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IMPROVING THE ECONOMIC MECHANISM FOR ENSURING FOOD SECURITY IN REGIONS BASED ON THE ASSESSMENT OF REAL PURCHASING POWER: A STRESS-TEST APPROACH

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Abstract

A regional affordability indicator is only as reliable as the time windows behind it. The Food Affordability Buffer (FAB), introduced for Kashkadarya Region in an earlier diagnostic study, subtracts compounded food-price inflation from nominal per-capita income growth. This paper shows that the January–June 2026 value published in that study, 6.6 percentage points, set a year-on-year income comparison against a six-month price change. Re-estimated on matched windows, the buffer falls to 2.7–3.2 points, depending on whether point-to-point or average price levels are used. Monthly food-price indices recovered from the published figure and validated against the reported compounded values allow the buffer to be expressed in real terms, its erosion between 2025 and mid-2026 to be decomposed, and break-even stress tests to be run. Of the 9.5-point fall, about 92% reflects slower nominal income growth (18.1% to 9.3%) and 8% a faster twelve-month food-price rise (5.8% to 6.6%), part of it a base effect from the deep price declines of May–July 2025. The break-even monthly price pace dropped from 1.40% to 0.74%, and four of the eight months of 2026 ran above it. A gap of about 4 points between the implied agricultural output deflator (9.9%) and consumer food inflation (5.8%) points to producer-side price pressure that retail data alone would miss. The buffer is still positive but much thinner than first reported, and monitoring rules built on it should enforce window alignment.

Keywords: food affordability; real income; window alignment; food-price inflation; stress test; Kashkadarya; Uzbekistan

Highlights

- The published 2026 buffer compared a 12-month income change with a 6-month price change.
- Matched windows cut the first-half 2026 buffer from 6.6 to 2.7–3.2 points.
- About 92% of the buffer's fall since 2025 comes from slower income growth.
- The break-even monthly food-price pace halved, from 1.40% to 0.74%.
- The implied output deflator exceeds consumer food inflation by about 4 points.

1. Introduction

Affordability is the point at which food availability meets a household budget. The 2025 global assessment of food security and nutrition warns that sustained rises in food prices can wear down household purchasing power even when supplies are adequate [1]. Empirical work points the same way, with a twist that matters for any margin-type indicator: in cross-country data for 2001–2021, income growth was the dominant driver of annual variation in food insecurity, while food-price inflation played a secondary but measurable role [2]. A complementary line of work argues that affordability should be

tracked through earnings relative to food prices rather than through the nominal cost of a diet, and builds "food wage" indices by deflating unskilled wages with food-price indices [3]. Both results suggest that the income side of an affordability margin deserves as much scrutiny as the price side.

Most operational monitoring still sits at national scale. Nowcasting tools now track food-price inflation for hundreds of countries and territories [4], yet decisions on storage, credit or targeted transfers are made by regional administrations that rarely hold the data such systems need. A review of food-system resilience assessment has called for diagnostics that work at finer spatial scales [5], and recent subnational composite indices answer that call from different angles [6]. A provincial resilience index for Indonesia, for instance, links stronger production capacity and better distribution access to more stable food prices [7]. Resilience work for six Asian countries treats inflation and climate stress as interacting shocks, transmitted to households through output, trade flows, price levels and purchasing capacity [8]. For Central Asia, scenario and machine-learning studies tie food security to productivity, structural change and resource constraints [9,10], a regional review points to fragmented governance and water scarcity [11], and agronomic work has identified large wheat yield gaps in Uzbekistan [12]. For Kashkadarya itself, remote-sensing and water-footprint studies document heavy reliance on irrigation and groundwater [13,14].

An earlier study of Kashkadarya Region combined official statistics for 2020–2026 into a four-dimension diagnostic and proposed the Food Affordability Buffer, FAB: nominal income growth per head minus compounded food inflation, both taken over one common interval [15]. It reported 12.3 percentage points for 2025 and 6.6 points for January–June 2026, and read both as favourable short-run signals. The indicator is attractive because it is simple, but a simple margin is only as sound as the windows from which it is built. In the published 2026 comparison, income growth is measured year on year (January–June 2026 against January–June 2025), whereas the price change covers the six months from January to June 2026. Setting a twelve-month income comparison against a six-month price comparison flatters the margin whenever inflation is positive.

