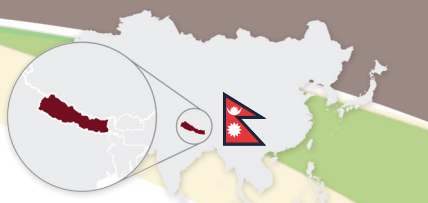

Climate-Smart Agriculture in Nepal

Climate-smart agriculture (CSA) considerations

A P I Agriculture contributes to about one-third of gross domestic product (GDP) in Nepal and provides employment to 74% of the economically active population. Since slightly less than half of agricultural producers in the country have transitioned to commercial production, efforts to conserve native plant genetic resources (PGR) through community seed banks (CSB), precise fertilizer management and integrated pest management technologies need to be scaled-up as a way to sustainably intensify the country's limited agricultural land.

A M P The country is endowed with an array of geographical, topographic, climate, and ecological conditions, as well as with diverse cultural norms and social groups. These have led to an uneven transformation of the society and its economy. Agricultural investments need to acknowledge this diversity through targeted interventions that are adapted to different agro-ecologies and farm types.

A M P CSA programs must target vulnerable social groups (e.g. women and youth) by making information and resources available and accessible to them. CSA investments not only enhance crop productivity, but can also contribute to improved working conditions for women (e.g., workload, physical burden) and their position in the society. Water harvesting, improved cattle and goat sheds, and biogas production have especially high potential to reduce the drudgery of farming for women.

P I Land degradation, fragmentation, and limited resource ownership are barriers for effective planning and increased productivity in Nepal. The role of the Agriculture Development Strategy (ADS) in facilitating mechanisms to support equitable and effective access and control over land, especially for women and youth, is essential for creating an enabling environment for on-field adoption and the scaling-out of CSA practices and technologies.

P I Several policies provide an enabling environment for the promotion of CSA actions, yet efforts to coordinate initiatives are sporadic, leading to the duplication of efforts and ineffective resource allocation. Sectors tend to work in isolation, limiting the development of an effective multi-sectoral vision that creates synergies and leverages resources. There is a need for improved governance and policy commitment for delivering planned results in a more integrated way. Capacity building for CSA planning and implementation can be a first step towards that.

I $ Some CSA technologies are costly and financial support is crucial for uptake, especially in resource-poor communities. The potential for national and international CSA finance is high as there are several opportunities attract new funding. To effectively prioritize and utilize such resources, mechanisms to monitor the targeting and allocation of funds are needed.

A I $ Information dissemination through information and communication technology (ICT) and farmer-to-farmer dissemination needs to be scaled-up to make the extension effort more rapid and effective. This will require initial government support, mainly in the form of subsidies.

I $ Highlighting practices that have proven most effective in delivering on CSA goals as 'champions' would aid in the diffusion of CSA investments across scales and regions of the country. This requires further efforts to take stock of the costs and benefits of CSA practices in a more systematic and comprehensive way, complementing the initial findings from this study.

A Adaptation M Mitigation P Productivity I Institutions $ Finance

The climate-smart agriculture (CSA) concept reflects an ambition to improve the integration of agriculture development and climate responsiveness. It aims to achieve food security and broader development goals under a changing climate and increasing food demand. CSA initiatives sustainably increase productivity, enhance resilience, and reduce/remove greenhouse gases (GHGs), and require planning to address tradeoffs and synergies between these three pillars: productivity, adaptation, and mitigation [1]. The priorities of different countries and stakeholders are reflected to achieve more efficient, effective, and equitable food systems that address challenges in environmental, social, and economic dimensions across productive landscapes. While the concept is new, and still evolving, many of the practices that make up CSA already exist worldwide and are used by farmers to cope with various production risks [2]. Mainstreaming CSA requires critical stocktaking of ongoing and promising practices for the future, and of institutional and financial enablers for CSA adoption. This country profile provides a snapshot of a developing baseline created to initiate discussion, both within countries and globally, about entry points for investing in CSA at scale.

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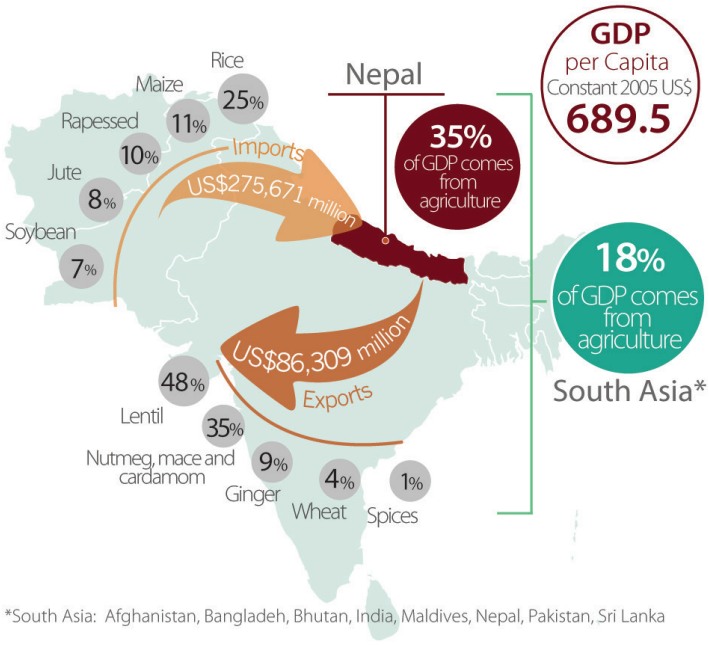
National context

Economic relevance of agriculture

Nepal is considered a low-income country, with a GDP per capita of US$ 689.5 in 2015 [3]. Agriculture is the mainstay of the economy and a traditional way of life for the people, contributing almost one-third of total GDP and providing employment to 74% of the economically active population. Agriculture exports provide important revenues for the country. However, insufficient production of key crops (such as rice and maize) to meet domestic demand explains the high import rates of staple crops in the country. The slow growth of the agriculture sector in recent years[1] has been associated with farming practices highly dependent on weather conditions, insufficient irrigation facilities, unavailability of agricultural inputs (particularly seed and fertilizers), and an increasing trend of land fallowing and abandonment [4].

Economic relevance of agriculture in Nepal[3, 5]



*South Asia: Afghanistan, Bangladeh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka

People, agriculture and livelihoods in Nepal [3, 5, 6]

Demographics

28.5 million people live in Nepal

82% live in rural areas

People living below

US$3.10/day: 48%

US$1.90/day: 15%

National poverty line: 25%

27% live in rural areas

Distribution of wealth (Index)

0 = Absolute equality
1 = Absolute inequality

0 — 0.3 — 1

Gender inequality (Index)

0 = Absolute equality
1 = Absolute inequality

0 — 0.5 — 1

Access to basic needs

Potable Water: 89% of total population; 90% of rural population

Electricity: 76% of total population; 72% of rural population

Education: 85% of the youth are literate

Land holding

26% of the agricultural landholders are Women

Small-scale farmers (<0.5 ha): 53%

Large-scale farmers (>1ha): 20%

Jobs in agriculture

74% (8 million) people are employed in primary production agriculture

61% are women

39% are men

Youth employed in production: No data

Agriculture productivity and incomes

Value added per worker in agriculture (Constant 2010 US$)

OECD: 20,820
South Asia: 1,109
Nepal: 451

Monthly earnings (Average)

US$ 54.66 per month

US$22.31 per month

1 Agricultural growth was at 2.2% during 13th plan period, while the national economic growth rate was estimated at 2.9% in the same period. The 13th plan was implemented from 2013/14-2016/17, which had target to achieve 6% economic growth and 4.5% growth of the agriculture sector.

People, agriculture, and livelihoods

The population of Nepal has been increasing steadily at an annual rate of more than 2%, reaching 28.5 million people in 2015[2]. This growth trend has been particularly strong in urban areas. A rise in rural-to-urban migration has been accompanied by an increase in the importance of non-farm activities for income generation. Despite this trend, the large majority of the population still derives its livelihoods from agriculture, usually practiced on fragmented plots of land. Agriculture is dominated by small-scale farms of less than two hectares (ha)[3], which occupy roughly 76% of the country's cultivated land [6].

Remittances from migration[4] are among the largest contributors to poverty reduction and the incidence of absolute poverty in Nepal (i.e., people living on less than US$ 1.25/day), which has reduced from 53% in 2004 to 25% in 2011[5]. Despite this, inequality remains very high, as indicated by a low Gini Index (a score of 32.8 out of 100). Poverty and inequality is particularly pervasive in rural areas and in the mountainous and mid and far western regions of the country [3].

Gender division of labor is embedded in cultural norms and varies across socio-economic contexts, caste systems, ethnic groups, and religion. Women play an important role in household food security and nutrition quality, as they are the main cultivators of subsistence crops (such as maize and millet) and the keepers of traditional knowledge regarding food production, storage, and processing (cooking). Women engage mostly in rain fed agriculture and are more active in the mountainous areas, carrying out time-consuming, labor-intensive activities. Women, for example, are the main workers in rice fields in Nepal. Men, meanwhile, tend to manage irrigated fields and are the main decision-makers in the Terai region [8, 9].

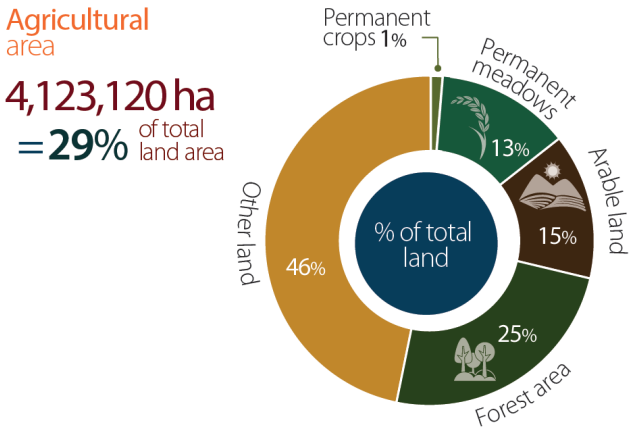
Women's access to decision-making and control of resources households remains limited by traditional and patriarchal norms[6]. Studies have revealed that women tend to have less access and ownership rights to productive resources (especially land) compared to men, rendering their households more exposed to food insufficiency and limiting their ability to access credit or make long-term agricultural investments on the land [8].

Land use

Agricultural land occupies 29% of the country's land area,the equivalent of 4,123,120 ha. Around 15% of this area is classified as arable, whereas 17% of the land is under permanent meadows or pastures [5]. The forest area in Nepal has been maintained at 25% since 2005 [3][7].

Since most of the arable land area is already exploited, agricultural intensification has been the predominant strategy for productivity increases, manifested through the cultivation of three or more crops a year and a higher use of fertilizers (especially in hilly and mountainous areas). However, per capita arable land availability (0.082 ha/person) is less than half of the world's average [3] and hampers commercialization and the realization of economies of scale for small-sized farms by constraining farm mechanization.

Land use in Nepal [5]



Agricultural production systems

Subsistence agriculture and crop-livestock integration are the main characteristics of Nepalese agriculture. The country has three representative agro-ecological zones (AEZs), oriented east to west, and characterized by different altitudes, climates, and agricultural production systems [10].

The **mountain region in the north,** situated at more than 2,000 meters above sea level (m.a.s.l.), has a warm-temperate to alpine climate. The predominant agricultural activities in this zone are transhumant livestock production (e.g., hilly cattle, goats, sheep, etc.), rain-fed crop cultivation (e.g., potato, barley, and buckwheat), and temperate fruits (e.g., apple and pear). Around 29% of the area is grazing land and crops are mainly rain-fed ('bari' land). The region is also characterized by high population migration rates to lower altitude areas, scarce road infrastructure, and minimal education opportunities.

The **mid-hill region**, ranging between 300 and 2,000 m.a.s.l., has a climate that varies between subtropical to warm temperate. Crops are grown in upland terraces and irrigated fertile lands in river basins and valleys ('khet'

2 This represents an increase from approximately 18 million in 1990.

3 Average land holding is 0.7 hectare.

4 Driven by employment opportunities, Nepal has witnessed a surge in youth migration to various foreign destinations in the last decade, with crude net migration decreasing from -1.21 during 1995/00 to -6.42 during 2005/10 [7]. Crude net migration refers to the ratio of net migration to the average population in a year. The value is expressed per 1,000 inhabitants. Higher negative values mean more inhabitants are leaving rather than entering the country.

5 The poverty incidence in Nepal reduced from 30.9% of the population in 2004 to 25.5% in 2010 and 21.6% in 2017.

6 According to Hindu beliefs, which remain a building block of the Nepalese society, property transfer and inheritance remains within the male line.

