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DEUTSCHE ZUSAMMENARBEIT

Sustainable Agricultural Practices Under a Changing Climate

Implemented by:

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

RISHA SOLUTIONS

Sustainable Agricultural Practices Under a Changing Climate

ABSTRACT

This synthesis report is a collection of successfully applied sustainable agricultural practices in Tajikistan. Different agricultural projects and farmers were interviewed on their agricultural approach based on which we derived a series of best practices that have proven to be successful in different areas and climates in Tajikistan.

This publication was produced with the financial support of the European Union and the German Federal Ministry for Economic Cooperation and Development, BMZ. Its contents are the sole responsibility of GIZ and Risha Solutions and do not necessarily reflect the views of the EU or the Federal Ministry for Economic Cooperation and Development, BMZ.

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Abbreviations

ACTED	Agency for Technical Cooperation and Development
AKF	Aga Khan Foundation
ASDP	Agency for the Support of Development Processes
DAI	Development Alternatives, Inc.
FFS	Farmer Field Schools
GDP	Gross Domestic Product
GERES	Group for the Environment, Renewable Energy and Solidarity
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
GmbH	Limited Liability Company
ICPO	International Charity Public Organisation
IPD	Innovations and Participation for Development
IPBES	The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPM	Integrated Pest Management
IRDP/TRIGGER	Integrated Rural Development Project/Towards Rural Inclusive Growth and Economic Resilience
MSDSP	Mountain Societies Development Support Programme
N/A	Not applicable
N/I	no information
NCC	Non-commercial Cooperative
NGO	Non-Governmental Organsation
PITTU	Polytechnic Institute of Tajik Technical University
PO	Public Organisation
ToT	Training of Trainers
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environmetal Programme
WFP	World Food Program
WHH	Deutsche Welthungerhilfe
WRM	Water Resources Management
WUAs	Water User Association

Image: Landscape in Tajikistan @Risha Solutions

Introduction

The territory of the Republic of Tajikistan is one of the world's hotspots for species diversity and living organisms and plays an important role in the conservation of global biodiversity.[1] The geographical position of the country in the centre of the Eurasian continent at the junction of different floristic and faunal regions of the Northern Hemisphere, among the powerful mountain systems of Central Eurasia, large deserts and a complex landscape, contributed to the concentration of the richest biological diversity with numerous endemic species.

The following report documents sustainable farming practices for the **Integrated Rural Development Project (IRDP)/Towards Rural Inclusive Growth and Economic Resilience (TRIGGER)** implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ GmbH), funded by the German Federal Ministry for Economic Cooperation and Development and co-financed by the European Union.[2]

IRDP/TRIGGER sets out to include a **climate change and resilience perspective** across all its components, as climate change has severe impacts on Tajikistan's economy and specifically on the agricultural sector as well as on water supply systems. The Project is particularly building and strengthening expertise on climate change and **sustainable agriculture.** Thereby, the value chain approach will be complemented by a farming system perspective and increased green and resilient agrotechnological practices to promote climate change adaptation and **biodiversity conservation.** Furthermore, climate change management will be introduced to agribusinesses and further strengthened in water resource management at the basin level.

The need for sustainable agriculture owes its origin to the philosophy of **'holism'**, which conveys and represents the interconnectedness of agricultural systems. The conservation and sustainable use of scares natural resources enables sustaining production rates and promotes a sustainable growth rate of the agricultural system.

The following synthesis report summarizes successful agricultural practices currently in use in Tajikistan that contribute to a sustainable agricultural production system.

The **purpose** of this report on sustainable agricultural practices is to **illustrate best practices for sustainable soil, plant, and water management.** The described best practices have all been successfully implemented by diverse national and international organizations alike and deem to be suitable for replication and scaling.

The illustrated farming practices provide an overview and servce as an inspiration for implementing organisations and village advisors to support the adaptation to climate change and increasing biodiversity, thus and strengthen the resilience of farmers.

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1. МПБЭУ (2018): Summary for policymakers of the regional assessment report on biodiversity and ecosystem services for Europe and Central Asia of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. M. Fischer, M. Rounsevell, A. Torre-Marin Rando, A. Mader, A. Church, M. Elbakidze, V. Elias, T. Hahn, P.A. Harrison, J. Hauck, B. Martín-López, I. Ring, C. Sandström, I. Sousa Pinto, P. Visconti, N.E. Zimmermann and M. Christie (eds.). МПБЭУ secretariat, Bonn, Germany. 48 pages https://doi.org/10.5281/zenodo.3237428
2. National Strategy and Action Plan for the Conservation and Rational Use of Biodiversity of Tajikistan - Dushanbe 2003

Biodiversity in the Agricultural Sector of Tajikistan

Biodiversity is of utmost importance for the agricultural sector. Biodiversity provides a multitude of ecosystem services, vital for environmental sustainability and human well-being. The natural capital of agricultural landscapes is a source of food, fibre, firewood, fodder and provides additional ecosystem services such as nutrient cycling, soil fertility, water conservation and pollination. The richness of genetic diversity in the agricultural landscapes guarantees better adaptation to changing conditions such as severe droughts, the variability of precipitation, early and late frost events as well as other weather extremes. Adaptation to climate change is gaining urgency globally and, in this regard, sustainable farming and biodiversity conservation play a key role in addressing the challenges due to extensive land degradation and the consequent loss of ecosystem services but also in alleviating threats posed by climate change. The livelihood and food security of many citizens, particularly rural communities depend heavily on the biodiversity of agricultural landscapes, be it subsistence farming or income earned from the cultivation of crops, orchards or livestock breeding.

However, plant and species diversity, which provide for food security and human well-being, are under increasing threat due to the overuse of ecosystems or unstainable land use practices, with climate change putting further stress on these ecosystems. Particularly in Central Asia, biodiversity is in rapid decline.[3] According to the report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (МПБЭУ) for Europe and Central Asia, 21% of endemic species and 11% of critically endangered species are under threat. Agriculture, the biggest economic sector in Tajikistan plays a notable role here. The increase in animal husbandry is one of the major drivers for biodiversity loss and also contributes significantly to the rise in greenhouse gas emissions. The latest Economics of Land Degradation Report[4] further states that 40-100% of the arable land in Central Asia is degraded, thus highly vulnerable to climate change as well.

Tajikistan has ratified the Convention on Biological Diversity, as well as the Nagoya and the Cartagena protocol. The National Strategy and Action Plan for the conservation and rational use of biodiversity, developed in accordance with the state environmental policy, contribute to the sustainable environmental development of the country. They are focused on the adoption of coordinated decisions in the use of biological resources and contribute to the harmonisation and convergence of the ideas of scientists, scientific research and government directives and their implementation on the ground. With the agrarian reform program from 2020 to 2030 of the Republic of Tajikistan and the countries commitment to the Convention on Biological Diversity's Kunming-Montreal Global Biodiversity Framework[5], it is expected that biodiversity conservation and sustainable agriculture find a significant increase in importance.

Despite these international and national commitments to protect the country's diversity, there has been a continuous decline in species diversity, specifically in agrarian landscapes, threatening the ecological bal-

3. МПБЭУ (2018): Summary for policymakers of the regional assessment report on biodiversity and ecosystem services for Europe and Central Asia of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. M. Fischer, M. Rounsevell, A. Torre-Marin Rando, A. Mader, A. Church, M. Elbakidze, V. Elias, T. Hahn, P.A. Harrison, J. Hauck, B. Martín-López, I. Ring, C. Sandström, I. Sousa Pinto, P. Visconti, N.E. Zimmermann and M. Christie (eds.). МПБЭУ secretariat, Bonn, Germany. 48 pages https://doi.org/10.5281/zenodo.3237428

4. Mirzabaev, A., Goedecke, J., Dubovyk, O., Djanibekov, U., Le, Q.B., Aw-Hassan, A. (2016). Economics of Land Degradation in Central Asia. In: Nkonya, E., Mirzabaev, A., von Braun, J. (eds) Economics of Land Degradation and Improvement – A Global Assessment for Sustainable Development. Springer, Cham. https://doi.org/10.1007/978-3-319-19168-3_10

5. Kunming-Montreal Global biodiversity framework: https://www.cbd.int/doc/c/e6d3/cd1d/daf663719a03902a9b116c34/cop-15-l-25-en.pdf

ance in the natural ecosystems of Tajikistan and the enforcement of laws concerning biodiversity is weak. As a consequence, many species of plants and animals have become rare and endangered.[6] Along with natural factors, agricultural production and other industrial development have played a significant role in the decline of biodiversity. This specifically as the agricultural sector still dominates the country's economy.

Definition of Sustainable Agriculture and best practices

While the terms **sustainable farming and sustainable agricultural practices** are loosely defined in the literature, the project follows the definition along the resilience concept, balancing economic, social and environmental factors.[7] This is in line with the United Nations Environmental Programme's (UNEP) definition that sustainable farming is "farming that meets the needs of existing and future generations, while also ensuring profitability, environmental health and social and economic equity. It favours techniques that emulate nature to preserve soil fertility, prevent water pollution and protect biodiversity. It is also a way to support the achievement of global objectives, like the Sustainable Development Goals and Zero Hunger."

Sustainable agriculture is understood as a combination of different practices accounting for the need for a holistic approach to achieving economic, social and environmental sustainability and strengthening the resilience to climate change and climatic shocks. Depending on the context (geographic and climatic environment, current farm structure, etc.) different best practices combined make up a system that we can call sustainable agriculture. Sustainable agriculture is an environmentally friendly method of growing crops that helps farmers to adapt and builds the resilience of the agricultural system and the community to climate change impacts while meeting the need for food and textile without compromising the next generation's future needs. The benefits of sustainable agriculture are large and contribute to (1) an improvement in the overall health of the ecosystem, (2) minimise the environmental impact in the surrounding ecosystem, (3) a reduction of environmental and climate risks, (4) an optimization of resource use and to the conservation of resources, (5) leads to high production benefits with low production costs, and (6) contributes to the conservation or even an increase in biodiversity with subsequently has beneficial impacts on the ecosystem.

A sustainable agricultural system builds on several best practices together that jointly contribute to increased soil fertility and water retention and enhanced climate resilience of the system overall and is in line with market demand contributing on the one hand to sustainable income and for the farmer's family's food and nutrition security, as illustrated in the figure below:

Figure 1: Illustration of a sustainable agricultural system (own Illustration. Pictures: Unsplash & Microsoft)

6. Red book of endangered species, of the Republic of Tajikistan (2010)
7. As defined in the Capacity Development Strategy on Climate Change & Agrobiodiversity of the Project (2022)

Methodology

The research methods used for the compilation of best practices consisted of **secondary data collection** through a desk review of project reports, publications, training documents and alike as well as primary data collection through stakeholder interviews and field visits.

For the secondary data collection, the team of Risha Solutions developed an excel based evaluation sheet and conducted stakeholder interviews based on a list of key stakeholders provided by IRDP/TRIGGER. The evaluation of sustainable farming practices takes a climate change and resilience perspective and was focused on the **value chains of the IRDP/TRIGGER** project and the implementation areas of Rasht and Zarafshon valley. Where suitable we extended the radius of the mapping and included additional best practices from other corners of the country.

Field visits to Rasht and Zarafshon valley in the spring of 2022 complemented the data from the stakeholder interviews and the documentation of farming practices.

Assessed projects and interventions

In the following section, we will shortly introduce the projects that we have assessed that ranked above 10 points in the assessment framework (see chapter above). We assessed the projects and hence the agricultural system and not the individual farming practice. A total of 14 projects and organisations were interviewed. A detailed list of the interviewed organisations and projects, whose best practices are illustrated in this report can be found in Annex 3.

Interview partners

To assess agricultural practices in Tajikistan on the above-introduced criteria assessing current agricultural practices, a series of interviews with local and international organisations and experts have been conducted.

Based on the information provided the assessment has been conducted based on the above-introduced evaluation sheet. The evaluation of the project does not intend to rate the project per se, but rather rates the project interventions based on their sustainability in a changing climate and helped us to identify the best suitable practices in Tajikistan to increase the resilience of farming communities. A detailed list of interviewed partners and their contact details can be found in Annex 2.

Evaluation of Sustainable Agriculture

In an excel-based evaluation form, we evaluated sustainable agricultural interventions as implemented by local and international organisations in Tajikistan based on a set of criteria. The evaluation form is shared alongside this report with the project team. For the purpose of this report and to examine the individual good practices in more detail, we explain each practice, which we call “best practice examples”, in the following chapter.