We are not aware of a subnational study for Uzbekistan that audits the temporal alignment of an income–price margin, expresses the margin in real terms, or asks how much price pressure it can absorb. This paper addresses those gaps for Kashkadarya with four objectives: (i) to re-estimate the 2026 buffer on matched windows; (ii) to express the buffer in real terms and decompose its change between 2025 and mid-2026 into income and price components; (iii) to find the monthly price pace, and the persistence of that pace, that would exhaust the buffer; and (iv) to compare nominal agricultural output growth with official real growth in order to gauge a producer-side price wedge.

Relative to the earlier study, the contribution is diagnostic and methodological rather than descriptive. We take its indicator and data as given, test the indicator's internal consistency, and put it under stress. We do not repeat its four-dimension framework or its pressure–response mechanism [15], and the results below should be read as a refinement, and in one respect a correction, of its affordability findings rather than as an independent data set.

2. Materials and Methods

2.1. Data

Every input comes from the earlier study [15] and from the official series it cites [16–19]. No new data were collected. Table 1 lists the inputs and where each one sits in the earlier study.

Table 1. Inputs used in this study and their location in the earlier study.

Variable	Values used	Period	Location
Per-capita aggregate income	10.84; 19.91; 23.52 million UZS	2020; 2024; 2025	Text, Section 5.2 [16]
Per-capita aggregate income, intermediate years	12.9; 15.3; 16.9 million UZS (one decimal)	2021–2023	Data labels, Figure 3
Per-capita aggregate income, first half	12.55 vs 11.48 million UZS	H1 2026 vs H1 2025	Text, Section 5.2
Food-price index (previous month = 100)	20 monthly values	Jan 2025–Aug 2026	Figure 4 [18]; recovered, see 2.2
Reported compounded price change	5.82%; 2.71%; about 2.1%	2025; Jan–Jun 2026; Jan–Aug 2026	Text, Sections 5.2–5.3
Gross agricultural output, current prices	32.62; 39.08; 43.59; 49.95 trillion UZS	2022–2025	Text, Section 5.1 [17]
Real growth, agriculture, forestry and fisheries	4.3%	2025	Text, Section 5.1 [19]

2.2. Recovering the monthly price series

The earlier study reports the monthly indices only as a line chart. We recovered the twenty plotted values by locating marker centres in the figure image and converting pixel rows to index points through the axis tick marks. Values were rounded to two decimals for 2025 and to one decimal for 2026, the resolution at which the 2026 points sit. Three published numbers served as checks. Compounding the recovered 2026 values gives 2.71% for January–June and 2.09% for January–August, matching the reported 2.71% and "about 2.1%". The 2025 values compound to 5.79% against 5.82% reported; the 0.03-point gap probably reflects pixel resolution and rounding, though a small transcription difference cannot be excluded. Every price-derived quantity below should therefore be read as accurate to roughly ±0.1 percentage point.

2.3. Indicators and the matching rule

Let I_m be the monthly price index (previous month = 100). The chain-linked price level with December 2024 = 100 is given by Eq. (1), and the compounded price change between months s and t by Eq. (2).

$$L_t = \prod_{m=1}^{t} \frac{I_m}{100} \quad (1)$$

$$\pi(s,t) = \frac{L_t}{L_s} - 1 \quad (2)$$

Nominal income growth g is the percentage change of per-capita income over a comparison interval, and the buffer is the difference in Eq. (3). It is meaningful only when g and π describe the same interval. We call this the matching rule. For a year-on-year income comparison the price change must also be a year-on-year change. Two matched versions are used: the point-to-point change over the

twelve months ending in the last month of the income window, and the ratio of mean price levels over the income window to the mean over the same window one year earlier.

$$\mathrm{FAB} = g - \pi \quad (3)$$

Income deflated by food prices grows at the real rate in Eq. (4). Because FAB = (1 + π)r, the nominal buffer exceeds real growth by πr (Eq. 5).

$$r = \frac{1+g}{1+\pi} - 1 \quad (4)$$

$$\mathrm{FAB} = (1+\pi)r \quad (5)$$

The change in the buffer between two periods splits additively into an income part and a price part (Eq. 6). For stress testing, the break-even monthly pace p* is the constant monthly food-price rise that would equal one year of income growth after twelve months (Eq. 7), and the exhaustion horizon n* is the number of months a pace p must persist before cumulative price growth equals that income growth (Eq. 8).

$$\Delta\mathrm{FAB} = \Delta g - \Delta\pi \quad (6)$$

$$p^* = (1+g)^{1/12} - 1 \quad (7)$$

$$n^*(p) = \frac{\ln(1+g)}{\ln(1+p)} \quad (8)$$

On the supply side, the implied output-price effect δ is the ratio of nominal to real growth (Eq. 9), where x_n is nominal and x_r real growth of output.

$$\delta = \frac{1+x_n}{1+x_r} - 1 \quad (9)$$

The stress tests are arithmetic scenarios, not forecasts. They hold income growth at its observed value and let prices evolve; sensitivity is shown on a grid of income growth and food inflation. We make no causal claims.

