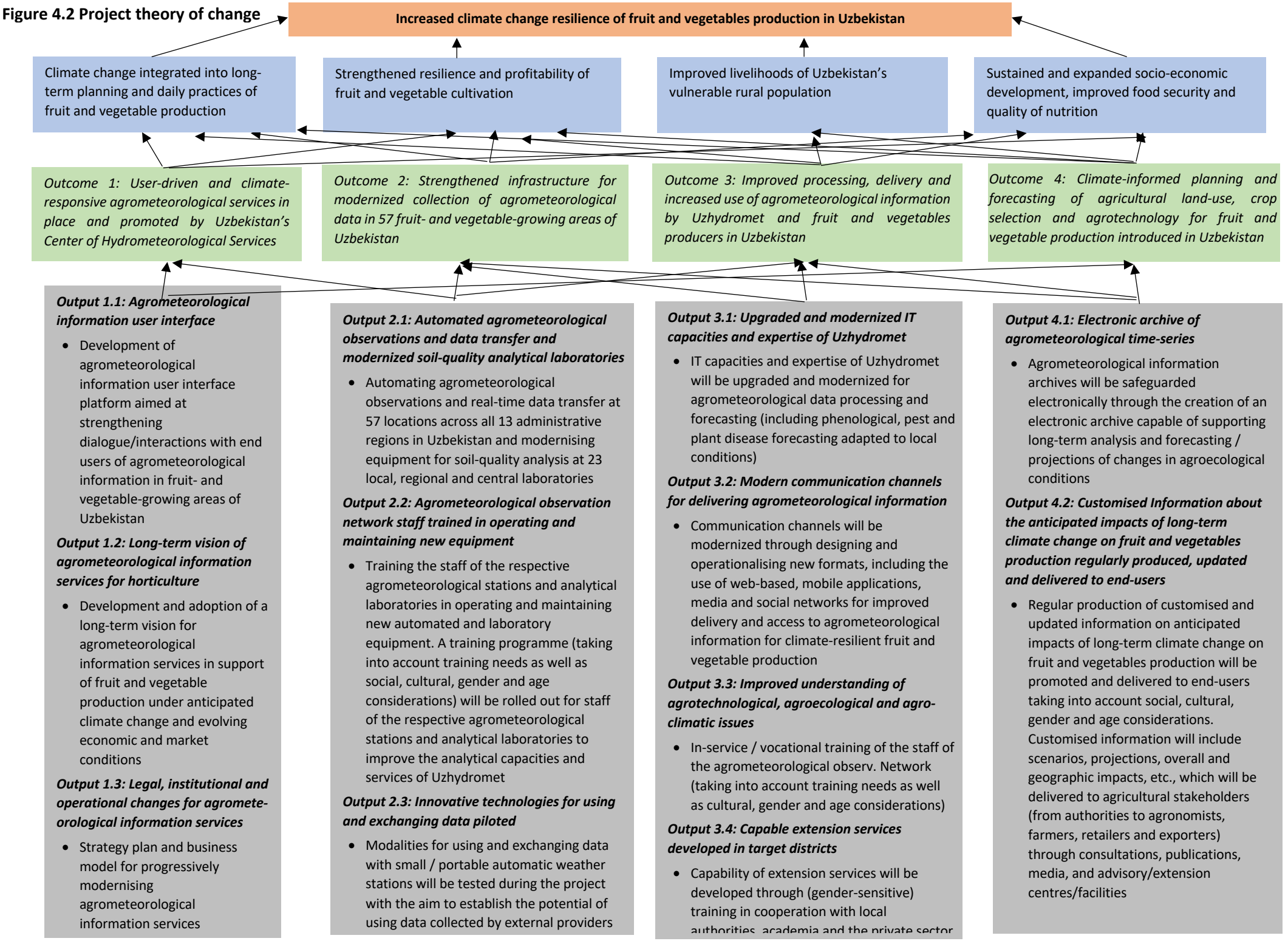
Output 4.2: Customised Information about the anticipated impacts of long-term climate change on fruit and vegetables production regularly produced, updated and delivered to end-users

Regular production of customised and updated information on anticipated impacts of long-term climate change on fruit and vegetables production will be promoted and delivered to end-users. Customised information will include scenarios, projections, overall and geographic impacts, etc., which will be delivered to agricultural stakeholders (from authorities to agronomists, farmers, retailers and exporters) through consultations, publications, media, and advisory/extension centres/facilities.

Table 4.2 Logical framework analysis of project design

Expected Results	Indicator	Means of Verification	Baseline	Target	
				Mid-term	Final
Reformed agrometeorological services	User interface platform implemented	User interaction mechanism in place	No user interface	In place	In place
	Long-term vision achieved for agrometeorological service in Uzbekistan	Vision document available	No long-term vision	In place	In place
	Legal and business-model changes implemented at Uzhydromet	Changes justified and documented	No legal / business model	Drafted / formulated	In place
Modernised collection of agrometeorological data	Stations / posts automated and operational at 39 locations, 23 soil quality laboratories modernized	Tender and hand-over documentation	None for the specified locations	39 stations / posts and 23 labs	39 stations / posts and 23 labs
	Uzhydromet staff trained	Training records	No staff trained	100 staff trained	200 staff trained
	Modalities developed for data exchange with small weather stations	Discussion paper available	None	Study under way	Paper available
Improved processing, delivery, and use of agrometeorological information	IT capacities for agrometeorological data and forecasting upgraded / developed	Tender and hand-over documentation, training records	Basic capacities	Improved capacities	Improved capacities
	New formats developed for delivering agrometeorological information	New products and channels, usage statistics	No modern products and channels	2 new product formats / 2 new channels	4 new product formats / 3 new channels
	Min. 200 Uzhydromet staff trained in agroecological issues and agrotechnology	Training records, course curriculum	No staff trained	100 staff trained	200 staff trained
	Extension services for horticultural end users functional at 57 locations	End-user surveys	Agromet services at 3 locations	Services at 20 locations	Services at 57 locations
Climate-informed long-term planning in horticulture	Climate-change information produced and regularly shared for strategic horticultural planning	Information products, user interaction records, policy documents	No information products	3 information products	Half-annual production
	Agrometeorological archives safeguarded	Electronic archive	No archive	Archive started	Archive in place

Figure 4.2 Project theory of change



Assumptions:

