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ANTICIPATING LARGE AND WIDESPREAD **SEASONAL DEPRIVATION IN THE SAHEL**

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**SAHEL ADAPTIVE
SOCIAL PROTECTION
PROGRAM**

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SUMMARY

In addition to being regularly confronted with unpredictable shocks such as floods, droughts, or conflicts, Sahelian households have to deal with the effects of seasonality. This leads to a significant reduction in food and non-food consumption across the season, exposing the poor to transient food insecurity and malnutrition.

Recent household survey data collected across the Sahel show that monetary consumption drops significantly between the non-lean and lean season, enough to push vulnerable households below the poverty line. Given that many households are just above the poverty line, even small seasonal differences in average consumption can result in large swings in poverty.

Instead of cutting consumption of more expensive or nutritious food, households reduce the consumption of the most fundamental food items in their consumption basket. While dietary diversity did not decline between the non-lean season and the lean season, both expenditure and quantities consumed of staple foods appeared to be significantly lower in the lean season, putting poor households at risk of malnutrition and food insecurity.

Rural households are the most vulnerable to the effects of seasonality due to their dependence on rainfed subsistence agriculture. Taking Burkina Faso, Mali, Niger, Senegal, and

Chad as a whole, 65.5 percent of the rural population live in a household where the head works primarily in agriculture and 86.5 percent of rural households had cultivated fields in the previous agricultural season. Although seasonal swings in welfare are concentrated among agricultural households, even households where the main income earners work outside of agriculture can experience lean season welfare losses as they may have secondary activities linked to agriculture. For example, in Burkina Faso and Senegal, households in which the head works primarily in industry or services still experience a drop in consumption during the lean season.

Since the impacts of seasonality are large and can be anticipated, the coverage of regular safety net programs that help households cope should be broadened. While much emphasis is currently placed on responding to unpredictable shocks, seasonal food insecurity could be better tackled by providing regular transfers early in the season, when prices are lower and fewer households have fallen into extreme deprivation.

1 Background

In addition to idiosyncratic and covariate shocks that are frequent and often unpredictable, Sahelian households have to deal with the variations in welfare induced by seasonality. The vast majority of the Sahel's population is exposed to both 'covariate' shocks that hit all community

members at the same time (like droughts or floods) and 'idiosyncratic' shocks that affect only certain households (like ill health or injury). These shocks reduce households' present and future welfare, as they often resort to a variety of negative coping strategies in response.¹

Yet on top of these unpredictable shocks, livelihoods in the Sahel – most of which are in agriculture or pastoralism – also revolve around seasonal variation in rainfall, temperature, and other climatic conditions. Households have to endure a ‘lean season’ when output from the agricultural cycle may be low or herds may be lacking pasture (for further information on seasonality, see Annex 1). Such seasonality occurs every year, but when the timing or level of rainfall or temperature change significantly from regular patterns, that may constitute a shock. Poverty is already widespread in the Sahel so understanding the impact of seasonality and developing Adaptive Social Protection (ASP) systems that respond to unpredictable shocks and seasonality is crucial.

New household survey data can illustrate Sahelian households’ susceptibility to seasonality in more detail, guiding how ASP systems can jointly address chronic poverty, seasonal swings in welfare, and unexpected shocks. This brief draws on the ‘Enquête Harmonisée sur les Conditions de Vie des Ménages’ (EHCVM), which collected harmonized data from Burkina Faso, Mali, Niger, Senegal, and Chad during two distinct ‘waves’ throughout

2018 and 2019. These waves correspond approximately to the lean and non-lean season in Burkina Faso, Mali, Niger, and Senegal, so comparing them reveals the impact of seasonality in those countries; in Chad this is not the case so the sections of the report making cross-season comparisons will not include Chad (for a full discussion of the methodology, see Annex 2). The 2018 rainy season, which would determine the extent of the 2019 lean season, was regarded as ‘above average’ in terms of the timing and reliability of rainfall, making it possible to isolate the additional impact of ‘regular’ seasonality over and above the effects of unpredictable shocks.^{2,3}

The brief answers three questions. First, the brief examines households’ susceptibility to seasonality, in terms of the managing and coping strategies they choose. Second, the brief assesses the overall seasonal differences in consumption, food security, and subjective poverty, to ascertain how much seasonality matters. Third, the brief considers which types of households suffer the largest lean-season losses, to help identify who should be targeted for future ASP programs.

2 Sahelian households are vulnerable to the effects of seasonality

Sahelian households have limited options to manage and cope with the negative impacts of shocks and seasonality. The literature identifies five main risk-mitigating strategies against shocks.

First, households with *diversified livelihoods and non-agricultural income sources* may be less exposed to the effects of shocks and seasonality.⁴ Second, households may *borrow* in seasons when incomes or own production are reduced, but such strategies will be more tenable for those with better access to financial markets.⁵ Third, households can *save, store output, or accumulate assets during surplus seasons*, which can then be sold or consumed when needed.^{6,7} Fourth, certain households may have access to *informal insurance* whereby communities pool risks and

provide support to those in need.⁸ Fifth, *government policy* – and, in particular, access to social protection – influences the income on which households can draw.⁹

As this section demonstrates, access to these strategies for managing and coping with shocks and seasonality is limited for Sahelian households. This also aligns with evidence from Brunelin, Ouedraogo, and Tandon (2020) – also using EHCVM data – which shows that Sahelian households frequently adopt negative coping strategies in response to covariate or idiosyncratic shocks, including reducing spending on food, education, and health care.

2.1

Households rely primarily on agriculture and their income sources are not well diversified, especially in rural areas

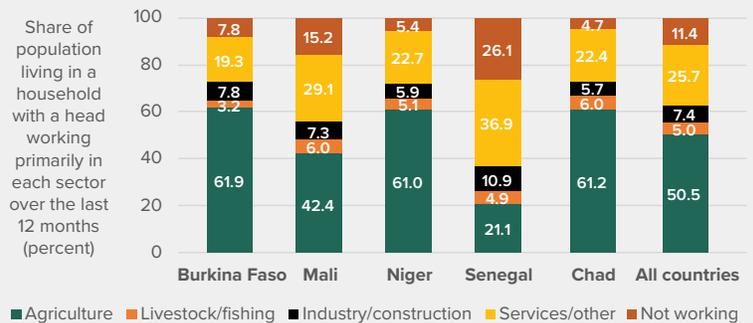
Sahelian households depend mainly on rainfed agriculture, which is especially exposed to the effects of seasonality. In the absence of widespread irrigation systems, agriculture in the Sahel is mainly rainfed, so yearly swings in temperature and rainfall are crucial for determining output (see Annex 1 for further details). Taking Burkina Faso, Mali, Niger, Senegal, and Chad as a whole, 50.5 percent of the population live in a household where the head's primary sector of work was agriculture. A further 5.0 percent of the population live in a household where the head worked primarily in raising animals or fishing during the previous 12 months (*Figure 1*).

Yet there is substantial variation between the five countries. The share of households where the head works primarily in agriculture or in livestock or fishing is around two-thirds in Burkina Faso, Mali, and Chad, with Senegal having a much smaller share (around one quarter) of the population living in such households.

Sahelian households' reliance on agriculture is confirmed by observing the types of jobs in which household heads – and other household members – engaged during the previous seven days. Across the five countries, the majority (52.8 percent) of households had a head engaged in farming in the previous seven days (*see Panel A of Figure 2*). Around 27.6 percent of households had a head engaged in non-farm household enterprise work and 13.4 percent had a head engaged in wage-employment. Once again, Senegal is the exception, where household heads were more widely engaged in non-farm enterprise work than in farming in the previous seven days. Similar patterns emerge when considering whether any member of the household had engaged in farming, non-farm enterprise work, or wage work in the previous seven days (*see Panel B of Figure 2*).

FIGURE 1.

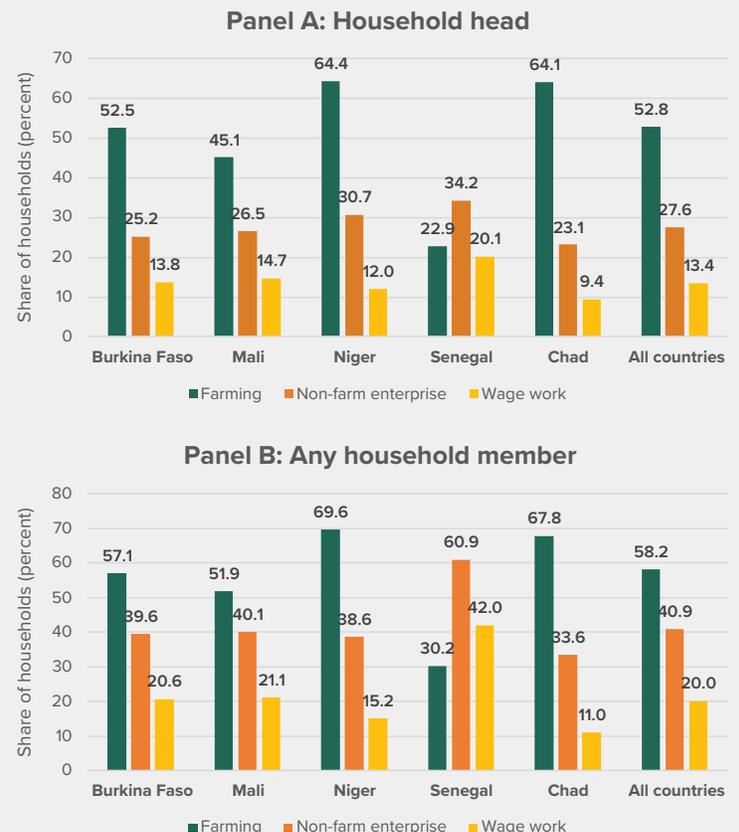
Share of the population living in households where the head is primarily engaged in different employment sectors over the last 12 months by country (percent)



Note: Individual-level sampling weights applied. Primary occupation is the one in which the household head spent the most time working in the previous 12 months. Source: EHCVM and World Bank estimates.

FIGURE 2.

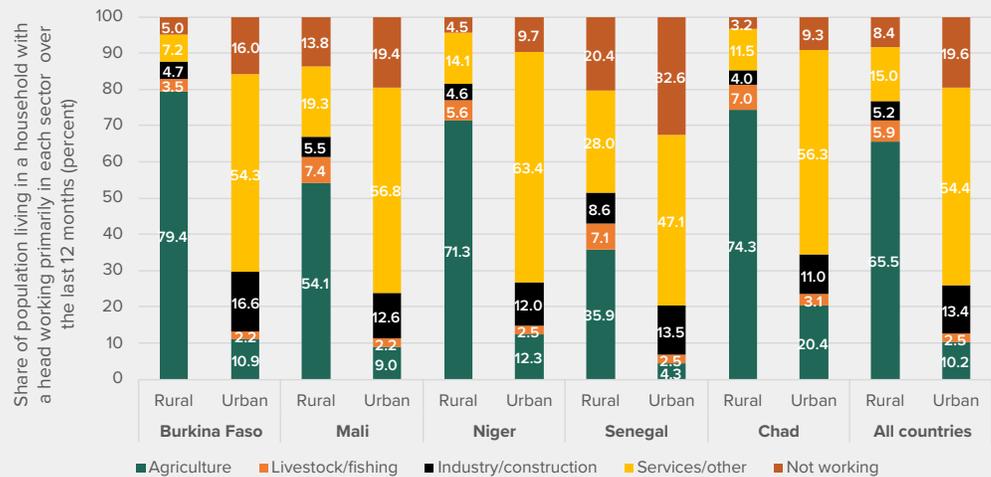
Share of households in which the head or any member engaged in farming, non-farm enterprise work, or wage work in previous seven days, by country



Note: Household-level sampling weights applied. Source: EHCVM and World Bank estimates.

FIGURE 3.
Share of the population living in households where the head is primarily engaged in different employment sectors, by country and urban-rural

Note: Individual-level sampling weights applied. Primary occupation is the one in which the household head spent the most time working in the previous 12 months. Source: EHCVM and World Bank estimates.

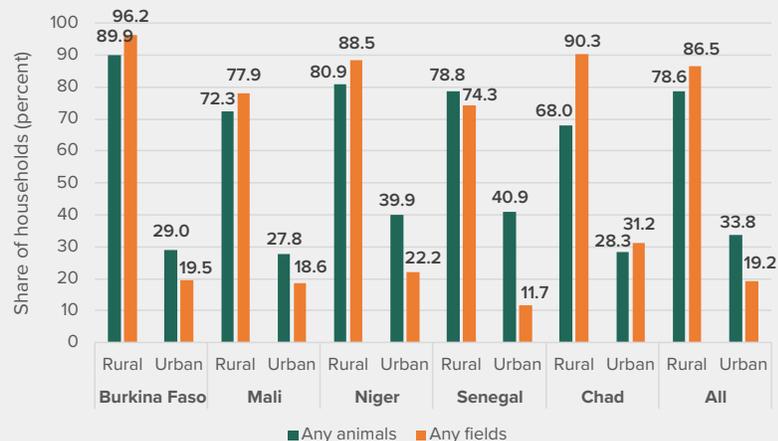


Rural areas are far more dependent on agriculture and less dependent on services and industry than urban areas. Pooling the five countries, 65.5 percent of the rural population lived in a household where the head worked primarily in agriculture in the previous 12 months compared with 10.2 percent of the urban population (*Figure 3*).¹⁰ Conversely,

around 15.0 percent of the rural population lived a household where the head worked in services, compared with 54.4 percent of the urban population. Insofar as agriculture is more exposed to seasonality, this would suggest that rural households are the most vulnerable.