The excel-based evaluation form that was used covered the following six parts:

1. Biodiversity
2. Climate Change Adaptation
3. Resilience & Adaptive Capacity
4. Economic Benefits
5. Inclusion of vulnerable groups
6. Knowledge management and scaling

The evaluation form can be found in **Annex 1**. For a detailed analysis of the individual intervention please contact the respective GIZ project staff.

Rating of the interventions

Each part included two to ten questions to evaluate how the sustainable agricultural practices addressed each topic and what tools were used. Additionally, parts one to five of the evaluation framework included a ranking to what extent the sustainable agricultural practices contributed to biodiversity conservation, climate change adaptation, resilience & adaptive capacity, and short and long-term economic benefits, respectively to the inclusion of vulnerable groups. The evaluation criteria are presented in the table below. A maximum of 18 points were possible to be awarded by the individual projects/interventions. The evaluation team acknowledges a degree of subjectivity to the rating as a limitation of the research. Potential personal biases were eliminated by a three-person evaluation team.

Category	Assessment of practice	Total points
Biodiversity	The intervention had: 5 = very high positive impact on biodiversity; 4 = high positive impact on biodiversity; 3 = positive impact on biodiversity; 2 = no impact on biodiversity 1 = negative impacts on biodiversity	**5**
Climate Change Adaptation	Did the intervention help the farmer/community adapt to climate change? 5 = yes, with immediate benefits 4 = yes, with benefits in 2-5 years 3 = yes, but only to some parts of the community 2 = no adaptation benefits, only mitigation benefits 1 = neither adaptation nor mitigation	**5**
Resilience & Adaptive Capacity	Adaptive capacity 5 = whole community strengthened 4 = part of the community is strengthened 3 = individual household is strengthened 2 = immediate risks averted 1 = adaptive capacity has not been strengthened	**5**
Economic Benefits	2 = long-term benefit 1 = short-term benefit 0 = no economic benefit	**2**
Inclusion of vulnerable groups	1 = vulnerable groups were included 0 = vulnerable groups were not included	**1**

Table 1: Rating table

Summary of best practices applied in Tajikistan

The following best practices applied in Tajikistan contribute to biodiversity conservation or even enhancement and help farmers strengthen their and the ecosystem's resilience to climate change impacts. These practices were derived from the assessed interventions, with a focus on Rasht and Zarafshon valley with some practices beyond this geographic scope.

Which practice and which combination is best suited for a specific location depends on many environmental and economic conditions and has to be pre-assessed before implementation.

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Documentation of Best practices for sustainable farming

The practices are divided into four different categories a) Soil management practices, b) Plant management practices, and c) water management practices. In the end, additional knowledge management practices are listed that have proven to be successful in the context of Tajikistan.

Figure 2: Core themes for the structure of the report

Soil management practices

Soils play an important role in climate change mitigation and adaptation. On the one hand, soils store carbon and are hence a source for climate change mitigation by decreasing greenhouse gas emissions in the atmosphere. On the other hand, good soil management help to build resilience to climate change through improved nutrient contents, water storage and increased biodiversity.

Proper soil management bears great potential to decrease the emission of greenhouse gases from agriculture, enhance carbon sequestration and build resilience to climate change. Given the central role soil plays on the global carbon (C) and nitrogen (N) cycles and its impact on greenhouse gas emissions, there is an urgent need to pay more attention to soil management and the introduction of good soil management practices.

Intercropping

Description of practice:

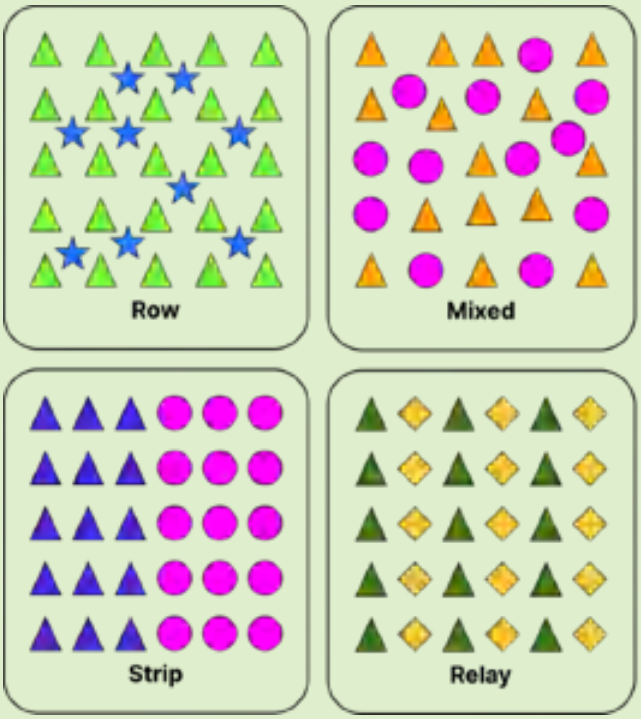
Intercropping is the cultivation of combined crops (e.g., tomato - corn - beans). There are three basic classifications for intercropping: a) mixed cropping, which involves planting a variety of compatible plants together without any definite arrangement (e.g. maize planted together with beans); b) row cropping or alley cropping, in which different crops are planted alongside each other in rows (e.g. alternating rows of carrots and onions); c) temporal intercropping, in which a slow-growing crop is planted together with a faster growing one, which is harvested earlier, allowing the slow-growing crop to subsequently occupy the entire planting area (e.g. potatoes and pumpkins).

Combined crop cultivation helps increase biodiversity, which attracts many beneficial pollinating insects. In addition, a combined crop can improve yields by making efficient use of available planting space and nutrients. Some crops also help each other to develop as they have a positive impact on each other (e.g. chilli or garlic protects other plants from pests). As flowering increases, intercropping also favours pollinating insects and thus beekeeping.

The associated crops should belong to different plant families, in order not to share the same pests and diseases and to have different requirements on soil fertility and nutrients and extracting them from different horizons of the soil. The strips should be wide enough that each strip can be managed independently. At the same time, they need to be narrow enough that each crop can influence the microclimate and yield potential of the adjacent crops. Individual difference between the rows depends on the associated crops.

Possible forms of intercropping:

- Strip: crops are grown simultaneously in independent rows within the same field
- Row: crops are grown together simultaneously and a minimum of one crop is planted in a row
- Mixed: there is no specific order to the crops
- Relay: the growing system is dependent on the lifecycle stage of the intercropped plants. Typically, the second crop in the intercropping schedule is planted after the first crop reaches the reproductive stage and before it reaches peak maturity



Forms of intercropping. ©Risha Solutions

Examples:

In a tomato field, corn can be planted every 1.5 meters between tomatoes. When corn grows, it creates a favourable microclimate for the tomato and protects it from direct sunlight. In addition, it is an additional income for the farmer. Also, the cultivation of mixed crops is used for sowing corn and beans. The corn serves as a support for the beans that climb onto it. The beans, in turn, store nitrogen in the soil, which feeds the corn. Between the potato crop, the horse bean also can be cultivated as mixed cropping which gives a good yield.

Table 2

Practice details	Climate Change	Economic & environmental benefits
 Intercropping in Jafr village. ©GIZ		
Location: Rasht valley, Jafr village **Implementing agency:** PO "Rushnoi" **Timeframe:** seasonal activity **Budget:** low cost but requires good knowledge of which crops can be planted together	With a diversified plot, the farmer increases his chances of successfully dealing with the uncertainty of climate change and extreme climate events such as late frost. Further, the farmer can use potential chances created by climate change, such as an earlier planting period due to increased temperatures or the introduction of new varieties that suit the new climatic conditions (e.g. the plantation of cucumbers and tomatoes in the Pamir mountain region).	▸ Intercropping increases the diversity of products to be harvested and reduces the risk of complete loss of harvest by pests and diseases as these normally are host-specific. ▸ Intercropping maintains soil fertility as nutrients are not emaciated unilaterally. ▸ Intercropping increases biodiversity and thus beneficial and predatory insects are attracted. ▸ Through diversified crops, the flowering season is prolonged, which is favourable for beekeeping.
Knowledge management	**Inclusiveness**	**Documentation**
All projects that promote intercropping provided specific training events for farmers and village advisors.	All farmers were targeted	GIZ guide on biodiversity enhancing farming methods https://www.landuse-ca.org/wp-content/uploads/2019/11/Documentation-of-biodiversity-enhancing-land-use-methods.pdf

Crop Rotation

Description of practice:

Crop rotation is a science-based alternation of crops (and fallow) in time and placement in the fields.

Crop rotation is one of the most important methods of sustainable cultivation. With the introduction of crop rotation, the land area is divided into approximately equal plots. Crop rotation means planting different annual crops in a specific order for several years in the same field. Each crop is sown in a certain sequence according to the crop rotation scheme.

The use of crop rotation contributes to the preservation of soil structure, the conservation of biodiversity, and the prevention of pests.

Crop rotation maintains soil fertility as crops have different nutrient requirements. In addition, this technique prevents the accumulation and spread of soil-borne diseases and pests. In Tajikistan, crop rotation is not very often practised despite its benefits. This might be on the one hand that farmers do not know the benefits of crop rotations, or do not know how to transition to a crop rotation system. However, through the promotion of oilseeds (flax, sunflower and wild safflower/saffron) and legumes (chickpeas, green peas, lentils) the farmers are encouraged to diversify their field and with it introduce crop rotation. Specifically, pulses produce and store nitrogen in the soil and thus improve soil fertility while most of these crops are also important for pollinators.

To build the correct alternation of crops in a crop rotation, you need to know them - the best predecessors. The predecessor crop is the crop that occupied the field in the previous year. Its influence on soil fertility and the yield of the subsequent crop and its evaluation as a predecessor is related to its biology and cultivation technology.

With permanent cropping, pathogens accumulate on the plant residues Simply changing crops in the fields deprives the pathogens (usually soil fungi) and pests of their host plant, and hence reduces the risk of pests for the following cultivation.

Examples:

A suitable field crop rotation scheme can be as follows:

- Pure fallow / Winter rye / Potato
- Spring wheat + clover (with clover overseeding)

For example, after a pure fallow, winter rye will be cultivated, and potatoes will be planted after harvesting winter rye. In this case, the predecessor of winter rye is pure fallow, and for potatoes, winter rye.

Good predecessors are tilled, annual legumes and winter crops. Satisfactory – spring cereals.

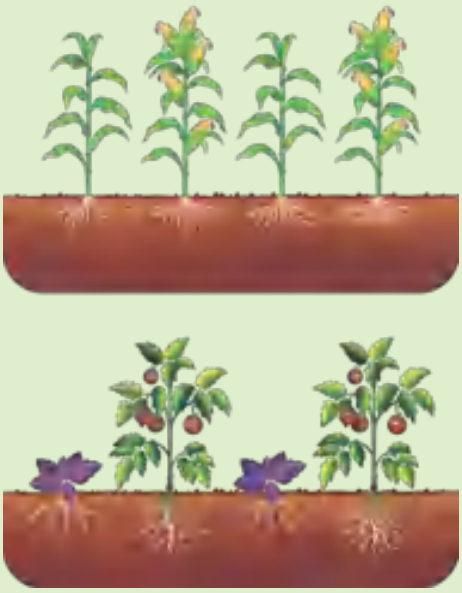


Table 3

Practice details	Climate Change	Economic & environmental benefits
Location: Sughd region – Konibodom, Kuhistoni Mastchoh, J.Rasulov, B.Gafurov, Spitamen, Zafarobod. Khatlon region – Jayhun, Vakhsh, Kushoniyon, A. Jomi **Implementing agency:** Cooperative "Sarob" **Timeframe:** seasonal activity **Budget:** low cost but requires good knowledge of which crops can be planted together	Through increased soil fertility the overall resilience to climate change impacts is increased ▸ Reduction of potential harvest loss due to pests (which are increasing with higher temperatures) ▸ Reduce the harmful effects of wind and water erosion on the soil	▸ Improved soil fertility increases productivity and improvement of the quality of crop production; ▸ Increase of soil fertility and preservation of nutrients reduces the need to apply additional fertilizer; ▸ Reduction of contamination of crops, and their susceptibility to diseases and pests;
Knowledge management	**Inclusiveness**	**Documentation**
Cascade training approach – master trainers train field agronomists, and after the field agronomist are consulting farmers	Women were trained as field agronomists to consult specifically female farmers	Brochures and booklets

Soil Cover / Mulching

Description of practice:

Mulch is a layer of organic material applied around trees or between crops. Covering the surface of the soil with different materials is considered an essential method to keep soil moisture, provide nutrients, reduce weeds, avoid erosion, and alleviate heat waves. Organic mulch can consist of grasses, hay, leaves, wood shavings, wool, or manure. Weeds that are hand-picked around annual crops can also be used as mulch. For most farmers, mulch is not widely available in Tajikistan, as weeds and leaves are traditionally used as cattle feed. Therefore, mulching is usually applied only around tree holes where the results of its use are more effective and visible. Wherever possible, it is recommended to apply mulch not only around trees but also between rows of annual crops.