- Government and food and vegetable producers are interested and willing to engage in the development and use of agrometeorological information.
- Fruit and vegetable producers are willing to change behaviors and adopt new practices by using improved climate and agrometeorological information
- Sector authorities/Stakeholders and partners are willing to adopt new institutional and regulatory mechanisms to ensure the incorporation of climate and agrometeorological information and data into long-term planning and daily practices of fruit and vegetable production.
- Strong collaboration between all relevant stakeholders for agrometeorological information collecting, sharing and use.
- Fruit and vegetable production, retail/distribution and export sectors want to make use of agrometeorological services to improve efficiency, business continuity, and resilience to climate change.
- Water allocation agreements set up with relevant neighboring countries will remain stable even in times of changing water supply during climate change that do not cause severe water shortages

Drivers:

- Capacity of Uzhydromet to deliver high-quality and reliable agrometeorological data for better resilience of fruit and vegetable production against the climate change impacts.
- Capacity of all stakeholders to share and use agrometeorological data and information.
- Strong political support for open access to agrometeorological information.
- Policy, legal and planning frameworks and infrastructures that are based on agrometeorological information.
- Awareness of the value of using climate and agrometeorological information to be better protected and prepared against climate change impacts
- Demand for climate information in various sectors, in particular agriculture.
- Collaborative partners on the national and international levels.
- increased need to ensure efficient and well-planned horticultural practices in the face of increased water insecurity and projected changes in water availability from neighboring countries or Syr Darya basin

Impact

Intermediate Outcomes

Project Outcomes

Project Interventions

Assumptions & Drivers

Table 4.3 Preliminary assessment of associated risks

Probability	Impact	Mitigation Measure(s)
1. Lack of capacity, engagement and cooperation among national or local institutions to fully carry out the agreed project interventions		
Medium	Medium	Uzhydromet will be a key executing entity in the project which is based on strong country demand. The project will ensure the full engagement of different ministries and other stakeholders in improving the delivery and use of agrometeorological services. The enhancement of interaction between producers and end-users of information and of their capacities is at the core of project design.
2. Geopolitical and intrastate tensions, both political and specifically related to water and land use in Uzbekistan and Central Asia.		
Low	Medium	Through continuous monitoring, stakeholder engagement and the establishment of robust governance and coordination mechanisms, the project will mitigate the risk of tensions, including interstate and intrastate tensions related to water and land use, affecting project delivery. With these measures risk probability can be reduced to Low.
3. Conflicting interests among stakeholders, including mandate / 'turf wars' on the national or the local level.		
Medium	Medium	Based on a stakeholder analysis and extensive stakeholder consultations, the project will mitigate potential conflicting interest among stakeholders amongst others through the establishment of an inclusive consultation and coordination mechanism for the development and the delivery of agrometeorological services. With these measures risk probability can be reduced to Low.
4. Socio-economic risks		
Low	Low	The project has been identified as low risk and will ensure that the socio-economic diversity, vulnerability and livelihood risks will be considered in all project activities.
5. Operation and maintenance of infrastructure and equipment may be compromised in the long-term.		
Low	Medium	The project is based on a strategy and commitment for long-term operation and maintenance of equipment and observation infrastructure to ensure the sustainability of project results.

GFC investment criteria

The overview above provides a snapshot of how GEF investment criteria will be met by project design. Without further quantifying indicators in Table 4.2 at this point of project development, the section below further explains project links to the specific GEF investment criteria[77].

Impact potential

The project will improve climate resilience, incomes and livelihoods of estimated 2.5 million farmers and 3.5 million dehkans households in all 13 regions of Uzbekistan.

[77] As defined in GCF Investment criteria indicators. Meeting of the Board 1-4 July 2018. GCF/B.20/Inf.14, 2018.

Paradigm shift potential

As catalyst of cultural change, the project will help shift several prevailing paradigms (Box 4.2).

Box 4.2 Project-induced paradigm shifts

(1) The project will invert the traditional supply-focussed CULTURE of providing climate and hydrometeorological information in Uzbekistan by bringing end users to the fore of the design and implementation of agrometeorological services, and by linking their delivery to users' needs – much in line with WMO's principles of the Global Framework for Climate Services and its support to the implementation of the respective National Frameworks[78];

(3) The project will help redesign the obsolete BUSINESS and INSTITUTIONAL model of collecting and providing agrometeorological (and eventually, climate and hydrometeorological) information by linking it to modern realities, the principles of public access to information, and to the actual and prospective user demand and market potential, thus capitalising on business investment opportunities while protecting vulnerable groups unable to fully afford market-oriented services.

(2) For the first time, the project will bring long-term climate-change knowledge directly into Uzbekistan's strategic agricultural planning through building robust capacities for continuously supplying relevant, understandable and actionable climate information to the various parts and players of the value chain for the SUSTAINABLE development of Uzbekistan's horticulture.

Based on these shifts and anticipated tangible results, comparable effects can be achieved in the future in other areas which 'neighbour' the project field either geographically or thematically.

- Geographically, the approach can be expanded to cover Uzbekistan's entire territory and population.
- Thematically, Uzhydromet can expand the approach and results far beyond agrometeorology to cover the entire field of hydrometeorological and climate services.
- Thematically in the agricultural field, improved agrometeorological services can be expanded beyond fruit and vegetables cultivation.

Sustainable development potential

- The project will help enhance income and alleviate poverty in rural communities, in particularly among the estimated 20 million members of dehkan families in the project area.
- The project will improve food security and quality of nutrition of 30 million Uzbekistan's population due to a stronger and more reliable supply of higher-quality vegetables and fruits.

In the long-term, the project will tangibly contribute to the attainment of several Sustainable Development Goals (see Box 4.3).

[78] Cf. Concept Note on GCF Support on Climate Information Services.

Box 4.3 Contribution of project results to attaining Sustainable Development Goals

SDG 1 NO POVERTY

1.2 Reduce by half the proportion of people living in poverty

1.5 Build the resilience of and reduce the exposure and vulnerability of the poor to climate-related extreme events

SDG 2 ZERO HUNGER

2.1 Ensure access to safe, nutritious and sufficient food

2.3 Double the agricultural productivity and incomes of small-scale food producers, including family farmers

2.4 Ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters

2.A Increase investment in rural infrastructure, agricultural research and extension services

SDG 8 DECENT WORK AND ECONOMIC GROWTH

8.2 Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including a focus on high-value added and labour-intensive sectors

SDG 13 CLIMATE ACTION

13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters

13.2 Integrate climate change measures into national policies, strategies and planning

Source: https://sustainabledevelopment.un.org/; formulations of SDGs and their tasks are simplified.

Needs of the recipient

Uzbekistan alone would not be able to achieve the anticipated project results. Like in most Central Asian countries, in Uzbekistan the Governmental funding of the hydrometeorology sector has traditionally been very limited. Currently Uzhydromet operates with a minimal budget of 17 – 20 million Uzbek so'ms per year (ca. 2.5 million USD at the current exchange rate), which is heavily biased towards personnel costs. The organisation works under only partially realistic assumption of cost-recovery from the market which is neither well developed, nor is capable to ensure the recovery of the costs of hydrometeorological and climate services.