FIGURE 4.
Share of households owning animals and cultivating fields, by country and urban-rural

Note: Household-level sampling weights applied. 'Any animals' measured at the time of the interview. 'Any fields' refers to whether fields were cultivated in the previous agricultural season. Source: EHCVM and World Bank estimates.

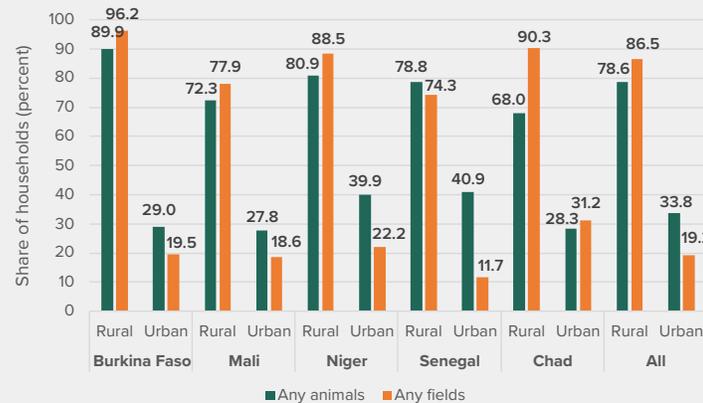


Looking beyond the household head alone, cultivating fields for agriculture and owning livestock are widespread, especially in rural areas. Pooling all five countries, 86.5 percent of rural households had cultivated fields in the previous agricultural season compared with 19.2 percent of urban households (*Figure 4*). Additionally, around 78.6 percent of rural households owned animals (of any kind)

compared with 33.8 percent of urban households. Thus, while agricultural and livestock-oriented activities are clearly concentrated in rural areas, they are not totally absent from urban areas, potentially exposing at least some households in or near towns and cities more directly to the effects of seasonality.

FIGURE 5.
Diversification of household employment sectors, by country and urban-rural

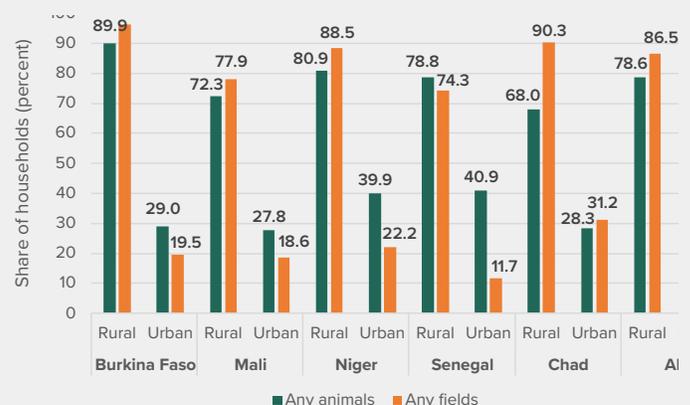
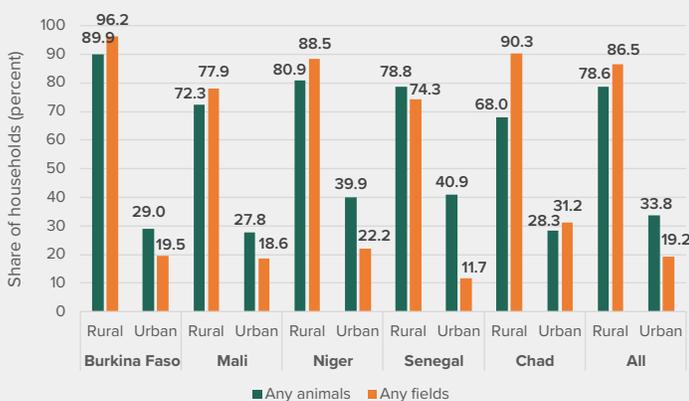
Note: Household-level sampling weights applied. Only working-age household members (those aged 15-64 years or more) that reported being employed or in unpaid family work in the previous 12 months used to assess the sectoral diversification of the household. Households without any working members coded as zero for number of sectors. Source: EHCVM and World Bank estimates.



Households' income sources are not especially well diversified among their members. Diversifying the types of employment in which households engage – by having different household members work in different sectors – provides a potential mechanism for managing or coping with the effects of seasonality. Yet only a little under half of households (46.8 percent) had any working-age¹¹ household members primarily working outside of agriculture or livestock/fishing in the previous 12 months, with households engaging in 1.5 different sectors on average (*Figure 5*). Senegal is once again an exception, where 78.4 percent of households had one member working primarily outside of agriculture or livestock/fishing in the previous 12 months. Additionally, urban households have a much more diversified portfolio of income-generating activities than rural households.

Among those households engaged in agriculture, diversification of the crop portfolio is low. Crop diversification can be measured using the agricultural module of the EHCVM by simply counting the number of types of crops that households cultivate as the primary crop in each of their plots.¹² This measure can be refined by also constructing a special 'crop diversification index', which takes into account the share of household land that is devoted to each type of crop.¹³ Taking Burkina Faso, Mali, Senegal, and Chad together, agricultural households cultivate just over two crops on average (*Panel A of Figure 6*). Additionally, looking at the specific types of crops households cultivate, more than half of agricultural households (55.1 percent) only cultivated food crops (defined as millet, sorghum, maize, or groundnuts) as the primary crop in each of their plots rather than cash crops (defined as all other crops, *Panel B of Figure 6*).¹⁴

FIGURE 6. Diversification of the crop portfolio in the previous agricultural season, by country



Note: Household-level sampling weights applied. Niger excluded due to differences in the way that plot-level information was captured. Sample focused only on households cultivating at least one crop in the previous agricultural season. Crop diversification index calculated as one minus the Herfindahl index for concentration in the crop portfolio. Millet, sorghum, maize, and groundnuts classed as food crops; all other crops classed as cash crops. Source: EHCVM and World Bank estimates.

2.2

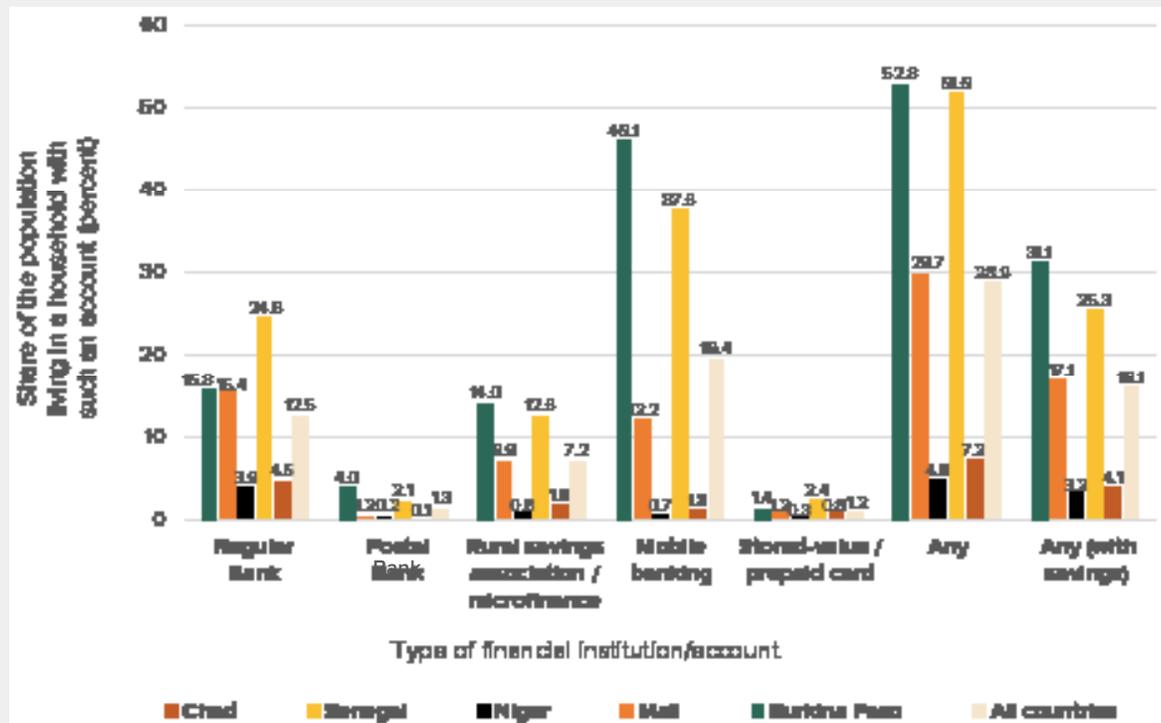
Relatively few Sahelian households have access to savings, and neither borrowing nor selling assets are widely used as coping mechanisms

Penetration of financial institutions is generally low, and most households do not hold savings, although there is sizeable variation between the five EHCVM countries.

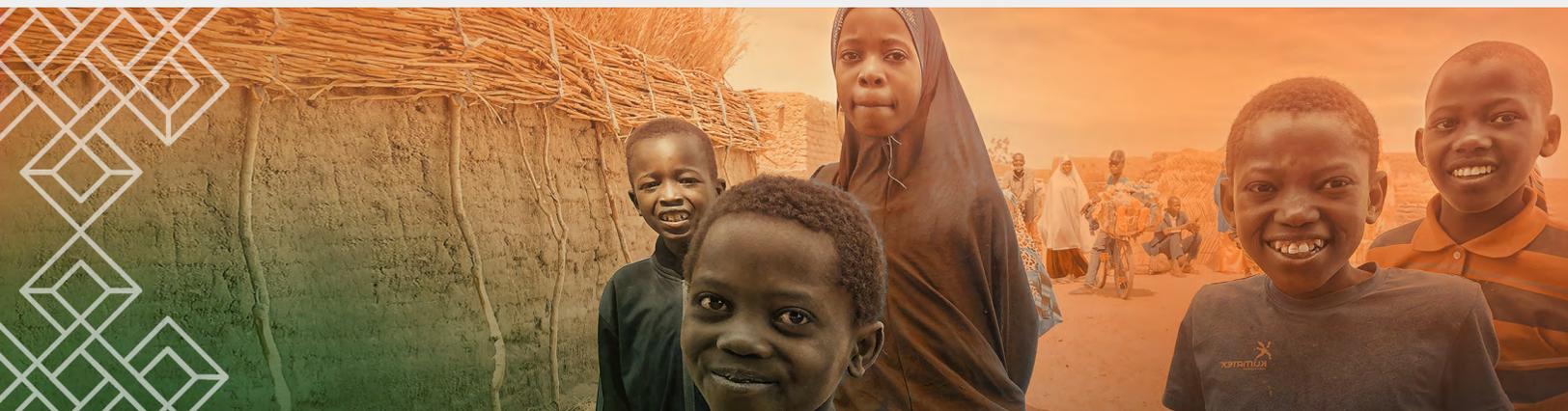
Access to financial markets may help households cope with the effects of seasonality through credit or insurance products, while savings may enable households to smooth any losses in consumption that arise in the lean season. Taking Burkina Faso, Mali, Niger, Senegal, and Chad together, around 28.9 percent of the population live in a household in which any member held an account with a financial institution, and

just 16.1 percent of the population live in a household in which any member actually held savings (*Figure 7*).¹⁵ Nevertheless, financial inclusion differs significantly between the five countries, with more than half of the population of Burkina Faso and Senegal living in a household where someone holds an account compared to less than 1 in 10 in Niger and Chad. This higher financial inclusion in Burkina Faso and Senegal seems to be driven largely by the penetration of mobile banking, the most prevalent form of account in the two countries.

FIGURE 7.
Share of the population with access to financial institutions and savings, by country



Note: Individual-level sampling weights applied. Statistics capture whether any household member had an account or had savings. Source: EHCVM and World Bank estimates.



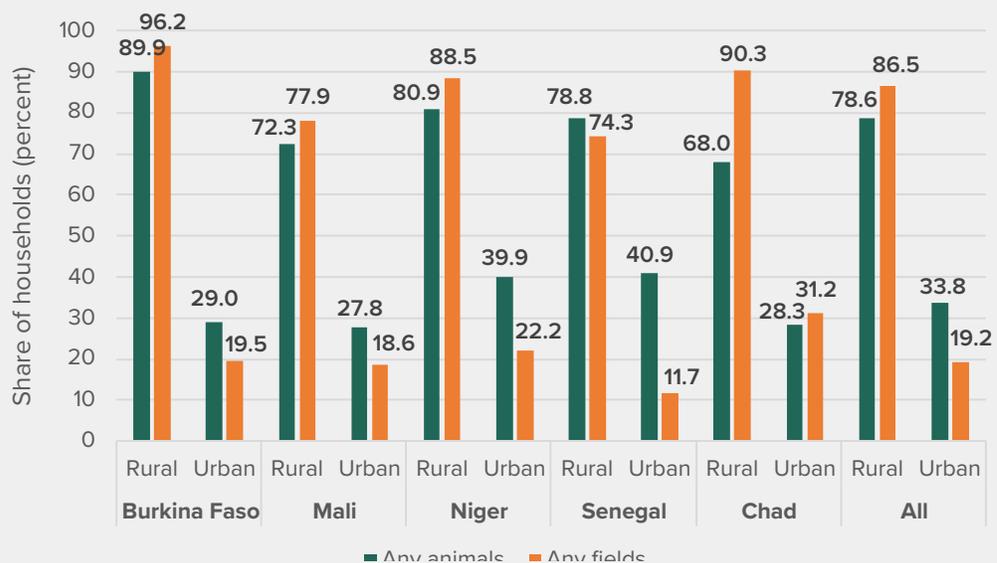
Mobile phones are more prevalent in Burkina Faso, Mali, and Senegal than in Niger and Chad; this influences the possible mechanisms for promoting financial inclusion and distributing government assistance. In Burkina Faso, Mali, and Senegal, around 95.3 percent, 93.7 percent, and 98.8 percent of households owned at least one mobile phone respectively (*Figure 8*). This may partially explain why those three countries – especially Burkina Faso and Senegal – have higher levels of mobile banking. In Niger and Chad, however, only around 72.7 percent and 64.4 percent of households owned mobile phones, meaning that large swathes of the population do not have access to the mobile network, especially in rural areas. This not only constrains mobile banking, but it may also determine the methods that governments can use to inform, register, and then pay people through social protection programs.