Covering slopes is also a successful anti-erosion measure. Bare soil should be covered with cover crops which are planted after the harvest of cash crops. Cover crops are not intended to be harvested and contribute to the quality and fertility of the soil. Common cover crops include legumes (e.g., red clover, peas, beans), cereals (e.g., rye, wheat, oats), grasses (e.g., barley ryegrass, millet), and broadleaf species (e.g., buckwheat, mustard).

Women in the field. ©GIZ

Examples:

The radius of the circle covered with mulch, in the centre of which is located the plant, should be approx. 45 cm (for shrubs) and 75 cm (for medium-sized trees). Under trees, shrubs, and perennial vegetable plants, the mulch is usually not removed, but a new layer is applied annually. With these efforts, after 2-3 years, the soil structure is noticeably improved.

Mulching. ©GIZ

Table 4

Practice details	Climate Change	Economic & environmental benefits
Location: Sughd region and Rasht valley **Implementing agency:** PITTU named by academician Osimi and PO "Rushnoi" **Timeframe:** seasonal activity **Budget:** low cost, however availability of mulch is a concern in Tajikistan	Climate change adaptation: ▸ Improved soil water storage ▸ Increased resilience to heavy rain, heat, and strong winds Climate change mitigation: ▸ Improved soil carbon storage through cover crops and decreased soil erosion	▸ Reduction of economic loss through soil erosion. ▸ Improved soil quality and fertility will lead to better harvests in the next season. ▸ Sometimes, harvested cover crops can improve family nutrition or be used as fodder crops ▸ The restoration of degraded land increases yields for farmers, more income from crops ▸ Cost savings through water savings
Knowledge management	**Inclusiveness**	**Documentation**
Handout of booklets and brochures Farmer field schools, field days, exchange visits, training events	The project included all farmers, incl. women and other vulnerable groups	By PITTU there is no documentation publicly available RO Rushnoi: GIZ guide on biodiversity enhancing farming methods

Vermicompost

Description of practice:

Biohumus is a highly effective organic fertilizer, which is formed by the waste product of earthworms. The process of obtaining biohumus is called vermiculture and is based on the biological characteristics of worms. Worms swallow pieces of organic matter and transform them in the intestines into humates, and then they are excreted in the form of small round lumps. Within 1-2 days, this raw material loses its unpleasant odour, and after 4-6 weeks it turns into a high-quality organic fertilizer – called vermicompost. Vermicomposting is a highly efficient way to restore nutrients depleted by chemical fertilizers and improves the water-holding capacity of the soil, increases water infiltration, enriches carbon and improves soil health.

However, not every worm is suitable and specific composting worms are needed. Since 2012, within the framework of various projects, Californian worms have been brought from Russia for further development in Tajikistan. Given enough food and space, the worm population can double within 90 days, and hence reproduction is simple.

To date, biohumus production is very developed in several regions of the country, such as B. Gafurov, J. Rasulov and Tursunzoda districts. But also, farmers of the Spitamen district brought the Californian worms from Uzbekistan and are now producing biohumus. Most farmers who grow organic products buy vermicompost for their farms but vermicompost can easily be produced at home.

Vermicomposts are advantageous against normal compost in Tajikistan, as the worms have fewer requirements on the composition of the waste products and the turnover is also much faster.

©Unsplash

Table 5

Practice details	Climate Change	Economic & environmental benefits
Location: J. Rasulov, B. Gafurov and Tursunzoda districts **Implementing agency:** Cooperative Sarob **Timeframe:** seasonal activity **Budget:** low cost	Through vermicompost, soil fertility and health are increased which in turn prevents weeds and pests.	▸ Reduces the need for pesticides and fertilizers; ▸ Duration of action is maintained for 4-5 years.
Knowledge management	**Inclusiveness**	**Documentation**
Farmer field schools, exchange visits and training events	All farmers of target villages were included	Booklets and brochures

Restoration of Degraded Areas

Description of practice:

Land degradation is the most pressing environmental problem in Tajikistan, including soil erosion, salinization, waterlogging, soil pollution and loss of soil productivity. Predominantly water erosion is widespread. According to UNDP, nearly all agricultural land shows some level of degradation. Land degradation is in most cases a result of poor land management.

Restoration in Tajikistan is taking place through the use of organic fertilizers (manure, compost), water-saving technologies, improved cultivation methods, such as crop rotation and intercropping, and the introduction

of improved varieties. For example, improved irrigation techniques were used for the cultivation of gardens (see chapter on water management) and different species were introduced that are more drought-resistant.

Example drought-resistant species:

A simple and reliant recommendation for farmers is the cultivation of species that do not need a very large quantity of water or can withstand a dry spell. These include different types of beans, peas (cowpeas, black-eyed peas and field peas), quinoa (as tested in Muminobod), Okra, summer squashes, sunflowers and most type of herbs. The use of drought-tolerant species in combination with good soil practices (see chapter on soil management, specifically mixed cropping) results in better yields.

Within some projects, drought-tolerant varieties were imported, specifically tomatoes. This might be a suitable option, however, its sustainability needs to be carefully evaluated if varieties can be reproduced in the country or if the farmer's dependence on project support is increased.

Soil erosion. ©Freepik

Table 6

Practice details	Climate Change	Economic & environmental benefits
Location: Sughd region — Konibodom, Kuhistoni Mastchoh, J.Rasulov, B.Gafurov, Spitamen, Zafarobod. Khatlon region — Jayhun, Vakhsh, Kushoniyon, A. Jomi Rasht & Zarafshon **Implementing agency:** Cooperative Sarob, MSDSP, UNDP **Timeframe:** long term **Budget:** high cost	Decreasing the levels of land degradation of surrounding areas and agricultural fields has positive effects on the resilience of agricultural land and improves the adaptive capacity resp. reduces the vulnerability to climate change.	▸ Better land = better yield ▸ Reduction of needed fertilizer ▸ Additional income from newly cultivated areas ▸ Reduction of technical and mechanized work
Knowledge management	**Inclusiveness**	**Documentation**
Farmer field schools, exchange visits, training events	All farmers of target villages were included	Booklets and brochures

Planting in Saline Soil

Description of practice:

The soil salinization levels are very high in Tajikistan and hence problematic for the cultivation of agricultural produce. It is estimated that over 12% of soils in Tajikistan contain too high levels of soil. However, exact statistics are difficult to be found, as soil sampling is rarely done. Even small levels of salinization can lead to a reduction in harvest of up to -25%. Mostly salinization is a result of improper irrigation practices / over-irrigation and reduced groundwater levels.

Certain salt-tolerant crops can be planted in relatively saline soils, such experiments have been made in Muminobod with potatoes, pulses and maize. Also, as salt-tolerant crops in the Asht district of the Sughd region, the staff of the Soil Reclamation Station of the Institute of Soil Science sowed alfalfa seeds of the Vakhsh 300, Kizilkesek and Evrika varieties, as well as seeds of the sorghum varieties ICSV-172 and ICSV-745. Cultivation of salt-resistant and high-yielding varieties of alfalfa - Kizilkesekskaya, Evrika, Skipter and sorghum - Sugar graze and Speed feed are recommended for involvement in crop rotation and rational use of saline lands.

Field research work to identify salt-tolerant crops in Asht region. ©Risha Solutions

Field research work to identify salt-tolerant crops in Asht region. ©Risha Solutions

Table 7

Practice details	Climate Change	Economic & environmental benefits
Location: Asht district of Sughd region, Muminobod district of Khatlon region and Lakhsh district of Rasht valley **Implementing agency:** Soil melioration station of Sughd region, Caritas **Timeframe:** seasonal activity **Budget:** relatively high costs & efforts depending on the level of salinization	Decreasing the levels of soil salinization has positive effects on the resilience of agricultural land and improves the adaptive capacity resp. reduces the vulnerability to climate change.	Through the restoration of salinized lands, farmers can grow fodder crops or keep additional livestock that contributes to the farmer's income even if the soil is still too saline for the cultivation of crops.
Knowledge management	**Inclusiveness**	**Documentation**
Farmer field schools, exchange visits, training events	Farmers, owners of land exposed to salinity	Brochures, booklets and scientific articles, dissertation

Restoration of Pasture Land

Description of practice:

Natural pastures are often degraded due to overgrazing and the percentage of soil cover is relatively low. Fencing is considered to be the first necessary step towards restoring these lands, as it will improve fodder production.

The second stage includes the re-seeding of plots with fodder crops. Cultivation of grazing land should be kept to a minimum, as roots of grasses and herbaceous plants remain in the soil and will sprout unless herbivores are added.

Mostly, asparagus and alfalfa seeds are used for reseeding pastures. To conserve and promote biodiversity, native grasses or herbaceous plants that produce feed for livestock and are suitable for grazing in adverse conditions, such as drought, can also be used. The latter are usually better adapted to local climatic conditions and more resistant to diseases and pests.

Fenced pasture area in Rasht valley. ©GIZ

Table 8

Practice details	Climate Change	Economic & environmental benefits
Location: Rasht valley **Implementing agency:** PO "Rushnoi" **Timeframe:** seasonal activity **Budget:** fencing pasture areas is very expensive and can often not be covered by farmers themselves.	▸ Wind-blown sediment reduction; ▸ Stopping the process of land degradation; ▸ Improving the qualitative composition of the soil, increasing its biomass; ▸ Reduction of surface runoff, cessation of formation of gullies and ravines.	Improvement in the quantity and quality of feed increases the income of farms
Knowledge management	**Inclusiveness**	**Documentation**
Farmer field schools	All farmers of target villages were included	Manuals, booklets and brochures

Plant management practices

Good plant management is key all over the globe, to ensure good yields, prevent pests and sustain food and nutrition security. In Tajikistan, poor plant management practices can frequently be overserved that resit in less agricultural crop yield as well as disturbance of the stability of the agroecosystems. In this part, sustainable plant management practices are shown that were successfully tested in Tajikistan and accepted by farmers.

A plant management practice is said to be any method or practice that is technically and environmentally sound and which when utilized in agricultural crop production prevents or reduces the common problems related to general agricultural production.

Generally, the diversification of species and their varieties has shown to be beneficial to yields and increased the overall resilience of a farmer towards severe climate events, such as frost, heavy rain, wind, etc. Therefore, this chapter first introduces practices that concern diversification. The following section introduces plant management practices under changing climatic conditions and pest management practices.

Monoculture in Zarafshon valley. ©GIZ

Monoculture in Zarafshan valley. ©GIZ

Plant cultivation according to ecological conditions

Tajikistan being a very diverse country with a multitude of different agroecosystems requires a nuanced approach from the selection of the species and variety to the selection of the plot and cultivation scheme. Since the climatic conditions of each region are different and changing climatic conditions, it is very important that farmers carefully assess the conditions on their plots and plan for their cultivation season accordingly. **Agricultural plans** are a helpful tool to understand water resources, wind conditions, and sun exposure on the field and help to cultivate the appropriate species based on the conditions found in their field (see illustration below of a farm planning map). Too often farming decisions are taken based on pure market demand. While market demand is important to ensure the harvest can be sold, a balance needs to be found between, suitability for the plot conditions and market value.

Agricultural plan. ©freepik

Ecological planting calendars are another useful tool to be developed in farmer field schools, taking into account the climatic conditions of the specific area and the requirements of the cultivated crop. That is, varieties with a longer growing season can be used. At the same time, there are types and varieties of vegetables traditional to Tajik culture, which become problematic to grow under a changing climate. Sowing and harvesting times are changing. Oftentimes sowing should happen at an earlier date, when soil and air humidity, and temperature are optimal for sowing. This means that maturation occurs a little earlier than required.

An example of an ecological calendar for Savnob and Roshorv, Tajikistan can be found https://issuu.com/cornellbotanicgardens/docs/bartangvalley-1

Seed availability in Tajikistan

Seed availability and seed quality remain to be a challenge for Tajikistan and continue to be one of the greatest impediments to bridging the vast yield gap. Farmers in Tajikistan either reproduce their own seeds, buy them on the market and/or from service providers or receive them from different development projects. With few official seed banks in place and limited capacities for seed quality analysis in-country, farmers are often left to guess the quality of seeds they reproduce, buy or receive.

