Final Advance Estimate of 2019 Wheat Production in Nepal using the CCAFS Regional Agricultural Forecasting Toolbox (CRAFT)

10 May 2019

The final advance estimate of 2019 wheat production was obtained on 10th May, 2019 using CRAFT, the CCAFS Regional Agricultural Forecasting Toolbox (see Methods on page 2). According to CRAFT, the total wheat production in 2019 is forecasted to be 2,003,885 MT, a 2.81 percent increase compared to the production level of 1,949,001 MT in 2018. The expected yield rate of wheat in the country is 2.92 MT per hectare. Furthermore, the forecasted figure is a 6.3 percent increase compared to the average production level of the last five years. The forecast was made based on the Ministry of Agriculture and Livestock Development (MoALD)'s records of wheat planted area received on 7th May, 2019 (678,354 hectares) and is based on a prediction uncertainty of ±7.5 percent. See **Figure 1** for MoALD's data on wheat planted area (2013/14-2018/19), wheat production (2013/14 – 2017/18) and the CRAFT wheat production forecast for 2019.

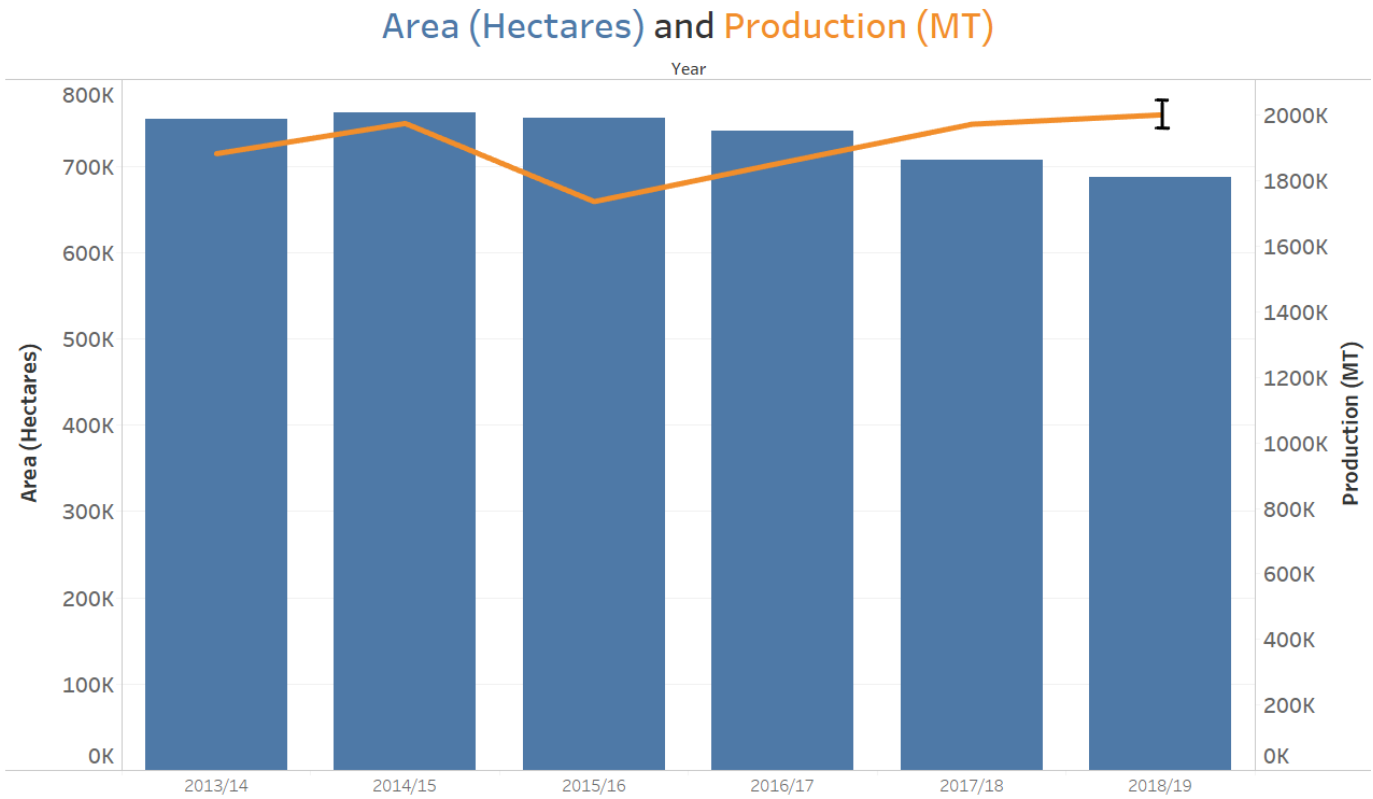

Figure 1: Wheat area, wheat production and CRAFT wheat production forecast for Nepal, 2013-2018 (Source: MoALD; CRAFT)

There has been a 4 percent overall decrease in the sown area of wheat from last year. Despite this, the relative consistency in wheat production is credited to favorable rainfall during the maturity period of crop growth. The Government of Nepal's Department of Hydrology and