Households do not appear to take out loans to try to cope with the lean season. Across all five EHCVM countries, around 16.2 percent of household had outstanding loans at the time of the survey. Looking at the dates that households took out their last loans does not reveal any clear seasonal patterns in extending credit.

There is no clear evidence that households are able to sell livestock in response to seasonality. Despite the hypothesis that households may use sales of livestock as a buffer to insulate against losses induced by shocks or seasonality, existing evidence from both the Sahel and other countries suggests that this mechanism is not frequently observed in practice.¹⁶ In-keeping with this, in the EHCVM data, the number of animals that households own in fact appears to be very slightly higher in the wave corresponding to the lean season, taking Burkina Faso, Mali, Niger, and Senegal together.

FIGURE 8.
Share of households that own at least one mobile phone, by country and urban-rural

Note: Household-level sampling weights applied.
Source: EHCVM and World Bank estimates.

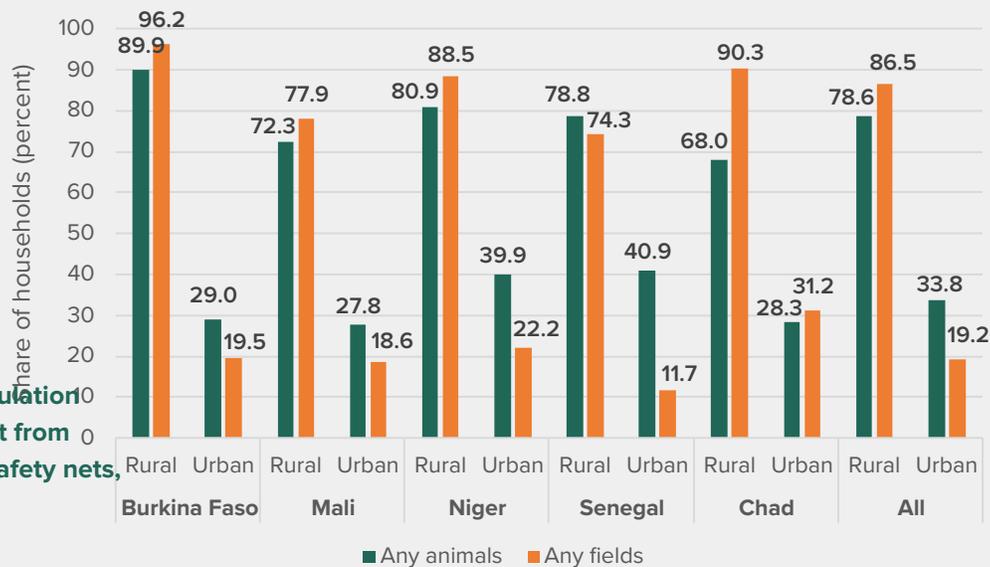


2.3 Receipts of food and cash transfers are limited

Few households receive food or cash transfers, although in-kind benefits are more widespread. Distribution of food, cash, or in-kind benefits may further help to smooth consumption between the lean and non-lean season. Around 10.5 percent of Sahelians live in a household that received food during the previous 12 months, and 3.6 percent live in

a household receiving cash transfers (**Figure 9**). Yet a much larger share of the population receives in-kind support in the form of care for children under 5 and bed nets. These in-kind benefits may help boost longer-term efforts to build human capital, but they will not necessarily support households in coping with short-term shocks and seasonality.

FIGURE 9.
Share of the population receiving support from different social safety nets, by country



Note: Individual-level sampling weights applied. Statistics capture whether any household member received that type of support during the previous 12 months. Source: EHCVM and World Bank estimates.

3 Seasonality strongly influences Sahelian households' welfare

Since households' ability to manage and cope with seasonality is limited, deprivation looms in the lean season. Overall monetary consumption drops significantly between the non-lean and lean season, enough to push vulnerable households below the poverty line. Yet

specifically, it is consumption of key staple food items that is reduced, threatening households' food security. It is therefore unsurprising that households also self-report lower wellbeing – through subjective poverty measures – during the lean season.

3.1

Monetary consumption is lower and monetary poverty is higher in the lean season

Poverty is substantially higher in the lean than in the non-lean season in the Sahel. The share of the population living below the national poverty line in the wave of the EHCVM survey corresponding to the lean season was 13.7 percentage points higher in Burkina Faso, 6.6 percentage points higher in Niger, and 8.1 percentage points higher in Senegal compared to the wave corresponding to the non-lean season (*Figure 10*).¹⁷ This has potentially severe implications given that monetary poverty in the region is already high.¹⁸

This increase in poverty arises because overall monetary consumption is significantly lower in the lean season. Pooling the data from Burkina Faso, Niger, and Senegal, it appears that mean real monetary consumption is 9.5 percent lower in the lean season wave than in the non-lean season wave;

a difference of about 0.35 USD 2011 PPP per person per day (*Figure 11*). Even relatively small seasonal differences in average consumption can result in large swings in poverty, if average consumption is low and many households are only just above the poverty line (which is especially true in Niger). These results are based on a measure of consumption that has been adjusted to account for the different prices that households interviewed in different locations or at different times may have faced; that is, the consumption aggregate was spatially and temporally deflated. Yet similar results persist even if an unadjusted (or nominal) measure of consumption is used instead. This means the results are not driven solely by these price adjustments. This, in turn, reinforces the idea that seasonality brings about large swings in household welfare.

FIGURE 10.
Difference in share of the population living below the national poverty line between the lean season and non-lean season waves

Note: Chad excluded from the analysis as waves do not match the lean and non-lean season. Mali excluded from the analysis due to limitations on the consumption data. Individual sampling weights applied. Consumption deflated and adjusted for comparison with national poverty line in each country. Seasonal differences are statistically significant at the 5 percent level in a Linear Probability Model, which includes controls for household characteristics and region fixed effects. Source: EHCVM and World Bank estimates.

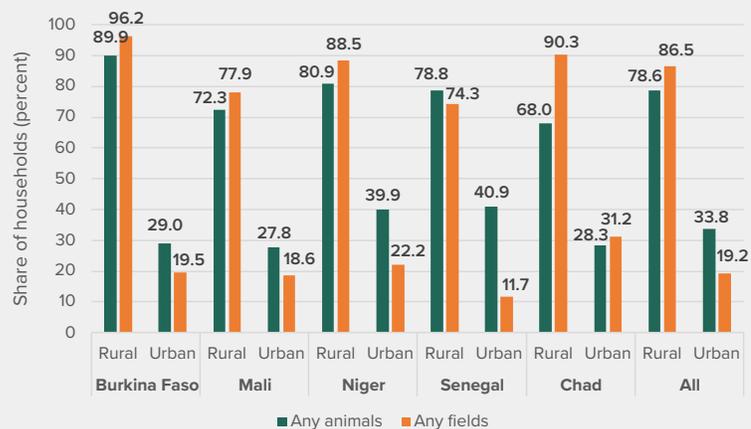
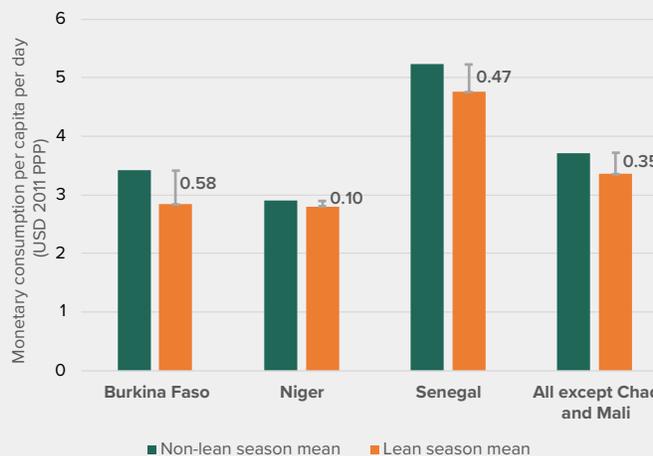


FIGURE 11.
Difference in total monetary consumption per capita between the lean season and non-lean season waves

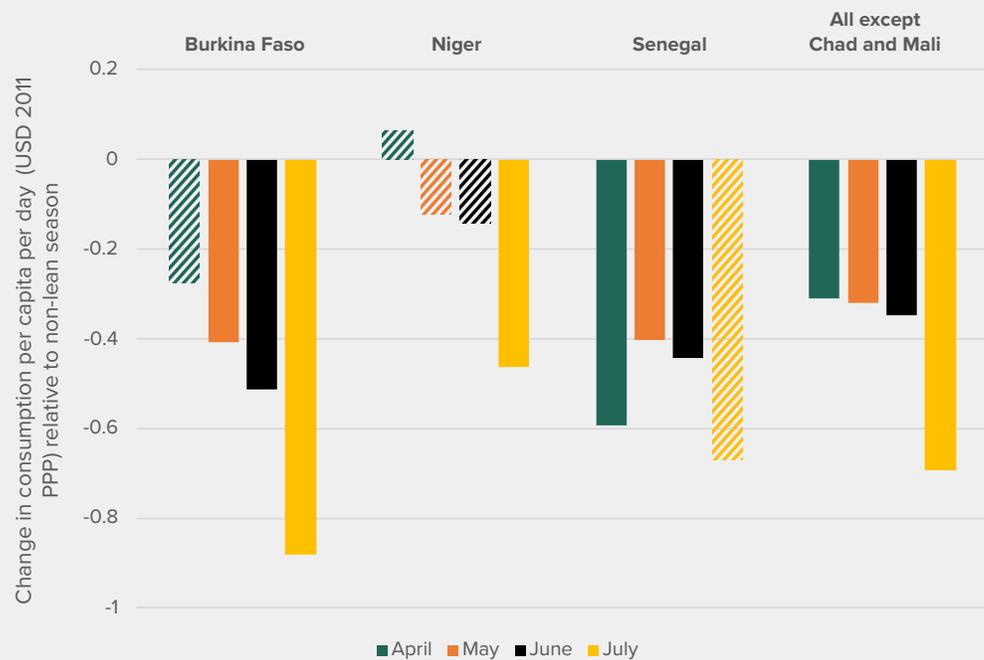
Note: Chad excluded from the analysis as waves do not match the lean and non-lean season. Mali excluded from the analysis due to limitations on the consumption data. Individual sampling weights applied. Consumption deflated and adjusted to per capita per day USD 2011 PPP terms. All seasonal differences are statistically significant at the 5 percent level in a log-linear regression, which includes controls for household characteristics and region fixed effects. Source: EHCVM and World Bank estimates.



If anything, these results may understate the effects of seasonality on welfare, given the timing of EHCVM data collection. In Burkina Faso, Mali, Niger, and Senegal, the interviews for the lean season wave largely took place between April 2019 and July 2019: this aligns well with the pastoral lean season, but the agricultural lean season normally continues until September or October, so its full effects may not be captured. This is corroborated by month-by-month

analysis, especially from Burkina Faso and Niger, which suggests that the welfare impacts of seasonality became more severe between April 2019 and July 2019 (Figure 12).¹⁹ The month-by-month results also show little indication that May – the month in which Ramadan predominantly took place and where an uptick in consumption may be anticipated – displayed unique patterns for overall consumption compared with the other months of the lean season.

FIGURE 12.
Regression results showing the difference in total monetary consumption per capita between the non-lean season and different months in the lean season



Note: Chad excluded from the analysis as waves do not match the lean and non-lean season. Mali excluded from the analysis due to limitations on the consumption data. Individual-level sampling weights applied. All results significant at the 5 percent level, except for patterned bars. The non-lean season is the excluded category. Specifications run with consumption in USD 2011 PPP per person per day as the dependent variable and have as regressors the gender, age, and education level of the household head, household size, the dependency ratio, household walls material, household roof material, household floor material, access to electricity, access to improved drinking water, and access to improved sanitation as well as region fixed effects. Standard errors are clustered at the 'grappe' level. Source: EHCVM and World Bank estimates.