When choosing a seed, the following characteristics are taken into account:

- Purpose of consumption (for fresh consumption or processing)
- Productivity
- Weight, colour, shape (round, oblong, etc.), taste
- Transportable or not
- Season (early, mid, late)
- Resistance to diseases
- Growing conditions (in open ground or greenhouse)
- Treated or no

Generally, we can divide seeds into **hybrid seeds and open-pollinated (varietal) seeds.**

Open-pollinated seeds: Open pollinated plants are produced by seeds that have resulted from the natural pollination of the parent plant, either through self-pollination or through pollination by bees or other natural means. As opposed to hybrid seed, the plants generated from the seeds will be similar to the parent plants.

Hybrid seeds are obtained as a result of grafting different forms and, types of crops. In hybrid seeds, the purpose of grafting different forms and types of crops is to improve quality indicators. These hybrid seeds usually result in higher harvests; however, they cannot be reproduced by the farmers themselves. Not knowing the difference between varietal and hybrid seeds and purchasing either on the market or through middlemen, several farmers reseed hybrid seeds with drastically decreased yields in comparison to the first year.

The following table lists the main differences between varietal and hybrid seed production (Source: Tamil Nadu Agricultural University)

Table 9

Varietal seed production	Hybrid seed production
It is single-parent multiplication	It needs two or more parents
The isolation distance requirement is less	The isolation distance requirement is more
Production is by open pollination	Production is by managed control pollination (Female)
Seed can be used continuously for ¾/5 generations	The seed has to be changed every time
The production technique is uniform (multiplication)	Techniques differ with crop
Production care is less	Production care is more
Yield will be lower	Yield will be higher
Profit is less	Profit is higher

When it comes to choosing seeds, the trade-off between maximizing productivity and adaptation to the local agro-ecological conditions, including trends in climate change, should be considered carefully. Even though hybrids usually produce more yield and are consequently demanded by farmers, they also create a system of dependency on imported seeds. Some projects in Tajikistan do support the import of hybrid seeds, however and are hardly economically sustainable for farmers.

At the institutional level, Tajikistan lacks varietal development and testing programmes. The private sector is little involved in the seed sector so that seed multiplication and dissemination are highly dysfunctional. Seed inspection and certification institutions and testing laboratories to legally ensure the quality of seeds that reach the marketplace have very low capacities. Local and imported varieties and seeds reproduced from hybrid seeds are mixed on the market. This consequently leads to a loss of varieties and a reduction in harvest for farmers. As long as a functioning governmental seed system is missing, private seed reproduction remains crucial for Tajikistan to meet the demand and decrease import dependency.

Women in her seed bank in Rasht valley Tajikistan ©GIZ

Plant Diversification

Seedbanks and Nurseries

Description of practice:

Seedbanks

In Rasht and Aini, local varieties of grain, vegetables and fruits were collected from all villages and nearby areas and a seed fund was created together with local farmers. The seedbanks are quite rudimentary, neither seed analysis nor breeding are taking place. However, through these local seedbanks, farmers are preserving local varieties as well as their independence. The seedbanks also ensure a genetic exchange, even if minimal. Both seed banks are run by women.

The seed bank can be visited in Jafr and Mazor villages of Rasht district.

Nurseries

Similarly, traditional orchards are often more suitable for farmers. Primarily, it is cheaper to establish a traditional or semi-intensive orchard with local varieties as local plants are cheaper and fewer plants/ha are required to grow an orchard (approx. 500-600 compared to 2600-3125). In addition, a semi-intensive orchard system based on local varieties will allow growing vegetables and fodder crops between the trees. This usually outweighs the potential economic disadvantage that orchards created with local varieties.

Table 10

Practice details	Climate Change	Economic & environmental benefits
Location: Rasht valley **Implementing agency:** PO "Rushnoi" **Timeframe:** seasonal for crops /up to 15 years for orchards **Budget:** low cost but requires a local seed bank and nursery	Traditional species and diversified landscapes increase the resilience and	This is beneficial from an economic point of view since the cost of pesticides is significantly reduced, production levels are stabilized, and the amount of water required for irrigation is reduced. In addition, local varieties bear fruit much longer (30-50 years compared to 10-12 years).
Knowledge management	**Inclusiveness**	**Documentation**
Farmer field schools, Field days, exchange visits, training events	The project worked specifically with women	Available in brochures, local and international magazines

Crop Diversification

Description of practice

The introduction of newly cultivated species and improved crop varieties is a practice aimed at increasing plant yield, quality, health and nutritional value as well as at increasing crop resistance to diseases, pests and environmental stresses. Crop diversification refers to the incorporation of new crops into agricultural production, taking into account different returns on value-added crops that offer additional marketing opportunities.

The main drivers of crop diversification include the following:

- increase incomes of small farm
- ability to withstand price fluctuations
- mitigation of increasing climate variability
- balancing food demand and nutrition requirements
- improvement of fodder for livestock

Climate change in Tajikistan has changed the agroecological conditions in many areas of the country. Changing precipitation patterns and higher temperatures bring challenges as well as opportunities for farmers. Different varieties or entirely new species might be better suited under the new environmental conditions.

One project has introduced species that are more drought-resistant, such as melons, pumpkins, and corn. Further, farmers were provided with seeds that are not traditional for these areas, such as red beans, coriander, and radish to diversify their product range. The seeds of these crops have enabled farmers to generate additional income from the crop in an interim short time after the harvest of the main crops.

Table 11

Practice details	Climate Change	Economic & environmental benefits
Location: Devashtich district, jamoats Mujun, Vahdat and I. Somoni **Implementing agency:** ICPO JOVID **Timeframe:** seasonal activity **Budget:** low cost but requires good knowledge of which crops can be planted together	The development of new and improved varieties increases the resistance of plants to various stresses that may arise as a result of climate change.	On a diversified plot, the farmer is more likely to cope with the uncertainty and/or changes caused by climate change. Cold can negatively affect one crop, while the production of another crop may increase.
Knowledge management	**Inclusiveness**	**Documentation**
Farmers were trained in the framework of the conducted training events, Farmer Field Schools (FFS) and demo plots	Target farmers were women and youth	Booklets

Plant management techniques under a changing climate

Protection Against Frost

Description of practice

As spring approaches, farmers start preparing for the new planting season. One of the main activities at this time is the preparation for late frosts. A sharp drop in temperature in March and early April is occurring more and more frequently in Tajikistan, and in particular in the Sughd region. The situation is dangerous because at this time fruit trees, such as apricot, almond, peach and cherry, are already blooming and late frost can damage the blossoms, which consequently has severe impacts on the harvest. Particularly, apricot, apple, plum, pear and cherry trees are very cold-sensitive. Also, grapes and potatoes do not tolerate frost well.

Smoke:

One of the most popular methods to protect plants from spring frosts is smoke. Smoke creates a curtain, an obstacle between the cold and the plants and warms the air by several degrees. It will help with frosts not lower than -4°C. Small fires are lit on the leeward side of the orchards at a distance of 100 m from each other. The size of the bonfire should be up to 1.3-1.5 m wide and 0.5-0.7 m high. For the bonfire, everything that burns well can be used. Such as straw, dry branches and leaves, mowed grass, dry manure, etc. The fire is kindled in advance with the expectation that the most severe frosts occur in the early morning.

Other frost protection measures practiced in Tajikistan:

- Soil: Soil conditions make a great deal of difference in frost protection. Heat is absorbed by the soil during the day and released to warm the blossoms at night and early in the morning. Increased soil moisture contents level the soil temperature differences between day and night-time while it also increases solar energy absorption resulting in higher heat storage.
- Mulching (see above)
- Hilling crops: covering the stems with soil and/or straw or other organic mulch. Each hilling should add about 4 inches of soil or mulch, up until the mound is 12 inches tall. Hill when the soil is relatively dry and not wet and muddy.
- Root top dressing: spreading a thin layer of material (compost or sand) onto the field
- Tree cover: cover complete trees with burlap, sheets, tarps, etc., that extend to the ground to trap in the earth's accumulated warmth.
- Fertilizer: spray all plants with a micronutrient mix
- Abundant or moisture-charging watering: moderate watering 1-2 days before frost reduces the sap flow of trees and slows down their awakening

Prolongation of the resting phase of fruit trees:

As an anticipatory measure of late frost events, the resting phase of fruit trees and grapes can be prolonged either through winter irrigation or through the application of a specific oil.

Winter irrigation in orchards and vineyards is the most frequently practised frost protection measure in Tajikistan. In January and February, when irrigation water is available in large quantities, orchards are irrigated. The moist soil freezes and thus prolongs the resting phase of trees. Another option to prologue the resting phase is the application of **Aria oil** sprinkled on fruit trees. The solution consists of 20 litres of 80% Aria oil to 1000 litres of water and is sprayed on the trees before they start to flower. The Aria oil acts as a film and protects from frost by prolonging the dormant phase of fruit trees.

Table 12

Practice details	Climate Change	Economic & environmental benefits
Location: Sughd region, Asht district **Implementing agency:** 1. PO Neksigol Mushovir 2. PITTU **Timeframe:** seasonal activity **Budget:** depending on the chosen method, it is relatively expensive for farmers in Tajikistan.	Adaptation to more frequent late spring and early winter frost events.	Preservation of the yield

Knowledge management	Inclusiveness	Documentation
SMS warnings are a useful tool to inform farmers about upcoming frost events, booklets, brochures, manuals, online resources	All farmers with orchards or vineyards	Monthly agricultural recommendations of experts, and articles in the newspaper *Agroinform.tj*, booklets and brochures, online resource *Hosil.tj*

Frost Protection in Asht district.
@Risha Solutions

Prolongation of the Agricultural Season

Description of practice

Climate change brings mostly additional stressors to the agricultural system, however, at times there are also opportunities that can arise. According to long-term meteorological data, in various regions of the Republic of Tajikistan, the number of days with temperatures above 10°C after the normal harvesting times of winter crops is increasing. In the Sughd region, the weather stays above 10 degrees for approx. 100-110 days, in the Gissar valley approx. 120-130 days, and in the Bokhtar and Kulob regions approx. 140-150 days. This duration of temperatures above 10 degrees, allows for the cultivation of yet one more cycle of grain or vegetable crops. For this last cultivation of the year, it is important to use crops that will still ripen in the given number of days. While in the valleys and wind-covered areas the period may be longer, at higher altitudes the days suitable are much fewer. The resistance of seeds to the wind speed must also be taken into account; if the wind is strong, then low-growing varieties should be chosen.

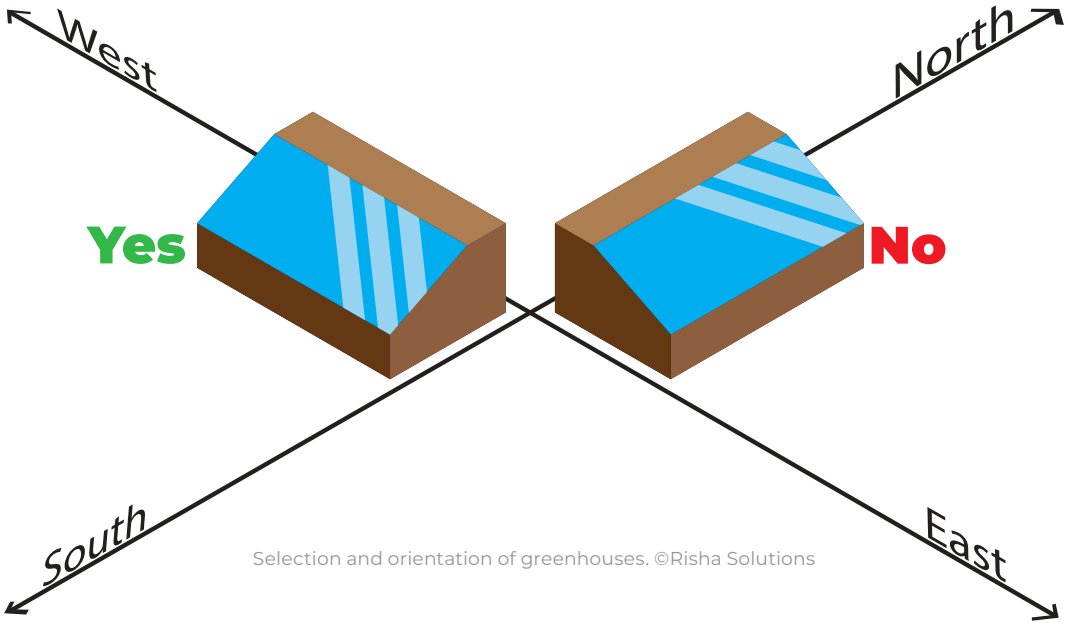
Table 13

Practice details	Climate Change	Economic & environmental benefits
Location: Sughd region **Implementing agency:** PITTU named by academician Osimi **Timeframe:** seasonal activity **Budget:** low cost but requires good knowledge of suitable plant species	Using the new opportunity for an additional planting period can increase economic resilience for other negative climate impacts	Additional harvest
Knowledge management	**Inclusiveness**	**Documentation**
Training events, field exchange visits	N/A	Booklet Handouts

Solar Greenhouses*

Description of practice

In the mountainous regions of Tajikistan, the natural conditions are extremely harsh: in winter, the temperatures often drop below -30°C and the amount of precipitation is very low (less than 300 mm per year). However, the weather in mountainous areas is very sunny, especially in winter. Solar radiation can be used for non-seasonal agricultural activities through greenhouses. The climate inside the greenhouse heated by the sun's rays is suitable for growing vegetables nearly all year round, even in winter. Such structures are particularly useful in areas where natural resources are limited, and food security and economic development are at stake. For the construction of solar greenhouses, an open area is best suitable that has no shade from trees or buildings. The solar greenhouse is designed along the east-west axis: the length of the south side increases so that the sun's rays fall on the largest possible surface (see image below).