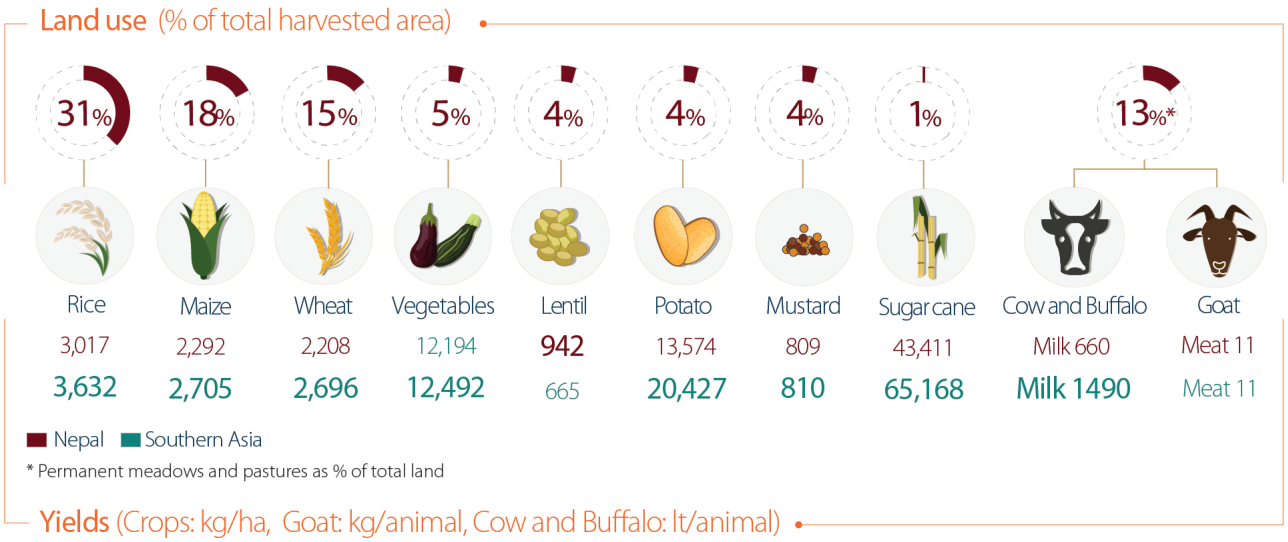
7 Government sources even claim an increase in the forest area from 39.6% to 44.7% during the 13th planning period. However, the data shall be interpreted with caution since the methods for calculating the forest land vary from the WB/FAO methods.

land). Maize, millet, grams, potato, ginger, cardamom, and temperate fruits, particularly citrus, are the main crops grown in bari land, whereas rice and wheat are common in khet lands. Dairy and commercial vegetable production are rapidly growing in places nearby market centers in this zone.

The Terai region in the south, located below 300 m.a.s.l., is home to the majority of cropland in the country and a key contributing area to the agricultural GDP of Nepal. The highly fertile soils allow for the cultivation of rice (the main crop in the region), wheat, chickpea, lentil, oilseed, mustard, sugarcane and tropical fruits (e.g., mango, litchi). Crop intensification is very common in this region. Farmers in this zone also rely on livestock production, mainly cattle, goats, and buffalo.

The following infographic shows a selection of agriculture production systems key for Nepal's food security. The importance is based on the system's contribution to economic, productivity and nutrition quality indicators. For more information on the methodology for the production system selection, consult Annex 1.

Production systems key for food security in Nepal[5]



Rice, maize, and wheat are the key food crops in the country, occupying approximately 31%, 18%, and 15% of the total harvested area and contributing 7.5%, 1.7%, and 1.5%, respectively to the national GDP [5]. Still, average yields of these crops remain well below regional and global averages despite government efforts to invest in improved varieties and promote the use of inputs [5]. Timely unavailability or distribution of seeds and fertilizers, inadequate nutrient management, and high dependence on monsoon rainfall due to a lack of irrigation are among the main reasons for low agricultural productivity [4].

With the recent development of local market centers and road corridors, vegetable production is growing at a fast rate (9% per year) [11] and has already emerged as an important contributor to the national economy (3.53% of GDP) [5]. This has also resulted in a higher use of inputs, especially of chemical fertilizers.

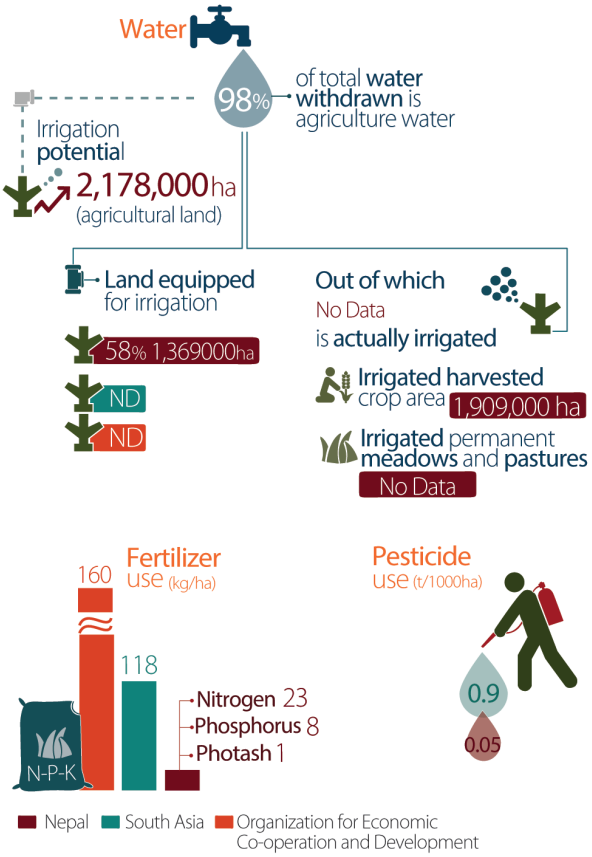
Lentil and mustard are the main crops cultivated in the winter season[8] and a key income source in the Terai region, along with sugarcane. Farmers are increasingly converting their farms to sugarcane plantations, following the establishment of sugar factories in the region. Increased water scarcity and labor shortages have also encouraged farmers to switch from seasonal crop production to biannual or even perennial crops (such as sugarcane) [5].

Input utilization and application varies greatly across Nepal's AEZs. Higher adoption rates of modern varieties and agrochemicals (i.e., fertilizers and pesticides) are found in the Terai, followed by farmers in the hills and mountains [12].

Animal husbandry is common to all AEZs, but is especially predominant in mountainous areas. People use livestock for various purposes, including milk, meat, transportation, hides/skin, and manure. The dairy industry (e.g. cow and buffalo) provides extra income and sources of nutrition for smallholders farmers nearby large market centers. In addition, goats are a key income-generation source for smallholders in hilly and mountainous regions. However, livestock productivity in Nepal is low compared to regional averages. As a result, demand for livestock and livestock products, and particularly milk and meat, has outstripped supply in Nepal.

8 There are three main cropping seasons in Nepal: the main season (July-October); winter (November-February); and summer (March-June).

Agriculture input use in Nepal [3, 5]



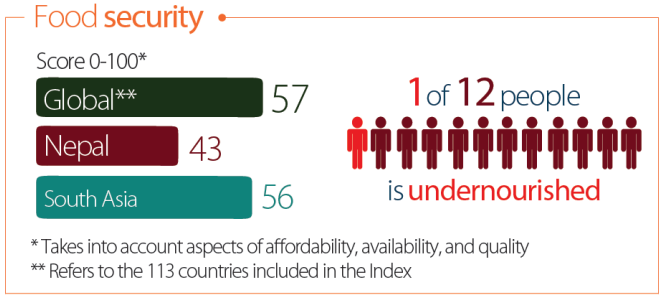
Food security and nutrition

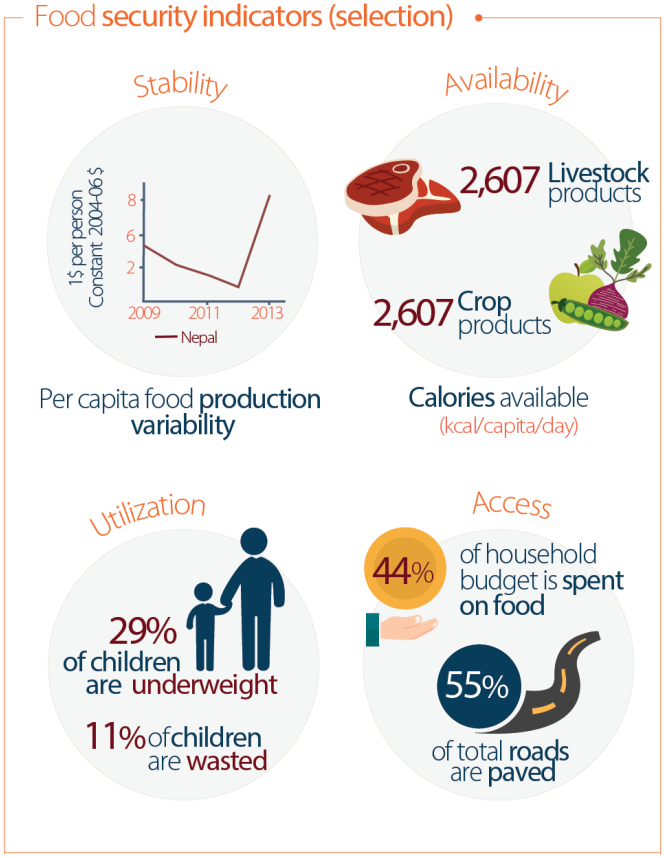
Nepal has experienced improvements in food (kcal) availability, protein and fat intake, and a decline in undernourishment and underweight rates over the past years [13], owing to governmental efforts to boost food security throughout the country.

Despite these trends, Nepal ranks 82nd out of 113 countries in the Global Food Security Index, and food deprivation is estimated at 51 kcal/person/day [14]. There is significant regional disparity in food availability in Nepal, associated with exposure to climate events (especially droughts in the hill and mountain districts) [15] and a high dependency on food aid. Difficult geographical conditions, a poor road network, inadequate warehouse infrastructure, poor Information and Communication Technologies (ICT) tools and lack of timely and relevant information and low household incomes are key challenges to food distribution and access in the country.

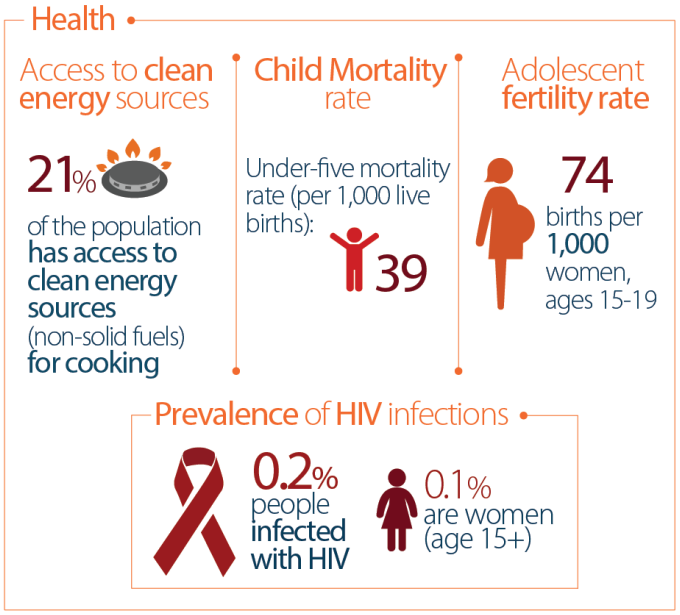
Although Nepal is one of the richest countries in term of agro-biodiversity, people today tend to eat less diverse and nutritious foods than in the past. Malnutrition rates in the country are among the highest in the world, disproportionately affecting women and girls in poor households [8]. Malnutrition is also higher among socially marginalized and disadvantaged groups (such as the Dalits) due to a lack of basic health and sanitary measures and the absence of early warning systems and food safety nets that once existed within these communities (e.g. *Dharma Bhakari* [9]). These conditions are likely to be exacerbated in the future, under a more unpredictable and extreme climate.

Food security, nutrition, and health in Nepal [3, 5, 13, 14, 15]





9 Traditional form of community food reserve system in which food grain reserves are stored in temples to be used in times of food insecurity.



Agricultural greenhouse gas emissions

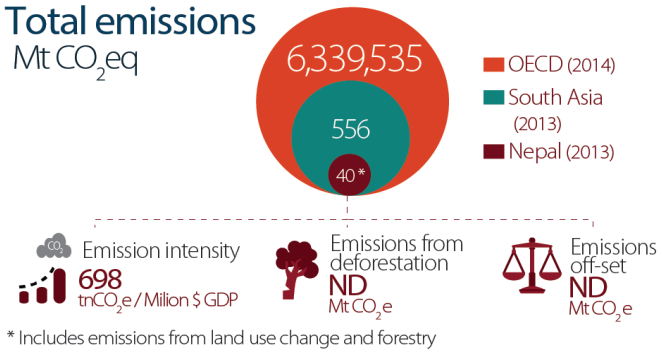
Nepal's GHG emissions are estimated at roughly 40 megatons of CO_2 equivalent (CO_2eq) per year, including emissions from Land Use Change and Forestry (LUCF)[10] [16]. Per capita annual GHG emissions, including LUCF, are less than a quarter of the world average, at 1.52 tons of CO_2eq.