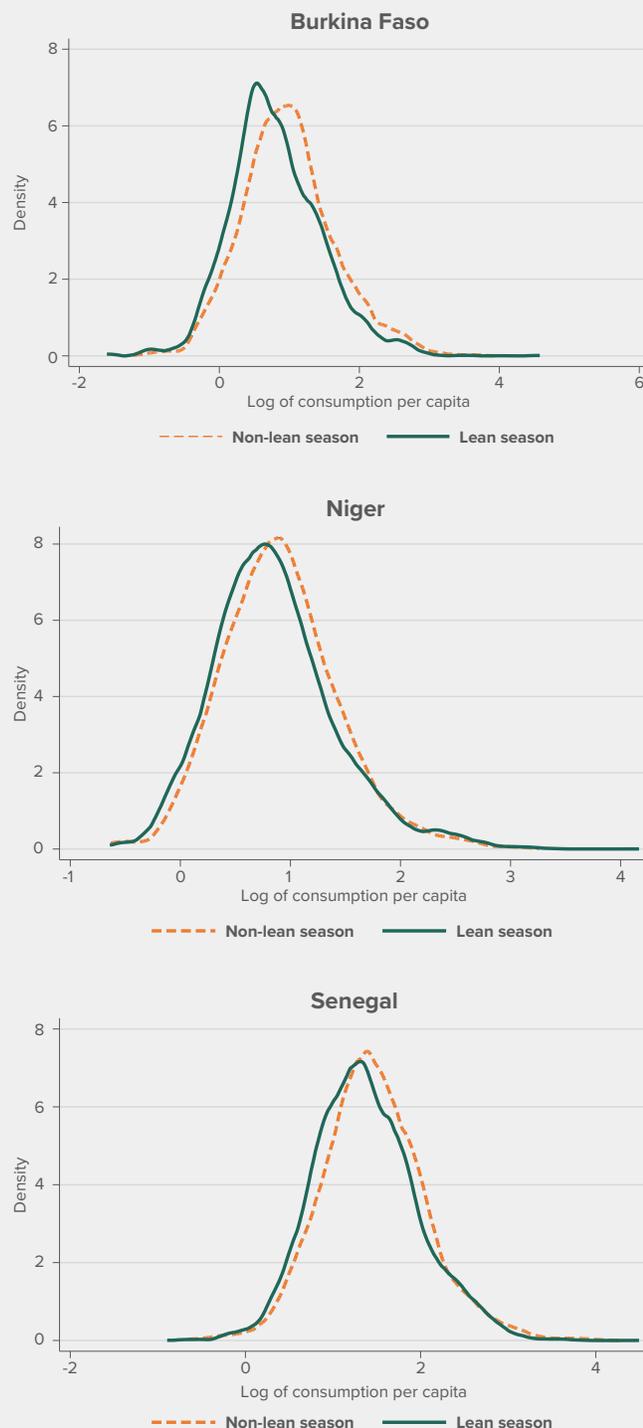
Overall monetary consumption is lower in the lean season wave across virtually the entire consumption distribution.

Indeed, looking at the probability density functions for the log of consumption in the lean season wave and in the non-lean season wave for Burkina Faso, Niger, and Senegal, it is only around the 90th percentile that the two distributions start to converge (*Figure 13*). This suggests that exposure to the effects of the lean season is widespread and is not only a phenomenon concentrated around the mean or among those households just above the poverty line.



FIGURE 13.

Kernel density charts showing the difference in total monetary consumption per capita between the lean season and non-lean season waves across the full consumption distribution



Note: Epanechnikov kernel density function used. Bandwidth set to 0.1. Chad excluded from the analysis as waves do not match the lean and non-lean season. Mali excluded from the analysis due to limitations on the consumption data. Individual-level sampling weights applied. Source: EHCVM and World Bank estimates.

3.2

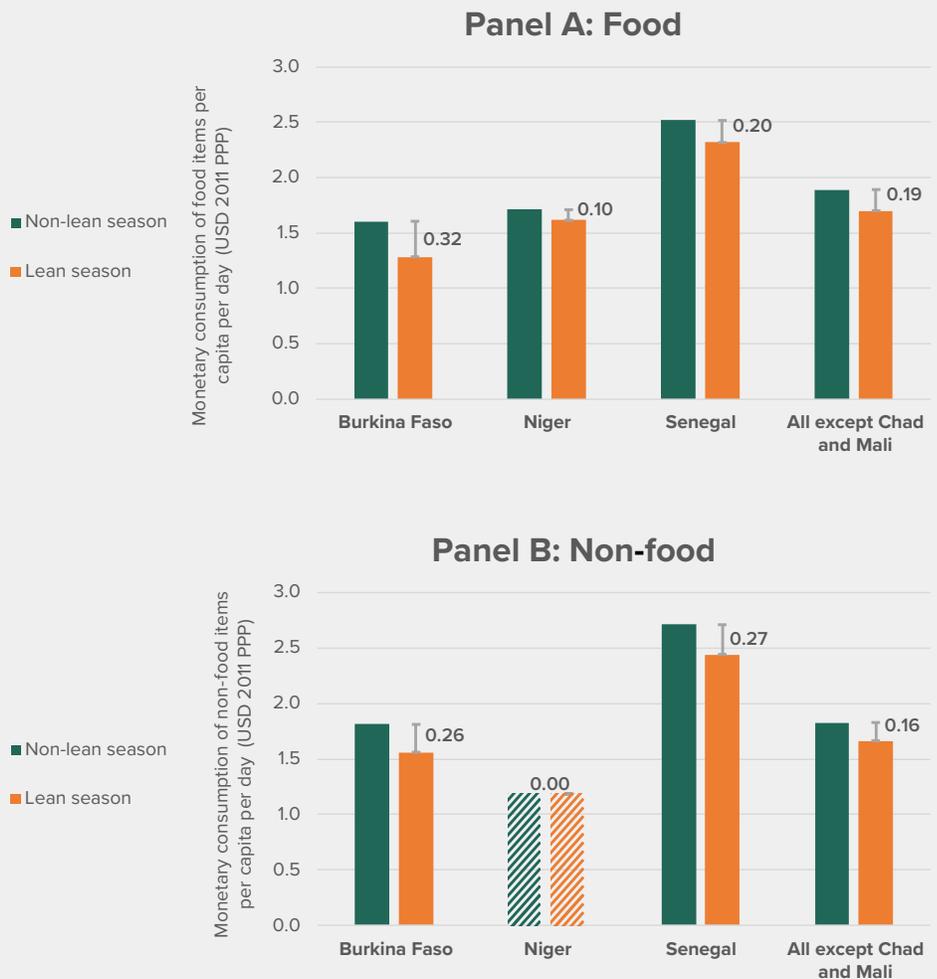
Consumption of key staple food items drops in the lean season, a phenomenon consistent with more extreme deprivation

Seasonal differences are slightly larger for food consumption than non-food consumption, although this is partly an artifact of the data collection approach.

Taking Burkina Faso, Niger, and Senegal together, food consumption in the lean season wave was 10.1 percent lower (about 0.19 USD 2011 PPP per person per day) while non-food consumption was 9.0 percent lower (about 0.16 USD 2011 PPP per person per day) than in the non-lean season (*Figure 14*). This difference between food and non-food consumption may, however, reflect the recall periods on which the EHCVM

questionnaires focus: the consumption of food items was generally recorded for the previous seven days, while non-food items were recorded for the previous seven days, 30 days, 3 months, 6 months, and 12 months, which may be less sensitive to seasonal swings. Nevertheless, even when the analysis is restricted to non-food items for which the recall period was 3 months or less, the differences in consumption between the lean and non-lean season waves are not as large for non-food items as for food items.

FIGURE 14.
Difference in food and non-food consumption per capita between the lean season and non-lean season waves

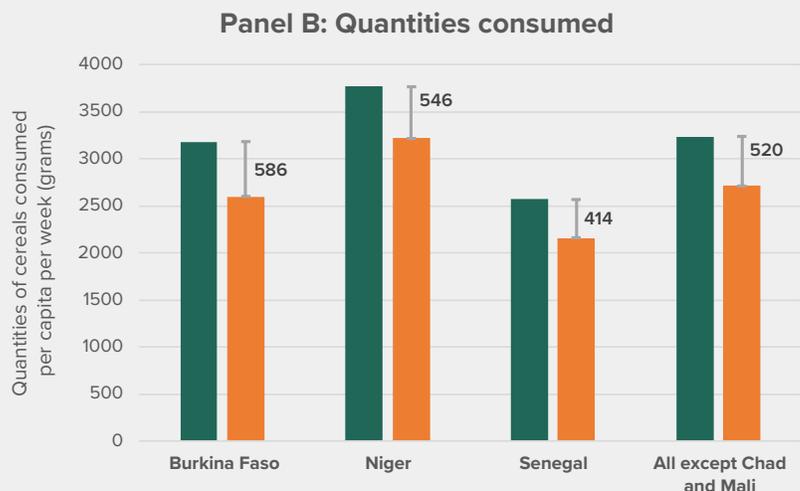
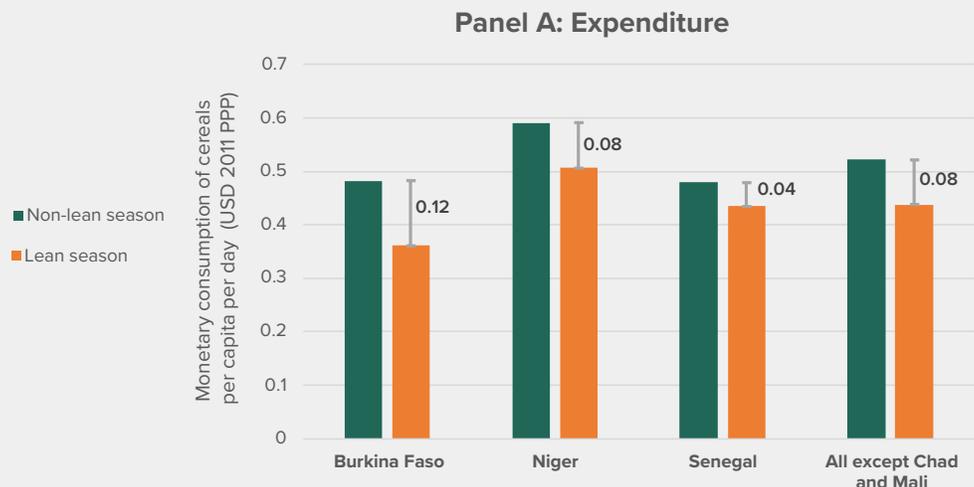


The lean season drop in food consumption is consistent with more extreme forms of deprivation, so seasonality puts Sahelian households at risk of food insecurity.

While dietary diversity²⁰ did not decline between the non-lean season and the lean season, both expenditure and quantities consumed of staple foods appeared to be significantly lower in the lean season wave (*Figure 15*). As such, any decrease in the quantity of food items is not likely to come from price changes alone, especially as food prices normally start rising soon after harvest. Suggestive month-by-month results indicate that dietary diversity may in fact

have improved slightly in May, the month in which Ramadan predominantly took place, but expenditure and quantities consumed of staple foods were lower for all four months in the lean season wave.²¹ These season-to-season changes in consumption do not match the more ‘typical’ ways in which households would cope with price and income shocks, whereby consumption of more expensive or nutritious food would be reduced but consumption of staple foods would be maintained. Instead, households are cutting the consumption of the most fundamental food items in their consumption basket.

FIGURE 15.
Difference in expenditure on cereals and quantities of cereals consumed between the lean and non-lean season waves



Note: Chad excluded from the analysis as waves do not match the lean and non-lean season. Mali excluded from the analysis due to limitations on the consumption data. Individual sampling weights applied. Cereal food items comprise raw cereals (including rice, sorghum, millet, maize, and wheat) as well as pasta, bread, croissants, and other similar baked products. Consumption deflated and adjusted to per capita per day USD 2011 PPP terms. All seasonal differences are statistically significant at the 5 percent level in a log-linear regression, which includes controls for household characteristics and region fixed effects. Source: EHCVM and World Bank estimates.

3.3

Subjective measures confirm that households themselves perceive the deprivation they face in the lean season

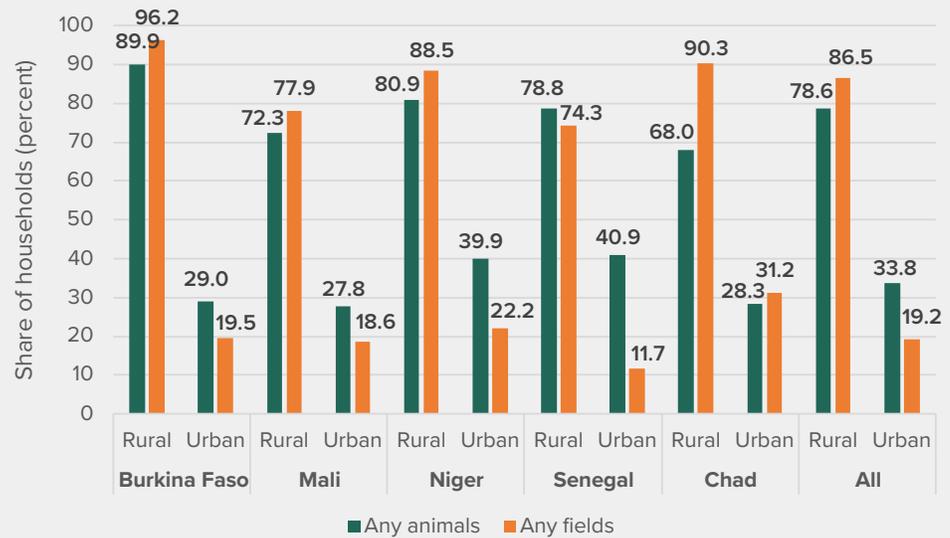
Subjective poverty is also higher in the wave corresponding to the lean season, at least for Mali, Niger, and Senegal.

In particular, when respondents were asked to classify their households on a scale of wellbeing from very poor to very rich, the share of the population living in households describing themselves as either poor or very poor was 6.2 percentage points higher in the lean season wave in Mali, 5.6 percentage points higher in Niger, and 5.6 percentage

points higher in Senegal (Figure 16). Qualitatively similar results were observed for these three countries when respondents were asked to assess how they thought they lived, on a scale from difficultly to well. It therefore appears that there are differences between the lean and non-lean season in terms of how households perceive their wellbeing, which corroborate the observed differences in monetary consumption and poverty.