Selection and orientation of greenhouses. ©Risha Solutions

*different other types of greenhouses are used in Tajikistan which, however, none of our interviewees are using and therefore are not described here.

When selecting the best location to build a solar greenhouse the following aspects should be considered:

- availability of water (river, well, canals, snow);
- plenty of direct sunlight;
- quality of soil and rate of land/soil degradation.

A trench should be dug with a depth of approx. 1 m. The trench must be deeper than the average freezing depth of 50 cm. The lower 50 cm of the trench is buried in layers of fresh manure and fertile soil. Fresh manure is used to heat the soil and serves as fertilizer.

Double wall with insulation: The two walls of the greenhouses are made of clay with the middle filled with insulating material, usually straw, sawdust or another wood residue.

1. The inner layer stores heat during the day and release the heat at night. This layer can be built with mud bricks and compacted with soil or stones.
2. An insulating layer (straw, sawdust)
3. An external load-bearing wall constructed from mud bricks compacted soil or stones.

Solar greenhouses are already very developed in Tajikistan and built in several mountainous regions, for example, in Aini, Asht, Kulob, B. Gafurov, J. Rasulov and Spitamen districts.

Table 14

Practice details	Climate Change	Economic & environmental benefits
Location: Aini, Asht, Kulob, B. Gafurov, J. Rasulov and Spitamen districts **Implementing agency:** Geres **Timeframe:** N/A **Budget:** instalment cost of the greenhouse is expensive	Solar greenhouses are an effective use of natural resources. Yields are mostly protected against the outside climate and its changing variability.	▸ Opportunity to grow vegetables in winter time; ▸ Provision of basic foodstuffs; ▸ Creation of new sources of income for residents of suburban areas;
Knowledge management	**Inclusiveness**	**Documentation**
Training of Trainers (ToT), exchange visits, field days	Target farmers from the mountain district	Manuals, booklets, brochures, posters, and publications

Istarafshan district, Sughd region. ©Risha Solutions

Other plant management practices

Terracing

Description of practice

A terrace is a levelled surface used in agriculture to cultivate on slopes, hilly, or mountainous terrain. Terracing increases arable land, allows water to seep into the soil, and reduces the risk of soil erosion. Therefore, it is recommended to install terraces on slopes with a slope of 20% or more. A terrace can however also be used on relatively flat lands to prevent erosion.

This technology is easily applicable, and is not very costly, however, requires a lot of manual labour. It has been used since 2001 in Tajikistan on small and large (>30 ha) plots.

Results:

- Reduction of soil erosion and nutrient run-offs
- Saving of irrigation water and organo-mineral fertilizers (3 - 5 times)
- Increase in yields in a relatively short time (3-4 years).

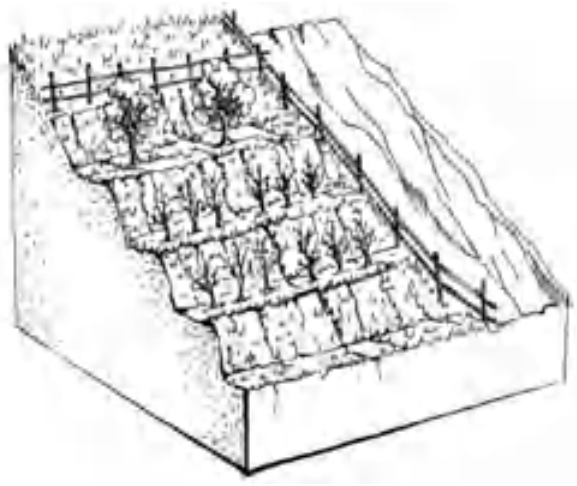


Illustration of terracing @GIZ

Table 14

Practice details	Climate Change	Economic & environmental benefits
Location: Zindakon village Aini district **Implementing agency:** PO IPD/ Welthungerhilfe **Timeframe:** seasonal activity **Budget:** low-cost but labour intensive	This technology promotes adaptation to climate change by optimizing water use, soil erosion and run-off protection in case of heavy rains. Terracing also reduced the risk of landslides and mudflows caused by heavier spring rains.	Increased food, fodder and wood production
Knowledge management	**Inclusiveness**	**Documentation**
Farmers were trained in the framework of the conducted training event, FFS and demo plots.	Small land farmers in mountain areas	Manuals, booklets, brochures, posters, and publications

Fencing with Natural Materials

Description of practice

Due to the frequent uncontrolled grazing of livestock in rural areas, it is often necessary to install a fence. Fencing is important especially if cultivated fields are located near livestock corridors. There are several types of fencing, such as mesh wire, barbed wire, natural materials (such as dry stone walls) and hedges.

The most suitable and recommended are hedges from native trees and shrubs, as they increase biodiversity, and provide habitat for pollinators and birds and firewood when cut back before winter. Hedges also protect against strong winds and soil erosion and are maintaining moisture in the soil. However, it should be noted that the construction and maintenance of this type of fence might require irrigation at least in the first years after planting.

One of the most useful and popular hedges is the rose hip. Rosehip provides additional income to the farmer and with its dorns is rarely eaten by goats. Rose hips are best planted in two rows in a checkerboard pattern. The optimal distance between seedlings in one row is 60-80 cm. Rosehip grows rapidly, so in a couple of years, a solid living, beautiful and prickly fence will grow.

Table 15

Practice details	Climate Change	Economic & environmental benefits
Location: Sughd region, Aini, Rasht valley **Implementing agency:** PO Rushnoi, UNDP Rasht, WHH **Timeframe:** seasonal activity **Budget:** mostly only fences made from natural materials are affordable to farmers	Fencing can have the following positive effects, given that it is protected from grazing: ▸ improved soil cover; ▸ increased plant diversity; ▸ decreased wind velocity; ▸ decreased surface runoff and evaporation.	Decreased risk of harvest loss from grazing animals and potential additional benefits from living fences
Knowledge management	**Inclusiveness**	**Documentation**
Farmers were trained in the framework of the conducted training events, FFS and demo plots	Well accepted by farmers in arid and mountainous areas	Articles, brochures and posters

Early Cultivation of Seedlings

Description of practice

In Tajikistan, the early stages of cultivating vegetable crops through direct seeding are accompanied by several problems. These include low soil temperature, lack of irrigation water, and soilborne diseases and pests of seedlings. Therefore, it is recommended to grow vegetable seedlings in pots with either a specific substrate or a mix of soil and compost.

The early cultivation of crops in pots is practised in a protected environment that is either a greenhouse (see solar greenhouses above) or inside the house behind a window. Wintergardens in Tajik households are very suitable for early cultivation in pots before transplanting them into the soil once outside temperatures have increased.

Growing vegetable seedlings in plastic pots has many advantages:

- higher productivity / higher market value
- the ability to maintain optimal soil moisture;
- good conditions for the formation of the plant root;
- ease of transplanting into the open soil/ higher survival rates;
- requires less indoor space;
- reusability of plastic cups.

The microclimate, whether in-house or in greenhouses, should be maintained optimal for each crop. For cold-resistant crops, the temperature should be 14-17°C, for heat-demanding crops 20-24°C, and for pepper 25-28°C.


Transplating. © Risha Solutions


Transplating. © Risha Solutions


Transplating. © Risha Solutions

Table 16

Practice details	Climate Change	Economic & environmental benefits
Location: Sughd and Khatlon region **Implementing agency:** International NGO GERES **Timeframe:** early spring **Budget:** medium cost	Yields are mostly protected against the outside climate and its changing variability.	▸ Earlier harvest and longer vegetation period; ▸ grow heat-demanding crops in the higher altitudes (e.g.: tomato, pepper); ▸ higher success rates per seed; ▸ reduced use of fertilisers.
Knowledge management	**Inclusiveness**	**Documentation**
ToT, exchange visits, field days	Farmers/women vegetable growers	Manuals, booklets, brochures, posters

Forest Belts

Description of practice

Forest shelter belts ©GIZ

Forest belts have many benefits to the farmland and not only protect against flooding but also wind erosion, improve water retention rates in soils, and prevent soil erosion and the growth of ravines. Forest belts should consist of one or more rows of trees and shrubs planted around the agricultural field. The best tree combination is tall trees such as poplars and smaller trees that can also be fruit trees , nut trees, and broad and thorny shrubs such as rose hips or sea buckthorn. The bushes provide a habitat for a variety of insects and small mammals and may serve as protection from livestock grazing (see fencing practice). Forest belts can be seen in most parts of the country. For example, around the apricot orchard in the Asht district, in the Aini and Gorno Matcha districts, and other locations.

However, many farmers are hesitant to use parts of their scarce agricultural land to grow a forest belt, this, especially in areas where the agricultural land is very limited. Further, some farmers are hesitant given the very distinct division between forest and arable land in the laws of Tajikistan.

Table 17

Practice details	Climate Change	Economic & environmental benefits
Location: Rasht valley, Pamir **Implementing agency:** WHH, PO Rushnoi, GIZ **Timeframe:** 3-5 years depending on the tree composition **Budget:** medium costs	Soil protection from wind erosion; climate for beneficial insects; protection against evaporation of moisture from the soil surface; landslide protection.	Extra crop and firewood; Flowering trees and shrubs, in addition, provide a habitat for pollinators and other beneficial insects, and may also be of interest to beekeepers.
Knowledge management	**Inclusiveness**	**Documentation**
Training, field days, exchange visits	Small land farmers in mountain areas	Handouts GIZ: Tree belt guide

River Bank Protection

Description of practice

River bank protection is a measure aimed at strengthening the shores of artificial or natural water streams from the effects of currents, precipitation, soil erosion, and subsidence. Streams develop on steep slopes and eventually widen into ravines. Heavy rain on slopes often causes erosion in ravines, which are further enlarged in areas where there is only light soil coverage. Erosion can be reduced and prevented by building catchment dams using living or non-living materials. It is recommended to plant fruit trees and shrubs as living materials along the shore of the river. For several years, these activities have been financed by donor projects in the Zarafshon and Rasht valleys. But there are also cases when the residents and farmers themselves strengthen the banks and ravines with their funds, for example, in J. Rasulov and Asht districts.

River erosion. ©Risha Solutions

Table 18

Practice details	Climate Change	Economic & environmental benefits
Location: J. Rasulov and Asht district **Implementing agency:** several implementing organisations (PO Jovid, WFP, ACTED, PO IPD, UNDP Rasht) and farmers themselves **Timeframe:** seasonal activity (river banks need to be reinforced every year) **Budget:** low cost	▸ Decrease in surface runoff ▸ Soil improvement ▸ Reducing soil loss from erosion ▸ Protection against landslides and mudflows ▸ Flowering trees and shrubs, in addition, provide a habitat for pollinators and other beneficial insects, and may also be of interest to beekeepers.	Protection from loss of arable land and consequent loss of harvest. Potential additional income from the plants and trees cultivated as river bank enforcement.
Knowledge management	**Inclusiveness**	**Documentation**
Practical seminars and field days	Local target farmers	Handouts

Grafting of Fruit and Nut Trees

Description of practice

The grafting of trees is an ancient art that goes back to BC. Grafting is the best way to propagate fruit trees by artificially merging part of one plant (scion) with another (stock).

Grafting allows to:

- cultivate a new plant from root shoots or seedlings;
- cultivate several plant varieties on the same tree.
- form the desired crown of trees;
- replace one variety with another without uprooting the plant;
- rejuvenate the tree when it is ageing;

Rasht valley, Tojikobod. ©Risha Solutions

Grafting improves plant immunity, productivity, and resistance to difficult climatic conditions and diseases.