Meteorology (DHM) reported that the immediate post monsoon rainfall this season (October /November) has not been good but this rainfall deficit has been compensated by good rainfall since January (188 percent of normal) and has influenced the production in a positive way by providing adequate soil moisture during the maturity of wheat. Further, no significant crop losses for wheat was reported throughout the country. Refer to Figure 2 for province wise forecast of Wheat and its comparison to last year's productions.

Province	Area 2018 (hectares)	Area 2019 (hectares)	Percent change in Area	Production 2018 (MT)	Craft forecast 2019 (MT)	Percent change in production	Yield (Kg / Hectare) in 2019
Province 1	59,997	58,164	-3	188,680	198,654	5	3,415
Province 2	171,863	169,416	-1	566,895	589,475	4	3,479
Province 3	57,049	53,029	-7	169,273	168,354	-1	3,175
Gandaki	41,097	37,907	-8	94,772	92,543	-2	2,441
Province 5	147,722	144,830	-2	484,582	481,560	-1	3,325
Karnali	83,505	76,128	-9	160,213	153,756	-4	2,020
Sudur Paschim	145,610	138,880	-5	308,736	319,542	4	2,301

Table 1: The table shows provincial percent change of wheat planted area from 2017/18 to 2018/19 (in hectares) as well as wheat production from 2018 and CRAFT forecast for 2019 (in MT), (Source: MoALD; CRAFT)