Given the current economic situation and trends (GDP growth slowed to 4.9% in the first half of 2018 compared to 7% in the same period 201779 and Government debt to GDP ratio was equivalent to 24.3% in 2017 up from 10.46% in 2016 80), it is not realistic to expect the required state financing that would allow for the needed structural changes and investments as proposed in this project. As is common, the currently under development Concept for the Innovative Development of the Hydrometeorological Service of the Republic of Uzbekistan[81], being fully in line with the conceptual

[79] World Bank: https://www.worldbank.org/en/country/uzbekistan/overview

[80] The State Committee of the Republic of Uzbekistan on Statistics (https://www.stat.uz/en/)

[81] https://regulation.gov.uz/ru/document/3336

design of this project, will not be fully funded from the state budget but will partially rather rely for its implementation on external sources.

Significant market shifts, such as the increasing ability and willingness of the export-oriented part of the horticultural sector to pay for customised agrometeorological information, can be expected in the middle-term. However the current system of agrometeorological services is unprepared to fully capitalise on such opportunities, as this would require structural changes, some of which are yet to take place. GFC financing can have a catalytic effect, at the same time improving the quality of agrometeorological services and demonstrating their potential and, eventually, user and market value so that a more sustainable model can be built.

Unlike in other parts of Central Asia, foreign investments in developing Uzbekistan's hydrometeorology as a whole have been so far small, only beginning to appear e.g. through World Bank's regional efforts, and are not yet sufficient to help change Uzhydromet's operating model. Aligning GCF funding with that of other international projects and initiatives focussing on both hydrometeorology and the agricultural sector, promise synergetic effects. An overview of potential synergies is provided in Table 4.5.

Finally, the connection between hydrometeorological services and the economic (i.a. agricultural) output in the context of climate change is yet to be fully understood in Uzbekistan, and the project expects to contribute to such understanding.

Country ownership and policy impact

The proposal is fully aligned with Uzbekistan's INDC (see Box 2.1) and policy decisions and documents concerning the development of modern climate-resilient agriculture at large and horticulture in particular (see Chapter 1).

As important adaptation measures, the submitted in 2017 INDC lists the improvement of climate resilience of agriculture through the diversification of food crops production pattern, resistance to pests and diseases, and crop varieties adopted to conditions of changing climate, as well as the further improvement of irrigation water management and innovative technologies for water saving. Raising awareness and improved access to information about climate change are deemed necessary for all groups of population, as is widening the participation of the public, women and local communities in climate-related planning and management. The project will directly address these dimensions by providing climate- / weather information for optimised agricultural operations, management and planning at the community level.

The draft agri-food development strategy 2019 to 2030[82] contains numerous references to the importance of accounting for climate change in agricultural planning and the needs to address it. The strategy specifically acknowledges the need for increased use of information from weather stations e.g. for modern irrigation scheduling, and suggests to employ the piloted extension services to strengthen capacity of farmers to adopt climate-smart farming practices (which would again require improved and more targeted agrometeorological support e.g. for optimising inputs and practices through precision farming). The mentioned above Concept for the Innovative Development of the Hydrometeorological Service of the Republic of Uzbekistan is fully in line with the conceptual design of this project too. Finally, as the National Adaptation Plan of Uzbekistan is in its early development through a preparation process recently approved by the GCF, the project offers considerable

[82] [Government of Uzbekistan] 2019

opportunities for synergies as well as a possibility to contribute to the agricultural part of NAP at the conceptual stage, thus further considerably raising GCF impact.

The national designation authority (Uzhydromet) is the initiator of the project idea and has been strongly involved in project development from the very beginning. Uzhydromet is committed to fully integrate project results in its daily operations. The project will not only help modernise agrometeorological network and service capacities, but will also assist Uzhydromet in making legal and operational changes necessary to make the transformation sustainable. Among other elements, it will help adopt a new business model of cost-recovery that will provide a more reliable foundation to the sustainability of Uzhydromet and its services for end users.

With agricultural producers and Uzhydromet being an integral part of design, the project will strive to establish strong long-term connections between the various users at all levels and Uzhydromet as the provider of agrometeorological services. These linkages will remain once the project is completed, and users will continue to interact with Uzhydromet in order to receive information they need. With mechanisms for user interaction and for monitoring user satisfaction built through the project, external demand will give strong push to the continuity of services and project results.

By fostering the vision and the sustainable business model for Uzbekistan's agrometeorological (and, indeed, hydrometeorological – see the upscaling potential above) services and by expanding the horizon for climate-informed strategic planning in agriculture the project will directly support the evolution of Uzbekistan's policy framework in these field. Indeed, in order to be implemented, such changes ought to be codified in Uzbekistan's legislative and policy documents, which is among the project's long-term impact ambitions (even though such legal and policy changes per se are not included in project outputs).

Many of the projects' conceptual ideas are also shared by Uzbekistan donors as is visible in he recent brief on the options for agricultural extension services[83], while most of the World Bank's climate-smart recommendations for Uzbekistan agriculture are directly relevant to the project objectives and are to be informed through improved agrometeorological information and services as shown in table 4.4 below.

Table 4.4 Adaptation options for Uzbekistan's agriculture

Category of adaptation	**Adaptation measures and investments**
A. Infrastructural	
Farm protection	Hail protection systems (nets) [a, b] Install plant protection belts [a] Lime dust on greenhouses to reduce heat [a] Vegetative barriers, snow fences, windbreaks [a] Move crops to greenhouses [a] Smoke curtains to address late spring and early fall frosts [a, b] Build or rehabilitate forest belts [a]
Water management	Enhance flood plain management (for example, wetland management) [a] Construct levees [a] Drainage systems Irrigation systems: new, rehabilitated, or modernized [a] Water harvesting and efficiency improvements [a]
B. Programmatic	

[83] [World Bank] 2019.