Table 19

Practice details	Climate Change	Economic & environmental benefits
Location: Lakhsh region **Implementing agency:** PO "Development of Cross Border Relations in Jirgatol district" **Timeframe:** seasonal activity **Budget:** low cost but requires good knowledge of grafting techniques and tree species	Some grafting methods allow for fruit or nut trees to be grown in climatic conditions that are usually not suitable. Example: • Sweet almond on a bitter almond root is more resistant to harsh climates and can hence be grown at higher altitudes	Quicker harvest gains through grafting a new variety onto existing rootstock. Prolongation of the harvesting period through rejuvenation. Potentially reduction of harvest loss through increased resilience

Knowledge management	Inclusiveness	Documentation
Farmers were trained in the framework of the conducted training events, FFS and demo plots	Any farmers in the target region were included in the training events	N/A

Regional Seed Exchange

Description of practice

Most farmers are "self-employed" and produce a small amount of fruit, vegetables and grains. Most are for their consumption and a smaller amount is for sale on the local market. A huge challenge for farmers is the poor quality of seeds and seedlings. By creating a mechanism to store and multiply local seeds and establishing a seed exchange system, farmers are enabled to produce their own seeds for the next planting season. The seed fund allows local farmers to have access to high-quality seeds during the planting season when there is little opportunity for the farmer to purchase seeds. After the harvest, the farmer returns some of his harvests to the regional seed bank so that another farmer can use them the following year. This practice allows local farmers not to worry about the provision of sowing seeds, reduced their dependence on supporting organisations, and ensures a regular exchange between farmers.

Spitamen district, Sughd region.
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This system should if possible include:

- Seed analysis to identify high-quality seeds
- Training events on seed storage
- Establishment of local seed banks
- Facilitation of local seed exchange between farmers

Table 20

Practice details	Climate Change	Economic & environmental benefits
Location: Rasht valley and Sughd region **Implementing agency:** PO Rushnoi, PO ASDP Nau **Timeframe:** seasonal activity **Budget:** the seed bank could either be farmers-driven and low-cost or a more elaborate seed bank can be supported by a project	▸ Biodiversity improvement ▸ Development of new lands ▸ Efficient use of irrigation water ▸ Land reclamation improvement	▸ Production diversification ▸ Quality harvest ▸ More income ▸ Increase in sown area ▸ Opportunity to sell your products

Knowledge management	Inclusiveness	Documentation
ToT, exchange and field visits	Mostly subsistence farmers	No documentation is available from this project

Integrated Pest Management

Description of practice

Integrated pest management is defined by the UN as "the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment."

The agrotechnical method of pest and disease control is a set of agricultural techniques that create unfavourable conditions for the development of pests and pathogens, as well as favourable conditions for increasing the protective properties of the plants themselves. Global experience in pest control shows that reliable protection of cultivated plants is possible only with the use of an integrated plant protection system. Among the agrotechnical practices, the most distinguished are crop rotations, tillage, cleaning and sorting of seeds, timing and methods of sowing, fertilizers, timing and methods of harvesting, etc. The correct observance of agricultural technology of crops can save plants from diseases and pests.

Biological pest control is the cultivation or breeding of natural enemies to pests. This includes insectivorous birds, predatory insects, toads, frogs, etc. Most biological pest control methods are based on the natural connection of all creatures living in nature. They do not contradict its normal circulation and do not cause environmental damage.

Tomato pests. ©Risha Solutions

Table 21

Practice details	Climate Change	Economic & environmental benefits
Location: all regions of Tajikistan **Implementing agency:** Sarob, PO Neksigol, PO IPD, DAI **Timeframe:** seasonal activity **Budget:** low cost but requires good knowledge of Integrated Pest Management (IPM)	By promoting the diversification of the farming system, IPM practices increase the resilience of farmers to potential risks posed by climate change, such as damage to crops by new emerging pests and diseases.	The IPM method allows farmers to avoid the cost of pesticides and the fuel, equipment and labour required to apply them.
Knowledge management	**Inclusiveness**	**Documentation**
FFS, training events	All farmers	Booklets, brochures, posters, manuals

Water management practices

Agricultural land in Tajikistan covers an area of about 4.6 million hectares, which is only about 30% of the country's total land area of which only about 7% is arable land.[8] Estimates calculate a potential for irrigated land at 1.57 million hectares.[9] The contribution of agriculture to the country's GDP is at 24%.[10] However, the cost of production per cubic meter of irrigation water remains low, worsening food security and causing water scarcity for the rural population. Rational water use is a set of measures to reduce water consumption and improve the efficiency of wastewater treatment to save resources, protect nature and improve economic efficiency in agriculture One of the main problems of farmers during the growing season is the lack of irrigation water. That is, during the sowing season, farmers take turns receiving irrigation water. The goal of rational water use is the optimal distribution of irrigation water among irrigation consumers.

8 USAID (2016). Tajikistan-Property Rights and Resource Governance Profile.
9 OSCE (2019.) Water Management in Agriculture & Government of Tajikistan. (2001). Concept on the rational use and protection of water resources in the Republic of Tajikistan. https://www.osce.org/files/f/documents/2/8/413231.pdf
10 World Bank statistics 2020. https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?locations=TJ

Zarafshon valley. ©GIZ

Water Saving Techniques: Low-tech solutions

Under as well as overwatering of crops is a major threat to crop development. With the current water distribution system in place, many farmers in Tajikistan flood fields when the water is allocated to them, hence overwatering the fields. The water allocation, depending on location is on average every 10 days. Crops will not be water for 9 days, then overwatered at day 10. This leads to unnecessary stress for the plant and can increase the risk of pest outbreaks. Regular and optimal watering of crops is essential for the best yield results.

There are several options to preserve water before installing an expensive drip or tubular irrigation system. In the following section counter lines and soil ridges as well as the plantation of trees and bushes are illustrated.

Other options for water preservation include measures to increase soil moisture:

- Increased soil cover with cover crops
- Mulching
- Mixed cropping, incl. plant diversification, crop rotation, and intercropping
- Optimal selection of crop of the water availability

*These practices are described in the relevant sections in the chapters soil and plant management.

Counter-Lines / Soil ridges

Description of practice

One effective measure is to build small soil ridges to collect rainwater and prevent rainwater run-off in hilly areas. Even during periods of low rainfall, enough water is collected for crop growth. The small ridges are usually about 10-15 cm deep and require to be redone after heavy rain events, or at least seasonally.

Another option is to install contour lines made of living material. These contour lines not only retain water and infiltrate rainwater, but they also stabilize the soil and develop into strong lines of vegetation. Depending on the planting material and the water availability, the establishment of contour lines might require additional watering in the first year of the plantation, which is not everywhere possible.

Counterlines. ©GIZ

Table 22

Practice details	Climate Change	Economic & environmental benefits
Location: not specified **Implementing agency:** farmers **Timeframe:** regular activity **Budget:** low cost	Adaptation benefits to higher temperatures and increased risk of drought periods.	Avoidance of an expensive irrigation system. Increased yield through regular and adequate watering
Knowledge management	**Inclusiveness**	**Documentation**
N/A	N/A	N/A

Increasing Water Retention Rates

Description of practice

Growing trees and bushes along small streams and gutters slow the water speed and increase the water infiltration into the ground. One way to stop soil erosion along streams and rivers is to plant trees along them. Trees that like to keep their roots in water grow easily from cuttings, such as poplar or tugai trees. It is recommended to plant 2 or more rows of cuttings, this holds the soil in place and begins to create the conditions necessary for the return of other plants and animals.

Under suitable conditions, planting trees helps restore damaged land and provides firewood, timber, food for humans and animals, and medicines. Planting trees can turn poor and infertile soil back into rich and fertile soil. But trees planted in harsh conditions need effective care to grow well. Some trees grow better when planting their cuttings in the soil and watered until they grow roots and leaves (e.g. poplar). Trees grown from cuttings also produce fruit or seeds faster than trees grown from seeds.

Table 23

Practice details	Climate Change	Economic & environmental benefits
Location: Rasht and Zarafshon valleys **Implementing agency:** UNDP Rasht office MSDSP **Timeframe:** 3-4 years to reach effectiveness **Budget:** low cost	Trees improve soil quality and fertility by promoting water retention and reducing water stress in years with low rainfall. Trees reduce the impact of extreme weather events such as droughts and heavy rains.	Vital role in improving food security by serving as a way to diversify production systems; Farmers reduce dependence on a single food crop and ensure there is enough grass for animals. For example, if an annual crop is destroyed by drought, the trees will still provide fruit, fodder, fuelwood, timber and other products, often of high commercial value.
Knowledge management	**Inclusiveness**	**Documentation**
Exchange visits, field days	Youth farmers	Handouts

Cleaning Drainage Networks

Description of practice

Agricultural land must have sufficient water for optimal food production, including crop production and livestock grazing. Having a proper drainage system will ensure that excess water can be removed and drained quickly after periods of particularly heavy rainfall, which will greatly limit any negative impact or damage to the soil. Drainage of agricultural land is a system of engineering structures for collecting and removing excess moisture reserves (drainage zone), lowering the level of mineralized groundwater, as well as creating conditions for the removal of salts harmful to plants from the root-inhabited soil layer. If necessary, periodically, the water of the collector-drainage networks can be used for the irrigation of crops. Periodic irrigation is the elimination of deficiency in irrigation water, which can be observed annually during the most intense irrigation periods on individual lands for organizational, economic and technical reasons, as well as in dry years during the growing season on farmers' plots.

In the conditions of land shortage in Tajikistan, where suitable lands make up 7% of its territory, and out of 762 thousand hectares of irrigated area, 98.7 thousand hectares are salinized to varying degrees. This is the result of unsatisfactory operation of the collector-drainage network and vertical drainage in most of the irrigated areas. And now, the situation is aggravated by the fact that the newly organized dekhkan, farms and production cooperatives are unable to repair and clean the drainage network, and also keep them in working order. Conducting cleaning of collector-drainage networks every 4-5 years will improve the ameliorative condition of irrigated lands and reduce the level of soil salinity.

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Table 24

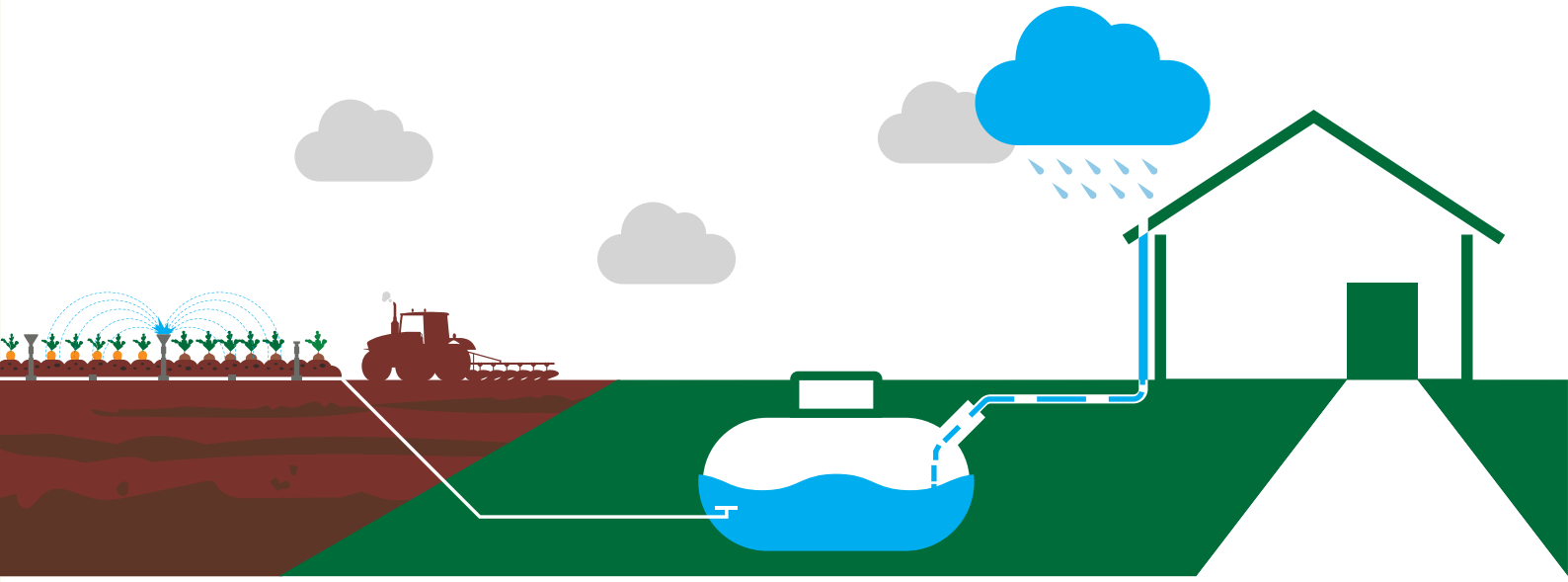
Practice details	Climate Change	Economic & environmental benefits
Location: Aksu and Khoja Bakirgon watershed **Implementing agency:** Helvetas **Timeframe:** annual activity **Budget:** medium costs	▸ Sustainable irrigation water management; ▸ Reduction in soil salinity; ▸ Decreasing the groundwater level; ▸ Restoration of degraded lands; ▸ Sustainable flood protection.	▸ Yield increase ▸ Improve soil quality ▸ Access to growing more profitable crops
Knowledge management	**Inclusiveness**	**Documentation**
ToT, FFS, meetings, field days	Farmers from target Water User Associations (WUAs)	Handouts

