ORIGINAL TITLE OF PROJECT

STRENGTHENING AGRO-ECOSYSTEMS RESILIENCE FOR CLIMATE CHANGE ADAPTATION TO IMPROVE FOOD AND NUTRITION SECURITY

KEY FACTS

Sustainable Development Goals (SDGs):	1, 2, 4, 5, 6, 8, 12, 13 and 15
Countries:	Nepal
Project Symbol:	TCP/NEP/3701
FAO Contribution:	USD 350 000
Duration:	1 October 2018 – 30 September 2021
Contact: E-mail:	FAO Representation in Nepal FAO-NP@fao.org
Implementing Partners:	Ministry of Agriculture and Livestock Development (MoLAD).
Beneficiaries:	Farmers in the districts of Dang, Gulmi and Mustang, and Government staff.
Country Programming Framework Outputs:	Priority Area 1: Food and nutrition security and safety. Outcome 1.1: Crop, livestock and fishery production and productivity increased through strengthened capacity of the delivery institutions and producers. Output 1.1.3: Crops. Output 1.1.5: Genetic Resources.

BACKGROUND OF THE PROJECT

The dynamic interactions between the physical elements (climate and weather) and living organisms that comprise agro-ecosystems have been impacted by climate change. These include changes in the characteristics, roles and functions of natural enemies, pollinators, decomposers, nutrient recyclers and symbiotic agents, as well as in agro-ecosystem services (AES), like nutrient/energy flow, the natural control of crop pests and diseases, pollination, the decomposition of organic matter and symbiosis. In Nepal, agro-ecosystems account for around 29 percent of the country's surface area. However, these agro-ecosystems face numerous challenges, including a decline in the diversity and population of natural enemies and pollinators, an increase in the frequency of outbreaks and resurgences of crop pests and diseases, pollination deficits and the deterioration of soil health and fertility. These challenges are further exacerbated by poor agricultural practices, like the excessive use of agrochemicals, slash burning, flood irrigation and monocropping. Moreover, farmers in Nepal are generally unaware of the value that

agro-ecosystem services add to farming activities, while regular agro-ecosystem analysis (AESA) and surveillance are lacking. In this context, the project was designed to ensure sustainable agri-production and promote environmental conservation by improving agro-ecosystem services. More specifically, the project sought to promote and conserve agro-ecosystem services by defining the roles and responsibilities of relevant stakeholders and developing the technical capacities of farmers, agricultural researchers and Government personnel.

IMPACT

The project aimed to strengthen food security and nutrition in Nepal by fostering higher quality agro-ecosystem services (AES) in the districts of Dang, Gulmi and Mustang. Local farmers have started to adopt good agricultural practices that will sustainably enhance production and productivity, while Government institutions and personnel remain in a stronger position to oversee the improvement of AES.

ACHIEVEMENT OF RESULTS (INCLUDING ELEMENTS OF SUCCESS)

The project initially sought to geographically map AES and identify the strengths and existing challenges related to pollination, natural pest/disease control, nutrient recycling, symbiosis and soil microbiology. Following the identification of target farmers and agro-ecosystems, a baseline survey on farmers' knowledge of AES was conducted, weather data was collected and analysed, and a database of potentially viable AES for development was prepared. Subsequently, samples were collected to evaluate soil biodiversity, a study was completed on the physicochemical properties of soil, and land cover maps were developed using geographic information system (GIS) data.

Following the farmer field school (FFS) approach, good agricultural practices related to pollination, natural pest/disease control, nutrient recycling and soil microbiology were tested and validated for use in the production of apple, citrus and mustard. In total, 25 FFS facilitators were trained, which allowed for the delivery of nine FFS sessions, one for each target crop in Dang, Gulmi and Mustang, as well as three refresher trainings, reaching a total of 260 beneficiaries. In addition, agro-ecosystem training was delivered to 45 Government staff, and support was provided to resource centres for the production and application of microorganisms that improve farming activities. The project also facilitated the provision of agricultural inputs and technologies to target farmers and Government staff.