3. Results and Discussion

3.1. Matched windows cut the first-half 2026 buffer by more than half

Table 2 sets the published and matched estimates side by side. The 2025 value needs no correction in the sense that annual income growth and the December-to-December price change describe the same calendar year, although a comparison of average annual price levels would be the stricter match and requires 2024 monthly data that the earlier study does not provide. For the 2026 half-year the picture changes. With the price change measured over the twelve months to June 2026, the compounded rise is 6.6% rather than 2.7%, and the buffer falls from the published 6.6 points to 2.7. Using average price levels for January–June of both years gives a rise of 6.1% and a buffer of 3.2 points. The matched range of 2.7–3.2 points is less than half the published figure.

Table 2. Food Affordability Buffer under published and matched windows (percentage points unless stated).

Estimate	Income growth, g (%)	Price change, π (%)	FAB	Real growth, r (%)	FAB − r
2025 vs 2024 (income annual; price Dec/Dec)	18.09	5.82	12.27	11.60	0.67
H1 2026, as published (income y/y; price Jan–Jun, 6 months)	9.30	2.71	6.59	6.42	0.17
H1 2026, matched, point-to-point (price Jun/Jun, 12 months)	9.30	6.56	2.74	2.57	0.17
H1 2026, matched, average levels (H1 2026 vs H1 2025)	9.30	6.09	3.21	3.03	0.18

Source: authors' calculations from data in [15]. The earlier study rounds the published 2026 value to 6.60; subtracting the rounded inputs gives 6.59. Matched price changes use the recovered monthly series (Section 2.2).

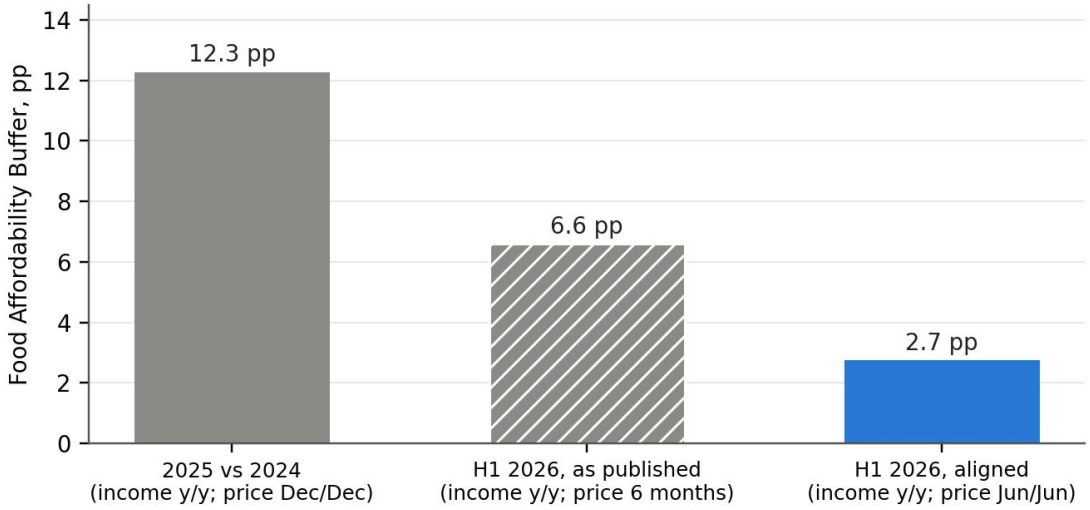

Figure 1. Buffer values for 2025 and for January–June 2026, under the published window and under a matched twelve-month window. Source: authors' calculations from data in [15].

Neither matched version turns the buffer negative. The average household in the region still saw nominal income growth above food-price growth, which supports the direction of the earlier study's message and weakens its magnitude. The distinction matters for how the number would be used: a buffer of 6.6 points reads as comfortable headroom, whereas 2.7 points is a margin that a single bad quarter of price news could remove.