Water Saving Techniques: High-tech solutions

Water Storage In Reservoirs

Description of practice

Rainwater harvesting is the technique of collecting and storing rainwater in natural reservoirs. Rainwater is environmentally friendly and safe. It does not contain a large amount of lime, so it will not able to affect the health of sensitive plants. Rainwater does not contain impurities such as fluorine or chlorine, which can damage both the plant and the soil alike. Storing water in water reservoirs for the dry summer months is particularly effective with other water-efficient irrigation methods. Rainwater harvesting provides an independent water supply while otherwise water supply is regulated. The reservoirs are particularly important in the occurrence of drought. Further, reservoirs help mitigate flooding in low-lying areas, and reduce the need for wells that might deplete groundwater levels. They also contribute to the availability of drinking water, since rainwater is practically free of salts and other pollutants.



Water reservoir. ©Risha Solutions

Table 25

Practice details	Climate Change	Economic & environmental benefits
Location: Sughd region, Rasht and Zarafshon valleys **Implementing agency:** GERES, UNDP, MSDSP **Timeframe:** seasonal activity **Budget:** high cost	Climate change has changed rainfall patterns in Tajikistan. Rainwater harvesting – for the development of agriculture, livestock and other agriculture – is a way for people living in conditions of high rainfall variability to adapt to potential water scarcity.	Mitigation of water scarcity at critical stages of crop growth and supplemental irrigation can increase yields by more than 100%.
Knowledge management	**Inclusiveness**	**Documentation**
Practical training events, FFS	N/I	Posters, manuals, booklets

Drip and Tubular Irrigation

Description of practice

Drip irrigation has been used commercially since the early 1960s. Today, drip irrigation is one of the most progressive and effective irrigation methods, based on the flow of water in small doses to the root zone of plants. The amount and frequency of water supply are adjusted according to the needs of the plants. Water flows to all plants evenly and in the same amount. In recent years, a wide range of drip irrigation equipment has been developed, making drip irrigation reliable and easy to use. Drip irrigation applications are especially effective:

- in places of lack of water;
- on sloping and uneven terrain and foothill lands;
- on highly permeable soils (such as stony, sandy, gravelly, etc.).

Tubular irrigation. Water loss also happens in the field, as some water flows to the end of the field and is discharged. This happens when different volumes of water are supplied to the irrigation furrows. The share of water loss in the field is up to 50% of the supplied water. The principle of tubular irrigation is that a fixed volume of irrigation water is supplied to the furrows, which allows uniform moistening of the soil surface under the crop and reduces water loss from discharge. When cultivating cotton and other crops on irrigated lands, watering is the most labour-intensive operation. When irrigating cotton from a temporary irrigation network, the beginning of the furrows was fixed with paper, film, etc. It takes 1.5-2 people a day to irrigate a hectare of cotton. It is especially difficult to water at night when watering is stopped due to the threat of erosion of the temporary network.

Through the use of these methods, the period of irrigation was reduced, and the amount of water was reduced, which made it possible to irrigate more land. And also, these irrigation methods made it possible to protect the soil from erosion processes. Using water-saving irrigation methods, arid zones of the target area were created gardens.

With drip irrigation, the soil is moistened with water supplied by low-flow point sources of water, as a result of which only a small part of the total soil volume is moistened. To use a drip irrigation system, a concrete tank to store water is built or plastic barrels are installed, depending on the area to be irrigated. Pipes and droppers (emitters) are Chinese, Turkish and local production. Depending on the type and age of crops, 2 l/h, 4, 6, 8, etc.

Drip irrigation.
©Risha Solutions

©Freepik

Table 26

Practice details	Climate Change	Economic & environmental benefits
Location: Sughd and Khatlon regions **Implementing agency:** Helvetas **Timeframe:** one time set up and continuous repair **Budget:** high costs	Adaptation benefits to higher temperatures and increased risk of drought periods. Reducing the risk of spreading diseases and weeds; ▸ Preservation of soil fertility; ▸ Ensuring optimal soil moisture.	Economical use of water from 3 to 10 times; ▸ Saving energy by saving on pumping water; ▸ Increased yield by 30% - 50% and improved fruit quality; ▸ Reducing the cost of mineral fertilizers by 50% - 60%; ▸ Savings on agrotechnical measures (cultivation, fertilization, direction or management of water in the field, etc.);
Knowledge management	**Inclusiveness**	**Documentation**
ToT, FFS, exchange visits, field days	Farmers of target WUAs	Presentation, booklets, brochures, manuals, online articles

Water Accounting

Description of practice

When irrigating crops, it is necessary to keep records of irrigation water. Water accounting comprises different approaches to quantifying water resources. In Tajikistan, the following water-measuring devices were used in the demonstration sites of the target Water User Associations:

- Thompson spillway (BT-90);
- Chipoletti spillway (VCh-50)

The Thomson water accounting system is recommended in practice for water flow rates ranging from 1 to 30 litres/second.

Table 27

Practice details	Climate Change	Economic & environmental benefits
Location: Aksu and Khoja Bakirgon watershed **Implementing agency:** Helvetas, PO Neksigol Mushovir **Timeframe:** regular maintenance **Budget:** high cost	Irrigation water metering ensures the optimal use of water and thus helps farmers adapt to climate change. Watering according to the norms and schedule will provide the plant with the water it needs at the right time.	If water consumption is reduced, the cost of production also decreases.
Knowledge management	**Inclusiveness**	**Documentation**
ToT, FFS, Field days and exchange visits	Farmers from target WUAs	Handbooks, booklets and posters

Knowledge management practices

Local community agricultural extension agents (village advisers)

Agricultural Extension is a service that provides rural people with access to the knowledge and information needed to improve the productivity and sustainability of production systems, improve quality of life and improve livelihoods. The new agricultural policy in Tajikistan, emphasizes the importance of services dissemination of knowledge and experience. However, extension models based on public services and private agro-dealers and service providers are not enough to meet the needs of farmers in very rural areas, since they cannot afford to pay for extension services. These farmers rely on traditional knowledge and peer exchange.

The local community-based rural extension model promotes climate change adaptation and risk reduction by strengthening the capacity of communities to identify and select appropriate strategies in response to the observed impacts of climate variability on local livelihoods. The model promotes a rural outreach and education program that assists many communities that would not otherwise receive technical support services.

As a result of these services, farmers are generally able to increase crop yields and livestock productivity. This, in turn, has a positive impact on the health and food security of families. In addition, rural knowledge disseminators help local communities develop affordable new products for local markets.

Rural extension programs help to reduce the cost of providing extension services resulting from the scale and complexity of centralized systems. Rural disseminators of knowledge and experience profitably accumulate new knowledge and technical skills and thus can earn additional income by charging for the services they provide.

Farmers field school

The Farmer Field School (FFS) is a group learning process that was originally used by several to promote integrated pest management. The FFS combines the concepts and methods of agroecology, experiential learning and community development as a group learning process. In general, the FFS aims to increase farmers' understanding of the environmental processes that affect crops and animal production through on-site learning such as field observations, simple experiments and group analysis. The knowledge gained as a result of the training allows participants to independently make locally appropriate decisions regarding crop production methods.

The FFS approach is radically different from previous agricultural extension programs where farmers expect to implement general recommendations formulated by experts from outside the local community. Consequently, FFS are not always well received in Tajikistan.

To adapt to climate change, farmers need to better understand the processes that affect the performance of the different production systems they manage, and constantly experiment with and adapt these production systems.

Moreover, even the knowledge of agronomy that farmers acquire by participating in farmer field schools, customs and the ability to continuously adapt working methods are essential to enable farmers to cope with climate change. FFS might be a good platform for farmers to exchange experiences with new practices and new species and varieties cultivated. However, FFS might lack the necessary long-term understanding of the changes projected on climate change and hence require outside knowledge and guidance.

Farmer Field Schools are a powerful group learning mechanism that reaches thousands of small farmers with knowledge and technical content, which each of them can adapt to their own unique circumstances. In addition, as noted, these processes enable farmers to participate more effectively, both individually and collectively, in agricultural development processes.

Conclusion

Tajikistan is facing dire consequences of climate change with projections showing a further increase in temperatures and unpredictability of weather changes. These changes pose an increasing challenge and risk for the agricultural systems in Tajikistan that already suffer from land degradation and resource overuse. Concurrently, the rates of global loss of biodiversity and in particular agrobiodiversity are also a challenge for Tajikistan. With more farmers practising monoculture and the application of chemical pesticides not only plant and animal species are decreasing.

Sustainable agriculture works with nature, rather than against it. It recognises the fact that nature is complex and accordingly endeavours to understand interactions between plants, animals and insects. Sustainable agriculture aims to meet the need for food at present, without compromising the ability of future generations to farm.

This report illustrates several sustainable farming practices that contribute to climate change adaptation, biodiversity conservation and strengthening the resilience of a farm and a farming system which are already successfully practised in Tajikistan based on an assessment conducted with implementing and partner institutions in Tajikistan. The illustrated farming practices provide an overview and serve as an inspiration for implementing organisations and village advisors to support the adaptation to climate change and increasing biodiversity, thus strengthening the resilience of farmers.

Tajikistan has a multitude of different agroecosystems with every farm having different resources as well as farmers' interests. This requires a nuanced approach from the selection of what to plant, how to grow and which practices to apply. It should be highlighted that these farming practices are not meant to be alone standing measures. It is recommended to implement a combination of these practices suitable for each farm based on available resources. Further, given the different climatic conditions of each region, it is very important that farmers carefully assess the conditions on their plots and plan for their cultivation season accordingly.

Based on these guidelines GIZ will conduct specific training events for village advisors and implementing partners to introduce farm planning and environmental assessment tools as well as step-by-step instructions for implementing a selection of the above-described practices. The first training module will be available in the summer of 2023. For further questions please contact the GIZ team.

Zarafshon valley. ©Risha Solutions

Annexes

Tajikistan. ©Flickr

Annex 1: Assessment framework

Table 28

Biodiversity			
Rating 1- 5	Description of the impacts on biodiversity at the farming plot	How did the intervention contribute to an increase of biodiversity in the surrounding ecosystem?	Livelihood benefits
The intervention had: 5 = very high positive impact on biodiversity; 4 = high positive impact on biodiversity; 3 = positive impact on biodiversity; 2 = no impact on biodiversity 1 = negative impacts on biodiversity	How has the intervention improved the level of biodiversity on the farm? What practices have been introduced? What are the new species?	This may include improved habitat for pollinators, improved soil cover in surrounding ecosystem	How has the community/ farmer benefited from (or is likely to benefit from) increased biodiversity?