FIGURE 16.
Difference in subjective poverty between the lean season and non-lean season waves

Note: Chad excluded from the analysis as waves do not match the lean and non-lean season. Individual sampling weights applied. Subjectively poor are those classing their wellbeing as poor or very poor. Seasonal differences are statistically significant at the 5 percent level in a Linear Probability Model, which includes controls for household characteristics and region fixed effects for hard bars, but not for patterned bars. Source: EHCVM and World Bank estimates.



4 The impacts of seasonality are not uniform across all Sahelian households

Agricultural households in rural areas are the most affected by seasonality, but even those reliant on non-agricultural sources of income are vulnerable to seasonal swings in welfare. First, it appears that households use non-farm enterprise work as a coping mechanism during the lean season, but such opportunities are not available for everyone.

Second, the drop in consumption between the non-lean season and the lean season is larger for households in rural areas and those that cultivate crops. Third, many households where the head works primarily outside of agriculture appear to suffer lean season welfare losses.

4.1

Non-agricultural activities provide a mechanism for coping with seasonality, but these are not open to all households

Sahelian households are more likely to engage in non-farm enterprise activities in the wave corresponding to the lean season. Pooling the data for Burkina Faso, Mali, Niger, and Senegal, it appears that the household head was around 3.6 percentage points more likely to engage in non-farm enterprise work in the lean season wave (*Panel A of Figure 17*). Households were also 3.6 percentage points more likely to have any member engaging in such work (see *Panel B of Figure 17*). These estimates cover both

primary and secondary activities, as household members were able to report separately whether they worked in wage-employment, farming, non-farm enterprises, or as an apprentice in the seven days prior to the interview. The effects were largest in Senegal, where non-farm enterprise activities are the most widespread. In the other EHCVM countries, the option to adopt these types of short-term coping strategies to diversify income may be more constrained, especially in rural areas.

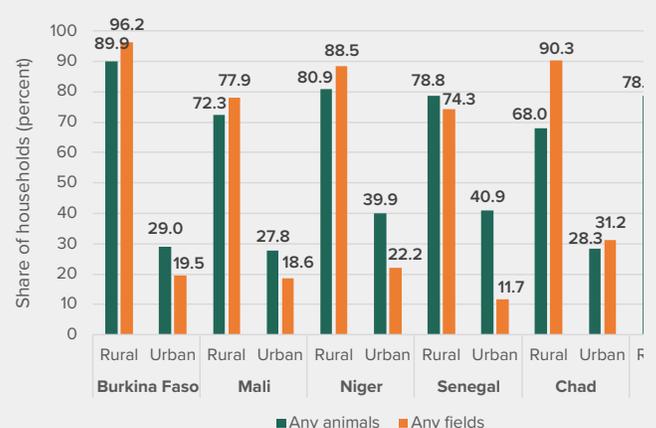
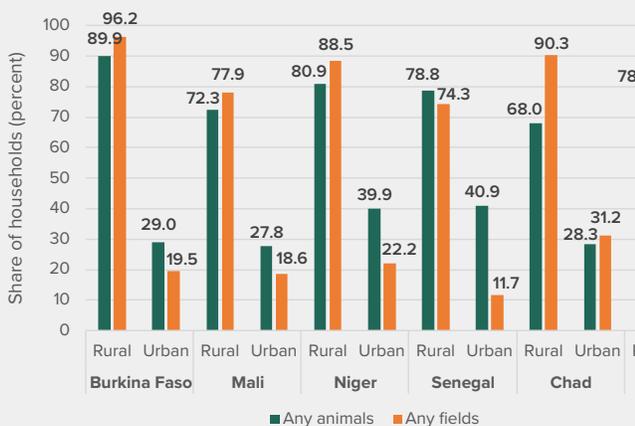


FIGURE 17.
Difference in the share of household heads or any household members engaged in non-farm enterprise activities between the lean season and non-lean season waves in the last seven days

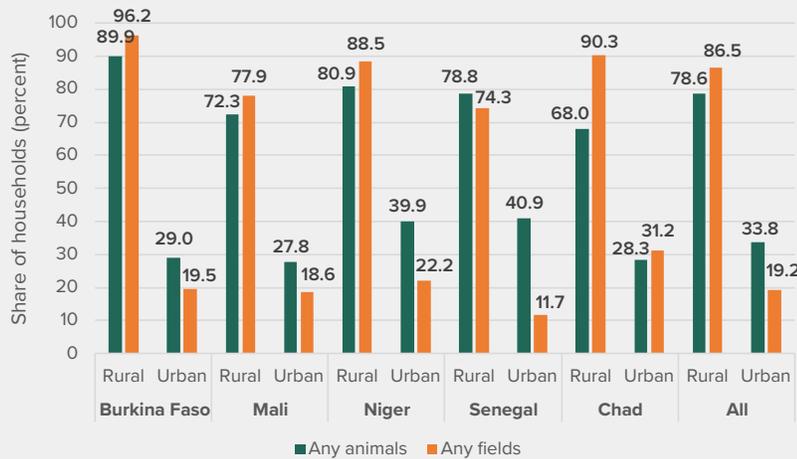
Note: Chad excluded from the analysis as waves do not match the lean and non-lean season. Individual sampling weights applied. Recall period covers activities undertaken in the previous 7 days. Seasonal differences are statistically significant at the 5 percent level in a Linear Probability Model, which includes controls for household characteristics and region fixed effects for hard bars, but not for patterned bars. Source: EHCVM and World Bank estimates.

4.2 Rural, agricultural households were most affected by seasonality

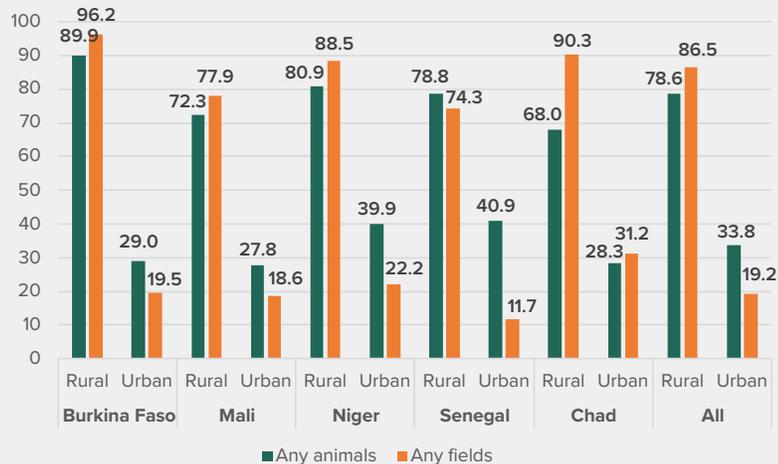
Seasonal changes in welfare are mainly concentrated in rural areas in the Sahel.²² Simply looking at the absolute differences in monetary consumption between the lean season wave and the non-lean season wave suggests, on the face of it, that seasonal swings are quite similar in rural and urban areas (see *Panel A of Figure 18*), but this is misleading for three main reasons. First, the base level of consumption was higher in urban areas than in rural areas, so in percentage terms, lean season losses in urban areas were lower on average than in rural areas (see *Panel B of Figure 18*). The only exception is Senegal, the

country with the largest urban population. Second, there are important cross-country differences: in particular, for urban households in Niger, consumption was if anything higher in the lean season wave than in the non-lean season wave. Third, when the differences between the two waves are tested formally using a series of log-linear regressions, the seasonal difference for urban areas is only statistically significant at the 5 percent level for Senegal, and it is *not* statistically significant at the 5 percent level for Burkina Faso, or Niger, or the pooled sample of Burkina Faso, Niger, and Senegal.²³

FIGURE 18.
Difference in total monetary consumption per capita between the lean season and non-lean season waves, split by urban and rural households



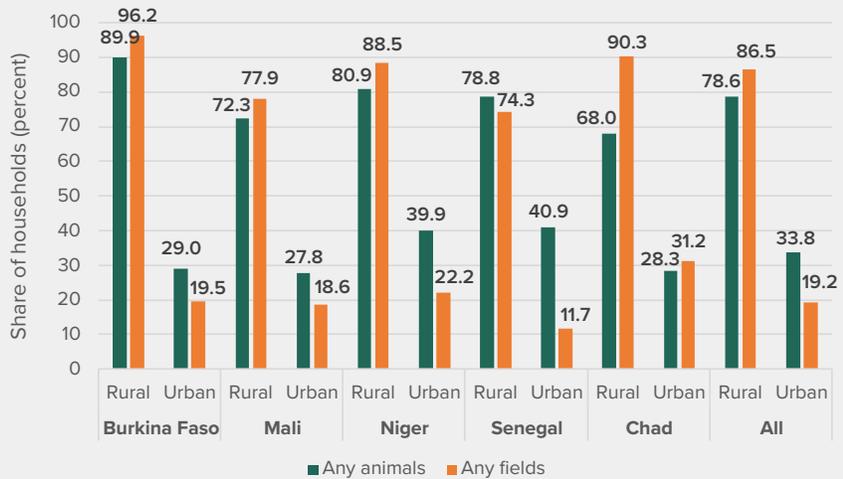
Note: Chad excluded from the analysis as waves do not match the lean and non-lean season. Mali excluded from the analysis due to limitations on the consumption data. Individual sampling weights applied. Consumption deflated and adjusted to per capita per day USD 2011 PPP terms. Grey bars represent absolute difference between lean and non-lean season in USD 2011 PPP terms. Seasonal differences are statistically significant at the 5 percent level in a log-linear regression, which includes controls for household characteristics and region fixed effects for hard bars, but not for patterned bars. Source: EHCVM and World Bank estimates.



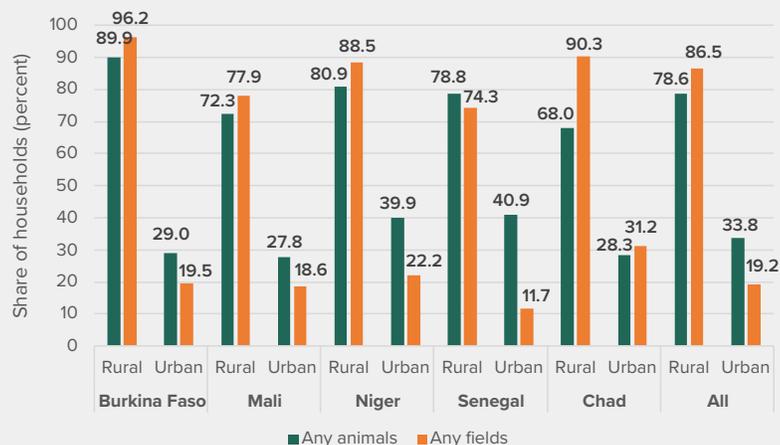
Within rural areas, seasonal swings in welfare are concentrated in the large share of households that cultivate crops; households avoiding agriculture entirely do not experience the same seasonal shifts in consumption. Pooling all rural households in Burkina Faso, Niger, and Senegal, those that cultivated fields in the previous agricultural season experienced a drop in absolute consumption (0.34 USD 2011 PPP per person per day) more than three times larger than those that did not cultivate fields (0.10 USD 2011 PPP per person per day, see *Panel A of Figure 19*).²⁴ Since households

cultivating fields generally had lower base consumption than those not cultivating fields, these difference in the seasonal changes in consumption were even larger in percentage terms (see *Panel B of Figure 19*). Moreover, when tested with a set of log-linear regressions, the seasonal differences for rural households that did not cultivate fields were not statistically significant at the 5 percent level, in any of the countries or in the pooled sample. Households that do not engage in any agriculture are much less exposed to the effects of seasonality.

FIGURE 19.
Difference in total monetary consumption per capita between the lean season and non-lean season waves for rural households, split by whether households cultivated fields in the previous agricultural season



Note: Chad excluded from the analysis as waves do not match the lean and non-lean season. Mali excluded from the analysis due to limitations on the consumption data. Sample restricted to rural areas only. Individual sampling weights applied. Consumption deflated and adjusted to per capita per day USD 2011 PPP terms. Grey bars represent absolute difference between lean and non-lean season in USD 2011 PPP terms. Seasonal differences are statistically significant at the 5 percent level in a log-linear regression, which includes controls for household characteristics and region fixed effects for hard bars, but not for patterned bars. Source: EHCVM and World Bank estimates.



4.3

Even households where the main income earners work outside of agriculture experience lean season welfare losses
Having a household head working outside of agriculture is no guarantee of avoiding the effects of seasonality.