More than half of the country's total emissions come from the agricultural sector. Of all agricultural emissions, 60% are attributable to enteric fermentation and manure management from livestock production. Meanwhile, approximately 24% of agricultural emissions result from cropping practices including rice cultivation, crop residues, cultivation of organic soils, burning of crop residues, and the use of synthetic fertilizers. Promotion of practices and technologies geared towards improved efficiency in animal production (e.g., balanced animal nutrition, reduction of disease incidence, and genetic improvement) can, therefore, be crucial for GHG reduction in Nepal. Recent trends in cropland intensification suggest an accelerated increase in agricultural emissions unless adequate measures to apply and manage agricultural inputs (such as precise fertilizer management techniques) are implemented.

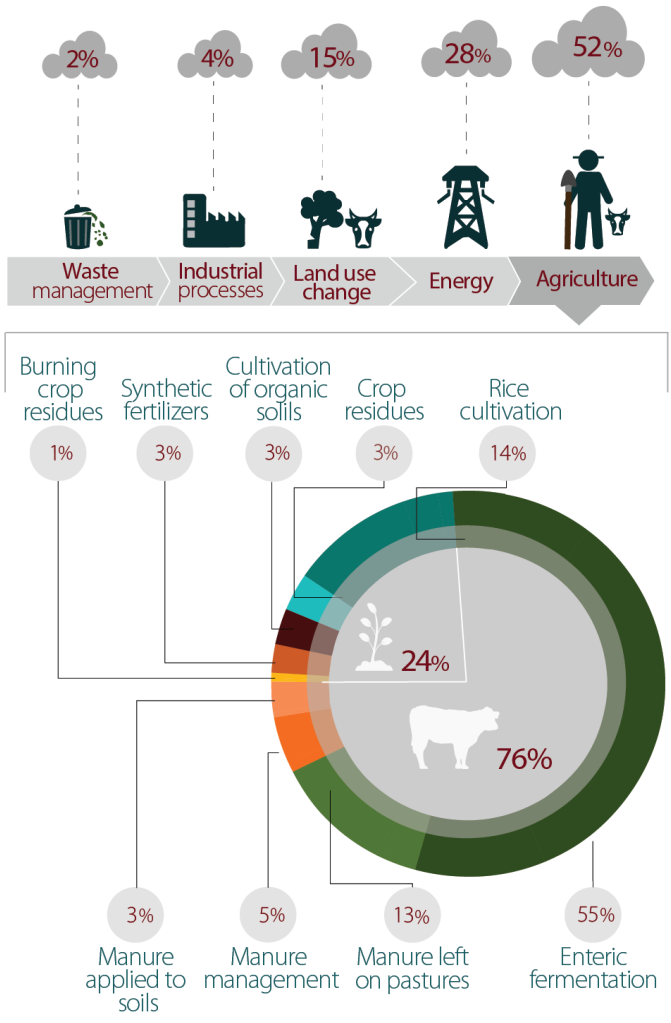
Challenges for the agricultural sector

Despite various efforts to increase production and productivity of agriculture, the gap between national food demand and supply is increasing in Nepal. The population is expected to reach approximately 33 million by 2030 and 36 million by 2050, with particularly high growth rates in urban areas. Similarly, life expectancy is also projected to increase from 70.9 years in 2015 to 73.7 years by 2030 and 78 years by 2050 [17]. Household consumption expenditures are also increasing in the country at an annual rate of 2.9% [3] and people tend to consume more rice, vegetables and meat products than before.

Greenhouse gas emissions in Nepal [5, 16]



* Includes emissions from land use change and forestry



10 Data available for the years 1992-2012.

With agricultural activities practiced on small, fragmented pieces of land[11], poor road access, mechanization and commercialization of food and food products remains a challenge for small-scale farmers. Although some cooperative-based marketing systems have been established for vegetable and dairy sectors, the market structure for other crops and livestock is very weak and unknown among most farmers. Support for minimum prices or other market risk reduction measures (e.g., warehousing, insurance) are scarce.

In the absence of rigorous land use planning, many agricultural areas in the country have been converted to serve other non-agricultural purposes (such as housing). This has effectively led to a shrinking of land area available for cultivation and pastures. A surge in youth migration to towns and cities has led to further land abandonment in remote areas. Community forestry programs, meanwhile, have successfully led to an increase in the forest cover in Nepal.

An increase in cropping intensity[12] has not only allowed for the production of more food on limited arable land, but has also contributed to environmental and soil health degradation, manifested through lower soil fertility, high soil erosion (especially in the areas with intense tillage), and higher environmental pollution.

Limited knowledge about sustainable agricultural practices is attributed to the low coverage of agricultural extension services in the country (the extension worker to farmer ratio in Nepal is roughly 1:1,000). This has not only led to low yields [19], but also to the adoption of practices that have done more harm than good to the soil and the environment. Overgrazing in the hilly and mountainous regions has affected the availability and productivity of native pastures. Meanwhile, crop intensification without adequate fertilizer management has contributed to the loss of soil micronutrients and soil organic matter across all regions [1].

The underperformance of the agriculture sector is also linked to the inadequacy of irrigation services in the country. Around 55% of agricultural land is reported to be irrigated, yet year-round provision of water is often limited, making major crops like rice and wheat highly dependent on rainfall and potentially bringing about new conflicts over water resources.

Nepal also lacks a reliable supply of quality seed and inputs, contributing to low seed replacement rates (SRR)[13] for rice (4.4%), wheat (4-8%), maize (3.8%), and pulses (1.6%) [20], compared to a desirable rate of 25%-30%. Moreover, despite government subsidies, fertilizer use is very low in the country, due to a lack of timely supply and know-how for adequate application.

Next to crop cultivation, livestock production is a key source of income and livelihoods for the majority of farm households. Yet, low livestock productivity is a major challenge, especially for poor farm households. Although in 2015 the government established a separate Ministry of Livestock Development, progress in enhancing availability and quality of livestock-targeted extension is slow and access to modern animal health services and genetic improvement services remains scarce. Use of traditional breeds (and limited availability of improved breeding stock), inadequate housing and feeding conditions, insufficient supply of inputs such as quality feeds, lack of strong milk/meat/wool processing plants and other commercial operations as well as a lack of established insurance schemes and risk transfer mechanisms are among the main reasons for underperformance of the livestock sector.

Poor investment capacity is linked with high poverty rates among smallholder farmers in Nepal. Government investment in the agriculture sector has been diminishing in recent years, while foreign investment in the agriculture sector is less than 1% of total foreign investment in the country [21].

Due to its landlocked position, Nepal's trade relations are mainly developed with India. Although the country is trying to enhance trade relations with China, trade with India is likely to dominate for the foreseeable future. Nevertheless, strong trade barriers (e.g., high tariff rates and sanitary and phytosanitary requirements and other non-tariff barriers) have discouraged Nepalese exports to the country.

Agriculture and climate change

Precipitation in Nepal ranges between 150 mm and over 5,000 mm per annum, varying considerably across the country's topography. Roughly 80% of the total rainfall occurs during the monsoon season, which usually lasts over three months [22].

An analysis of weather data recorded between 1971 and 2012 shows significant spatial and temporal (inter-annual) variation, with increases in annual precipitation of 0.7 mm/year and temperature increases of 0.04°C/year and 0.01°C/year for maximum and minimum temperature, respectively. Particularly high precipitation increases were registered at higher altitudes (up to 6.6 mm/year), while decreases were experienced in mid-hills regions (-2.3 mm/year) [22]. Other studies reported increased variation of rainfall and a higher risk of drought events in the winter seasons in Nepal. An increase in the number of dry days in pre- and post-monsoon periods and of heavy rainstorms was also identified [26].

Based on the averages of several Global Circulation Models (GCMs), climate projections for Nepal suggest a continued

11 The average land holding per person in Nepal has been decreasing, from 0.8 ha in 2001/02 to 0.7 ha in 2011/12.

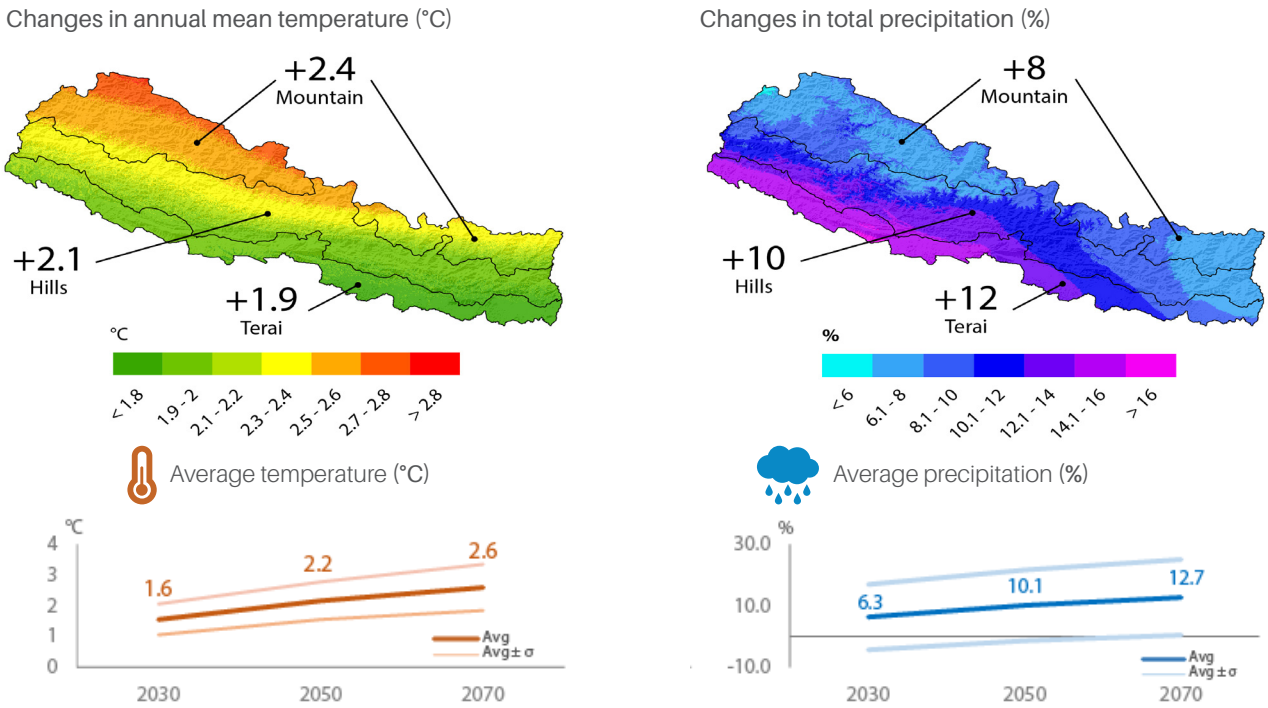
12 Calculated using the effective area sown to temporary crops divided by the physical area under temporary crops. Cropping intensity in Nepal has increased from 1.78 in 1991/92 to 1.85 in 2011/12, with steadier growth recorded in the Terai than in the hills and mountains [18]

13 SRR indicates the percentage of the cropped area that sowed with quality (certified) seed compared to farm saved seed..

increase in mean annual temperature[14], a faster warming of the country's western regions, (compared the eastern region), changes in precipitation during the monsoon period (with variations from -14 to 40%), as well as the increased likelihood of heavy precipitation events. While there is considerable uncertainty in climate models with respect to precipitation, it is likely that Nepal will receive higher total rainfall in the future, particularly in the central and western regions [27].