A database of the lessons learned through the testing and validation of good agricultural practices was developed. This database will support the replication and scaling up of improvements in agro-ecosystem services throughout the country, in addition to strengthening capacities across Government sectors. The project also facilitated events to encourage local authorities and stakeholders to commit to the scaling up of climate-sensitive agricultural production strategies. In particular, an awareness-raising campaign on an emerging problematic disease (Apple scab) was delivered, facilitating the demonstration of disease identification and control measures to local apple growers.

IMPLEMENTATION OF WORK PLAN AND BUDGET (INCLUDING IMPEDIMENTS AND CONSTRAINTS)

All project activities were carried out in accordance with the approved budget. Owing to the delays caused by the outbreak of Coronavirus Disease 2019 (COVID-19) and the associated limitations on conducting in-person activities, a no-cost project extension was requested and approved. Subsequently, project activities were carried out as stipulated in the revised work plan.

FOLLOW-UP FOR GOVERNMENT ATTENTION

The project was well embedded in Government structures that are committed to sustainably improving AES and the associated human resources. Moreover, Government institutions, such as Agriculture Knowledge Centres (AKCs) and Local Municipalities, remain central to monitoring the long-term performance of initiatives developed under the project. The feedback provided by these institutions, in addition to other national institutions concerned with agriculture, pesticides and biodiversity conservation, will support the MoLAD and Department of Agriculture (DOA) in designing their annual programmes of work.

A series of key follow-up areas were identified during the project. These include: formulating, reviewing and updating policies, strategies, programmes and guidelines related to crop production and AES so that they better contribute to food security and nutrition and food safety; strengthening coordination across levels of Government for the design and implementation of interventions on food security and nutrition and food safety; equipping technical institutions with the capacities, policies and plans needed to support the scaling up of sustainable agricultural management systems; developing the capacities of farming communities through FFSs for the identification and uptake of agro-ecological technologies and practices that sustainably increase productivity and production; developing the capacities of Government institutions to monitor and analyse agricultural production and food security and nutrition trends; assisting stakeholders to improve and diversify production, promote agribusinesses and create market linkages; implementing farmer business schools (FBSs) to strengthen the capacities of farm entrepreneurs, including women-led producer groups, to develop agribusiness enterprises; diversifying local cropping systems; and developing private sector needs-based investment plans and formulating value chain development strategies for selected high-value commodities.

SUSTAINABILITY

1. Capacity Development

Although relevant policies and legal frameworks to support project sustainability are either in place or being developed, notable policy gaps exist for the implementation and scaling up of actions to improve AES. Nevertheless, the project was well embedded in Government structures that will likely remain committed to developing AES on both a local and national scale. Notably, the project strengthened partnerships between Government structures, national institutions, local stakeholders and farming communities for the monitoring of AES-related initiatives, which will guide the development of future work plans. As such, federal, provincial and local governments are expected to integrate the accomplishments of this project and the key lessons learned from it into their broader development programmes.

2. Gender Equality

The needs and priorities of both men and women were addressed under the project. Notably, men and women benefited equitably from project initiatives, while at least 50 percent of participants at FFSs were women.

3. Environmental Sustainability

Project initiatives simultaneously targeted environmental, economic and social dimensions of agri-food systems development by seeking innovative and holistic solutions to the complex and interrelated challenges of poverty, hunger and malnutrition, rural abandonment, environmental degradation and climate change. More specifically, emphasis was placed on developing nature-based solutions to agricultural challenges, such as the application of biocontrol agents, biopesticides and natural enemies instead of chemical pesticides, and promoting the use of organic fertilizers, farmyard manure (FYM) and compost instead of chemical fertilizers. This shift in farming activities will ultimately support agro-biodiversity conservation and improve AES.

4. Human Rights-based Approach (including Right to Food and Decent Work)

The development of agro-ecological approaches in Nepal promotes the right to adequate food and decent work by enhancing yields and the quality of produce, supporting rural agriculture, and reducing poverty. Moreover, the enhancement of AES improves the working conditions of farmers, providing them with access to agricultural inputs, increasing their production and productivity, and encouraging diversity both in terms of crop production and diets.