Table 29

Climate Change Adaptation										
Rating 1- 5	Which natural hazards are the famers expe-riencing?	How do the experienced natural hazards impact farmers?	To what extent are the natural hazards triggered by unsustainable land use?	To what extent are the natural hazards triggered climate change?	Climate Change Adaptation Measure taken	Does the intervention use or propagate the use of indigenous, climate-resilient varieties? If so, which ones?	Did the intervention apply climate smart technologies, if so which ones?	How exactly did the intervention benefit the farmer / the community?	Did the intervention use weather information?	Did the intervention use climate information? If yes, which ones?
Did the intervention help the farmer/ community adapt to climate change? 5 = yes, with immediate benefits 4 = yes, with benefits in 2-5 years 3 = yes, but only to some parts of the community 2 = no adaptation benefits, only mitigation benefits 1 = neither adaptation nor mitigation	Please select from the list	Please describe how the natural hazard has impacted the crops grown; if possible quantify. E.g. an extended drought period of 4 weeks has reduced the tomato harvest by 20% in June 2021	Please describe, based on your subjective estimate from the field visit or by interviewing, what might be causes for the natural hazard. To what extent was the farmer already badly prepared for the natural hazard (e.g. no installed irrigation system, no shade, overuse of soil) and to what extent does climate change contribute (e.g. more frequent droughts)		Measures taken include: new crop varieties, plot selection, changes in cropping calendar, or decision to change the crop etc.	This question will be helpful to connect to the research component	Considered are only technologies, all "good" adaptation practices shall be listed under the previous column. Technologies may include: irrigation system, measure-ments for soil moisture, any meteorological data, solar power, etc.	Benefits may include: increased resilience, reduced vulnerability to climate risks, increased production, reduced production losses, etc.	Short-term or seasonal weather forecasts, e.g. from hydrometric stations	Long-term climate forecasts

Table 30

Resilience & Adaptive Capacity			
Rating 1- 5	How was the adaptive capacity of an individual or a community strengthened?	Which ecosystem services were improved?	What are the mitigation benefits / the mitigation potential of the intervention?
Adaptive capacity 5 = whole community strengthened 4 = part of the community is strengthened 3 = individual household is strengthened 2 = immediate risks averted 1 = adaptive capacity has not been strengthened	Please describe what the intervention did.	https://en.wikipedia.org/wiki/Ecosystem_service	Did the intervention apply one of the following mitigation measures: 1. Fertilizer: Change to organic fertilizer or reduction of chemical fertilizers 2. Improved soil carbon, health and fertility (e.g. through crop rotation, regeneration periods, etc.) 3. Protection of surrounding ecosystems for improved ecosystem service management (e.g. cultivation of surrounding areas for improved water management, nesting places for pollinators) Where possible, please quantify

Table 31

Economic benefits		
Rating	Intervention brought short term economic benefits	Intervention brought long term economic benefits
2 = long term benefit 1 = short term benefit 0 = no economic benefit	List all economic benefits during the first season	List all economic benefits that have been/can be realized in the next few years

Table 32

Vulnerable groups		
Rating	Who of the specifically vulnerable groups (e.g. youth, elderly, women, etc.) were included?	How were they included?
1 = vulnerable groups were included 0 = vulnerable groups were not included		

Table 33

Knowledge management & Scaling			
Is detailed project/ practice information publicly accessible, if yes where?	How are / were farmers trained?	Has the intervention already been scaled?	Potential for scaling

Annex 2: List of interview partners

Table 34

#	Name	Organisation	Date of contact
1	Takhmina Sayfulloeva	Cooperative “Sarob”	10.03.2022
2	Magzumbek Mavlonov	PO “Development of cross border relations in Jirgital district”	15.03.2022
3	Malika Abdusamieva	Association “Women and Society”	22.03.2022
4	Daler Nabiev	currently employed by GIZ, (interviewed for his former position in the RDP 1 project, Welthungerhilfe Consortium, PO IPD)	14.03.2022
5	Akobirov Mirzosho	PO Rushnoi	15.03.2022
6	Abdujabbor Hakimov	PO IPD/Welthungerhilfe	13.06.2022
7	Farhod Soliyev	DAI Global	12.03.2022
8	Shohida Tuliyeva	Helvetas	21.05.2022
9	Negmadzhon Negmatov	GIZ Khujand office	23.03.2022
10	Husein Toshmatov	ICPO JOVID	16.03.2022
11	Naim Rashidov	PITTU named by academician Osimi	19.06.2022
12	Bunyod Sadiev	NCC Sarob/single expert	07.06.2022
13	Shavqat Juraev	NCC Sarob/single expert	03.06.2022
14	Jamshed Abdujalilov	NGO GERES	10.06.2022
15	Saymuddin Muhiddinov	UNDP office Rasht valley	16.03.2022
16	Bakhtiyor Ashurov	CARITAS Switzerland	22.09.2022
17	Nabi Alidodov	MSDSP	03.02.2023

Annex 3: List of organisations and project teams interviewed

Table 35

1. SAROB

Project 1: N/I

Duration: 3 years

Area: 14,300 ha

Financial Scope of the intervention: 248,000 EUR

Implementation area:

Sughd region - Konibodom, Kuhistoni Mastchoh, J. Rasulov, B, Gafurov, Spitamen, Zafarobod.

Khatlon region - Jayhun, Vakhsh, Kushoniyon, A. Jomi

Project 2: Improving the quality of life and food security through sustainable management of natural resources in the Zarafshan Valley

Duration: 5 years

Area: 173 ha

Financial Scope of the intervention: 500,000 USD

Implementation area: Zarafshon valley

Short description of the project and organisation:

SAROB was founded in 2011 and is organized as a non-profit cooperative with self-employed agricultural advisors being its members. Introduction of new technologies, supply of crop seeds and agricultural machinery. Currently, the organization covers 40,000 ha of land, and works with the following crops: cotton, apricot, wheat, onion, apples, potatoes, corn, sunflowers and melons.

2. Polytechnic Institute of the Tajik Technical University

Implementation area: Khujand

Short description of project and organisation:

PITTU - Polytechnic Institute of the Tajik Technical University named by academic M. Osimi in Khujand is one of the leading technical universities in Tajikistan. Located in Khujand.

3. GIZ

Project name: Strengthening of Livelihoods through climate change adaptation in Kyrgyzstan and Tajikistan

Duration: 4 years

Area: 500 ha

Financial Scope of the intervention: 4 Mio EUR

Implementation area: Kuhistoni Mastchoh, Devashtich and J. Rasulov districts

Short description of project and organisation:

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH has been working in Tajikistan since 1995. GIZ focuses on the following priority areas in Tajikistan:

- Environment and climate
- Economic development and employment
- Social development

4. PO "Rushnoi"

Project name: Biodiversity in Agricultural landscapes

Duration: 2 years

Area: 18 ha

Financial Scope of the intervention: 94,000 USD

Implementation area: Rasht district, Jafr and Mazor villages

Short description of project and organisation:

The Public Organization Rushnoi is located in the Rasht Valley and works in the areas of horticulture, pasture management, vegetable growing, and advising farmers, improving biodiversity in all districts of the Rasht Valley.

5. Innovations and Participation for Development (IPD)

Project 1: Biodiversity in Agricultural landscapes (and other projects)

Duration: 2 years

Area: average size of plot 0.5 - 2 ha

Financial Scope of the intervention: N/A

Implementation area: Zarafshon valley - Aini and Panjakent districts

Project 2: Rural Development Programme I

Organisation: IPD (subcontractor of consortium member)

Duration: 4 years

Area: N/I

Financial Scope of the intervention: N/I

Implementation area: Zarafshan Valley (Aini and Panjakent districts)

Short description of project and organisation:

The Public Organization IPD (Innovations and Participation for Development) is founded with the aim of supporting the sustainable development of the population of the Republic of Tajikistan through the implementation of social, economic and development programs. The foundation of IPD has been encouraged by the international NGO Welthungerhilfe / German Agro Action. IPD was established with the objective to support the improvement of rural livelihood in the country. The organization, in its activity, follows to the principles of the equal approach, participation and introduction of innovative methods in problem-solving.

6. NGO GERES

Project name: N/I

Duration: 4 years

Area: average size of plot 4+ha

Financial Scope of the intervention: 1,200,000 EUR

Implementation area: Zarafshon valley - Aini district, Asht district

Short description of project and organisation:

The French organization GERES (Group for Environment, Renewable Energy and Solidarity) has been working in Tajikistan since 2011. The specific project interviewed aims to develop a sustainable process that will improve the living conditions and economic opportunities of about 1,000 vulnerable rural households, especially those headed by women.

7. DAI Global

Project name: Feed the future

Duration: 5 years

Area: N/I

Financial Scope of the intervention: N/I

Implementation area: 12 districts of Khatlon province, Bokhtar zone

Short description of project and organisation:

DAI works on the frontlines of global development. Transforming ideas into action—action into impact. Its activities include the design an inclusive partnership facility to provide competitive performance-based grants, subcontracts, and technical assistance.

8. ICPO 'JOVID'

Project name: N/I

Duration: 1 year

Area: N/I

Financial Scope of the intervention: N/I

Implementation area: B. Gafurov, J. Rasulov and Spitamen districts

Short description of project and organisation:

The INTERNATIONAL CHARITY PUBLIC ORGANIZATION «JOVID» was established in August 2002.

Mission: *«To improve rural population livelihoods in the Republic of Tajikistan, to make input into country food security through Lending programs development and consulting services improvement and implementation of intensive technologies».*

9. Caritas Switzerland

Project name: Weather - Water - Climate Services in Tajikistan

Duration: N/I

Area: N/I

Financial Scope of the intervention:

Implementation area: Muminobod

Short description of project and organisation:

Caritas Switzerland - *"Weather - Water - Climate Services in Tajikistan"* project.

Caritas Switzerland's programme in Tajikistan focuses on improving agricultural livelihoods within mountainous environments, while simultaneously reducing vulnerability to natural disasters.

10. MSDSP

Project name: Improving the well-being of smallholder farmers through connecting to the agricultural production chain and adapting to climate change in Zarafshon Valley

Duration:

Area: 4000 small farmers

Financial Scope of the intervention: N/I

Implementation area: Panjakent, Aini and Kuhistoni Mastchoh disticts

Short description of project and organisation:

Goal of the project is improving the living standard of small rural farmers by increasing productivity, value of agricultural products and improving the quality of final products in the context of climate change.

Task of the project is:

- → Help to improve the well-being of at least 4,000 small farmers by integrating within production groups, providing access to quality agricultural inputs and agricultural expert advice.
- → Contribute to the efficiency of the agricultural value chain by supporting individual participants in the value chain and connecting individual links in the chain.
- → Improving the process of agricultural advisory services at the local level.

11. Helvetas

Project name: National Water Resources Management

Duration: 4 years

Area: N\A

Financial Scope of the intervention: N/I

Implementation area: Spitamen, J. Rasulov and B. Gafurov disticts

Short description of project and organisation: The Water Resources Management (WRM) project, funded by the Swiss Cooperation Office, is working to strengthen and achieve effective water management at the basin level, functioning of irrigation systems, as well as at the farm level in the Tajik part of the Syrdarya River Basin in the Sughd region.

Activities are carried out with the aim of increasing the security of irrigation water supply, ensuring food security, reducing the risks of natural disasters associated with water, and as a result of achieving an improvement in the living standards of the population, and ensuring indicators of socio-economic growth in individual rural communities.

The WRM project is implemented by the HELVETAS Consortium, which consists of Helvetas Swiss Intercooperation, ACTED and GIZ. In 2016, the WRM Project introduced and demonstrated simple and affordable water saving technologies such as short furrow irrigation, drip irrigation systems and black film mulching in 9 FFS and 9 WUAs located in the Project target area.

12. UNDP

Project name: Strengthening the capacity of communities in Khatlon region and Rasht valley

Duration: 3 years

Area: more then 100 ha

Financial Scope of the intervention: N/I

Implementation area: Rasht valley

Short description of project and organisation: The Project is implemented in Rasht valley and aims residents of pilot rural areas, women, and men from vulnerable households and/or from rural settlements facing development issues, are equipped with skills for employment, self-employment and innovations in farming and agribusiness spheres and are able to more actively participate in and contribute to inclusive and sustainable rural development.

13. Association “Women and Society”

Project name: TRIGGER I

Duration: 3 years

Area: 2 ha

Financial Scope of the intervention: total investment per ha 900 TJS

Implementation area: Sugd region, Asht district, Mehrobod village

Short description of project and organisation: The Association "Woman and Society" (AWS) is a non-profit organization whose mission is to improve the status of women and the social and economic recovery of society through the provision of various kinds of services. AWS was established in February 1995 and registered in April of the same year by the Department of Justice of the Sughd region of the Republic of Tajikistan. In December 2007, in accordance with the law “On Public Organizations”, AWS was re-registered in the Department of Justice of the Sughd region.

The main goal of the project is *“To raise farmers' resilience to climate change impacts"*.

Tasks is Top inform farmers about exciting adaptation measures and to teach them how to apply these measures in their activities.

14. Polytechnic Institute of Tajik Technical University named by academician Osimi

Interview conducted did not refer to one specific project but to their academic courses and experiences.

Zarafshan valley. ©GIZ

Published by: Deutsche Gesellschaft fuer Internationale Zusammenarbeit GmbH (GIZ)

Registered offices Bonn and Eschborn, Germany

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Desing / Layout: Doniyor Sanginov

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As at June 2023, Dushanbe