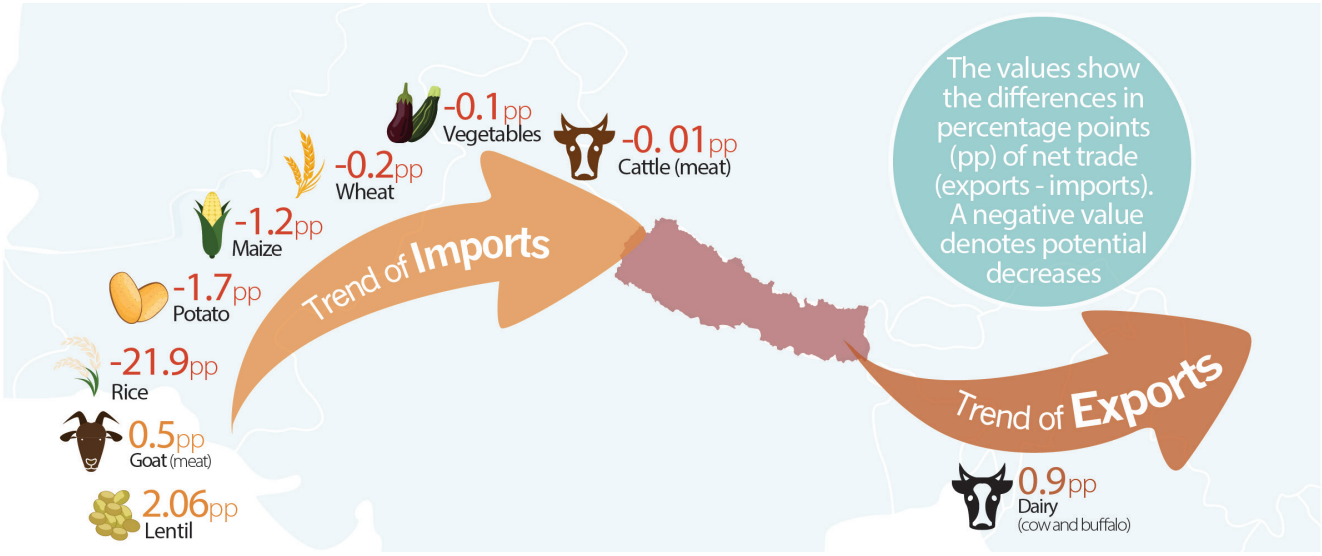
Changes in precipitation patterns are likely to affect rain-fed agricultural activities, causing significant annual yield variability and higher production risks. Climate change is also expected to increase the frequency of weather-related hazards (e.g. droughts and floods), further affecting croplands and yields. Costs associated with the impacts of climate variability and extreme events are estimated at US$ 270-360 million/year (expressed in 2013 prices), representing 1.5 to 2% of the country's GDP [28].

Projected changes in temperature and precipitation in Nepal by 2050 [23, 24, 25]



Potential economic impacts of climate change

The impact of climate change on net trade in Nepal (2020-2050) [29]



14 The increase ranges between 0.5 and 2.0° C by 2030.

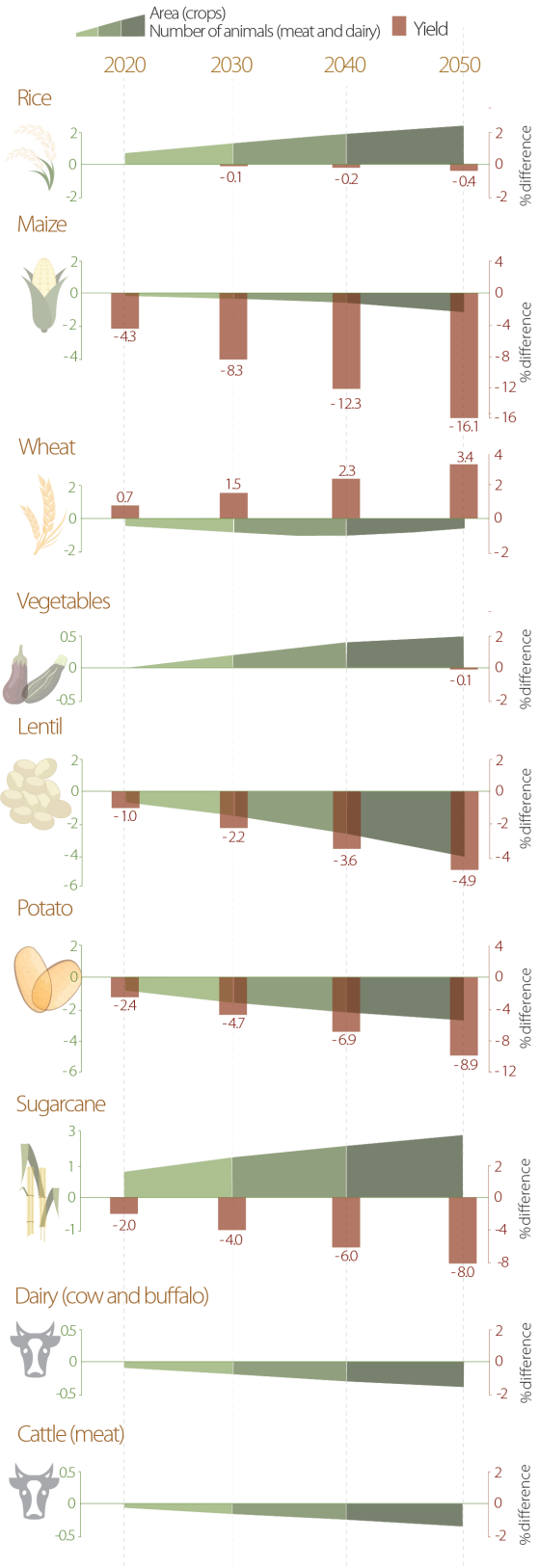
An analysis using the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT)[15] [Robinson et al., 2015] was carried out for the selected key production systems in Nepal, analyzing impacts of climate change over the period of 2020 – 2050, on net trade, yield and area (for crops), and animal numbers (for livestock products). The results are presented as the percentage differences between a scenario where climate change occurs (CC) compared to a scenario without climate change (NoCC). The results show that CC has mixed effects on agricultural production, potentially contributing to the increase in yields and land area for some crops, and decreases for others[16]. For example, climate change is likely to increase rice, vegetable and sugarcane crop areas, while reducing the area of maize, wheat, lentil and potato.

In terms of yield levels, maize, potato, sugarcane and lentil are likely to be most negatively affected by CC, as yields in 2050 are projected to be lower by -16.1%, -8.9%, -8.0% and -4.9% under a CC scenario, as compared to NoCC. Also rice and vegetable yields are expected to be lower under CC than under NoCC, yet the projected differences are comparably small (-0.4% and -0.1%, respectively). Wheat, on the contrary, is likely to benefit from climate change, as by 2050 the yield levels are shown to be 3.4% higher under CC than NoCC.

Regarding livestock, the future scenarios indicate that between 2020 and 2050, climate change will negatively influence the number of cattle and buffalo kept for dairy and milk production (by -0.46 and -0.32%), while the impact on number of goat is projected to be almost the same for both scenarios (+0.04pp under CC).

Regardless of the scenario, crop modeling results suggest that Nepal may become more dependent on imports of maize, potatoes, rice, vegetables (as group) and wheat in the period of 2020 to 2050. However, the impact is less pronounced under CC than under the NoCC scenario. Comparing both scenarios, climate change is projected to improve (decrease) the net trade deficit for several crops and livestock products, as net imports under CC are projected to be lower for rice (-21.9 percentage points [pp]), potato (-1.7pp), maize (-1.2pp), wheat (-0.2pp), vegetables (-0.01pp) and cattle meat (-0.01pp). At the same time, net import of lentils and goat meat are projected to be higher under CC by +2.06pp and +0.5pp, respectively, with goat meat transitioning from a net export product in 2020 to a net import product in 2050. In terms of exports, model results suggest that levels for dairy exports are likely to be more pronounced under CC by 0.9pp, compared to NoCC.

Climate change impacts on yield, crop area and livestock numbers in Nepal [29]



*A negative value denotes potential decreases in area and yield expressed as percentage change in a climate change scenario vs. non climate change

15 IMPACT, developed by the International Food Policy Research Institute [30], is a partial equilibrium model using a system of linear and non-linear equations designed to approximate supply and demand relationships at a global scale. This study used the standard IMPACT model version 3.2, less the IMPACT-Water module. The tool uses the General Algebraic Modeling System (GAMS) program to solve a system of supply and demand equations for equilibrium world prices for commodities. The tool generates results for agricultural yields, area, production, consumption, prices and trade, as well as indicators of food security.

16 The IMPACT model scenarios are defined by two major components: (i) the Shared Socioeconomic Pathways (SSPs), which are global pathways that represent alternative futures of societal evolution and (ii) the Representative Concentration Pathways (RCPs), which represent potential greenhouse gas emission levels in the atmosphere and the subsequent increase in solar energy that would be absorbed (radiative forcing) [31]. This study used SSP 2 and RCP 4.5 pathways.

CSA technologies and practices

CSA technologies and practices present opportunities for addressing climate change challenges, as well as for economic growth and development of the agriculture sector. For this profile, practices are considered CSA if they enhance food security as well as at least one of the other objectives of CSA (adaptation and/or mitigation). Hundreds of technologies and approaches around the world fall under the heading of CSA.

Most CSA practices identified in the study address key challenges to the agricultural sector, such as water stress, soil erosion and reduced soil fertility, and higher incidences of pests and diseases due to climate change. These practices include: *precision nutrient management* in cereals and rice (using leaf color charts or green seekers, and improving the timing, placement, rate and source of fertilizer application), *improved water and irrigation management* for rice, vegetables, potato and sugar cane (using waste-water collection and rainwater harvesting techniques, or implementing efficient irrigation such as ridge and furrows in potatoes, solar-based irrigation in rice, or micro-irrigation in vegetables), *soil conservation techniques* such as zero-tillage sowing and conservation agriculture[17] in wheat, maize, lentils and mustard, or even ratoon management for minimum soil disturbance in sugarcane.

Crop intensification techniques (legume intercropping or mixed cropping in cereals, sugarcane or lentils) are also common. Traditional crop rotation systems, such as rice-wheat in the Terai region, or maize-millet in the hill region, are sometimes further complemented by adding leguminous intercrops (such as mungbean catch-cropping between rice and wheat), which helps increase the system's overall productivity by allowing the cultivation of an additional crop, maintaining continuous soil cover, increasing soil organic matter, and replenishing soil nitrogen content.

Other techniques include *improved planting and management of crops* via integration of beekeeping for supplementary pollination, integrated pest management (for late blight and red ant in potato), or use of *drought-tolerant and high-yielding varieties* (lentil).

Livestock practices mostly address challenges related to fodder shortages and farm yard manure (FYM) management. Cattle, buffalo and goats (for meat and dairy) are particularly vulnerable to climate change in the mid-hill and higher mountain ranges, where increased water stress, temperature abnormalities and reduced fodder availability render livestock production challenging. Therefore, CSA practices for dairy and goat focus on the adoption of good husbandry practices such as: *improved feed and fodder management* via increased production, processing and storage of fodder crops (e.g. through agro-forestry); shift to total or partial stall feeding to improve *manure and nutrient management*, increase productivity and reduce/reverse deforestations, and promotion of *stress-tolerant breeds* by use of artificial insemination.

While the analysis focuses on crop- and livestock-specific practices, many of these measures increase their overall effectiveness if combined at farm level in a way to enhance the resilience of the whole agriculture system. For example, planting permanent trees and hedge crops can address landslide risks, complementing field-level CSA practices (such as precision nutrient management) and thus bring additional benefits to the system.

Also, changing from one crop system to another may be an efficient production decision on a farm in some cases. For instance, with rice being a highly water-demanding crop, changing it to a suitable alternative crop, which would increase the efficiency of water and help reduce methane emission, would be a more viable and sustainable option for both farmers and the entire agricultural system.

Furthermore, innovative methods for disseminating knowledge and skills need further exploration and promotion. Modern ICT-based approaches (mobile phone applications), have been used in pilot projects to provide agro-advisories and weather forecasts throughout the country[18]. Adapting the learnings from farmer-to-farmer extension systems for integrated pest management (IPM) (through farmers' school) and from similar approaches (such as diversity field schools, climate field schools) shows high potential for disseminating knowledge and skills, in a context where government resources for agricultural extension services are limited.