3.2. Where the erosion came from

Between 2025 and mid-2026 the buffer fell by 9.5 points on matched point-to-point windows (Table 3). Slower income growth, from 18.1% to 9.3%, accounts for 8.8 points, or 92% of the fall. The twelve-month food-price rise moved from 5.8% to 6.6% and adds 0.7 points. The split echoes cross-country evidence that income growth is the main source of year-to-year variation in food insecurity [2].

It also carries a monitoring lesson. A watcher of prices alone would have seen a twelve-month rate confined to a band of 5.6–6.8% from December 2025 to August 2026, a modest drift, while the margin was shrinking fast.

Table 3. Decomposition of the change in the buffer, 2025 to first half 2026 (matched, point-to-point).

Component	2025	H1 2026	Contribution to ΔFAB (pp)
Income growth, g (%)	18.09	9.30	−8.79
Twelve-month food-price change, π (%)	5.82	6.56	−0.74
Buffer, FAB (pp)	12.27	2.74	−9.53 (income 92%, price 8%)

Income growth over January–June 2026 is also the weakest in the series that can be assembled. Annual nominal growth of per-capita income was 19.0% in 2021, 18.6% in 2022, 10.5% in 2023, 17.8% in 2024 and 18.1% in 2025 (the 2021–2023 levels are read from the data labels of the earlier study's figure and carry one-decimal resolution), against 9.3% for January–June 2026 and a 2020–2025 compound rate of 16.8% a year. The 2023 dip shows that one slow year has occurred before and was followed by recovery. Whether 2026 repeats that pattern cannot be told from a half-year comparison set against annual figures, and quarterly income data would settle it.

3.3. Real terms: a small correction that grows with inflation

Deflating income growth by food prices gives real growth of 11.6% for 2025, 2.6% for January–June 2026 on the point-to-point match, and 3.0% on average levels (Table 2). The nominal buffer overstates real growth by πr, 0.67 points in 2025 and 0.17 to 0.18 points under the matched 2026 windows. At these inflation rates the distortion is minor. It grows with inflation, however: at 15% food inflation and 10% real growth the overstatement would reach 1.5 points. Reporting r beside the buffer costs one line of arithmetic and removes the issue. The measure is the aggregate-income analogue of the food-wage indices proposed for high-frequency monitoring of poor households [3]. The difference is that per-capita aggregate income is an average and says nothing about whether low-income households shared in the gain.

3.4. A base effect behind the rise in twelve-month inflation

The twelve-month food-price change drifted from 5.8% in December 2025 to 6.5% in August 2026, with a step from 5.9% in April to 6.8% in May (Figure 2). The step has a mechanical source. A twelve-month change is the compounded effect of the latest twelve monthly changes, so each month the newest value replaces the one from a year earlier. May 2025 was a month of falling prices (−0.86%) and May 2026 was flat, so the window lost a deflationary month and gained a neutral one.

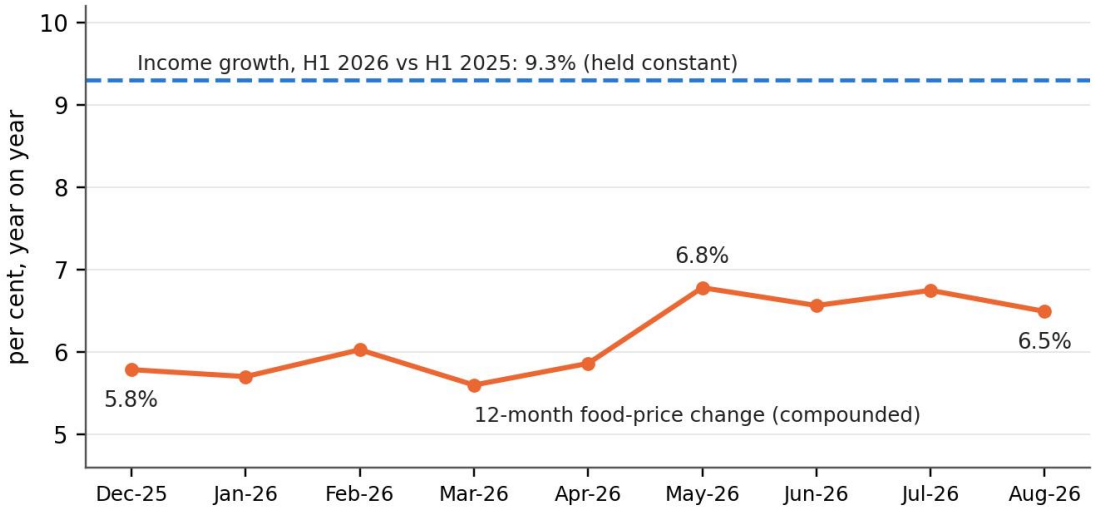

Figure 2. Twelve-month compounded change in the food price index, December 2025–August 2026, against income growth of 9.3% (January–June 2026 vs January–June 2025). Income growth is held at 9.3% in all months other than June 2026. Source: authors' calculations from the recovered monthly series (Section 2.2).