Even if the household head engages primarily in non-agricultural work, they may have secondary activities linked to agriculture, while the household may have other members engaging in agriculture as their primary or secondary activity. Pooling the data for Burkina Faso, Niger, and Senegal, around 36.8 percent of households where the head primarily engages in industry or construction and around 26.1 percent where the head primarily engages in services cultivated

fields in the previous agricultural season. In Burkina Faso and Senegal, this means that consumption still drops in the lean season wave for households in which the head works primarily in industry and services (see *Figure 20*).²⁵ Niger is the exception to this pattern, where households with heads in industry and services did not experience a drop in consumption in the lean season, although this is expected given the urban-rural patterns observed in *Figure 18* coupled with the fact that industry and services are concentrated in urban areas.²⁶

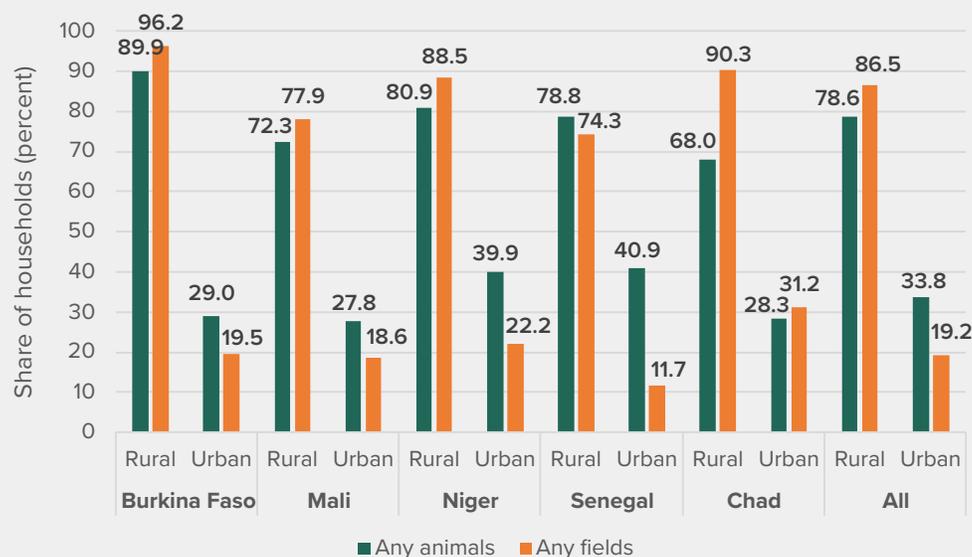


FIGURE 20.
Difference in total monetary consumption per capita between the lean season and non-lean season waves, split by the household head's primary occupation

Note: Chad excluded from the analysis as waves do not match the lean and non-lean season. Mali excluded from the analysis due to limitations on the consumption data. Individual sampling weights applied. Consumption deflated and adjusted to per capita per day USD 2011 PPP terms. Grey bars represent absolute difference between lean and non-lean season in USD 2011 PPP terms. Source: EHCVM and World Bank estimates.

5 Policy implications

Existing mechanisms to manage and cope with the effects of seasonality are limited, reinforcing the need for suitable ASP systems. Sahelian households are highly dependent on agricultural and pastoral activities, and there is little diversification of income sources or of the crop portfolio. Less than a third of the population live in a household where someone has an account with a financial institution, and saving rates are even lower; taking out loans does not seem to be a common feature of households' response to the lean season and existing coverage of cash transfers and food assistance is limited.

Households' welfare is substantially lower in the lean season, especially in rural areas and among agricultural households. Pooling data from Burkina Faso, Niger, and Senegal, overall monetary consumption is 0.35 USD 2011 PPP per person per day (about 9.5 percent) lower in the lean season, leaving many more households, especially in Burkina Faso and in Niger, in poverty. In rough terms, if households were compensated for these losses for the 90 days when the lean season were most severe, this would imply a per capita transfer each year of 31.50 USD. These seasonal swings in consumption are driven largely by reduced food consumption, especially of key staple foods, suggesting extreme forms of deprivation. The welfare effects also intensify as the lean season advances, with consumption generally being lower in July than in the 'pre-agricultural lean season' months of April and May.

Since the impacts of seasonality are large and can be anticipated, the coverage of regular safety net programs that help households cope should be broadened. Every year, considerable effort is dedicated to estimating the number of households that will be food insecure during the lean season. Annual response plans from both humanitarian agencies and governments are presented soon after the second cycle of the Harmonized Framework (or Cadre Harmonisé) in March. The number of food insecure households is significantly affected by unpredictable events such as conflicts or climate-related shocks. However, many households experience seasonal food insecurity that could be better tackled by providing regular cash transfers early in the season rather than through assistance during the lean season only.

Scaling-up regular safety net programs to address transient poverty and food insecurity would have at least two main benefits. First, responding earlier would be more efficient as households would be able to buy food more cheaply; during the lean season itself, food prices tend to be higher (see Figure 21 and Figure 22 in Annex 1). Second, responding earlier could reduce the overall number of households that need support. This could prevent major drops in food consumption, allowing households to plan their expenses and even make investments in other income-generating activities to better manage and cope with the effects of seasonality.

Adaptive social protection systems have the appropriate set of instruments to address seasonality alongside unexpected shocks and chronic poverty. Addressing chronic poverty, seasonality, and shocks in an integrated way requires the strengthening of ASP systems to enable them to cover the chronic poor, reach households facing seasonal food insecurity, and expand during crises. This hinges on the availability of regular resources – not just for extreme situations – on the strengthening of delivery mechanisms and the development of adaptive social registries so that chronically poor households as well as households in transitory need of assistance can be identified quickly.

Having access to cross-country microdata can substantially improve understanding of the effects of seasonality. This brief benefits enormously from the EHCVM, which not only harmonizes crucial information on welfare, employment, and household characteristics across Burkina Faso, Mali, Niger, Senegal, and Chad, but also collects data at two points in the year to allow for cross-season comparisons in Sahelian countries. Efforts to collect consistent and detailed microdata in the future, showing how welfare changes over time, will be crucial for guiding social protection and other policies, especially as countries aim to build back better after the COVID-19 crisis.

ANNEX I: SEASONALITY IN THE SAHEL

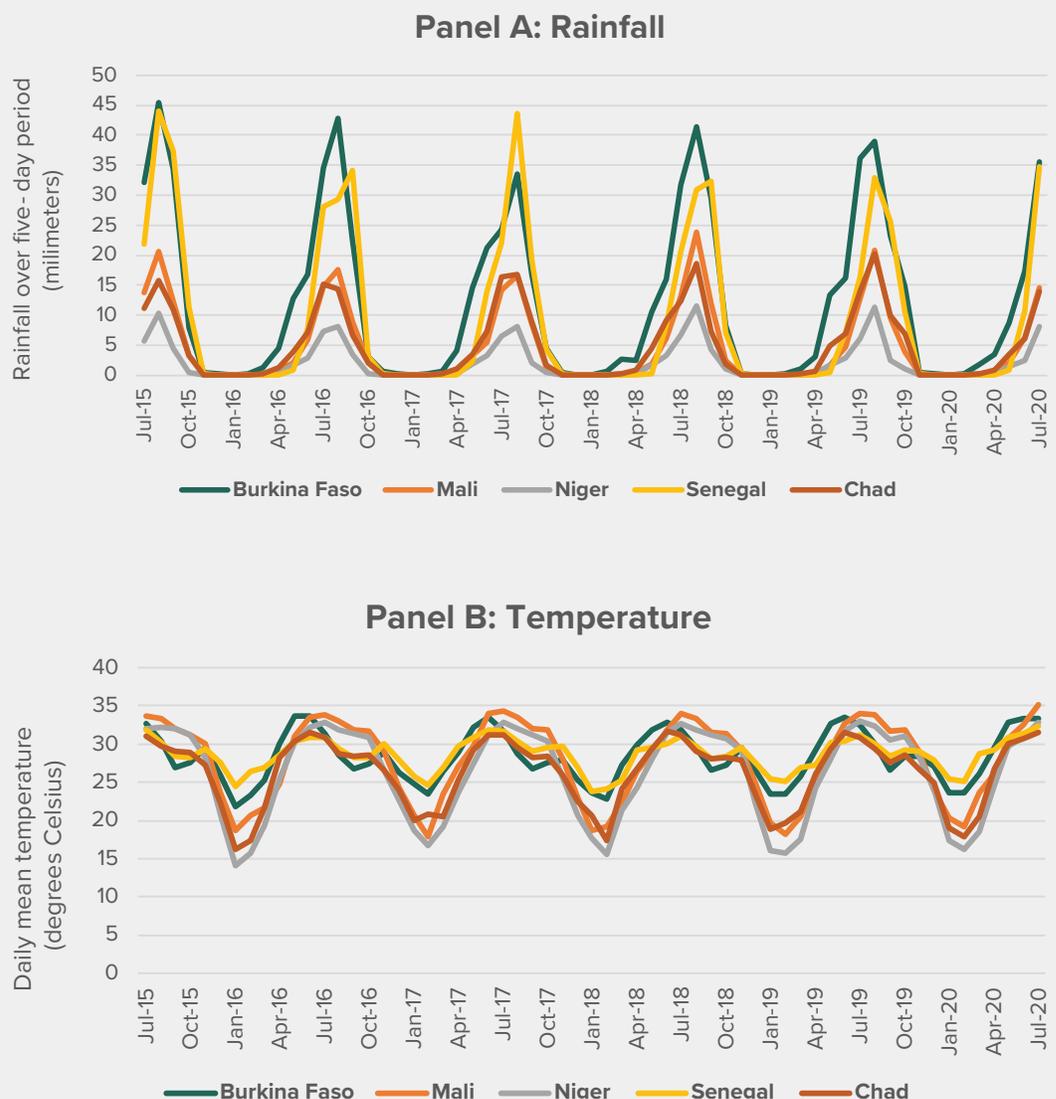
Rainfall varies dramatically across the year in Sahelian countries. The rainy season typically lasts from June to September, although rains may begin in April or May and continue until October or November (see *Figure 21*). The remainder of the year is extremely dry, underlining the importance of the rainy season for agricultural and pastoralist activities.

The agricultural lean season corresponds to the rainy season. The harvest season for millet and sorghum, the main coarse grains on which Sahelian households rely, ordinarily

centers around October and November of each year, coming directly after the rainy season (FAO, 1995; FEWS NET, 2018). This may be complemented by off-season cultivation of rice, maize, and other crops – primarily between January and March – which may be supplied with water through irrigation or undertaken in areas where flood waters recede; (FEWS NET, 2017). By the time the rains arrive again, agricultural households face a lean season in which they will not only have drawn down their main season and off-season harvest but also face the physical demands of planting their principal rainfed crops.

FIGURE 21.
Seasonal variation in rainfall and temperature in Sahelian countries

Note: Monthly averages taken for penta-daily rainfall and daily mean temperatures. Source: Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) data for rainfall, Climate Forecast System Reanalysis (CFSR) data for temperature, and World Bank estimates.



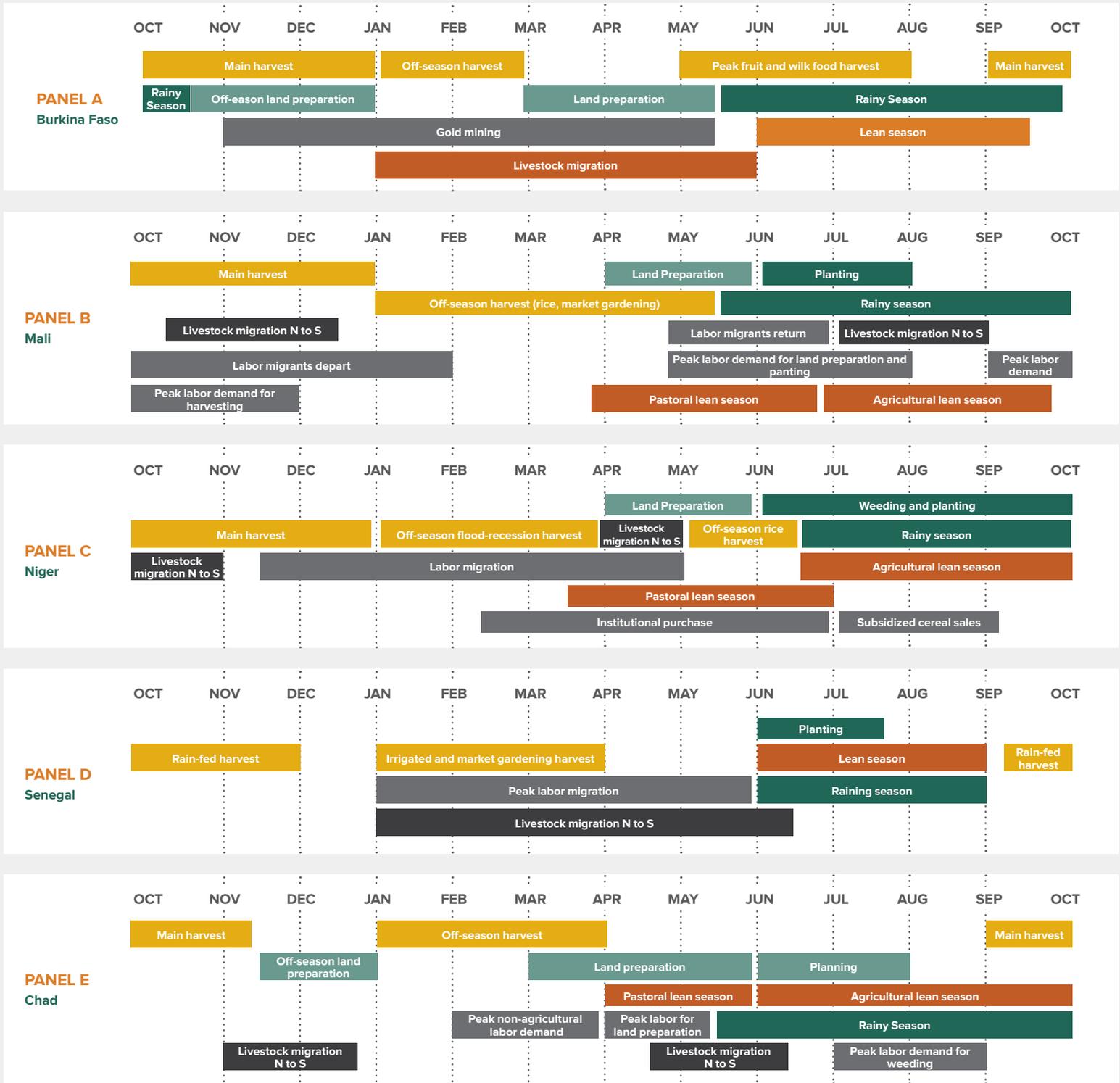
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The pastoralist lean season typically arrives before the rainy season has begun. Pastoralists rely on the rainy season between June and September to replenish pasture and water points, and hence the condition of their animals. Animals' condition influences milk production and the price for which

they can be sold. The lean season for pastoralists is therefore from April to June each year, just before the rains arrive (FEWS NET, 2018). *Figure 22* shows a more detailed representation of the seasonality for agriculture and pastoralist activities in Burkina Faso, Mali, Niger, Senegal, and Chad.