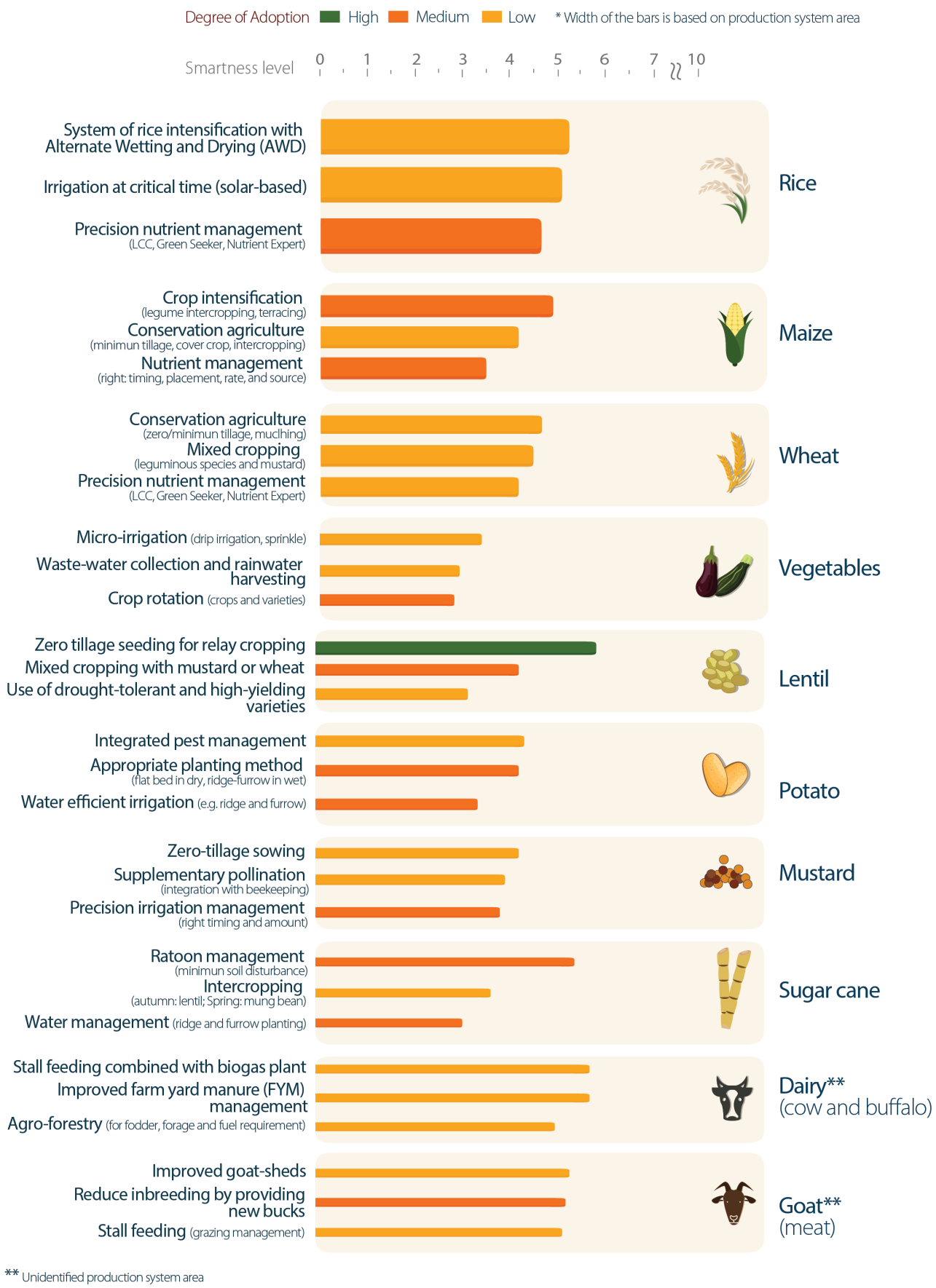
Last but not least, improved capacity of local institutions for planning, accessing funds and implementing climate change adaptation actions are important enablers of innovation. Building institutions at community level, such as community seed banks, can support communities in identifying, testing and adopting new CSA practices.

The following graphics present a selection of CSA practices with high climate smartness scores according to expert evaluations. The average climate smartness score is calculated based on the practice's individual scores on eight climate smartness dimensions that relate to the CSA pillars: yield (productivity); income, water, soil, risks (adaptation); energy, carbon and nitrogen (mitigation). A practice can have a negative/ positive/ zero impact on a selected CSA indicator, with 10 (+/-) indicating a 100% change (positive/ negative) and 0 indicating no change. Practices in the graphics have been selected for each production system key for food security identified in the study. A detailed explanation of the methodology is available in Annex 2.

17 Refers here to zero-tillage with mulching from crop residues.

18 For example: MoAD piloted an ICT based agro-advisory in its AMIS-PPCR project; LI-BIRD and CCAFS provided SMS based weather and agro-advisory service to farmers in Dang, Nawalparasi and Lamjung districts; ICIMOD and CEAPRED piloted SMS based agro-advisory in Kabhre district.

Selected CSA practices and technologies for production systems key for food security in Nepal



** Unidentified production system area

Case study: Solar-based irrigation system

Underground, or aquifer, water is the main source of irrigation in the Terai region, which accounts for 22.2% of total irrigated area in Nepal [21]. There, farmers often use diesel or electric pumps to extract water from underground sources. Yet these pumps are very expensive, depend on an unreliable electricity or diesel supply, and produce significant amounts of GHG emissions.

Solar-powered water pumping has been piloted as an alternative to diesel and electric pumps in Nepal. With support from the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) and the Climate and Development Knowledge Network (CDKN), Local Initiatives for Biodiversity, Research, and Development (LI-BIRD) piloted 12 solar-powered irrigation systems to extract water from various sources (e.g. streams, ponds, and aquifers) in Bardiya, Dang, Nawalparasi and Mahottari districts in Nepal's Terai region. Solar powered water pumping is an environmentally friendly CSA technology that reduces GHG emissions from diesel pumps while providing a reliable source of water for irrigation.

The initial investment for installing solar-based irrigation systems is high, as it costs approximately US$ 10,000 to install a solar unit capable of extracting 120,000 liters of water per day. Therefore, supporting the communities for the investment is important. For this project, 75% of the investment was incurred by the project funds, while the remaining 25% was covered by the local community. Farmers also generated additional resources by leveraging support from local and district development funds.

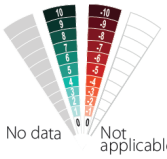
After the installation of the solar-powered irrigation system, farmers were able to establish rice nurseries and to transplant rice at earlier dates, minimizing the risk of crop failure. With a guaranteed water supply, farmers are gradually converting to commercial vegetable production, which is likely to increase cropping intensity by 200-300%, eventually leading to improved income.

A post-hoc investment analysis for the 12 solar-based irrigation systems shows that the average benefit-cost ratio of the investment is 4.6 over a period period of 12 years [32]. When these systems were installed, Nepal's government did not provide subsidies on solar-based water pumping for irrigation (though often there was 75% subsidy on solar-based pumping for drinking water). Yet the government recently revised the policy to include irrigation schemes in its subsidy scheme, which could encourage communities to invest in this technology in to the future.

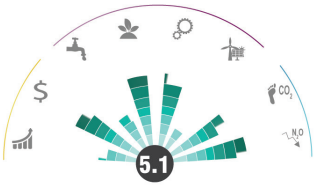
Photo: LI-BIRD

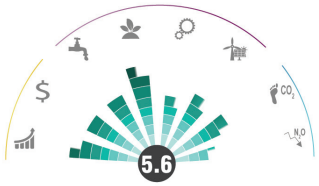
Table 1. Detailed smartness assessment for top ongoing CSA practices by production system as implemented in Nepal.

CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA Pillars
Rice (31% of total harvested area)				
System of rice intensification with Alternate Wetting and Drying (AWD)	Rain-fed Terai <30%	M		**Productivity** Increments in yield due to the higher number of tillers and better grain quality. **Adaptation** Minimizes water use and increases water use efficiency for rice cultivation. Enables larger area for cultivation in areas with limited water availability. **Mitigation** Reduced methane emission from rice fields.
	Irrigated Terai <30%	M		
Irrigation at critical time (solar-based)	Rain-fed Terai <30%	S M		**Productivity** Increases in productivity and income through system intensification. **Adaptation** Provides irrigation during critical periods (e.g. tillering and flowering). Makes water available for timely nursery establishment during dry summer. **Mitigation** Reduces GHG emission by replacing diesel pumps.
	Irrigated Terai <30%	M		
Maize (18% of total harvested area)				
Crop intensification (legume intercropping, terracing)	Mid-hill <30%	S M		**Productivity** Higher profits due to increased yield and reduced cost. **Adaptation** Use of residual moisture for sowing, allows 15 day early sowing to avoid terminal heat in late winter. Residues helps to retain soil moisture. **Mitigation** Reduces GHG emissions by reducing fuel and energy use. Promotes conservation of SOM.
Conservation agriculture (minimun tillage, cover crop, intercropping)	Mid-hill <30%	S M		**Productivity** Higher profits due to increased crop yields and reduced production costs. **Adaptation** Increases moisture retention due to mulching and cover crops, reduces soil erosion caused by heavy downpours. **Mitigation** Reduces fuel requirements for tillage. Mulching and cover crops increase soil carbon capture and Soil Organic Matter (SOM).



Yield Income Water Soil Risk/Information Energy CO_2 Carbon N_2O Nutrient

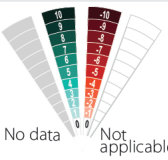
CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA Pillars
Maize (18% of total harvested area)				
Conservation agriculture (minimun tillage, cover crop, intercropping)	Terrai <30%	M		**Productivity** Higher profits due to increased crop yields and reduced production costs. **Adaptation** Increases moisture retention due to mulching and cover crops, reduces soil erosion caused by heavy downpours. **Mitigation** Reduces fuel requirements for tillage. Mulching and cover crops increase soil carbon capture and Soil Organic Matter (SOM).
Wheat (15% of total harvested area)				
Conservation agriculture (zero/minimum tillage, mulching)	Rain-fed Terai <30%	M		**Productivity** Higher profits due to increased yield and reduced cost. **Adaptation** Use of residual moisture for sowing, allows 15 day early sowing to avoid terminal heat in late winter. Residues helps to retain soil moisture. **Mitigation** Reduces GHG emissions by reducing fuel and energy use. Promotes conservation of SOM.
	Irrigated Terai <30%	M		
Mixed cropping with leguminous species and mustard	Rain-fed Terai <30%	S M		**Productivity** Increases total production and productivity per unit of land. Harvests of multiple crops increase income and food security. **Adaptation** Reduces the risk of total crop failure under unfavorable conditions. due to crop diversification. **Mitigation** Ensures long-term soil cover and conserves SOM. Legume integration increases soil Nitrogen, reducing use of synthetic fertilizer.
	Irrigated Terai <30%	S		
Vegetables (beans, cabbage and other brassicas) (5% of total harvested area)				
Micro-irrigation (drip irrigation, sprinkle)	Terai <30%	S		**Productivity** Increases in yield due to appropriate water management. **Adaptation** Increases availability of water. Minimizes water use per unit of production, increasing water use efficiency. **Mitigation** Reduces energy required for irrigation.

CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA Pillars
Vegetables (beans, cabbage and other brassicas) (5% of total harvested area)				
Micro-irrigation (drip irrigation, sprinkle)	Mid-hill <30%	M		**Productivity** Increases in yield due to appropriate water management. **Adaptation** Increases availability of water. Minimizes water use per unit of production, increasing water use efficiency. **Mitigation** Reduces energy required for irrigation.
Waste-water collection and rainwater harvesting	Mid-hill <30%	S		**Productivity** Increases in yield, income and household nutrition by enabling vegetable growing in extremely dry areas. **Adaptation** Increases water availability for crop production during water scarcity. **Mitigation** Reduces GHG emissions due to reduced fuel required for pumping and/or carrying water.
	Terai <30%	S		
Lentil (4% of total harvested area)				
Zero tillage seeding for relay cropping	Irrigated terai >60%	M		**Productivity** Promotes higher yield due to escape of terminal heat. Reduces production costs increasing profit. **Adaptation** Allows seed sowing even under water scarcity conditions. Allows early sowing, helping to escape terminal heat. **Mitigation** Protects soil structure and organic carbon reserves. Promotes fuel and energy saving due to reduced tillage.
	Rainfed terai 30-60%	M		
Mixed cropping with mustard or wheat	Rain-fed Terai 30-60%	S		**Productivity** Increases in income due to harvesting of multiple crops. **Adaptation** Reduces risk of complete crop failure. Allows optimum use of scarce water resources. **Mitigation** Increases above- and below-ground biomass and carbon capture compared to mono-cropping.

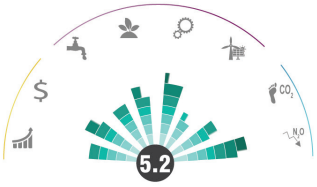
Yield Income Water Soil Risk/Information Energy CO_2 Carbon N_2O Nutrient

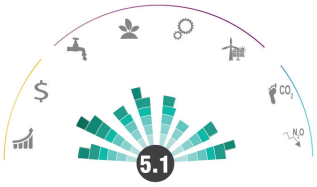
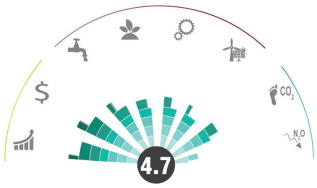
CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA Pillars
Lentil (4% of total harvested area)				
Zero tillage seeding for relay cropping	Irrigated terai 30-60%	S		**Productivity** Increases in income due to harvesting of multiple crops. **Adaptation** Reduces risk of complete crop failure. Allows optimum use of scarce water resources. **Mitigation** Increases above- and below-ground biomass and carbon capture compared to mono-cropping.
Potato (4% of total harvested area)				
Integrated pest management	Terai <30%	S		**Productivity** Ensures crop production and quality, hence potential increases in income. **Adaptation** Reduces crop losses due to red ants, even during moisture stress conditions. **Mitigation** Reduces GHG emissions by reducing use of synthetic pesticides.
	High hills/ Mountains <30%	S		
Appropriate planting method (flat bed in dry, ridge-furrow in wet)	High hills/ Mountains 30-60%	M L		**Productivity** Increases in yield and profit due to reduced production costs. **Adaptation** Optimizes the use of available soil moisture to avoid crop loss. Increases water use efficiency. **Mitigation** Reduces energy required for irrigation contributing to reduction in related GHG emissions.
	Terai 30-60%	S M		
Mustard (4% of total harvested area)				
Zero-tillage sowing	Rain-fed Terai <30%	S		**Productivity** Promotes higher yield due to escape of terminal heat. Reduces production costs, increasing profit. **Adaptation** Allows seed sowing even under water scarcity conditions. Allows early sowing helping to escape terminal heat. Maintains soil moisture in dry season. **Mitigation** Protects soil structure and organic carbon reserves. Promotes fuel and energy savings due to reduced tillage.