Table 4 lists the four replacements from May to August 2026. Taken together, the months that left the window (May–August 2025) sum to −2.49 points and those that entered (May–August 2026) to −1.90, so the new months were 0.59 points less deflationary than the old ones. The summer decline in 2026 was shallower than in 2025, −2.3% for May–July against −3.1%, and the twelve-month rate rose even though no month of 2026 was unusually inflationary. For the rest of the year the same arithmetic applies in the other direction: the index rose by a compounded 5.0% between August and December 2025, so the twelve-month rate will fall if the same months of 2026 rise by less and climb if they rise by more.

Table 4. Months entering and leaving the twelve-month window, May–August 2026 (monthly index change, %).

Month of 2026	Entering month (2026)	Leaving month (2025)	Net effect (pp)	Twelve-month rate after (%)
May	0.00	−0.86	+0.86	6.78
June	−1.30	−1.10	−0.20	6.56
July	−1.00	−1.17	+0.17	6.75
August	+0.40	+0.64	−0.24	6.49

Source: authors' calculations from the recovered monthly series (Section 2.2). Net effect is the entering value minus the leaving value; the compounded change in the twelve-month rate between April and August 2026 is 0.63 points, against 0.59 for the simple sum.

3.5. Stress tests: break-even pace and exhaustion horizon

The break-even monthly pace is 1.40% for the 2025 buffer and 0.74% for the matched 2026 buffer (Eq. 7). Against the first threshold, monthly food-price rises stayed below the line in all but two months of 2025 (March, 1.61%, and December, 1.52%) and in every month of 2026 (Figure 3). Against the

second threshold the position is different. Four of the eight months of 2026 ran above 0.74%: January at 0.8%, February and April at 1.0%, March at 1.2%. The remaining months, May to August, were flat, negative or small. Halving the threshold did not change what prices did, but it changed how much of the year sat above it.

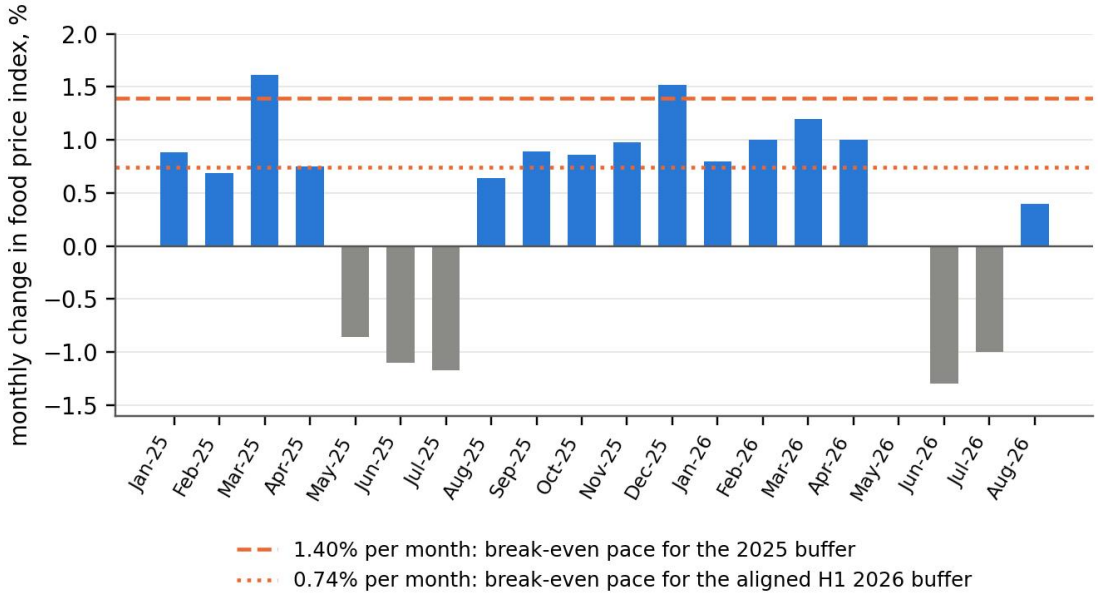

Figure 3. Monthly change in the food price index, January 2025–August 2026, with the break-even paces implied by the 2025 buffer and by the matched first-half 2026 buffer. Source: authors' calculations from the recovered monthly series (Section 2.2).