FIGURE 22. Seasonality in agricultural and pastoralist activities in five Sahelian countries

Source: FEWS NET.

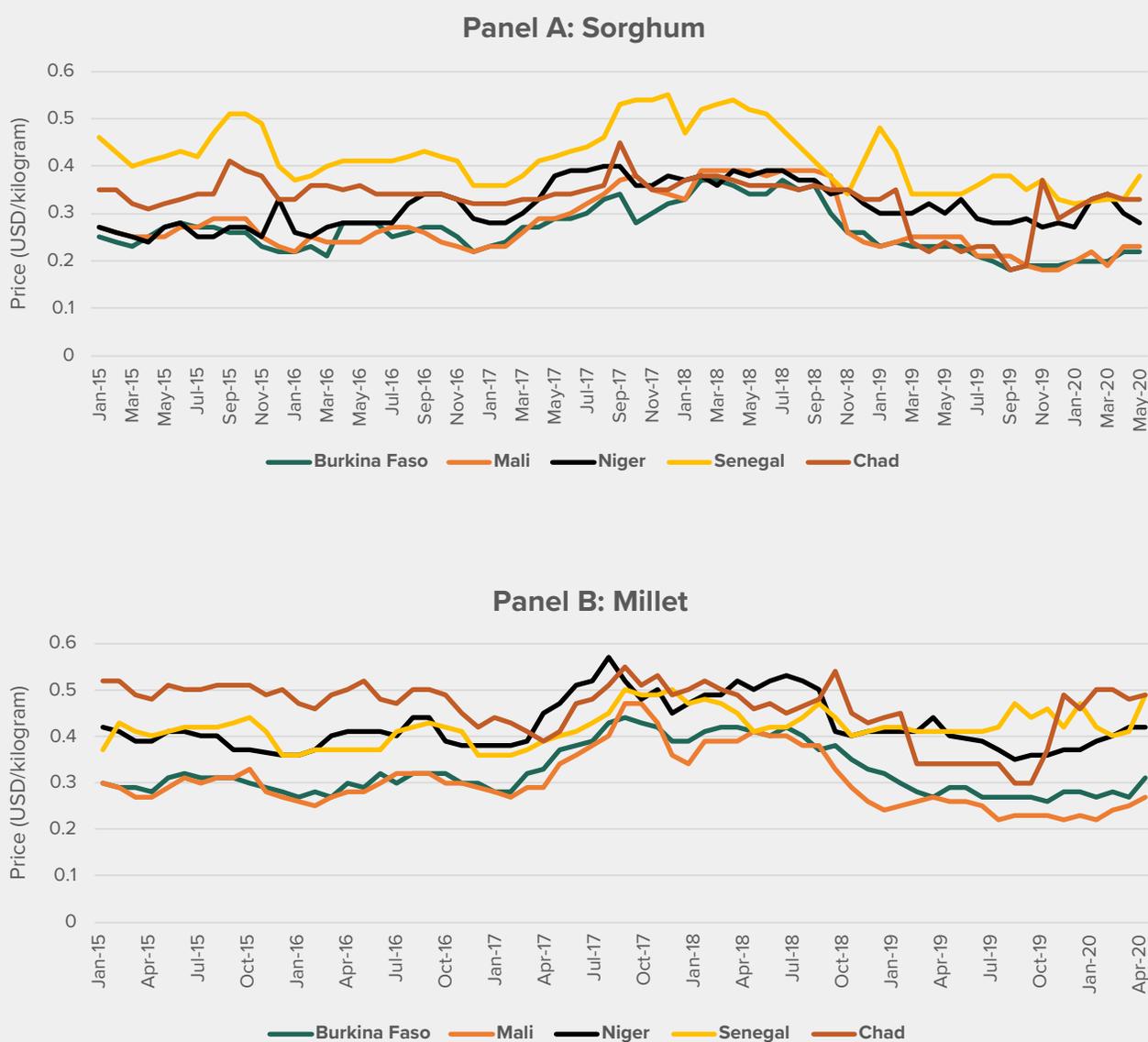


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Prices for agricultural output and for livestock also vary with the seasons in the Sahel. For rainfed agricultural products – including millet and sorghum – prices drop as supply rises heading into the main harvest in October or November of each year (see *Figure 23 and Figure 24*). As such, prices of agricultural products are at their highest during the agricultural lean season between June and

September. By contrast, livestock prices tend to be lowest in the pastoralist lean season between April and June each year, as households are forced to sell animals at ‘distress prices’ in order to cope (FEWS NET, 2017). Prices therefore provide an early indicator of the seasonal stresses on consumption and welfare that Sahelian households may be facing.

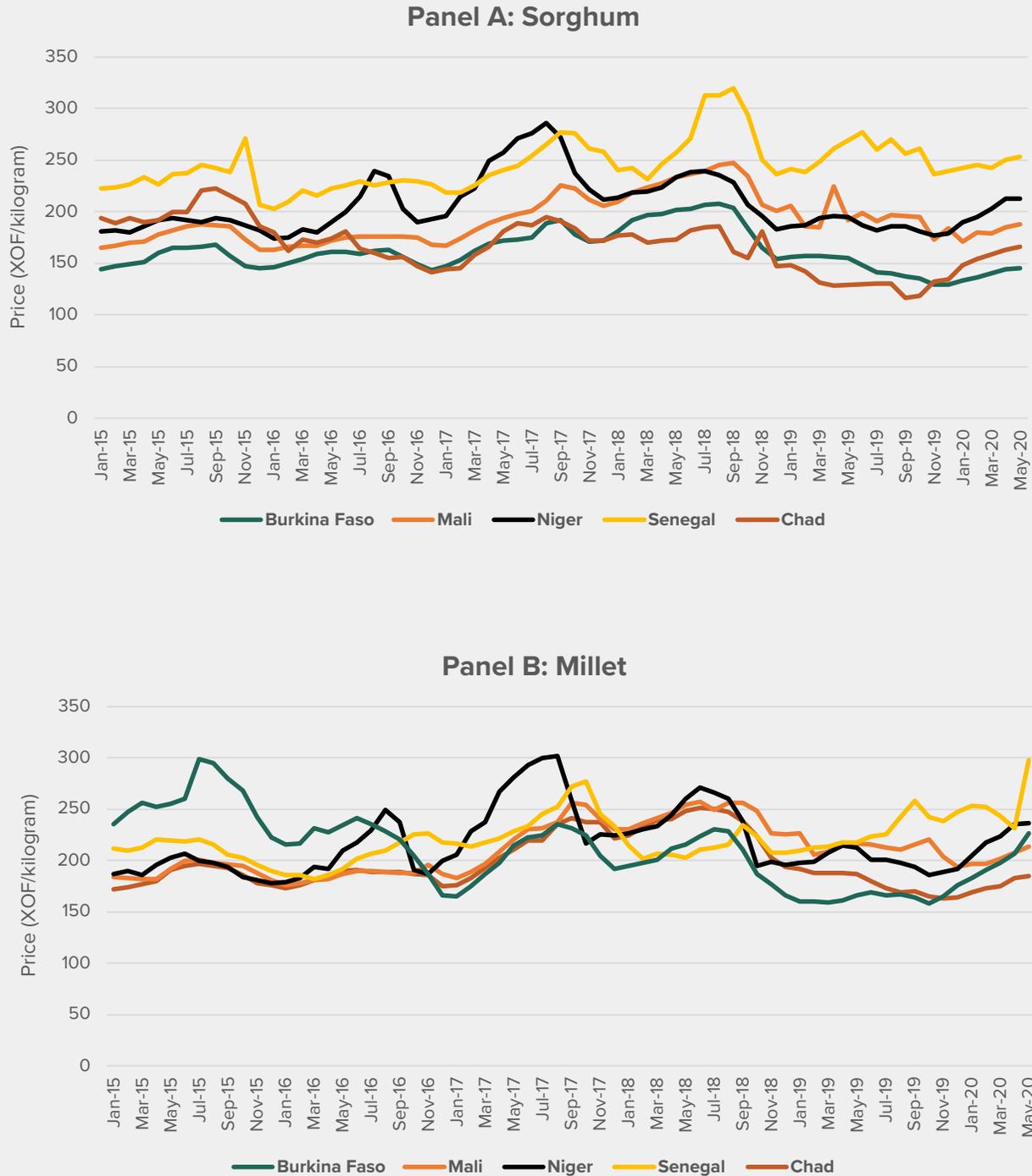
FIGURE 23.
Seasonal variation in staple crop prices in Sahelian countries according to Food and Agriculture Organization data



Note: Prices taken from the capital city market for each country. Sorghum prices are wholesale for Burkina Faso, Mali, and Niger and retail for Senegal and Chad. Millet prices are wholesale for Burkina Faso and Mali and retail for Niger, Senegal, and Chad. Source: Food and Agriculture Organization Food Price Monitoring and Analysis Tool and World Bank estimates.

FIGURE 24.

Seasonal variation in staple crop prices in Sahelian countries according to World Food Programme data



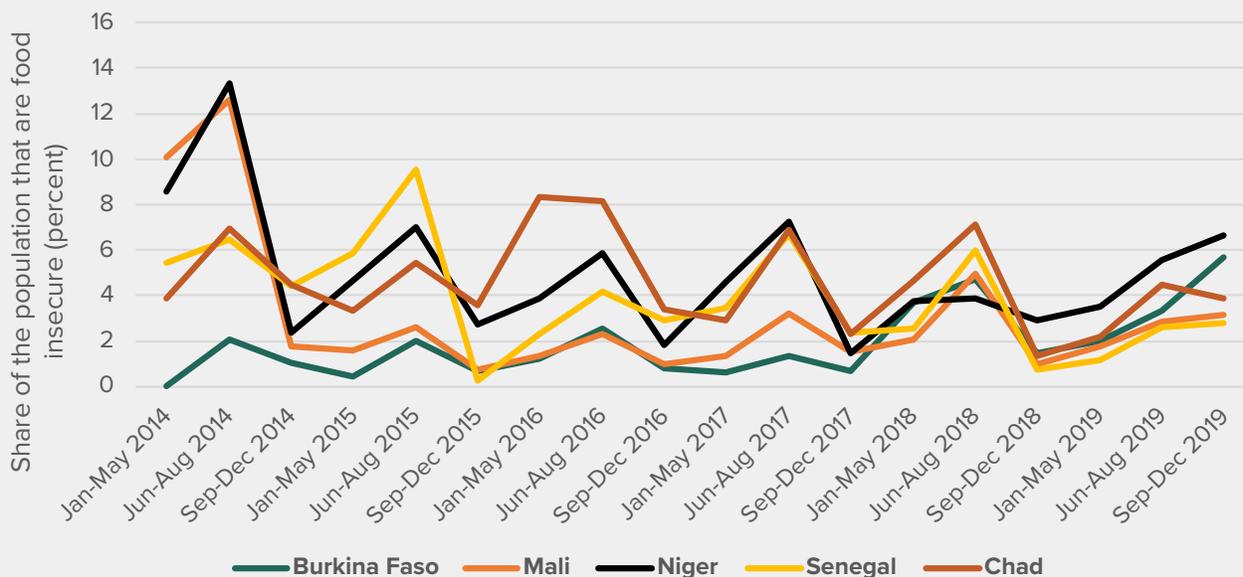
Note: All prices are retail prices. Prices shown are national averages. Source: World Food Programme Vulnerability Analysis and Mapping Food Security Analysis tool and World Bank estimates.

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The ‘consensual’ approach used by the ‘Cadre Harmonisé’ also suggests large swings in food insecurity between the seasons in Sahelian countries. The Cadre Harmonisé is a framework that brings together food and nutrition security experts to help synthesize a number of data sources, including food consumption surveys, nutrition surveys, the Household Economy Approach, or other information provided by agricultural surveys and market monitoring (Cadre Harmonisé, 2019). This framework is used to determine the distribution of food assistance in Sahelian

countries. As *Figure 25* shows, the share of the population that is classified as food insecure by this methodology – specifically those in the ‘crisis’, ‘emergency’, or ‘disaster/famine’ phase of the Cadre Harmonisé – typically rises in the period from June to August, which corresponds directly with the agricultural lean season in Sahelian countries. Thus, seasonality is captured by the tools that development practitioners use to monitor welfare and food security in the Sahel.

FIGURE 25.
Seasonal variation in food insecurity according to the Cadre Harmonisé



Note: Food insecure corresponds to any populations in Phases 3 (‘Crisis’), 4 (‘Emergency’), and 5 (‘Disaster/Famine’) of the Cadre Harmonisé. Population numbers used to calculate share of the food insecure population taken from the Cadre Harmonisé itself. Source: Cadre Harmonisé and World Bank estimates.