5. Technological Sustainability

Capacities were developed on agro-ecological practices through hands-on training programmes and FFSs. The technologies introduced were both appropriate and flexible, helping place farmers and households at the centre of food production decisions. The project also sought to avoid creating a dependence on top-down technology transfer that requires external inputs. Instead, self-produced and locally sourced inputs (including seeds) were favoured, reducing farmers' dependency on expensive and hard-to-access products. Importantly, most beneficiaries are not expected to require further technical assistance in applying the newly adopted agro-ecological methodologies.

6. Economic Sustainability

The economic sustainability of project interventions is grounded in the lower production costs and higher productivity per unit of land that will result from the promotion and application of AES. Importantly, the costs of agro-ecosystem inputs and services are expected to remain affordable to beneficiary farmers. This will also be bolstered by the commitment of Government institutions to allocate budgets to programmes on good agro-ecosystem practices. Additionally, private sector interest in developing goods and services related to supporting the adoption of these practices has started to grow.

DOCUMENTS AND OUTREACH PRODUCTS FROM THE PROJECT

Documents

- May 2020. Bibliographic databases (report). 9 pp.
- June 2020. Good management practices – production technology (report). 24 pp.
- June 2020. Review of the National Policies and Strategies Report. 13 pp.

- June 2020. Analysis of climate data trends (report). 24 pp.
- August 2020. Soil nutrients status and soil microorganisms (report).
- January 2021. Baseline study of agroecosystem services based on farmers' perception (report). 12 pp.
- June 2021. Field survey of pollinators, natural enemies, and beneficial microorganisms (report). 16 pp.
- June 2021. Preparation of the land use map and the mapping of pollinators and other beneficial organisms – GIS map of project districts (report). 12 pp.
- June 2021. Project technical support report (report). 192 pp.
- September 2021. Project document on "*Agroecosystem Services Improvement and Climate Change Adaptation Project in Nepal*" (document). 48 pp.

Information, Education and Communication Materials

- September 2021. Pollinator Insects (booklet). 8 pp.
- September 2021. Pollinator Identification (booklet). 8pp.
- September 2021. Important Pollinators (poster).
- September 2021. Apple Scab Disease (booklet). 8 pp.
- September 2021. Apple Root Rot Disease (booklet). 8 pp.
- September 2021. Below Ground Soil Organisms (booklet). 8 pp.
- September 2021. Predators, Parasites and Parasitoids (booklet). 8 pp.
- September 2021. Ecosystem Services Introduction (booklet). 8 pp.
- September 2021. Ecosystem Services (poster). 8 pp.
- September 2021. Soil Organisms (poster). 8 pp.
- September 2021. Combating Citrus Decline (translated manual). 76 pp.
- September 2021. FFS Good practice on Apple. 68 pp.
- September 2021. FFS Good practice on Mandarin. 38 pp.
- September 2021. FFS Good practice on Mustard. 26 pp.
- September 2021. Agroecosystem Good Practices (FFS report). 99 pp.