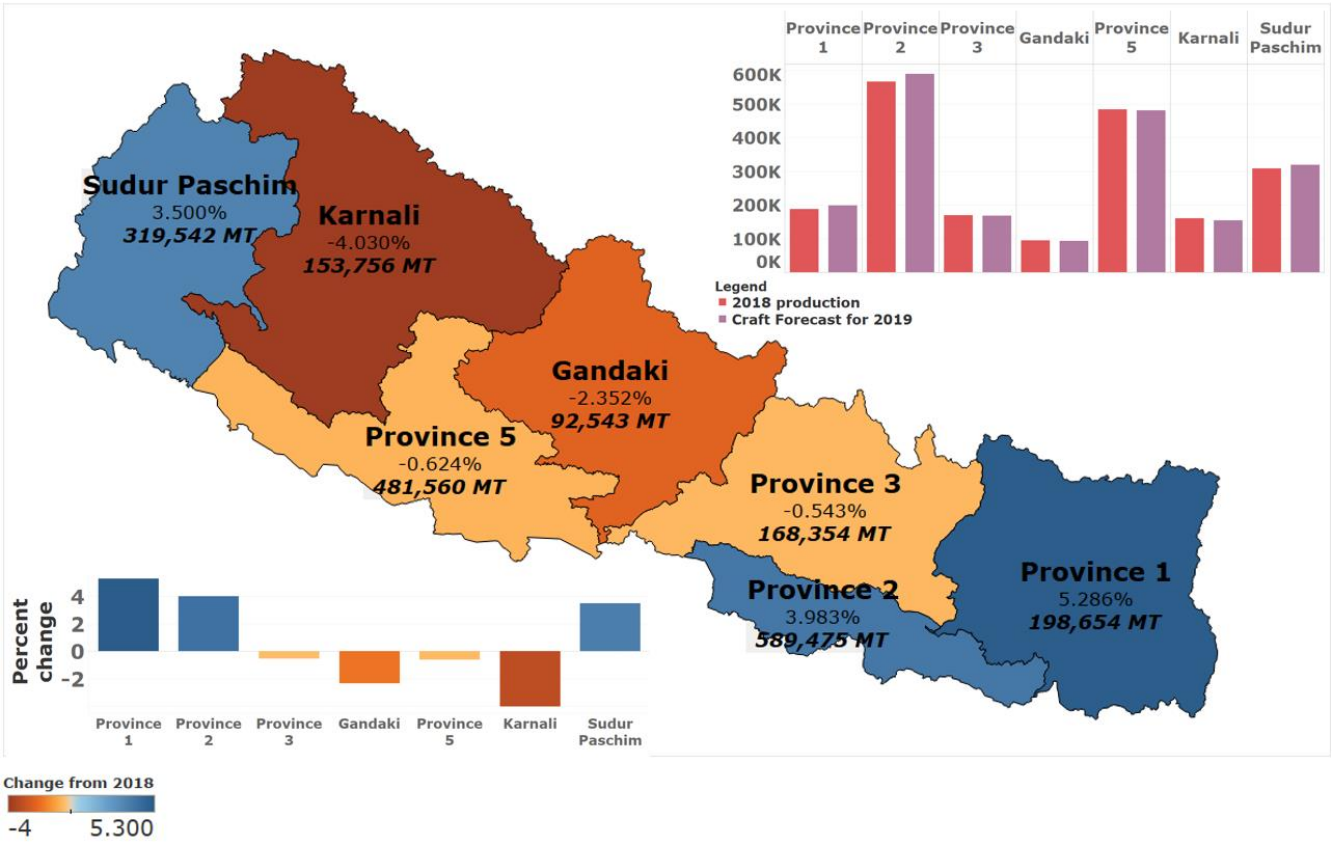

Figure 2: The map shows percent change of wheat production from 2018 and CRAFT forecast for 2019 (Source: MoALD; CRAFT)

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According to the analysis of data provided by Meteorological Forecast Division (MFD) of DHM's real time airport stations, the country had low rainfall at the start of post-monsoon with especially low rates in Central and Western Terai areas. However this effect has been mostly compensated for by the rainfall post January, which was 150—250 percent of average. The appreciable decrease in plantation area of wheat in Gandaki province and Province 3 is expected to bring about a relative decline in the production in these provinces. However, Karnali Province is the one facing the highest expected loss in production, also mostly due to loss of plantation area. There could also be small patches of crop failure in Karnali, but generally the crop condition has been reported to be good throughout the country. Similarly, in the Eastern parts of the country, rainfall has been very good during the maturity season of wheat, thereby aiding production. The scheduling of irrigation and pesticide management has been reported to be mostly good.

What is CRAFT?

Craft uses historical databases of weather and crop yields and current weather to estimate yields of various crops. The yield forecasting depends on data from various sources such as meteorological data (rainfall, temperature, humidity, bright sunshine hours, wind speed, wet spell, etc.), agro-meteorological data (phenology), soil data (water holding capacity), remote sensing data and agricultural statistics. CRAFT is a model that simulates plant-weather-soil interactions in quantitative terms and predicts the crop yield over a given area, prior to harvest, provided no extreme (statistically infrequent) conditions occur. These models are based on a "common sense" assumption that weather conditions are the main factor behind the inter-annual (short-term) variations for the de-trended crop yield series (Gommes et al., 2010).

The workflow in CRAFT starts with management, soil and weather inputs in gridded forms which are utilized by the crop simulation module under DSSAT to produce yields. The CPT module then produces seasonal climate forecasts and integrates with the DSSAT simulated yields to provide seasonally forecasted yields for each of the grids. These gridded yields are aggregated to the domain of interest by a GIS module inside CRAFT. The yields are then compared and calibrated externally against observed data to obtain the final yield forecasts.