Extension and market development	Demonstration plots and/or knowledge sharing opportunities [a, b] Education and training of farmers via extension services [a, b] National research and technology transfer through extension programs [a, b] Private enterprises, as well as public or cooperative organizations for farm inputs [b] Strong linkages with local, national, and international markets for agricultural goods
Insurance and subsidies	Crop insurance [(b)] Subsidies and/or supplying modern equipment [(b)]
R&D	Locally relevant agricultural research in techniques and crop varieties [a,, b]
C. Farm management	
Crop yield management	Change fallow and mulching practices to retain moisture and organic matter [a, b] Change in cultivation techniques [a, b] Conservation tillage [a, b] Crop diversification [a] Crop rotation [a] Heat- and drought-resistant crops/varieties/hybrids [a] Increased input of agro-chemicals and/or organic matter to maintain yield [a, b] Manual weeding [b] More turning over of the soil [a] Strip cropping, contour bunding (or plowing) and farming [a] Switch to crops, varieties appropriate to temperature, precipitation [a] Optimize timing of operations (planting, inputs, irrigation, harvest) [b]
Land management	Mixed farming systems (crops, livestock, and trees) [a] Shift crops from areas that are vulnerable to drought [a] Switch from field to tree crops (agro-forestry) [a]
Pest and fire management	Develop sustainable integrated pesticide strategies [a, b] Fire management for forest and brush fires [a, b] Integrated pest management [a, b] Introduce natural predators
Water management	Intercropping to maximize use of moisture [a, b] Optimize use of irrigation water (for example, at critical stages of crop growth, at night) [b] Use water-efficient crop varieties [a]
D. Indirect adaptation	
Market development	Physical infrastructure and logistics for storing, transporting, distributing farm outputs
Education	Increase general education level of farmers [a, b]
Water management	Improvements in water allocation laws and regulations Institute water charging or tradable permit schemes

Source: adapted from the World Bank[84]

a The project will contribute to strategic adaptation by providing information and advice about long-term climate changes and their implications for horticultural planning.

b The project will contribute to operational adaptation by providing timely agrometeorological information and advice for precision horticulture on the farm level.

Efficiency and effectiveness

This project's strong focus on user needs will contribute to project effectiveness, as agrometeorological services will be designed and delivered so that users can receive exactly the

[84] Sutton et al. 2013.

information they need and can use, in the formats and through channels they can access and understand. Consequently, project results will be directly linked to the actual production needs and outputs of fruit and vegetable growers and other players up the agricultural value chain.

The (cost-)efficiency of interventions will be ensured by building them upon Uzhydromet's existing infrastructure and capacities, gradually renovating, replacing and expanding them; and by relying on sustainable, cost-efficient and, where possible, locally-sourced technological solutions (e.g. providing bicycles rather than motor vehicles for surveying fields around agrometeorological stations).The best available local and international expertise and technology will be solicited through competitive procurement procedures which are otherwise routinely used by the accredited and executing entities which are to implement the project.

The project will rely on the best available expertise within and outside of the UN system, as well as the worlds' best practices in the field of agrometeorology through the application of highly competitive procurement procedures and relying on collaboration with partners such as the WMO which strongly supports the project rationale and is willing to extend technical and operational support to its implementation.

Feasibility of the proposed solution against alternatives

Uzhydromet is the key provider of agrometeorological services in Uzbekistan. Agrometeorological information and forecasts are regularly published in various formats (see chapter 3 above), some of which are available on-line. With its position, experience and geographical reach, there is presently no alternative to providing comparable services to the population, which is largely unable to pay for them but is critical to ensuring the resilience of Uzbekistan's horticulture.

Furthermore, being a state service, Uzhydromet is also in a unique position to be able to mobilise institutional support for extending the use of its information both on the central level (the Ministry of Agriculture) and within the regions through local authorities, the regional agricultural departments and the research and the educational system.

At the same time Uzhydromet's agrometeorological network has for a long time suffered from underfunding and lack of modernisation (chapter 3). The core of the network of 60+ hydrometeorological stations with agrometeorological observation programmes and 30+ agrometeorological observation posts dates back to the Soviet time and can no longer provide modern services to the agricultural community. Furthermore, agrometeorological (and, at large, climate and hydrometeorological) services have been traditionally oriented towards state and regional authorities, with little experience and infrastructure to carry information down to agricultural end users and to integrate with it directly usable agronomic and agroecological advice. There is also little experience in the country of translating and using climate-change knowledge to support long-term agricultural planning at all levels: from the central government to small and individual farms. Therefore, while Uzbekistan strongly promotes expanding horticulture, it has so far invested little in improving the effectiveness and sustainability of its agrometeorological system.

There are also other limitations on the current capacities for, and practices of, the production and publication of analytical agrometeorological information:

- at the moment, agrometeorological forecasts are produced manually, with no use of modern automated analytical systems or software;
- pest and decease development forecasts are not produced at all;

- information and forecasts are not sufficiently localised, at best being provided at the regional / oblast levels;
- a large array of retroactive agrometeorological data which could be used to calibrate models, improve forecasting techniques and analyse longer-term trends are still stored on paper and are at risk at eventually being lost.

Agricultural producers including small-scale farmers are keen to use meteorological and agrometeorological information too, and do so to the possible extent. Yet the local reach of such information is at present very limited. As most information products from Uzhydromet are intended for higher management levels, quite often end users do not get the information contained in there at all, although some of it is available on-line or is made available in other ways by regional and district authorities. And even if they do, they do not necessarily have sufficient knowledge of how to effectively use it.

Although privately-owned weather stations for real-time monitoring of local meteorological conditions exist and their number is increasing, the low ability of users to pay for their services makes this approach unfeasible in the near future. However the fact that tangible demand for such information nonetheless exist too points to longer-term future economic opportunities for private providers of weather and agrometeorological information and targeted services – and to the need to strengthen coordination of data flows and, eventually, the exchange of data, as at the moment there is no formal interaction between the owners and operators of such private installations on one side, and Uzhydromet on the other side. For this reason the project includes exploration of such opportunities and of how they could be used to further strengthen agrometeorological services in Uzbekistan.

Finally, remotely sensed / space data may in the longer run be a useful supplement to the ground network of Uzhydromet, however they are unlikely to ever fully replace it.

Above all, data delivery and feedback mechanism at the farm level, including well functioning agrometeorological support through extension services, would need to be build in any case and will require in-the-ground work as proposed under the current project design.