ACHIEVEMENT OF RESULTS

LOGFRAME MATRIX – ACHIEVEMENT OF INDICATORS

Project Code: TCP/NEP/3701

Expected Impact	**Contribute to food and nutrition security through improved agro-ecosystem services**	
Outcome	Degraded and deteriorating agro-ecosystem services improved for sustainable agriculture, food and environment	
	Indicator	1. Numbers of agro-ecosystem base farming package of practices and technologies developed for wider up-scaling. 2. Percentage of households adopted agro-ecosystem base farming practices by the target beneficiaries.
	Baseline	1. Baseline survey. 2. Baseline survey. The baseline survey found that target beneficiaries/groups were unaware of the agroecosystem-based farming package of practices for apple, citrus, maize, mustard and winter vegetables crops.
	End Target	1. Developed agro-ecosystem base farming package of practices on litchi, apple, citrus, maize, buckwheat, mustard, lentil, and winter vegetable crops (cole crops). 2. At least 70 percent of the target beneficiaries adopted improved practices.
	Comments and follow-up action to be taken	Around 70 percent of target beneficiaries, which included rural communities, farmers, decision makers in Government institutions at the national and subnational levels, intermediaries from NGOs at the national and subnational levels, universities and other academic institutions, adopted improved practices. <u>Ecosystem services restoration</u> – Farmer's awareness and knowledge of AES were raised, thus promoting the conservation and management of AES. – The implementation of various good farming practices was tested and validated. It was recommended that these practices form part of the agro-ecosystem-based farming package of practices for apple, citrus, mustard and winter vegetables crop production. <u>Pollination</u> – Pollinators (wild and commercial bees) increased crop production, creating an enabling environment for conservation and management. – Pollinator diversity was increased (i.e., richness and abundance). – A habitat for pollinators was created. <u>Soil nutrient recycling</u> – Remarkable changes were observed in the soil microorganism populations of *Trichoderma*, *Azotobacter* and *Actinomycetes*. – Fortified FYM, organic manure and micronutrients improved soil health. – Soil nutrients were replenished, and soil erosion was avoided through nutrient management practices, like conservation agriculture (e.g., minimum tillage, mulching and green manuring). – Soil testing was introduced and implemented together with soil nutrient management schemes. Beneficiary farmers were made aware of the importance of managing soil according to soil testing recommendations. <u>Natural pest control</u> – Chemical fertilizer and pesticide use was reduced or eliminated. – The diversity of soil arthropods increased through applying agro-ecosystem practices. <u>Agroecosystem restored through FFS activities</u> – Mulching practices and the use of safer botanicals and biopesticides created a habitat for beneficial predators and pollinators. – Additional food source shelters were provided in dearth periods for ecosystem service providers by adopting legume intercropping and companion crop planting.

		– Habitats and reproduction sites were created for soil arthropods that are responsible for maintaining living soil and naturally controlling pests/disease by using microorganism-based decomposers and focusing on the use of organic matter. <u>Follow-up actions</u> – The formulation, review and updating of policies, strategies, programmes and guidelines related to crops and AES providers so that they better contribute to food and nutrition security and food safety (including animal health, plant health and food safety compliance with the One Health framework). – Strengthening the functional partnership and coordination mechanism between all three tiers of Government for designing and implementing food and nutrition security and food safety-related interventions. – Equipping technical institutions at the federal, provincial and local levels with the capacities, policies and plans needed to support the scaling up of sustainable agricultural management systems. – Developing the capacities of farming communities through FFSs for the identification and uptake of innovative, inclusive and gender-sensitive agro-ecological technologies and practices to sustainably increase productivity and production. – Developing the capacities of Government institutions to monitor and analyse agricultural production and food security and nutrition trends and to collect and analyse disaggregated data relating to SDG targets. – Assisting stakeholders to improve and diversify production, promote agribusinesses and create market linkages. – Implementing FBSs to strengthen the capacities of farm entrepreneurs, including women-led producer groups, to organize themselves into agribusiness enterprises and promote/market prioritized agricultural commodities. – Diversifying local cropping systems with a focus on developing nutritious plant and animal products. – Developing private sector needs-based investment plans and formulating value chain development strategies for selected high-value commodities using the agro-ecological approach. Follow-up actions were well integrated into the Government system, as the project itself was embedded in Government structures that are both expected to persist beyond the project and committed to delivering sustainable results. Local governmental bodies within project areas (e.g., districts of Dang, Gulmi and Mustang) mainstreamed and integrated the project into their regular programmes. Additional support will continue to be provided by higher institutional authorities for human resources development and the laboratory production of biological pesticides and biofertilizers. Programme monitoring and evaluation was also initiated. Regular follow up is to be provided through the trimestral monitoring system of Governmental institutions, including AKCs and Local Municipalities. This feedback will support the MoLAD and DOA in planning their regular annual programmes. The Centre for Crop Development and Agro-biodiversity Conservations (CCDABC), Plant Quarantine and Pesticide Management Centre and Agriculture Forestry University each have specific follow-up responsibilities.
Output 1	Landscape mapping of agro-ecosystem services conducted, strengths and critical gaps on pollination, natural control, nutrient recycling, symbiosis and soil microbiology identified	
	Indicators	Target / Achieved
		Target: Achieved: Yes
Baseline		
Comments	Maps were produced, and assessment reports, survey reports and end-line survey reports were prepared. Notably, a land cover map was prepared, and farmers' perceptions and knowledge of AES were recorded. Repeated interruptions to implementation were experienced as a result of the COVID-19 pandemic.	
Activity 1.1	Identify targeted land areas/sites, farmer groups and agro-ecosystem/s for survey and surveillances, sampling/monitoring, adoption of best practices and piloting of the project	
	Achieved	Yes
	Comments	Targeted land areas/sites, farmers' groups and agro-ecosystems for surveying, surveillance, sampling, monitoring, the application of best practices and the piloting project activities were identified.
Activity 1.2	Carry out baseline survey	