The 2018 rainy season, which would determine the extent of the 2019 lean season on which this brief focuses, was regarded as relatively positive, enabling high agricultural productivity across the Sahel. For many areas in Burkina Faso, Mali, Niger, and Chad, biomass production during the 2018 rainy season was well above the 1998-2018 average, although in the Western Sahel – including in Senegal – rainfall was lower, leaving biomass somewhat depleted

(Action Contre La Faim, 2018; FEWS NET, 2019). The reduced scarcity of agricultural output across most Sahelian countries is corroborated by the relative stability or even slight decline in the prices of key staple crops, which at least partially emerges in *Figure 21* above (RPCA, 2019). As such, this brief covers a period of relative ‘normality’, which enables the analysis to try and isolate the effects of seasonality per se, rather than the effects of large covariate shocks.

ANNEX 2: DATA SOURCES AND METHODOLOGY

The main data source used in this brief is the ‘Enquête harmonisée sur les conditions de vie des ménages’ (EHCVM), which collected detailed household-level microdata from Burkina Faso, Mali, Niger, Senegal, and Chad. The EHCVM includes a wide range of information on households’ consumption, employment and agricultural activities, assets, education, health, and a plethora of other important indicators all of which are vital for assessing the impact of seasonality. The EHCVM data are representative at the national level for each of the five countries, but also at regional level.

The timing of the EHCVM surveys allows the impact of seasonality in four out of the five Sahelian countries to be analyzed in the same way. Each of the EHCVM were collected in two distinct waves, carried out at two different points in the year. The waves collected information on different households, so the EHCVM data do not have a panel structure. However, the data are representative at the

wave level, so it is possible to compare the two waves in each country to assess the impact of seasonality. As shown in **Figure 26**, for Burkina Faso, Mali, Niger, and Senegal, the bulk of the interviews in the first wave took place between October 2018 and December 2018, although interviewing began in Burkina Faso and Senegal in September 2018. The second wave for these four countries was carried out between April 2019 and July 2019. Thus, for Burkina Faso, Mali, Niger, and Senegal, the first wave roughly corresponds with the post-harvest season, especially as the 2018 rains were generally ‘good’, arriving on time and leading to above average biomass production (Action Contre La Faim, 2018). By contrast, the second wave captures the arrival of the 2019 pastoral and at least the first part of agricultural lean season.²⁷ Since the timing of the EHCVM is similar in Burkina Faso, Mali, Niger, and Senegal, results from these countries can be pooled as well as presented separately.

FIGURE 26. Timing of interviews in the EHCVM surveys

	2018							2019						
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Burkina Faso				795	1153	1224	342				259	1889	1221	133
Mali				1	522	1723	662	1			932	1777	958	24
Niger					1022	1291	667				432	1183	1230	195
Senegal				358	1100	1398	710				917	1541	1067	62
Chad	340	1421	1311	634				688	1258	1379	461			

Source: EHCVM and World Bank estimates.

The results for Chad are largely not included in the brief, given the timing of the EHCVM data collection there.

In Chad, the first wave of the EHCVM data was collected between June and September 2018, while the second wave was collected between January and April 2019. As such, in contrast to the other four countries in the EHCVM data, it is the first wave that may capture the agricultural lean season for Chad, while the second wave corresponds to the off season, when food supplies from rainfed agriculture should

be being topped up by irrigated agriculture. The results from Chad are therefore not pooled with the results from Burkina Faso, Mali, Niger, and Senegal.

Further temporal disaggregation may be possible by trying to isolate the months of the lean season more specifically, but these results should be treated with some caution. While the timing of the EHCVM data collection approximately coincides with the 2019 lean season for

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Burkina Faso, Mali, Niger, and Senegal, the correspondence is not perfect. Indeed, the second wave of the EHCVM starts and ends slightly too early in these four countries to capture the full extent of the 2019 lean season. Focusing mainly on June and July 2019 offers one potential avenue for trying to isolate the 2019 lean season. Yet the EHCVM survey was not designed to be representative at the month or even the two-month level: this may bias the results if certain types of households in different regions of the country – perhaps with better or worse welfare outcomes – were interviewed at different times throughout the wave. Thus, the analysis below focuses on the wave-level results, and the additional month-specific results should be interpreted with caution.

Ramadan overlapped with the lean season in 2019, which could lead the analysis to underestimate the effects of seasonality. In 2019, Ramadan took place from 5th May to 3rd June, falling directly in the middle of the lean season wave. All of the countries in the sample are majority Muslim – with Mali, Niger, and Senegal being almost exclusively Muslim – so this may impact consumption patterns. All other things equal, consumption typically rises for Muslim households in Ramadan and reported food insecurity declines (see, for example, MVAM (2021)). Thus, it may be that the overall lean season losses estimated in this analysis represent an underestimate of what might happen when Ramadan does not correspond with the lean season. Notwithstanding the caveats outlined above, looking at month-by-month results could help to understand how Ramadan influences the effects of the lean season on household consumption.

All of the monetary variables used in the analysis have been deflated spatially and temporally, to ensure that inflation does not bias the results. This is particularly important for monetary food and non-food consumption, arguably the most important final welfare outcome variables on which the brief focuses. The price indices used to deflate the monetary variables were constructed using price and expenditure data collected through the EHCVM itself.

The comparisons between the waves and hence the seasons can be enhanced using basic regressions to control for a host of household characteristics. This brief mainly looks at simple differences in means, taking the average value of each intermediate and final welfare outcome in the two waves of the survey and comparing them. To test any seasonal differences more formally,

however, and ensure they are not simply the product of differences in the sample between the two seasons, it is also important to consider how any differences in the outcome variables change when controlling for stable household characteristics, that is, household characteristics that would be not be expected to change dramatically season to season. Specifically, for household i , in community j , in region r , in country c , the analysis will run a regression of the form:²⁸

$$y_{ijrc} = \beta S_{ijrc} + X'_{ijrc}\gamma + G'_{rc}\mu + \varepsilon_{ijrc}$$

where y_{ijrc} is the outcome variable of interest, S_{ijrc} is a dummy variable capturing the season in which the household was interviewed, X'_{ijrc} is a vector of household controls, including the age, sex, and education of the household head, and the size and number of dependents in the household, G'_{rc} is a series of region fixed effects, and ε_{ijrc} is the error term. The coefficient β can be interpreted as the effect of seasonality. The variables in X'_{ijrc} and the fixed effects can be added incrementally to assess how β changes as further controls are added (Altonji, Elder, & Taber, 2005; Oster, 2019).²⁹ For outcome variables related to monetary consumption or quantities consumed, y_{ijrc} will be specified in logs to improve the model's fit.

To examine whether the impacts of seasonality are uniform, these regressions can be augmented with interaction terms. The brief simply shows whether the seasonal differences vary according to the 'cutting variables' that capture households' ability to manage and cope with seasonality (especially whether they are in rural areas and depend on agriculture). Yet to test these differential effects further, it is also helpful to run regressions of the form:

$$y_{ijrc} = \beta S_{ijrc} + \delta(S_{ijrc} \times Z_{ijrc}) + \pi Z_{ijrc} + X'_{ijrc}\gamma + G'_{rc}\mu + \varepsilon_{ijrc}$$

where all variables are defined as above, Z_{ijrc} gives the 'cutting variable', and δ can be interpreted as the differential impact of seasonality on certain types of households.³⁰

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ENDNOTES

- 1 See Brunelin, Ouedraogo, and Tandon (2020). For a broader review of the welfare effects of shocks and seasonality, see Dercon (2002). For a discussion of the consequent effects on poverty, see Dercon and Krishnan (2000).
- 2 See Annex 1 and in particular analysis by Action Contre Le Faim (2018) and FEWS NET (2019) for information on the 2018 rainy season.
- 3 Ramadan ran from 5th May to 3rd June in 2019. As discussed in Annex 2, this may, if anything, lead the analysis to underestimate the effects of seasonality, as consumption often increases in Muslim households during Ramadan.
- 4 See Alderman and Paxson (1994), Barrett, Reardon, and Webb (2001), Harrower and Hoddinott (2005), and Kaminski, Christiaensen, and Gilbert (2016).
- 5 See Pitt and Khandker (2002) and Khandker (2012).
- 6 See (2003), Fafchamps and Lund (2003), and Kazianga and Udry (2006).
- 7 In practice, it is often observed households are reluctant to sell their livestock during difficult times if they can stay above some subsistence level of consumption.
- 8 See Mace (1991), Townsend (1994), and Ravallion and Chaudhuri (1997).
- 9 See Bodewig (2019).
- 10 Taking all five countries together, around three-quarters of the population live in rural areas, although there are large differences between the most rural country (Niger; 82.5 percent rural) and the least rural country (Senegal; 52.3 percent rural).
- 11 Working-age household members are those aged 15 to 64.
- 12 The agricultural module of the EHCVM survey does not fully capture the extent of crop diversification in the sample, because only the primary crop for each plot is listed. In Burkina Faso, Mali, Senegal, and Chad, this is not a serious issue because the vast majority of plots (almost 9 in 10, unweighted) have only one crop anyway. In Niger, however, the majority of plots have more than one crop, so the results there would be significantly biased by this limitation in the survey. As such, Niger is excluded from this analysis.
- 13 Specifically, the crop diversification index is created by calculating a Herfindahl index of concentration of each household's crop portfolio, then subtracting this from one. See Adjimoti and Kwadzo (2018), Mango et al. (2018), and Dessie et al. (2019).
- 14 These simple classifications of food and cash crops draw on Food and Agriculture Organization (FAO) resources on food supply systems (see, for example, FAO (1997)).
- 15 The financial institutions considered are: regular banks; postal banks; rural savings associations or microfinance institutions; mobile banking; and stored-value or prepaid cards.
- 16 See Hoogeveen (2003), Fafchamps and Lund (2003), and Kazianga and Udry (2006).
- 17 Since the national poverty line – which is specific to each country – is used, it is not possible to combine results across different countries.
- 18 See forthcoming Poverty Assessments for the Sahelian countries included in this brief as well as the 2020 Poverty and Shared Prosperity Report, which places Burkina Faso, Mali, Niger, Senegal, and Chad in the global context (World Bank, 2020).
- 19 These month-by-month findings are taken from a set of regressions of consumption on a series of lean-season month dummies as well as region fixed effects and a basic set of controls. The results are less clear cut when taking raw difference in means between the data from each month. Controlling for household characteristics and region fixed effects is more important than in the simple wave-to-wave comparisons, because the EHVCM data were not designed to be representative at the month level, so different types of households could have been systematically interviewed more or less during different survey months.
- 20 Dietary diversity is captured through World Food Programme's (WFP's) Food Consumption Score (FCS). The FCS assesses dietary diversity by measuring the frequency with which different food groups were consumed over the previous seven days.
- 21 Pooling the data from Burkina Faso, Niger, and Senegal, the share of the population with poor or borderline dietary diversity, as per the FCS, was 4.2 percentage points lower in May 2019 than in the non-lean season, with this difference being statistically significant at the 5 percent level. The analogous differences between April 2019, June 2019, and July 2019 and the non-lean season were not statistically significant at the 5 percent level, except when focusing only on Burkina Faso. In contrast, the quantities of cereals consumed were between 400 and 550 grams lower for each month of the lean season compared to the non-lean season, with all these differences being statistically significant at the 5 percent level.
- 22 This is consistent with the findings from forthcoming separate analysis, linking the EHCVM consumption data to Water Requirement Satisfaction Index (WRSI) data on variation in water availability for crops in Sahelian countries. Given its precision, the analysis of the WRSI also confirms that seasonality leads to swings in welfare in the Sahel, over and above the impact of droughts and extreme weather shocks.

23 See Annex 2 for further details. It is particularly important to control for systematic differences in the sample for this type of sub-group analysis (that is splitting the sample into urban-rural, agricultural versus non-agricultural, and by the primary sector of work for the household head), because the survey is not designed to be representative at the sub-group-wave level.

24 As shown in Figure 2, 89.9 percent of rural households in Burkina Faso, 80.9 percent of rural households in Niger, and 78.8 percent of rural households in Senegal cultivated fields in the previous agricultural season.

25 Figure 20 reports only the point estimates for these differences, as it is difficult to run formal tests when the sample is split so finely.

26 Nevertheless, there is still a slight increase in consumption in the lean season for household whose heads work in industry and services in Niger, even when the sample is restricted to rural areas only.

27 The rains in 2019 arrived late in some western parts of the Sahel region, which may have led the 2019 lean season to arrive early as well, at least for pastoralists. However, the full effects of the late 2019 rains would be expected in 2020.

28 This approach follows a wide range of descriptive work looking at the impact of shocks and seasons on household welfare, see for example Dercon, Hoddinott, and Woldehanna (2005), Harrower and Hoddinott (2005), and World Bank (2005).

29 When y_{ijrc} is a binary variable, the regression will still be estimated using Ordinary Least Squares, yielding a Linear Probability Model. This means the coefficients can directly be read as marginal effects. The standard errors will be robust to the inherent heteroskedasticity introduced into the model from this approach, as they will be clustered at the 'grappe' level for each regression.

30 The regressions with interaction terms on which the brief draws have a continuous outcome variable. This avoids the challenges associated with estimating interaction terms with a binary outcome variable, which may arise even in Linear Probability Models (see, for example, Holm, Ejrnæs, and Karlson (2015)).

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