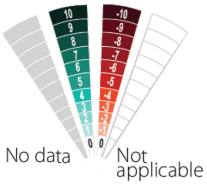
CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA Pillars
Mustard (4% of total harvested area)				
Zero-tillage sowing	Irrigated Terai <30%	S M		**Productivity** Promotes higher yield due to escape of terminal heat. Reduces production costs, increasing profit. **Adaptation** Allows seed sowing even under water scarcity conditions. Allows early sowing helping to escape terminal heat. Maintains soil moisture in dry season. **Mitigation** Protects soil structure and organic carbon reserves. Promotes fuel and energy savings due to reduced tillage.
Supplementary pollination (integration with beekeeping)	Rain-fed Terai <30%	M L		**Productivity** Increases crop yield due to greater pollination. **Adaptation** Copes against the reduced numbers of pollinators (including honey bee) due to erratic weather patterns and human influence. **Mitigation** Reduces the use of synthetic agro-chemicals, reducing the carbon footprint per unit of production.
	Irrigated Terai <30%	M L		
Sugar cane (1% of total harvested area)				
Ratoon management (minimum soil disturbance)	Rain-fed Terai <30%	S M		**Productivity** Reduces production costs, increases income. **Adaptation** Minimizes soil disturbance, maximizing moisture availability. Ratoons are more adaptive to climatic stresses. **Mitigation** Less fuel required for tillage thereby reducing GHG related emissions. Reduces water pumping/transport requirements.
	Irrigated Terai 30-60%	S M		
Intercropping (autumn: lentil; spring: mung bean)	Rain-fed Terai <30%	S		**Productivity** Increases in household income and profit due to harvesting of multiple crops. **Adaptation** Integration of legume crop diversifies the production system, hence reduces risk of complete crop failure. **Mitigation** Reduce requirement of synthetic Nitrogen-based fertilizers, reducing nitrous oxide emissions.



Yield Income Water Soil Risk/Information Energy CO_2 Carbon N_2O Nutrient

CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA Pillars
Sugar cane (1% of total harvested area)				
Intercropping (autumn: lentil; spring: mung bean)	Irrigated terai <30%	S		**Productivity** Increases in household income and profit due to harvesting of multiple crops. **Adaptation** Integration of legume crop diversifies the production system, hence reduces risk of complete crop failure. **Mitigation** Reduce requirement of synthetic Nitrogen-based fertilizers, reducing nitrous oxide emissions.
Cow and buffalo (milk) (NA)				
Stall feeding combined with biogas plantt	Terai <30%	S M		**Productivity** Increases in production due to balanced/ optimum nutrition. Reduces household expenditure on energy. **Adaptation** Reduces animal's stress during extreme climatic conditions by reducing exposure. Biogas reduces pressure on timber from forest. **Mitigation** Reduces pressure on grazing land and forests contributing to its preservation and promoting carbon capture.
	Mid-hill 30-60%	S		
Improved farm yard manure (FYM) management	Terai 30-60%	S		**Productivity** Reduces cost of production and increases profit from livestock and agriculture. **Adaptation** Improves soil health by increasing organic matter content and microbial activities. Increases possibility of farming in degraded soils (e.g. top soil erosion). **Mitigation** Reduces GHG emissions by reducing use of synthetic fertilizers.
	Mid-hill <30%	S		
Goat (meat) (NA)				
Improved goat-sheds	High-hill <30%	S		**Productivity** Faster growth and higher feed conversion ratio due to proper housing. **Adaptation** Reduces exposure to adverse climatic conditions, reducing animal stresses (e.g. cold waves). **Mitigation** Allows better manure management, thereby reducing related GHG emissions.

CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA Pillars
Goat (meat) (NA)				
Improved goat-sheds	Mid-hill <30%	S		**Productivity** Faster growth and higher feed conversion ratio due to proper housing. **Adaptation** Enhances soil moisture and fertility. Reduces soil erosion and increases biodiversity. **Mitigation** Increases carbon storage in soils. Reduces use of synthetic fertilizers and related GHG emissions.
Reduce inbreeding by providing new bucks	High-hill <30%	S		**Productivity** Reduces loss of assets and income from livestock, thereby increasing household profits. **Adaptation** Reduces the risk to extreme climate conditions without compromising production and quality. **Mitigation** Reduces fodder/forage required for attaining maximum yield. Reduces pressure on natural resources and related GHG emissions.
	Mid-hill 30-60%	S		

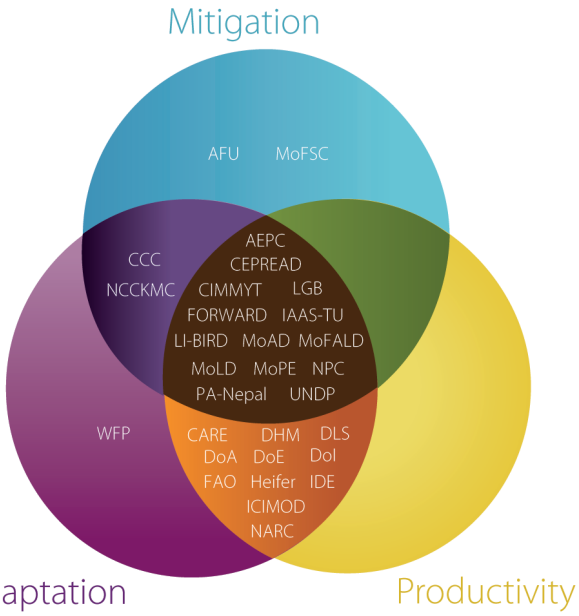


Yield Income Water Soil Risk/Information Energy CO_2 Carbon N_2O Nutrient

Institutions and policies for CSA

Nepal has multiple institutions and policies advancing sustainable agricultural development and climate change adaptation, and many of them are key for providing an enabling environment for research, development, and promotion of CSA practices. The following graphic highlights key institutions whose main activities relate to one, two or three CSA pillars (adaptation, productivity and mitigation). More information on the methodology is available in Annex 3.

Institutions for CSA in Nepal



AEPC Alternative Energy Promotion Center **AFU** Agriculture and Forest University **CCC** Climate Change Council **CEPREAD** Centre for Environmental and Agricultural Policy Research, Extension and Development **CIMMYT** International Maize and Wheat Improvement Centre **DHM** Department of Hydrology and Meterology **DoA** Department of Agriculture **DoE** Department of Environment **DoI** Department of Irrigation **DLS** Department of Livestock Sevices **FAO** Food and Agriculture Organization **FORWARD** Forum for Rural Welfare and Agricultural Reform for Development **IAAS-TU** Tribhuwan University - Institute of Agriculture and Animal Sciences **ICIMOD** International Centre for Integrated Mountain Development **IDE** International Development Enterprises **LGB** Local Government Bodies (DDC & VDCs) **LI-BIRD** Local Initiatives for Biodiversity, Research and Development **MoAD** Ministry of Agricultural Development **MoFALD** Ministry of Federal Affairs and Local Development **MoFSC** Ministry of Forests and Soil Conservation **MoLD** Ministry of Livestock Development **MoPE** Ministry of Population and Environment **NARC** Nepal Agriculture Research Council **NCCKMC** Nepal Climate Change Knowledge Management Centre **NPC** National Planning Commission **PA-Nepal** Practical Action Nepal **UNDP** United Nations Development Program **WFP** World Food Programme

Most of the institutions involved in CSA in Nepal promote practices for increasing agricultural productivity and food security, and environmental sustainability (eco-agricultural practices). While none of the government agencies had explicitly worked on CSA before 2016 (some CSA practices were promoted by agricultural extension workers without referring explicitly to the concept) several initiatives by non-governmental organizations (NGOs) have played an important role in informing policy makers on CSA.

Nepal adopted a new constitution in 2015 envisioning a federalist reform. Once the new federalist structure is in place, it will devolve the agricultural sector yielding higher authority and decision-power to local governments (i.e. municipalities and rural municipalities). This is likely to facilitate targeted, localized planning, and will contribute to promoting, implementing and monitoring of CSA practices in Nepal.

The Ministry of Population and Environment (MoPE) leads the formulation and implementation of climate change-related policies, strategies, and programs in Nepal. MoPE is the focal point for the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol, and the Clean Development Mechanism. In 2011, the National Climate Change Policy established a 25-member Climate Change Council (CCC) headed by the Prime Minster to provide strategic vision and direction to MoPE. Under MoPE, the Department of Environment (DoEnv) started implementing the Climate-Smart Villages (CSV) pilot program in 2016.

The Ministries of Agricultural Development (MoAD) and Livestock Development (MoLD) are responsible for developing technologies (through the National Agriculture Research Council [NARC]) and promoting them through public extension through 150 District Agricultural and Livestock Development Offices (DADOs, DLDOs) and hundreds of sub-ordinated Agricultural and Livestock Service Centers (ASCs, LSCs). Apart from these, the Ministry of Federal Affairs and Local Development (MoFALD) integrates CSA practices into local plans. Since agriculture is a devolved sector, the role of local government is crucial for increasing investments in CSA.

In general, these institutions operate within traditional hierarchical structures and with limited resources and capacity to operationalize their objectives. The institutions are highly fragmented and do not coordinate effectively, hindering the advancement of CSA on the public agenda, which requires aligned, integrated, multi-sectoral approaches to agricultural development. A multi-sectoral coordinating mechanism, such as the Nepal Planning Commission (NPC), has the potential to enhance coherence across sectors. NPC has already developed a climate-resilient planning guideline with the intention of improving climate-sensitive development planning for all sectors.

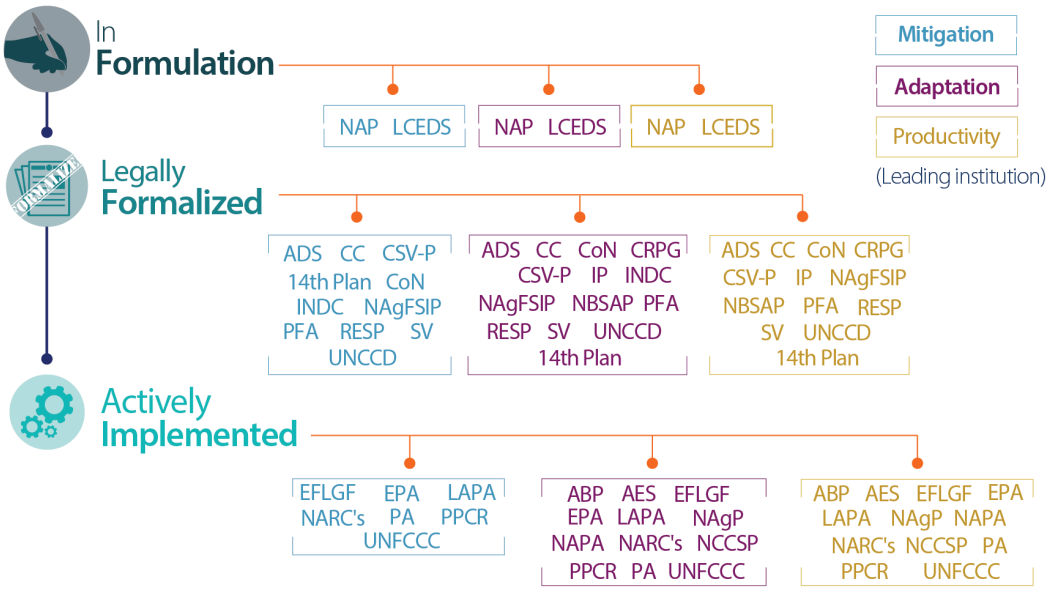
National and international NGOs and development agencies have been more proactive in supporting CSA

practices, implementing projects that aim to enhance the adaptive capacity and livelihoods of smallholder farmers and to address climate risks. Institutions like the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Development Programme (UNDP) have provided technical support to develop programs and policies for climate change adaptation in agriculture.
Several institutions have initiated projects with the explicit objectives of piloting and promoting CSA practices. For instance, LI-BIRD and CCAFS jointly implemented a CSA project through which they identified champion CSA practices for three AEZs and developed CSA scale-up strategies. LI-BIRD is also a key actor in implementing the CSV program.