	Achieved	Yes
	Comments	– Overall, 300 farmers (120 each from Dang and Gulmi and 60 from Mustang) were selected for the baseline survey and were made aware of the project. – Overall, 68% of respondents were not familiar with the concept of ecosystem services and around 90% perceived that climate change is affecting AES. – Around 61% of respondents did not have knowledge on pollination, pollinators and nutrient recyclers in the study districts. – None of the respondents were using bio-pest control measures in the project districts, owing to their lack of knowledge and the lack of support services. – Among the many drivers of ecosystem deterioration, climate change was recognized as a key driver that negatively affects ecosystem services (i.e., increasing the incidence of pests, driving habitat destruction, altering farming practices and affecting pollinators).
Activity 1.3	Collect weather data and analyse their effect on agro-ecosystem services	
	Achieved	Yes
	Comments	Weather data (maximum and minimum temperatures, precipitation and relative humidity) were collected and analysed. Significant changes in the precipitation and relative humidity were detected.
Activity 1.4	Desk review and bibliographic databases preparation on agro-ecosystem services	
	Achieved	Yes
	Comments	Compilations containing over 225 references of national significance on ecosystem services with farm benefits, the importance of soil nutrients, beneficial organisms (predators, parasites and pollinators) and botanicals with pesticide properties for pest management were prepared. Additionally, two dozen national policy documents were reviewed and outlined, and good management practices for apple, citrus and mustard were prepared.
Activity 1.5	Field survey, sampling and preservation of the collected samples	
	Achieved	Yes
	Comments	– Seventeen pollinators were identified in mustard, including high abundances of *Megachile* spp., *Halictus* spp. and *Andrena* spp., in addition to seven groups of arthropods (non-pollinators), two abundant groups of ladybird beetles and mustard sawflies. – For apple and citrus, the effects of agro-ecosystem practices (the use of fortified FYM, microorganisms, nutrient balancing and biological pesticides) were compared to farmers' existing practices. Pollinators were measured using a sweep net and soil arthropods were measured a using pitfall trap. For apple, there was a higher abundance (343 vs 220) and diversity (14 vs 13) of pollinators when agro-ecosystem practices were used compared to when farmers' practices were used. Overall, 11 soil arthropod taxa were detected. When agro-ecosystem practices were used, there was a higher abundance and richness of soil arthropod taxa than when farmers' practices were applied. – For citrus, 15 taxa of pollinators were detected, with a higher abundance (348 vs 228) and diversity (15 vs 14) of pollinators when agro-ecosystem practices were used compared to when farmers' practices were used. Similarly, 12 soil arthropods taxa were detected, with a higher abundance and richness of soil arthropod taxa when agro-ecosystem practices were used.
Activity 1.6	Develop site wise GIS maps and land cover/land escape maps showing the degree of climate change effect on agro-ecosystem services	
	Achieved	Yes
	Comments	Geographic information system land cover maps were prepared based on land use patterns. These included areas such as forests, shrublands, grasslands, agricultural land, barren areas, water bodies and snow/glaciers. Additionally, a soil nutrients status map and map of pollinator and soil arthropod diversity were prepared.
Output 2	Best practices on agro-ecosystem services tested and validated to address the gaps on pollination, natural control, nutrient recycling, soil microbiology and symbiosis through the FFS approach	
	Indicators	Target / Achieved
		Yes
Baseline		
Comments	Good practices were tested and validated for apple, citrus and mustard production through the FFSs. These practices addressed pollination, natural control, nutrient recycling and soil microbiology. Altogether, 12 FFS sessions were completed. Subsequently, the project team received AESA data, data on pollinators, predators and decomposers (including over 2 500 live and preserved specimens) and data on above and below-ground arthropods. Although the onset of the COVID-19 pandemic disrupted activities, the project team quickly adopted	