A threshold crossing means little if it is brief, which is what the exhaustion horizon measures (Eq. 8). Table 5 shows how long a given pace has to persist. With the 2025 buffer, a March-2025-type pace of 1.61% a month would need 10.4 months to consume the year's income gain, close to a full year. With the matched 2026 buffer the same pace would need 5.6 months, and the March-2026 pace of 1.20% would need 7.5 months. At the 2025 mean pace of 0.47% a month, the horizon shortens from 35 to 19 months. The buffer has therefore moved from a position in which one seasonal spike could not threaten it to one in which half a year of sustained pressure could.

Table 5. Exhaustion horizon n* (months) for selected monthly paces.

Monthly pace, p	p (% per month)	2025 buffer (g = 18.09%)	Matched 2026 buffer (g = 9.30%)
Break-even pace, p*	—	1.40 (12.0 months)	0.74 (12.0 months)
Peak monthly pace 2025 (March)	1.61	10.4	5.6
Second 2025 peak (December)	1.52	11.0	5.9
Peak monthly pace 2026 (March)	1.20	13.9	7.5
Mean monthly pace 2025	0.47	35.2	18.8
Mean monthly pace Jan–Aug 2026	0.26	63.4	33.9

Source: authors' calculations. The horizon assumes that income growth stays at the stated value while prices rise at the stated pace.

Table 6 turns the same logic into a sensitivity grid. At income growth of 9.3% and the observed twelve-month food inflation of 6.6%, real growth is 2.6%. If food inflation rose to 9%, real growth would fall to about zero, and at 12% it would be −2.4%. If income growth slowed to 5%, below any year in the series, a food inflation rate of 6% would already produce a real loss of 0.9%. The grid is deliberately coarse: its purpose is to show the width of the safe region, not to predict where the region will end up.

Table 6. Real income growth r (%) for combinations of nominal income growth and food inflation.

Income growth, g (%)	π = 3%	π = 6%	π = 9%	π = 12%	π = 15%
5.0	1.9	−0.9	−3.7	−6.2	−8.7
9.3	6.1	3.1	0.3	−2.4	−5.0
12.0	8.7	5.7	2.8	0.0	−2.6
18.09	14.7	11.4	8.3	5.4	2.7

3.6. A producer-side price wedge

On the supply side, the earlier study reported nominal growth of gross agricultural output of 14.6% in 2025 (from UZS 43.59 to 49.95 trillion) and an official real growth rate of 4.3% for agriculture, forestry and fisheries [17,19]. Dividing one by the other (Eq. 9) gives an implied price effect of 9.9%, about 4 points above the 5.8% rise in the consumer food price index over 2025. The comparison is rough. The nominal series covers gross output while the real rate refers to a sector aggregate, the deflators differ in composition (cotton, grain and livestock products against a retail food basket), and one figure is point-to-point while the other is an annual total.

If the wedge is real, producers faced faster price inflation than consumers did, and either margins along the chain or imports absorbed the difference. Reviews of agri-food supply-chain risk treat the economic position of producers, smallholders in particular, as a source of vulnerability separate from consumer-side outcomes [20]. Testing the wedge requires a producer price index for crops and livestock and regional input costs, neither of which is in the data of the earlier study. Pumping-energy requirements reported for the irrigation oasis [13] are one candidate explanation that this paper does not test.

3.7. Implications for monitoring

Three practical rules follow. A margin indicator should carry a stated window and should refuse to combine a year-on-year income change with a within-year price change. It should be reported with its real-terms counterpart and its break-even pace, since both are one-line calculations and the second turns an abstract margin into a number that can be compared with each monthly release. And any alert tied to twelve-month inflation should be read together with the base effect, because a hump in the twelve-month rate can originate a year earlier. These rules touch the earlier proposal for a dashboard with threshold alerts [15] but are narrower: they specify how the numbers feeding such alerts should be built, not where thresholds should sit. Threshold calibration needs a longer panel across regions, as the earlier

study itself notes [15]. A multi-region data set would also allow subnational composite indices of the kind now emerging [6,7] to carry a matched affordability margin as one component.