Project implementation modalities

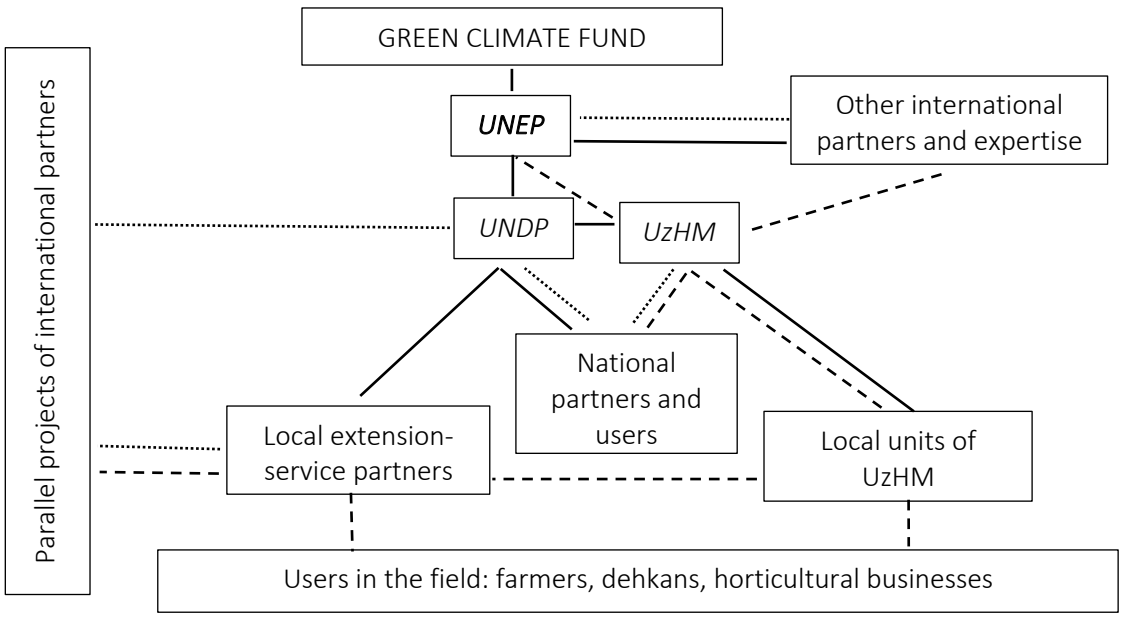
Being the leading global environmental agency with overall responsibility in the field of delivering environmental information for action, and having operational experience and regional presence in Central Asia, the UN Environment Programme (UNEP) is well placed to lead the project. As per its GCF Entity Work Programme, UNEP offers more than 20 years of experience working on climate change. It brings a comprehensive approach to climate change mitigation and adaptation that is grounded in both natural and economic science and is tied to the environmental and development concerns of countries. Based on its core science-based mandate, one of UNEP's seven sub-programs is entirely dedicated to keeping the world environment under review. Through its Science Division, UNEP has longstanding expertise in environmental and climate change information management and early warning. For example, with GEF and EC funding it is currently supporting over 50 countries in establishing or strengthening their environmental information management systems and using them for SDGs and MEA (amongst others) reporting. Through its global work on early warning and foresight, UN Environment enables stakeholders to respond to the latest emerging issues related to environment and climate change. Other examples include the CLIMWARN and Country Level Impacts of Climate Change (CLICC) projects managed within the Science Division, the Shared Environmental

Information Systems (SEIS), environmental monitoring and environmental statistics project activities implemented in the Pan-European region (including Central Asia) by UN Environment Europe Office, and the strong convening power at regional and sub-regional level in Central Asia.

UNEP convenes and facilitates regional environmental information networks and the world adaptation science program PROVIA. In the Pan-European region, UNEP Office actively supports the organization of the UNECE Working Group on Environmental Monitoring and Assessment and UNECE Joint Task Force on Environmental Indicators (JTF) that regularly convene environmental information experts and statistics from Eastern European Caucasus and Central Asia (EECCA) countries, including from Uzbekistan. UN Environment Europe Office, through its Sub-regional Office for Central Asia in Almaty, Kazakhstan, is also active in building capacity of environmental authorities and statistical offices in Central Asian countries in the promotion of Shared Environmental Information System (SEIS) principles of open access to environmental data. UNEP's Europe Office will assure overall strategic, managerial and substantive responsibility for project design, implementation and results, partnering with UNDP Uzbekistan Country Office and Uzhydromet as in-country executing partners for activities on the ground.

While keeping the overall strategic, managerial and substantive responsibility for project design, implementation and results, for activities on the ground it will enter into agreements with UNDP Uzbekistan country office and Uzhydromet as in-country executing partners, which will oversee and implement the project both centrally in Tashkent and in the 57 selected rural locations in accordance to well-established and tested project management guidelines and practices. As a co-Executing Entity, UNDP Uzbekistan Office, together with Uzhydromet, will be responsible for channelling GCF proceeds and the actual implementation of project activities.

Figure 4.3 Project implementation arrangements



Bold: Implementing agency Italic: Executing agencies Flows of:

- GCF project funds (parallel funds flows are not shown)
- guidance and advice
- cooperation and coordination

UNDP has extensive experience in the implementation of projects and programmes in Uzbekistan. In 2015 UNDP with Uzhydromet assessed climate change vulnerability across different provinces and sectors of economy and developed the first Climate Risk Profile for Uzbekistan. Uzhydromet has a long history of collaboration with UNDP and has carried out several joint projects, including technical assistance to Uzhydromet for designing and providing training programs for climatologists, as well as support for seminars and the supply of technological equipment to the Uzhydromet. The most relevant UNDP-Uzhydromet project funded by the Adaptation Fund has developed a drought EWS for the Amu Darya basin, incorporating automatic weather stations, use of new remote sensing techniques, improved prediction of river runoff and tools for disseminating information to farmers. Furthermore, between 2005-2016 UNDP has implemented 23 development projects associated with climate change with total value of USD 39.3 million.

The Centre of Hydrometeorological Service under the Cabinet of Ministers of the Republic of Uzbekistan (Uzhydromet) is the state agency for hydrometeorological services. Uzhydromet is tasked with the management, development and improvement of the state system of hydrometeorological observations; analysis, forecast and other hydrometeorological services for economic sectors and other users; and research in the field.

Besides their own staff and capacities, the executing partners will also rely on cooperation and services of a broad range of both national and international external providers such as:

- IT and communication companies – for developing information and communication infrastructure and services of the agrometeorological network;
- climate and agricultural research centres – for improving the analysis and delivery of climate-change information in support of horticultural planning nationally and locally levels;
- agricultural research and training establishments for agroecological and agrotechnological training of Uzhydromet staff;
- local/ regional agricultural universities and colleges, agricultural consulting companies and organisations, oblast- and district-level agricultural authorities for building and delivering extensions services in rural areas.

UNEP's project implementation procedures and safeguards will be used to ensure the smooth implementation of the project, the management of funds, programme quality assurance, fiduciary risk management, timely delivery of financial and programme reports to GCF and other requirements as per AMA requirements. UNEP will inter alia manage the disbursement of funds to UNDP as well as to other external organisations (as well as individual experts) on the international level.