	strategies that ensured the continuity of FFS-based learning, AESA and the monitoring of below and above-ground arthropods. These included: – A virtual group meeting between FFS groups and the AKCs to discuss the situation and plan activities. – The selection of 2–3 active and capable subgroup members to carry out FFS field management, AESA, data collection and the monitoring of arthropods. Lead participants ensured the adoption of strict norms and regulations and COVID-19 safety precautions at FFSs. Technical officers from AKCs were responsible for providing support if new problems occurred. – Covering critical topics by using facilitators and remote sessions (some other FFS sessions were not implemented because of the strict regulations in place).	
Activity 2.1	Training of Facilitators (farmers/junior technician) for the conduction of FFS on agro-ecosystem services (12-15)	
	Achieved	Yes
	Comments	Overall, 25 FFS facilitators graduated from the training. Three hands-on refresher trainings were carried out in each FFS.
Activity 2.2	Staff (municipality/village municipality) training on agro-ecosystem services and management of specific agro-ecosystem	
	Achieved	Yes
	Comments	The agro-ecosystem training was conducted for 45 Government staff across three districts.
Activity 2.3	Establish community based agro-ecosystem resource centre (at least one)	
	Achieved	Yes
	Comments	Community-based agro-ecosystem-related resource centres were already established in some places. These centres were visited, their needs were assessed, and it was deduced that they required capacity building for human resources. They already possessed adequate materials and accessories. Staff from Government resource centres and the agro-ecosystem-based community resource centres were trained on *Trichoderma* spp. production and use, *Trichogramma* spp. production and use, and the rapid bioassay and analysis of pesticide residue. The capacity of agro-ecosystem-based community resource centres, namely the Sayapatri IPM Resource Centre, Kabhre and Sri Gyaneshwar IPM Bio Resource Centre, Bharatpur-16 and Chitwan, were enhanced through hands-on training programmes.
Activity 2.4	Conduction of FFS	
	Achieved	Yes
	Comments	Nine agro-ecosystem based FFSs were carried out (one for each of the three target crops in each district), raising awareness on natural pests, pollination and nutrient management.
Activity 2.4.1	Preparation of FFS	
	Achieved	Yes
	Comments	A total of 260 participants (131 male, 129 female) graduated from the agro-ecosystem-based FFSs.
Activity 2.4.2	Testing and validation of best agro-ecosystem practices	
	Achieved	Yes
	Comments	For apple, citrus and mustard, best agro-ecosystem practices were tested and validated, facilitating their adoption by farmers. In general, both the attitude and activities of farmers were affected by these efforts. The main practices that were being adopted by farmers included: the introduction of organic matter; nutrient application in response to soil testing; the application of microorganisms for soil-borne disease; the use of botanicals and bio-pesticides for pest management; the identification and promotion of pollinators and predators; the use of pollinators in mustard, apple and mandarin; the use of legume-based cover cropping and intercropping; and the application of mulching.
Activity 2.4.3	Study on physiological, biological and behavioural changes of NEs, natural pollinators, beneficial micro-organism, pest and pathogens in selected agro-ecosystems	
	Achieved	Yes
	Comments	Pollinators, predators and soil fauna were monitored. Relevant data was collected and documented from apple, citrus and mustard agro-ecosystems. Around 2 500 arthropod specimens were collected for scientific identification and preservation. The study on physiological and behavioural changes could not be accomplished as it required an extensive stay in the field, which was not possible because of the COVID-19 lockdown.
Activity 2.4.4	AESA and surveillance	
	Achieved	Yes
	Comments	Carried out through the FFSs.
Activity 2.4.5	Mini lab establishment and operation	
	Achieved	Yes
	Comments	The hardware components of the infrastructure, materials and equipment for mini