The thinning of the buffer matters more in a setting like Kashkadarya, where irrigation dependence and groundwater pressure are documented [13,14] and where regional food-security trajectories depend on productivity and resource constraints [9–12]. A cost shock originating in water or energy would reach households through exactly the channels this paper measures: prices on the one hand, and the income growth that has to keep pace on the other.

3.8. Robustness and limitations

The main numbers do not hinge on the precision of the recovered series. Treating each recovered value as uniformly distributed within its rounding interval (±0.005 index points for 2025, ±0.05 for 2026) and drawing 20,000 samples gives 95% intervals of 2.6–2.9 points for the point-to-point buffer and 3.1–3.3 points for the average-level buffer. The same exercise puts the 2025 compounded change at 5.77–5.81%, slightly below the reported 5.82%, which points to a residual bias of a few hundredths of a point in the 2025 recovery rather than random noise. No draw comes anywhere near the published 6.6 points. The simulation covers rounding only; pixel-reading error is not modelled, which is why Section 2.2 quotes the wider ±0.1-point tolerance.

Five limitations bound these results. The monthly price series was recovered from a published figure and is accurate to about ±0.1 percentage point; the official series should replace it before submission. The sample has only twenty monthly observations, no 2024 monthly values (so the average-level match cannot be done for 2025), and no seasonal adjustment. Income is a nominal per-capita aggregate, available annually and for January–June 2026 only, and it hides distribution. The price index basket needs confirmation against the official indicator. The stress tests hold income growth fixed, whereas in practice income and prices move together to some degree; they show exposure, not expected outcomes. Finally, the output-price wedge mixes two different aggregates and should be treated as a hypothesis for testing.

4. Conclusions

On matched windows the first-half 2026 affordability buffer of Kashkadarya Region is 2.7–3.2 percentage points, not the 6.6 points first published. The buffer has lost 9.5 points since 2025, and 92% of that loss is slower nominal income growth (18.1% to 9.3%) rather than faster food prices (5.8% to 6.6%), which in turn rose partly because the summer 2025 price decline was deeper than the one in 2026. Real growth of food-deflated income dropped from 11.6% to about 2.6–3.0%. The break-even monthly price pace fell from 1.40% to 0.74%, and four of the eight months of 2026 were above it. A pace like that of March 2026 would use up the whole margin in 7.5 months. The implied output deflator for 2025, 9.9%, runs about 4 points ahead of consumer food inflation, a gap that deserves a producer-price test.

Until quarterly income data and the official monthly price file are in hand, the defensible reading is that affordability in Kashkadarya is positive but thin, and thinner than the published figure suggested. For the earlier study, this implies revising its first-half 2026 estimate, Table 2 and the related passages before submission.

Nomenclature

Symbol	Definition	Unit
I_m	Monthly food-price index, previous month = 100	—
L_t	Chain-linked price level, December 2024 = 100	—
π	Compounded food-price change over a stated interval	% or fraction
g	Nominal growth of per-capita aggregate income over a stated interval	% or fraction
FAB	Food Affordability Buffer, $g - \pi$	percentage points
r	Real growth of food-deflated income	% or fraction
p, p*	Monthly food-price pace; break-even pace	% per month
n*	Exhaustion horizon at pace p	months
δ	Implied output-price effect	% or fraction
x_n, x_r	Nominal and real growth of agricultural output	% or fraction

Declarations

Data availability. All inputs are published in the earlier study [15] or in the official statistical series it cites. The monthly price values were recovered from a published figure as described in Section 2.2; the recovered series and the calculation script can be shared on request.

Ethics. The study uses published aggregate statistics only and involves no human participants.

References

1. FAO, IFAD, UNICEF, WFP, WHO. The State of Food Security and Nutrition in the World 2025: Addressing high food price inflation for food security and nutrition; FAO: Rome, 2025. https://doi.org/10.4060/cd6008en
2. Bogmans, C.; Pescatori, A.; Prifti, E. How do economic growth and food inflation affect food insecurity? IMF Working Paper WP/24/188; International Monetary Fund: Washington, DC, 2024. https://doi.org/10.5089/9798400287336.001
3. Headey, D.; Bachewe, F.; Marshall, Q.; Raghunathan, K.; Mahrt, K. Food prices and the wages of the poor: A cost-effective addition to high-frequency food security monitoring. Food Policy 2024, 125, 102630. https://doi.org/10.1016/j.foodpol.2024.102630
4. Silva e Silva, L.; Mongeau Ospina, C.A.; Fabi, C. Food price inflation nowcasting and monitoring. Stat. J. IAOS 2024, 40(2), 325–339. https://doi.org/10.3233/SJI-230083
5. KC, U.; Campbell-Ross, H.; Godde, C.; Friedman, R.; Lim-Camacho, L.; Crimp, S. A systematic review of the evolution of food system resilience assessment. Glob. Food Secur. 2024, 40, 100744. https://doi.org/10.1016/j.gfs.2024.100744
6. Xu, Y.; Chou, J.; Zhao, W.; Li, Y.; Hao, Y.; Jin, H. Constructing a composite index to evaluate multidimensional variations in food security over different regions. Ambio 2025, 54(6), 1057–1073. https://doi.org/10.1007/s13280-024-02124-2