On the country level the project will be implemented following UNDP's National Implementation Modality (NIM), according to the Standard Basic Assistance Agreement between UNDP and the Government of Uzbekistan (10 June 1993) and the policies and procedures outlined in the UNDP POPP[85]. Uzhydromet as the Implementing Partner/Executing Entity for the project and will be accountable to UNDP for managing it, including the monitoring and evaluation of project interventions, achievement of project outcomes, reporting and effective use of UNDP resources.

The Project Board will be composed of representatives of UNDP and Uzhydromet and other selected ministries as appropriate (e.g., Economy, Finance, Agriculture, Water resources) as well as other key national partners and international partners engaged in parallel activities. The Project Board will be responsible for taking, by consensus, management decisions in accordance with standards that shall

[85] See https://info.undp.org/global/popp/ppm/Pages/Defining-a-Project.aspx

ensure management for development results, best value for money, fairness, integrity, transparency and effective international competition.

The National Project Director (NPD) will be appointed to execute the project on a day-to-day basis on behalf of Uzhydromet and will be accountable to Board. The NPD's prime responsibility will be to ensure that the project produces results specified in the project document, meet required standard of quality, timeliness and cost criteria. In addition, the NPD will be a liaison between UNDP and Uzhydromet as well as will other key organisations engaged in various components and activities as responsible parties / strategic partners. The Project Manager at UNDP will manage the project on a day-to-day basis.

The informal Technical Advisory Working Groups (TAWG) will support the project and will provide inputs to and endorsement of the design and quality of the project outputs. TAWGs members will be drawn from government, private sector, academia and civil society to provide guidance and technical advice on the project. A balanced representation of women and men in the TAWGs will be ensured. A Gender Advisor will be engaged by the project and will be a member of all TAWGs to ensure that gender is adequately mainstreamed in all technical discussions.

GCF funds will support the worktime of local and international project staff and core consultants, the procurement of hardware, software and external services, meetings, travel, communication and contingencies as outlined in Table 4.5. In a variety of ways GCF funds are expected to be matched by national and the international project cooperating partners.

Table 4.5 Estimated budget and cofinancing per project component

Project component	GCF budget, M USD	Matching budget, M USD	Matching sources		
			Uzhyd -romet	UNEP	UNDP
User-driven and climate-responsive agrometeorological services	**0.3**	**0.3**	x	x	x
Modernized collection of agrometeorological data in fruit- and vegetable-growing districts	**4.6**	**1.9**	x		
Improved processing, delivery and increased use of agrometeorological information	**6.8**	**0.2**	x		
Climate-informed planning of agricultural land-use, crop selection and agrotechnology for fruit and vegetable production	**0.6**	**0.2**	x	x	
Project management	**2.2**	**0.4**	x	x	x
TOTAL	**14.5**	**3.0**			

The overview of synergies through parallel financing is given in table 4.7. Most of the organisations listed in the table have confirmed their in-principle interest in cooperation, although the actual scale and modalities of co-funding are yet to be fully discussed.

Table 4.6 Tentative workplan per project component

	Y1	Y2	Y3	Y4
Shaping agrometeorological services				
User needs assessment, setting user feedback mechanisms	•	•	•	
long-term vision of agrometeorological services	•	•		
Legal, institutional and operational / business-model changes		•	•	•
Modernising the agrometeorological observation network				
Modernising agrometeorological observations and data transfer	•	•		
Training staff of agrometeorological stations		•	•	
Assessing potential / modalities of small / portable weather stations			•	•
Improving agrometeorological data processing and user services				
Modernizing capacities and expertise for agrometeorological data processing	•	•		
New formats and channels for delivering agrometeorological information	•	•	•	
Improving agroecological knowledge among Uzhydromet staff		•	•	
Developing extension services in the target districts		•	•	•
Introducing climate-informed horticultural planning				
Electronic safeguarding of agrometeorological time-series' archives	•	•		
Production of information about climate-change impacts on horticulture	•	•	•	•
Regular delivery of this information in print, electronically and face-to-face		•	•	•

Table 4.7 Synergies with selected parallel international projects

Organisation	Project [a]	Timeframe	Parallel [b] (total [c]) budget USD	Matching parallel activities	Details [f]
UNDP	Climate resilience of farming communities (Karakalpakstan)	2014 – 2020	1.5M (5.19M)	Automation of 5 agrometeorological stations. Set up and operation of 3 local extension centres. Data management and communication infrastructure.	1, 2
	Adaptation and resilience of farming in the Fergana Valley	2018 – 2020	0.5M (0.8M)	Capacity building for climate information users. Installation of small weather stations. Extension services and awareness raising.	3
FAO	Central Asian Initiative for Land Management II	2018 – 2022	0.5M (10.9M)	Automation of 9 agrometeorological stations in the Kashkadarya and the Jizak oblasts, training in drought monitoring, improving yield forecasting and agricultural production (Component 1, 2M)	4
World Bank	Horticulture Development Project	2015 – 2023	2.5M (637.4M)	Potential interest in use of climate knowledge and extension services (Component 1, total volume in 2018 – 2023 is 24.M).	5
	Climate adaptation and mitigation programme for the Aral Sea basin	2015 – 2021	0.5M (44.8M)	Regional climate knowledge services (12.5M), including upgrading monitoring networks and improving the use of climate information by end users.	6
	Central Asia Hydrometeorology Modernization Project	2011 – 2021	1.5M (27.7M)	Improving the management and provision of information by national hydrometeorological services (Component A, total volume USD 8.7M) .	7
Asian Development Bank	Horticulture Value Chain Development Project	2017 – 2021	-- [d] (567M)	Loans for horticultural production, storage improvement and processing. Potential interest in extension services.	8
OSCE	Support to development of farming and integration by promotion of web technologies	2018 –2019	-- [e]	Development of electronic information services for farmers	9
USAID	Agricultural Value Chain	2015 – 2020	1M (14M)	Extension / advisory services in 33 districts / 12 provinces Horticulturalist chat groups / mobile applications.	10, 11
GIZ	Sustainable Economic Development in selected regions of Uzbekistan	2015–2019	(10,3M)	Promotion / support of horticultural value chain in selected regions of Uzbekistan, incpuding extension services	12

a Project titles are shortened for convenience, for full details please see the references below.

b Parallel budget estimates are based on the available documentation and meetings during the international fact-finding missions to Tashkent in September 2018 an in June 2019. Most of the organisations confirmed their in-principle interest in cooperation, however the actual scale and modalities of possible co-funding are yet to be discussed during the full project development phase.

c Total budgets are shown where such information is available.

d The project provides loans to horticultural establishments, possibilities of co-funding agrometeorological support are at this point unclear.

e Specific budget information is not available, the total 2019 budget of 42 projects implemented by OSCE Project Coordinator in Uzbekistan is €2.5M.