Furthermore, Practical Action led a project to promote CSA practices for industrial crops through private sector engagement. The International Centre for Integrated Mountain Development (ICIMOD) and the Center for Environment and Agricultural Policy Research (CEAPRED) are piloting a Resilient Mountain Village concept with strong emphasis on CSA for hill systems.

The Government of Nepal has been proactive in setting up policies and strategies for climate change adaptation. The graphic shows a selection of policies, strategies and programs that relate to agriculture and climate change topics and are considered key enablers of CSA in the country. The policy cycle classification aims to show gaps and opportunities in policy-making, referring to the three main stages: policy formulation (referring to a policy that is in an initial formulation stage/consultation process), policy formalization (to indicate the presence of mechanisms for the policy to process at national level) and policy in active implementation (to indicate visible progress/outcomes toward achieving larger policy goals, through concrete strategies and action plans). For more information on the methodology, see Annex 4.

Policies for CSA in Nepal



ABP National Agro-Biodiversity Policy (2006) (MoAD) **ADS** Agriculture Development Strategy 2015-2035 (2015) (MoAD) **AES** Nepal Agriculture Extension Strategy (2007) (MoAD) **CC** Nepal Climate Change Policy (2011) (MoPE) **CSV-P** Climate-Smart Village Programme (2016) (MoPE) **CoN** Constitution of Nepal, (2015) (GoN) **CRPG** National Climate-Resilient Planning (2011) (NPC) **EFLGF** Environment Friendly Local Governance Framework (2013) (MoFALD) **EPA** Environmental Protection Act 1996 & Rule 1997 (1996) (MoPE) **INDC** Intended National Deduction Commitment (2016) (MoPE) **IP** National Irrigation Policy (2013) (MOI) **LAPA** National framework for Local Adaptation Plan of Action (2011) (MoPE) **LCEDS** National Low Carbon Economic Development Strategy (2015) (MoPE) **NAgFSIP** Nepal Agriculture and Food Security Country Investment Plan (2010) (MoAD) **NAgP** National Agriculture Policy (2004) (MoAD) **NAP** National Adaptation Plan (2015) (MoE) **NAPA** National Adaptation Programme of Action (2010) (MoPE) **NARC's** NARC's vision for Agricultural Research Policy (2011-2030) (2010) (NARC) **NBSAP** Nepal Biodiversity Strategy and Action Plan (2014-2020) (2014) (MoFSC) **NCCSP** Nepal Climate Change Support Programme (2011) (MoPE) **PA** Paris Agreement (2016) (MoPE) **PFA** Climate Change Adaptation and Disaster Risk Management in Agriculture: Priority Framework for Action (2011-2020) (2011) (MoPE) **PPCR** Pilot Program on Climate Resilience (2010) (MoE) **RESP** Renewable Energy Subsidy Policy (2016) (MoPE) **SV** Seed Sector Development Strategy (2013-25) (2013) (MoAD/NSB/SQCC) **UNCCD** United Nations Convention to Combat Desertification (2012) (MoPE) **UNFCCC** United Nations Framework for Climate Change (MoPE)

Nepal ratified the UNFCCC in 1994, signed the Kyoto Protocol in 2002, and ratified the Paris Agreement in 2016. The country has already submitted two National Communications to the UNFCCC, in 2007 and in 2013, and submitted its Nationally Determined Contribution (NDCs) in 2016. In the last decade, the government has formulated a number of key policies with an emphasis on managing climate change as a cross-cutting priority topic in national plans. A few notable policies include:

- The **Climate Change Policy**, which assigns high priority for climate change adaptation activities in the agriculture sector and explicitly demands that at least 80% of funds acquired for climate change adaptation go to local levels.

- The **National Adaptation Programme of Action** identifies immediate and urgent needs for climate change adaptation in the most vulnerable sectors, including agriculture and food security. Nine projects aligned with the NAPA are currently being implemented.

- The **Local Adaptation Plan of Action Framework** provides guidelines for local adaptation planning and implementation, creating opportunities for integrating CSA practices into local development plans as well as annual agricultural extension plans.

- The **Climate Change Support Programme** has so far supported 87 Village Development Committees (VDCs) and 9 municipalities in 14 districts in the formulation and implementation of 100 LAPAs (where CSA practices are an important component). About 40% of all NCCSP expenses have been incurred for adaptation work in the agriculture sector.

- The **Environment Friendly Local Governance Act**, supports VDCs and municipalities to adopt environment-friendly practices.

Most recently, the **National Adaptation Plan**, aims to identify and prioritize medium- and long-term goals and strengthen the national capacity to integrate adaptation into development plans in Nepal. It places particular emphasis on the most vulnerable sectors, including agriculture and food security.

Climate change adaptation started to gain momentum in the country with the establishment of the NPC and the 13th Plan (2014/15-2016/17). This plan, however, lacked targeted activities and sufficient budget for climate change activities, undermining its implementation. The **14th Plan (2017-2019)** explicitly stresses the need for scaling up climate–friendly technologies in agricultural production, and creating a favorable environment for the **CSV program** (launched in 2016), which targets 150 villages where CSA practices will be promoted.

These initiatives have been complemented by efforts to harmonize and integrate climate change into sectoral plans, such as:

- The **Agricultural Development Strategy**, which supports investments in agricultural research (with a particular focus on stress-tolerant varieties and breeds) and the development and/or strengthening of services to ensure CSA promotion (e.g. climate information, weather indexing systems, and early warning), among others [33].

- The **Strategic Vision of NARC for Agriculture Research**, which aims at enhancing institutional and technical capacity of MoAD and its DADOs for climate risk management, and disaster preparedness and prevention in the agricultural sector [34].

Various other sectoral policies advance agricultural adaptation to climate change. For example, the **Nepal Biodiversity Strategy and Action Plan** prioritizes the promotion of environment-friendly farming systems and targets to develop several projects to promote CSA by 2020.

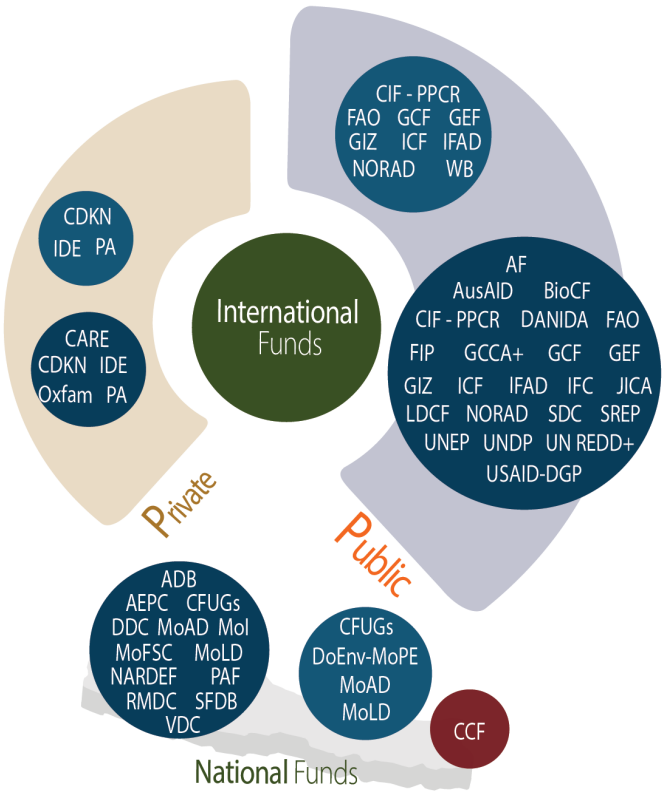
The country's **NDCs** are based on Nepal's existing climate change frameworks, policies, and strategies. The government pledges to develop and follow a comprehensive low-carbon economic development strategy. Specific targets aim at obtaining 80% of the country's energy supply from renewable sources by 2050, reducing dependency on fossil fuels by 50%. Nepal also plans to maintain the forest cover at 40% and to reduce emissions of 14 million tons of CO_2 equivalent by 2020. The NDCs identify the need for promoting climate friendly agriculture and livestock technologies along with farm commercialization. Among others, specific agriculture and livestock targets include implementing farmers' schools, promoting local and flood- and drought-resistant crop varieties, as well as installing biogas plants for renewable energy supply and improved manure management in 130,000 households and 200 communities across the country. The government seeks bilateral and multilateral grant support for achieving its climate change targets in priority areas, including the agriculture and livestock sectors [35, 36].

In summary, several key policies emphasize the government's commitment to address climate change challenges to agricultural development. However, harmonization and mainstreaming of sectoral policies remains a difficult task. Since the CSA concept and its operationalization is still new to policy makers, service providers, and implementers, capacity development is key for enhancing decision-making efficiency as well as better targeting, design, and implementation of the policies.

Financing CSA

Financing is critical for incentivizing farmers and communities, public institutions and the private sector to invest in the development and promotion of CSA in Nepal. The graphic highlights existing and potential financing opportunities for CSA in Nepal. The methodology can be found in Annex 5.

Financing opportunities for CSA in Nepal



- Funds actually accessed by country for CSA purposes
- Funds actually accessed by country for purposes other than CSA
- Funds not accessed by the country

ADB Agriculture Development Bank **AEPC** Alternative Energy Promotion Center **AF** Adaptation Fund **ADB** Asian Dev Bank **AusAID** Australian Agencyfor International Development **BioCF** World Bank BioCarbon Fund **CARE** Cooperative for Assistance and Relief Everywhere **CCF** Climate Change Fund **CFUGs** Community Forest User Group Fund **DANIDA** The Danish International Development Agency **DDC** District Development Committee grant **DoEnv-MoPE** Ministry of Population and Environment - Department of Environment **FAO** Food and Agriculture Organization of the United Nations **FIP** Forest Investment Program **GCCA** Global Climate Change Alliance **GCF** Green Climate Fund **GEF** Global Environment Facility **GIZ** German Society for International Cooperation **ICF** United Kingdom International Climate Fund **IDE** International Development Enterprises **IFAD** International Fund for Agricultural Development **IFC** Int ernational Finance Corporation **JICA** Japan International Cooperation Agency **KFW** German Development Bank International Climate Initiative **MI** Ministry of Irrigation **MoAD** Ministry of Agricultural Development **MoFSC** Ministry of Forest and Soil Conservation **MoLD** Ministry of Livestock Development **NARDEF** National Agricultural Research and Development Fund **NORAD** Norwegian Agency for Development and Cooperation **PA** Practical Action **PAF** Poverty Alleviation Fund **RMDC** Rural Micro-finance Development Coorporation **SFDB** Small Farmer Development Bank **SREP** Scaling Up Renewable Energy in Low Income Countries Program **UNDP** United Nations Development Programme **UNEP** United Nations Environmental Programme **USAID-DGP** United States Agency for International Development – Development Grants Program **UN REDD** United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation **VDC** Village Development Committee grant **WB** The World Bank

National opportunities for funding research and development in the agriculture sector include public funds channeled through various ministries and departments, commercial banks (which provide loans to farmers), NGOs, community forestry user groups (e.g., CFUG fund), and, to some extent, private sector companies (particularly seed and agribusiness companies).

Financing for the agricultural sector, both from the national budget and from international cooperation, has oscillated, decreasing significantly over the last decade. Hence, access to financing opportunities for CSA has been rather limited.

About 8.3% of all foreign grants and 7.8% of foreign loans are spent on the agriculture, forestry and fishery sectors[19]. Agriculture sector expenditure in 2012 was US$ 0.19 billion, or approximately 5% of the total agriculture GDP of the country [30]. Approximately US$ 17.8 million—representing 0.3% of the agriculture GDP[20] —was spent on agricultural research in 2012, which is lower than in neighboring countries, India and Bangladesh [37]. The share of agriculture expenditures in the total budget is likely to increase in the future in Nepal, although concerns over the capacity of MoAD and MoLD to expend the budget remain. Despite the fact that donor assistance increased slightly after the end of Nepal's 10-year conflict, the capacity to absorb these funds by the government has been limited [21].

The Ministry of Finance (MoF), through the Central Treasury, allocates funds to different ministries based on the annual program approved by the NPC. The focal ministry for CSA is MoAD, with MoLD, the Ministry of Irrigation (MoI), MoFALD, MoPE and their respective departments and district line agencies which play a pivotal role in channeling agricultural development funds and coordinating field implementation. Although some of these funds may have been accessed by farmers for adoption of CSA practices, the promotion of CSA or climate change adaptation is not the explicit purpose of these funds.