7. Wilujeng, W.T.; Komarek, A.M.; Aziz, A.A.; Permani, R. Measuring food system resilience and implications for food price volatility. Food Secur. 2026, 18(5), 1465–1485. https://doi.org/10.1007/s12571-026-01701-5
8. Favas, C.; Cresta, C.; Whelan, E.; Smith, K.; Manger, M.S.; Chandrasenage, D.; Singhkumarwong, A.; Kawasaki, J.; Moreno, S.; Goudet, S. Exploring food system resilience to the global polycrisis in six Asian countries. Front. Nutr. 2024, 11, 1347186. https://doi.org/10.3389/fnut.2024.1347186
9. Zhang, Y.; Li, T.; Hu, Q.; He, L.; Li, X. Food security changes in Central Asia during 1992–2019 and potential assessment in different scenarios based on self-sufficiency. Environ. Impact Assess. Rev. 2025, 114, 107900. https://doi.org/10.1016/j.eiar.2025.107900
10. Ma, Q.; Yang, Y.; Bai, Z.; et al. Decoupling driving factors and high-precision prediction of food security in Central Asia based on a coupled PLS-SEM and PSO-LSSVM model. Food Energy Secur. 2025, 14(3), e70089. https://doi.org/10.1002/fes3.70089
11. Aryn, B.; Hajjaji, A. Food security in Central Asia: Challenges and pathways to resilience. Eurasian Res. J. 2026, 8(2), 185–202. https://doi.org/10.53277/2519-2442-2026.2-04
12. Devkota, K.P.; Devkota, M.; Boboev, H.; Juraev, D.; Dilmurodov, S.; Sharma, R.C. Data-driven agronomic solutions to close wheat yield gaps and achieve self-sufficiency in Uzbekistan. Agric. Syst. 2025, 225, 104291. https://doi.org/10.1016/j.agsy.2025.104291
13. Ragettli, S.; Kreiner, A.; Yakovlev, A.; Anarbekov, O.; Al-Zu'bi, M.; Urazkeldiyev, A.; Siegfried, T. Unraveling agricultural water use in three Central Asian irrigation oases using remote sensing. J. Hydrol. Reg. Stud. 2025, 59, 102414. https://doi.org/10.1016/j.ejrh.2025.102414
14. Worqlul, A.W.; Akramkhanov, A.; Gafurov, Z. Water footprints of irrigated crops in the Chirakchi Watershed, Uzbekistan. Front. Agron. 2025, 7, 1595665. https://doi.org/10.3389/fagro.2025.1595665
15. Rakhmatov, S.R. Strengthening regional food security under water and price pressures: Kashkadarya Region, Uzbekistan. 2026.
16. National Statistics Committee of the Republic of Uzbekistan. Average per capita aggregate income of the population (quarterly, by regions); SIAT indicator 2.03.01.0062; updated 29 July 2026.
17. National Statistics Committee of the Republic of Uzbekistan. Total agricultural production (quarterly); SIAT indicator 1.03.02.0009; updated 1 August 2026.
18. National Statistics Committee of the Republic of Uzbekistan. Price index for socially significant consumer goods and services, Kashkadarya Region; SIAT indicator 1.11.01.0016; updated 7 September 2026.
19. National Statistics Committee of the Republic of Uzbekistan. Socio-economic situation of Kashkadarya Region in 2025; published 20 February 2026.
20. Xue, Y.; Yan, J.; Mohsin, M.; Mehak, A. Supply chain risks in agri-food systems: a comprehensive review of economic vulnerabilities and mitigation approaches. Front. Sustain. Food Syst. 2025, 9, 1649834. https://doi.org/10.3389/fsufs.2025.1649834