f Project detail references:

(1) http://www.uz.undp.org/content/uzbekistan/en/home/operations/projects/environment_and_energy/developing-climate-resilience-of-farming-communities-in-the-drou.html

(2) https://www.adaptation-fund.org/project/developing-climate-resilience-of-farming-communities-in-the-drought-prone-parts-of-uzbekistan/

(3) Enhancing the adaptation and strengthening the resilience of farming to Climate Change Risks in Fergana Valley. Draft UNDP project proposal to Climate change window of RTFD, April 2018

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ANNEX I Round-table consultations for the development of the Green Climate Fund project

Developing agrometeorological services for climate change resilient production of fruit and vegetables in Uzbekistan

Date: 11 June 2019

Venue: Business Center “Poytaxt”, 16, Sh. Rashidov street, Tashkent

AGENDA

Time	Session	Participants
09:30-10:00	Registration of participants	
10:00-10:30	Opening. Welcome speech Introduction of participants	Uzhydromet, UNDP, UNEP
10:30-11:30	Project presentation. Brief summary of the GCF proposal “Developing agrometeorological services for climate change resilient production of fruit and vegetables in Uzbekistan” Perspectives and synergetic activities of Uzhydromet, UNDP, UNEP, FAO, Ministry of Agriculture and others	Nickolai Denisov, International Expert
11:30-11:45	Coffee-break	
11:45-12:45	Perspectives and synergies with international organizations, end-users and partners of the project Follow-up discussion and reflections of the concept and proposed project components activities (projects of the World Bank, ADB, EU Delegation, OSCE, GIZ, USAID and other related organizations Ministry of Agriculture, Council of Farmers, Agro-producers, extension service providers, others)	Participants of the meeting
12:45-13:00	Road ahead, conclusions and closure	Uzhydromet, UNDP, UNEP
13:00-14:00	Lunch	

LIST OF INVITEES

Ministry of Emergencies

Ministry of Economics

Ministry of Foreign Affairs

Ministry of Finance

Ministry of Health

Ministry of Agriculture

Ministry of Water Resources

Ministry of Foreign Economic Relations, Investments and Trade

State Committee for Ecology and Environmental Protection

Uzbekenergo SJSC

Chamber of Commerce and Industry

Agency for Restructuring Agricultural Enterprises

The Council of Farmers, Dekhkan Farms and Landowners of Uzbekistan

National Association of Non-Governmental and Non-Commercial Organizations

Mahmud Mirzaev Research Institute of Horticulture, Viticulture and Winemaking

Tashkent State Agrarian University

Institute of Forecasting and Macroeconomic Research

Center for Economic Research

UNDP Uzbekistan

World Bank

Asian Development Bank

Regional Representation of the International Center for Agricultural Research in the Dry Areas of Central Asia and the Caucasus (ICARDA)

FAO

Uzbekistan AVC USAID project

GIZ

OSCE

Farmers' representatives

Representatives of agricultural information and consulting services

SELECTED PHOTOS






ANNEX II Regional consultations in the Samarqand oblast

Meetings with regional stakeholders in developing agrometeorological services for climate change resilient production of fruit and vegetables in Uzbekistan, 12 June 2019:

Regional Department of Hydrometeorology
Samarqand State University
Regional Department of Agriculture
Intensive gardens enterprise (fruits and derived products)
Agromir Business Group (fruit juice and preserves for domestic and export markets)
Branch of M. Mirzaev Research Institute of Horticulture, Viticulture and Winemaking
Samarqand Agricultural Extension Centre

ANNEX III **Project infographics** (English and Russian)

DEVELOPING AGROMETEOROLOGICAL INFORMATION SERVICES FOR CLIMATE CHANGE RESILIENT PRODUCTION OF FRUIT AND VEGETABLES IN UZBEKISTAN (2020-2023)

PROJECT LONG-TERM GOAL:

- Increased resilience of vulnerable rural communities and people;
- Increased health, well-being and food security of Uzbekistan at large.

MAIN ACTIVITIES:

- Support to long-term climate-informed planning of horticultural land-use, crop selection and agrotechnology
- Improvement of agrometeorological data processing, delivery and use
- Modernization and automation of agrometeorology data collection in 57 districts
- Helping in development of user-driven, climate responsive agrometeorological services

END-USERS/BENEFICIARIES:

estimated over **7 million** dehkans and farmers in **57** fruit- and vegetable-growing rural districts of Uzbekistan

45% of rural and **23% of the total population** of Uzbekistan)

IMPLEMENTATION:

UNEP, UNDP, Uzhydromet

IN COOPERATION WITH

ADB, OSCE, FAO, USAID, World Bank, Government of Uzbekistan

BUDGET:

USD 14.5 million from the Green Climate Fund

USD 3 million co-financing by Uzbekistan, UNEP and UNDP

UN environment | WORLD RESOURCES INSTITUTE | UNDP

By 2040 yields of selected horticultural crops may decrease by 40-60% due to climate change. (World Bank)

PROJECT IMPLEMENTATION MAP

26 meteorological stations to be automated under the GCF project

13 agrometeorological posts to be automated under the GCF project

GCF-supported extension service around infrastructure automated through parallel financing

9 stations to be automated under FAO project

5 stations automated by UNDP project

4 sites automated through other parallel contributions (China, USAID)

+23 local, regional and central soil quality laboratories *(not shown on the map)*

GCF Readiness Project in Uzbekistan, the joint project of Center for Hydrometeorological Service under the Cabinet of Ministers of the Republic of Uzbekistan, UNDP, UN Environment and WRI

For additional information visit our websites www.uz.undp.org, www.meteo.uz and gcf.climatechange.uz

РАЗВИТИЕ АГРОМЕТЕОРОЛОГИЧЕСКОГО ОБСЛУЖИВАНИЯ КЛИМАТОУСТОЙЧИВОГО ПРОИЗВОДСТВА ПЛОДООВОЩНОЙ ПРОДУКЦИИ В УЗБЕКИСТАНЕ (2020-2023)

ДОЛГОСРОЧНАЯ ЦЕЛЬ:

Повышение устойчивости особо уязвимого сельского населения к изменению климата

Улучшение здоровья, благосостояния и продовольственной безопасности населения Узбекистана

РЕЗУЛЬТАТЫ ПРОЕКТА:

Поддержка климатически обоснованного планирования землепользования, выбора сортов и технологий выращивания фруктов и овощей

Совершенствование обработки, предоставления и использования агрометеорологических данных

Модернизация и автоматизация сбора данных в интересах агрометеорологии в 57 районах страны