Several local funds, such as community forestry user group (CFUG) funds, have been used for the promotion of CSA practices, yet their effective use could be increased with greater coordination and cooperation between agriculture extension system and these local funds. Nepal has also accessed most of the climate change funds established under the UNFCCC framework. The Least Developed Country Fund (LDCF), for example, was accessed to develop Nepal's NAPA and the Adaptation Fund (AF), provided financial support to implement climate change adaptation activities in the western hills. The Climate Investment Fund (CIF), meanwhile, enabled the implementation of a Pilot Program for Climate Resilience (PPCR), part of which focuses on developing an agriculture management information system for promoting weather-based agro-advisory services to farmers. Finally, Global Environment Facility (GEF) funds— supported by the International Fund for Agricultural Development— have been used for running

19 Although these figures look higher than the regional average, different accounting methods place the figure to be somewhere between 2-3% of the total budget.

20 Expressed in US$ 2011 constant.

projects supporting agriculture sector adaptation, though none of these projects explicitly promote CSA practices.

Financing through Scaling-up Renewable Energy Program (SREP), the Forest Investment Program (FIP), the International Finance Corporation (IF), and BioCF (World Bank Bio Carbon Fund) has been accessed and used for promoting renewable energy, value chain development, agribusiness, and biogas—most of which are supportive of CSA goals. The World Bank and Asian Development Bank (ADB) have also invested in agricultural development and value chain projects, as have bilateral donors and INGOs.

Several upcoming initiatives represent important opportunities for potential CSA finance in Nepal. The World Bank plans to support the government in improving the livestock sector by increasing productivity, enhancing value addition, and improving climate resilience of smallholder farms and agro-enterprises in selected livestock value-chains. MoAD, MoLD and FAO are also collaborating to access the GCF for building resilience of smallholder farmers in Nepal. These financing opportunities will be crucial for advancing CSA in Nepal.

Nepal's CCP establishes an ambitious target to invest 80% of the climate change funds at the VDC level, with only 20% equally distributed among intermediary organizations for the purposes of coordination and implementation. An innovative approach to realize this goal has been Climate-Adapted Villages (CAV), piloted between 2013 and 2016, illustrating the ability of grassroots organizations to leverage local resources for adaptation. These pilots demonstrate that the integration of CSA into agricultural and local development plans increases the likelihood of co-finance and co-investment, which enhances the cost-effectiveness of climate finance.

Potential Finance

New international climate funds such as the Green Climate Fund (GCF) offer opportunities to leverage funds for scaling-up CSA throughout the country. Nepal has already been awarded small-scale financial support from the GCF to prepare its NAP (US$ 2.9 million). Nepal has initiated the process to access larger GCF grants in the near future.

Furthermore, there is great potential for increasing funding of CSA practices by focusing on investing in local government plans and extension systems. With the bulk of agricultural decision-making power devolved to the local government level, mainstreaming of CSA into local government plans allows for the mobilization of funds and block-grants received from the central treasury to scale-up CSA practices at the community level.

There is also vast potential for private sector engagement in CSA promotion, through weather-based insurance, ICT-based agro-advisory services, development and marketing of climate-resilient seeds, and the promotion of agricultural machinery and tools, among others. The banking sector can play an important role by increasing access to financial services to enable investments in capital-intensive CSA practices like solar-based irrigation, micro-irrigation systems, or cattle shed improvement. There is a need for assessing the constraints for increased private sector investment in this field and for removing barriers through effective public-private-partnerships.

Outlook

Overcoming institutional and policy barriers for CSA scale-up requires a multi-pronged approach to agricultural development and multi-stakeholder alignment and coordination. In this regards, strengthening the role of NPC could be crucial for advancing CSA practices on the public agenda in Nepal. Moreover, local policies, such as LAPAs, have proven successful in providing a model for planning and implementation of adaptation actions at lower levels of decision-making. LAPAs now represent opportunities for prioritizing and mainstreaming CSA actions.

Strengthening the capacity of frontline extension staff and establishing an institutional structure to coordinate the delivery of information to farmers is also important, especially where CSA practices and technologies are knowledge-intensive. Long-term planning and investment in infrastructure, access to productive resources for smallholders, institutional capacity, and strong public-private-cooperative partnerships would contribute to improving the research-extension-education continuum for enabling CSA. This also requires strengthening national climate and weather databases. Reliable and effective crop insurance, and weather forecasting and agro-advisory facilities are not possible without adequate investments in data collection and management. Such investments would also be a critical step towards increasing the government institutions' capacities for measurement, reporting and verification (MRV) of progress on national climate targets, which are adamant for successful implementation of climate policies outlined in the country's NDCs, and can be critical to increasing Nepal's access to financial resources dedicated to CSA.

Works cited

[1] FAO. 2010. "Climate-Smart" Agriculture. Policies, practices and financing for food security, adaptation and mitigation. Rome: Food and Agriculture Organization of the United Nations (FAO).

[2] FAO. 2013. Climate-smart agriculture sourcebook. Rome: FAO.

[3] WB. 2017. World Development Indicators: Nepal. Washington, D.C.: World Bank (WB). Available at: http://data.worldbank.org/data-catalog/world-development-indicators

[4] NPC. 2017. 14th Plan of Nepal 2017/18-2019/20. Kathmandu, Nepal: National Planning Commission (NPC). Available at:http://www.npc.gov.np/

[5] FAO. 2017. Food and agriculture data (FAOSTAT) for NEPAL. Rome: FAO. Available at: http://www.fao.org/faostat

[6] CBS. 2013. National Sample Census of Agriculture Nepal 2011/12. Kathmandu, Nepal : Central Bureau of Statistics, National Planning Commission Secretariat, Government of Nepal

[7] UN. 2014. Migration Profiles for Nepal: Common Set of Indicators. United Nations, DESA-Population Division and UNICEF. https://esa.un.org

[8] FAO. 2010. Assessment of Food Security and Nutrition Situation in Nepal, An input for the preparation of National Medium-Term Priority Framework (NMTPF) for FAO in Nepal.

[9] CARE. 2015. Nepal. Gender relations in Nepal. Kathmandu: CARE. Available at: http://www.care.org

[10] Pariyar, D. 2008. Country Pasture/Forage Resource Profiles. Rome: Publishing Policy and Support Branch, Office of Knowledge Exchange, Research and Extension, Food and Agriculture Organization of the United Nations (FAO). Available at: http://www.fao.org/

[11] VDD. 2011. Annual Progress Report. Vegetable Development Directorate 2011.

[12] Paudel, B. Radovich, T., Chan, C; Crow, S; Halbrendt, J; Thapa, K, Tamang, B.B. 2016. Potential of Conservation Agriculture Production System (CAPS) for Improving Sustainable Food and Nutrition Security in the Hill Region of Nepal. In: Chan, C; Fantle-Lepczyk, J. (2016) (Eds.). Conservation Agriculture in Subsistence Farming: Case Studies from South Asia and Beyond, pp 55-76. Available at: http://www.cabi.org

[13] GoN, FAO. 2013. Country Programming Framework 2013 - 2017. Kathmandu, Nepal: Government of Nepal (GoN) and the Food and Agriculture Organization of the United Nations (FAO). Available at: http://www.fao.org/3/a-az861e.pdf

[14] EIU. 2016. Global Food Security Index. The Economist Intelligence Unit (EIU). Available at:http://foodsecurityindex.eiu.com

[15] MoAC, WFP, FAO. 2011. Crop Situation Update: A joint Assessment of 2010 Summer Crops and Outlook for 2011 Winter Crops. Kathmandu, Nepal: Ministry of Agriculture and Cooperative (MoAC), World Food Programme (WFP) and Food and Agricultural Organization (FAO).

[16] WRI. 2017. Climate Data Explorer. Washington, DC: World Resources Institute. Available at: http://cait.wri.org

[17] UN. 2015. World Population Prospects: The 2015 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP.241. United Nations Department of Economic and Social Affairs, Population Division. Available at: https://esa.un.org

[18] CBS. 2014. Statistical Pocket Book of Nepal, 2014. Kathmandu, Nepal: Central Bureau of Statistics (CBS), National Planning Commission Secretariat, Government of Nepal. Available at: http://cbs.gov.np

[19] IRIN. 2013. ´The trouble with Nepal´s agriculture´. IRIN News. Kathmandu, 23 of January 2013. Available at: http://www.irinnews.org

[20] Basnyat, B. 2010. Improving seed security through the expansion of seed multiplication farms in the public, private and cooperative sectors in Nepal. Economic Policy Network II, MOF/ADB.

[21] ADB. 2013. Preparation of the Agricultural Development Strategy - Final Report. Kathmandu: Asian Development Bank (ADB).

[22] DHM, 2016. Study of Climate and climatic variation over Nepal. Kathmandu: Department of Hydrology and Meteorology (DHM), Ministry of Science, Technology and Environment.

[23] Collins M; Knutti R; Arblaster J; Dufresne JL; Fichefet T; Friedlingstein P; Gao X; Gutowski WJ; Johns T; Krinner G; Shongwe M; Tebaldi C; Weaver AJ; Wehner M. 2013. Longterm climate change: Projections, commitments and irreversibility. In: Climate change. The physical science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. [Stocker TF; Qin D; Plattner GK; Tignor M; Allen SK; Boschung J; Nauels A; Xia Y; Bex V; Midgley PM. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. pp. 1029–1036. DOI: 10.1017/CBO9781107415324.024

[24] Ramírez J; Jarvis A. 2008. High-resolution statistically downscaled future climate surfaces. International Center for Tropical Agriculture (CIAT); CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).Cali, Colombia.

[25] Ramírez-Villegas J; Thornton PK. 2015. Climate change impacts on African crop production. Working Paper No. 119. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Copenhagen, Denmark. Available at: http://hdl.handle.net/10568/66560

[26] Paudel, B., Tamang, B.B., Lamsal, K. & Paudel, P. 2011. Planning and costing of agricultural adaptation with reference to integrated hill-farming systems in Nepal. International Institute for Environment and Development (IIED), London, UK. http://pubs.iied.org

[27] NCVST. 2009. Vulnerability Through the Eyes of Vulnerable: Climate Change Induced Uncertainties and Nepal's Development Predicaments. Boulder, CO and Kathmandu, Nepal: Nepal Climate Vulnerability Study Team (NCVST), Institute for Social and Environmental Transition (ISET), Institute for Social and Environmental Transition-Nepal (ISET-N). Available at: http://i-s-e-t.org.

[28] IDS-Nepal, PAC and GCAP. 2014. Economic Impact Assessment of Climate Change in Key Sectors in Nepal. Kathmandu, Nepal: Integrated Development Society (IDS).

[29] Robinson, S., Mason-D'Croz, D., Islam, S., Sulser, T., Gueneau, A., Pitois, G., & Rosegrant, M. W. 2015. The International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT): Model description for version 3 (IFPRI Discussion Paper). Washington, D.C: International Food Policy Research Institute. Retrieved from http://ebrary.ifpri.org

[30] IFPRI. 2015. Statistics on public expenditures and economic development (SPEED). International Food Policy Research Institute (IFPRI), Washington, D.C.: http://dx.doi.org/10.7910/DVN/INZ3QK

[31] Thomson, A. M.; Calvin, K. V.; Smith, S.J.; Kyle, G. P.; Volke, A.; Patel, P.; Delgado-Arias, S.; Bond-Lamberty, B.; Wise, M. A.; Clarke, L. E.; Edmonds, J. A. 2011. RCP4.5: A pathway for stabilization of radiative forcing by 2100. Climatic Change 109(1-2):77-94.

[32] LI-BIRD, 2015 (unpublished). Installation of Solar-Energy Based Pump/Lift Irrigation System in Climate-Smart Villages of Nepal. Report Submitted to CCAFS for the project 'Piloting and Scaling out Climate Smart Village (CSV) in Nepal'.

[33] MOAD. 2015. Agricultural Development Strategy of Nepal. Ministry of Agriculture and Development (MoAD), Nepal.

[34] Chaudhury, A.; Sova, C.; Rasheed, T.; Thornton, T.; Baral II, P.; Zeb, A. 2014. Deconstructing Local Adaptation Plans for Action (LAPAs): Analysis of Nepal and Pakistan LAPA Initiatives. (September 16, 2014). Available at SSRN: https://ssrn.com/abstract=2496968 or http://dx.doi.org/10.2139/ssrn.2496968

[35] GoN. 2016. Nationally Determined Contributions (NDCs). Government of Nepal, Ministry of Population and Environment.

[36] Climate Analytics, Ecofys and NewClimate Institute, 2016. Climate Action Tracker. Nepal. Available at: http://climateactiontracker.org

[37] ASTI. 2017. Agricultural science and technology indicators. IFRPI. Available at: http://www.asti.cgiar.org/

For further information and online versions of the Annexes

Annex 1: Selection of agricultural production systems key for food security in Nepal (methodology)
Annex 2: Methodology for assessing climate-smartness of ongoing practices
Annex 3: Institutions for CSA in Nepal (methodology)
Annex 4: Policies for CSA in Nepal (methodology)
Annex 5: Assessing CSA finances in Nepal (methodology

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