		laboratories were established by the Government. The software component (i.e., human capacity building and the enabling environment) was performed as part of the project. This was decided at a meeting with Government counterparts on 1 July 2021. Ten staff from the Pokhara and Surkeht Government laboratories were trained on *Trichoderma* spp. production and use. Four Government staff from these laboratories were trained on bio-agent (*Trichogramma parasitiodes*) production and use. Eight staff from Governmental sectors from Gandaki and Karnali provinces were trained on the rapid bioassay and analysis of pesticide residues.
Activity 2.4.6	Soil health improvement	
	Achieved	Yes
	Comments	**Soil health improvement through organic amendment** In total, 370 litres of *Trichoderma* and 640 litres of effective microorganisms were delivered to farmers in Dang, Gulmi and Mustang through the FFSs, reaching 270 households. Farmers were made aware of the importance of healthy soil and began adopting related practices, such as the application of organic fertilizers, soil testing, soil monitoring, improving the status of soil and soil conservation. **Study on soil carbon footprint, soil moisture availability, soil nutrient balance and soil humus** – Soil samples were collected from Dang (68 farmers), Gulmi (54 farmers) and Marpha (22 farmers) and soil nutrient analysis was carried out. – Soil was determined to be acidic in Dang (mustard fields), moderately acidic to neutral in Gulmi (citrus orchards) and neutral to basic in Marpha (apple orchards). – Organic matter levels were detected at a (i) medium level in Dang, (ii) very low to low level in Gulmi and (iii) low to very high level in Marpha. – Nitrogen levels were (i) low to high in Dang, (ii) low to medium in Gulmi and (iii) low to high in Marpha. – In more than half of the samples (and, in some cases, almost all of them) phosphorus levels were (i) low in Dang, (ii) very low to very high in Gulmi and (iii) low to high in Marpha. Almost all samples had high potassium in Dang and low to very high potassium in Gulmi and Marpha. – Thirty soil samples (ten from each district) were used in the soil microorganism study. Only *Azotobacter* spp. and *Actinomycetales* spp. were commonly detected in the 10-4 diluted solution from Dang (mustard), Gulmi (citrus) and Mustang (apple), while *Trichoderma* spp. were found in four of the ten samples from Dang.
Activity 2.4.7	Adoption and up-scaling the best practices against climate extremes	
	Achieved	Yes
	Comments	In addition to providing farmers with appropriate farming technologies (below), several capacity development sessions were delivered to Government staff and other stakeholders. These trainings covered: – *Trichogramma chilonis* and *Aphelinus mali* production and use (6 men, 2 women). – *Trichoderma* spp. production and use (6 men, 2 women). – Rapid bioassay of pesticide residues on fruits and vegetables (6 men, 2 women). – Para-taxonomy (5 men and 6 women). – Agro-ecosystem-friendly practices (13 men, 6 women). In addition to providing the required software as part of the training, the following inputs were also delivered for facilitating the adoption and scaling up of best practices to combat climate extremes: – 200 secateurs, 200 pruning saws and 10 multipurpose steel ladders (for apple and mandarin management). – 20 litres of Neem-based insecticides and powdery mildew control pesticides. – *Beauveria bassiyana* and *Bacillus thuringiensis* bio-pesticides to test their efficacy against the Tent Caterpillar and Zygaena Moth.
Output 3	Lesson learnt from the testing and validating of agro-ecosystem services documented and data base prepared for it's up-scaling and replication as well as for public awareness	
	Indicators	Target / Achieved
		Target: Achieved: Yes
Baseline		
Comments	The lessons learned through the testing and validating of AES were documented. A database was prepared to support the replication and scaling up of interventions, as well as to raise public awareness on AES and	