Помощь в развитии агрометеорологического обслуживания, ориентированного на потребителей и учитывающего изменчивость климата

КОНЕЧНЫЕ ПОЛЬЗОВАТЕЛИ/БЕНЕФИЦИАРЫ

более **7 МИЛЛИОНОВ** дехкан и фермеров выращивающих плодоовощную продукцию в **57** сельских районах сельских районах Узбекистана

45% СЕЛЬСКОГО и **23%** от общего количества **НАСЕЛЕНИЯ** Узбекистана

ИСПОЛНИТЕЛИ ПРОЕКТА:

ЮНЕП

ПРООН

УЗГИДРОМЕТ

В СОТРУДНИЧЕСТВЕ С

ВБ

ОБСЕ

АБР

ФАО

ЮСЭЙД

ПРАВИТЕЛЬСТВО УЗБЕКИСТАНА

ОБЪЁМ ФИНАНСИРОВАНИЯ:

Зеленый климатический фонд - **14,5 МИЛЛИОНОВ ДОЛЛАРОВ США**

Со-финансирование со стороны Правительства Узбекистана, ЮНЕП и ПРООН **3 МИЛЛИОНА ДОЛЛАРОВ США**

[1]Источник: Всемирный банк

UN environment · WORLD RESOURCES INSTITUTE · UNDP

Из-за изменения климата к 2040 году урожайность некоторых фруктов и овощей может снизиться на 40–60%. (Всемирный банк)

КАРТА РЕАЛИЗАЦИИ ПРОЕКТА

26 метеорологических станций, которые будут автоматизированы в рамках проекта ЗКФ

13 метеорологических постов, которые будут автоматизированы в рамках проекта ЗКФ

СОВЕРШЕНСТВОВАВАНИЕ В РАМКАХ ПРОЕКТА ЗКФ ПРЕДОСТАВЛЕНИЯ КОНЕЧНЫМ ПОЛЬЗОВАТЕЛЯМ ИНФОРМАЦИИ, ПОЛУЧАЕМОЙ В РАМКАХ ПАРАЛЛЕЛЬНЫХ ПРОЕКТОВ

9 метеостанций, автоматизированных в рамках проекта ФАО

5 метеостанций, автоматизированных в рамках проекта ПРООН

4 станции/поста, автоматизированных в рамках других проектов (КНР, США)

+23 местные, региональные, центральные лаборатории анализа качества почвы *(не показаны на карте)*

Совместный проект Центра гидрометеорологической службы при Кабинете Министров Республики Узбекистан, Программы Развития ООН, ООН Окружающая среда и Института мировых ресурсов «Программа подготовки Узбекистана к доступу к ресурсам Зеленого климатического фонда».

Для получения дополнительной информации свяжитесь с нами: www.uz.undp.org, www.meteo.uz, gcf.climatechange.uz

ANNEX IV ’Market-place poster’ for GCF Global Programming Conference *Realising Climate Ambitions*, 19–23 August 2019, Songdo

UZBEKISTAN

GREEN CLIMATE FUND | GLOBAL PROGRAMMING CONFERENCE

Project title	DEVELOPING AGROMETEOROLOGICAL INFORMATION SERVICES FOR CLIMATE CHANGE RESILIENT PRODUCTION OF FRUIT AND VEGETABLES IN UZBEKISTAN

Result areas	Sector	Total financing, USD	GCF financing, USD	Financial instrument
Most vulnerable people, communities and regions Health and well-being, and food and water security	Public	17,5 million	14,5 million	Grant

Description of specific climate change problem and how the project will address it	Fruit and vegetables provide livelihoods to Uzbekistan's rural population, support food security, and contribute significantly to national exports. However the current and especially future horticultural production is increasingly threatened by aridity, scarcity of water and the frequency of extreme weather events. World Bank estimates that, under high-impact scenario and without robust steps to increase productivity and climate resilience of farming practices, yields of horticultural crops such as tomatoes, potatoes and apples can by 2050 be reduced by 35–45% in most agroecological zones of Uzbekistan, and up to 56–64% in the Eastern piedmont area. The project is designed to help Uzbekistan enhance agrometeorological observations, analysis, forecasting and end-user support services for climate-smart horticulture, thus contributing to its adaptation through improved planning of crops and land use, optimised agrotechnology practices and inputs. The project will introduce greater more systematic knowledge about climate variability into horticultural planning and operations on the strategic level of agricultural policy, and will thus support the expansion of the sector in line with the current policies of the Government of Uzbekistan seeking to transition farmers from traditional cotton production to higher-value and less-water intensive horticultural crops.
Alignment with key country priorities and stakeholders engaged	Provisions of the (I)NDC in the domains of adaptation of agriculture and of the social sector to climate change Policy of the Government of Uzbekistan' towards the accelerated development of the horticultural sector and extending its land-use Agricultural modernization strategy 2020 and the development of agricultural extension services in Uzbekistan

UZBEKISTAN

GREEN CLIMATE FUND | GLOBAL PROGRAMMING CONFERENCE

Project title:	DEVELOPING AGROMETEOROLOGICAL INFORMATION SERVICES FOR CLIMATE CHANGE RESILIENT PRODUCTION OF FRUIT AND VEGETABLES IN UZBEKISTAN
Activities	• Business and institutional development of agrometeorological services • Modernization and automation of agrometeorological data collection, processing, analysis and forecasting, • Production and delivery of innovative information products for horticultural farming both directly and through extension services • Technical advice and training for Uzhydromet, agricultural extension centres, farmers and dehkans • Development and systematic delivery of strategic-level climate information relevant for national- and regional-scale horticultural planning
Expected outcomes	• User-driven and climate-responsive agrometeorological services in Uzbekistan • Modernized collection of agrometeorological data in 57 fruit- and vegetable-growing districts of Uzbekistan • Improved processing, delivery and use of agrometeorological information for fruit and vegetables production at farm level • Climate-informed long-term planning of land-use, crop selection and agrotechnology for fruit and vegetable production in Uzbekistan
Paradigm shift potential	• *Invert the traditional supply-focussed approach to providing climate and hydrometeorological information by bringing end users to the fore of the design and implementation of agrometeorological services, and by linking their delivery to users' needs in line with WMO's Global Framework for Climate Services* • *Help redesign the business and institutional model of providing agrometeorological (and eventually, climate and hydrometeorological) information by linking it to the modern principles of public access to information as well as to the actual and prospective user demand and market potential* • *For the first time, bring long-term climate-change knowledge directly into Uzbekistan's strategic agricultural planning by building robust capacities for continuously supplying relevant, understandable and actionable climate information to the various parts and players of the horticultural value chain.*