The purpose of adopting CRAFT is to anticipate the impacts of climate variations on crop production in support of agricultural management and food security decisions. CRAFT provides an information platform to support resilience-building interventions through within-season forecasting of crop production, risk analysis, and climate change impacts. It provides a robust platform, which utilizes seasonal climatic forecasts and crop growth simulation model to forecast crop yield estimates. The forecast from CRAFT can provide a highly relevant and flexible platform that can be tailored to meet the needs of farmers, researchers and food security decision-makers. CRAFT does so by providing early probabilistic estimates of volume of crop production in specific areas at different times of the year.

CRAFT INPUTS

The spatial inputs include soil data, cultivar type, crop management inputs and irrigation mask. These data are more or less constant for a given period of time. The Soil and Terrain Database (SOTER) for Nepal was used as the soil source and the respective properties, such as texture, depth, soil moisture content, bulk density, infiltration capacity, and organic matter content were added to the CRAFT database for modelling. The general crop management practices data include dates of sowing/planting, irrigation and fertilizer applications which are different for the different ecological belts. These data are based on literature as well as regularly updated according to the input from WFP field staffs in consultation with Nepal Government employees. Data on crop variety was obtained using the calibrated genotypes obtained from Nepal Agricultural Research Council (NARC). The Ministry of Agriculture's statistics on district level irrigated area were used for the irrigation mask.

The spatio-temporal inputs include more time variant inputs such as weather data and crop acreage data. Weather data is the major driver of the CRAFT model, and the reliability of climatic parameters determine the reliability of model outcomes to a great extent. Department of Hydrology and Meteorology (DHM)'s ground station data for precipitation from 163 stations and temperature from 45 stations were used. Near-real time data is a prerequisite to get reliable yield forecasts. The satellite based weather products were opted for supplementing the existing historic climate data till the date of simulation. The crop mask data includes the spatial distribution of the areas under cultivation. This is periodically created for Nepal using district-level statistics on a crop gown area for different stages within a crop season.

This is the final estimate for the season.

Under the research theme on Climate Risk Management, the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) developed a crop yield-forecasting tool customized for the South Asia Region known as the CCAFS Regional Agriculture Forecasting Toolbox (CRAFT). CCAFS is a strategic partnership of CGIAR and Future Earth, led by the International Center for Tropical Agriculture (CIAT), which conducts research to identify and address the most important interactions, synergies and tradeoffs between climate change, agriculture and food security.

Methods

CRAFT incorporates a crop simulation model (DSSAT), a weather and seasonal forecast module (CPT) and a GIS mapping module (Map Win GIS). The tool provides the support for spatial input data, spatial crop simulations, integration of seasonal climate forecasts, spatial aggregation, probabilistic analysis of forecast uncertainty, and calibration of model predictions from historical agricultural statistics, analysis and visualization.

Acknowledgements

This publication is a joint product of the Ministry of Agricultural and Livestock Development (MoALD), World Food Programme (WFP), and the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) as part of the Nepal Food Security Monitoring System (NeKSAP). The objective of this collaboration is to strengthen early warning for better food security planning in Nepal in light of the present and anticipated changing climatic conditions. CRAFT provides advance information to stakeholders to better manage within-season climate risks to agriculture. In addition to its use in Nepal, CRAFT is also being used in Bangladesh, Sri Lanka and India.

This report relies on information provided through different agencies, including the Department of Hydrology and Meteorology (DHM), Nepal Agriculture Research Council (NARC), Department of Agriculture, MoALD, WFP, the International Centre for Integrated Mountain Development (ICIMOD), International Water Management Institute (IWMI), and International Research Institute for Climate and Society at Columbia University. All contributors are gratefully acknowledged for their support.

NeKSAP collects, analyzes and presents information on household food security, agriculture, and markets from across Nepal. NeKSAP is implemented by MoALD with strategic guidance from the National Planning Commission (NPC). WFP provides technical assistance for NeKSAP.

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