	strengthen Government sectors.	
Activity 3.1	Documentation of the agro-ecosystem practices and packaging the tested/validated best practices for its up-scaling at farm level	
	Achieved	Yes
	Comments	Agro-ecosystem practices were documented. The tested and validated best practices were packaged for scaling up in the future.
Activity 3.2	Develop IEC materials (printed materials, newspaper articles, and audio/video) success stories to launch the mass media campaign for creating awareness on agro-ecosystem services for public awareness	
	Achieved	Yes
	Comments	See list of documents produced.
Activity 3.3	Reinforce the adaptive capacity of rural communities in handling climate change impacts and initiate the institutional arrangements for scaling-up the adaptation strategies by setting the roles of individual actors involved in planning and implementation process	
	Achieved	Yes
	Comments	Local authorities participated in training events and committed to scaling up climate change-adaptation strategies. An awareness-raising campaign on the new and problematic disease, Apple scab (*Venturia inequalis*), was conducted in Mustang. Altogether, 17 men and 13 women participated, including the elected ward representatives of rural municipalities. In total, seven affected apple orchards in Upallo Marpha of Gharapjhong municipality were visited. Practical demonstrations were delivered for the identification of disease symptoms and for microorganism-culture and prophylactic disease control measures. An apple scab calendar was prepared, printed and distributed to participants. Apple growers who attended the event committed to following the instructions provided. The rural municipality committed to supporting farmers in terms of subsidizing effective bio-pesticides and micronutrients. The local community also urged for further technical support from FAO, when needed, to manage the disease.
Activity 3.4	Organize interaction and sharing workshops at local and national level on the project results	
	Achieved	Yes
	Comments	Workshops were organized at the district level in Dang, Gulmi and Mustang, with the notable participation of mayors, deputy mayors, the chiefs of AKCs, other key Government personnel and the National Project Coordinator. Local stakeholders and FFS participants interacted and committed to scaling up best agro-ecosystem practices. The final results-sharing workshop was held at the Gokarna Forest Resort in Kathmandu, with the participation of key Government secretaries, joint secretaries, undersecretaries and officials, the Director-General of the DOA, national project coordinators, representatives from national institutions and representatives from local governments and rural municipalities.
Activity 3.5	Establish national agro-ecosystem information management system (NAIMS) and web networking for identification, conservation and resource need ecosystem services	
	Achieved	Yes
	Comments	Project reports, IEC materials, manuals, translated materials, etc. were shared with the Centre for Crop Development and Biodiversity Conservation for uploading to the MoLAD web portal and further dissemination to stakeholders.
Output 4	Detail recommendations and proposal prepared for wider replication/up-scaling/dissemination of improved adaptation practices/agro-ecosystem services against climate change effect.	
	Indicators	Target / Achieved
		Target: Achieved: Yes
Baseline		
Comments	A project framework document on AES that can mitigate the effects of climate change was drafted. This will support the replication, scaling up/out and dissemination of improved adaptation practices.	
Activity 4.1	Feasibility study	
	Achieved	Partially
	Comments	The identification of beneficiaries, a stakeholders' consultation, and the collection of relevant information and data was conducted as an alternative to the study (because of COVID-19 disruptions). This included: – A workshop at Yellow Pagoda Hotel, Kathmandu on 15 September 2021 for the preliminary preparation of the Detailed Project Document for scaling up/out. The MoALD, DOA, Nepal Agricultural Research Council, CCDABC and other key stakeholders attended. – Gathering feedback from the results-sharing workshopheld at the Gokarna Forest Resort, Kathmandu on 1 October 2021.

Activity 4.2	Preparation of the full project proposal and submission	
	Achieved	Yes
	Comments	Submitted to the Government counterpart for the second review process.