

# AFFORDABILITY OF NUTRITIOUS FOODS FOR COMPLEMENTARY FEEDING IN **RWANDA**

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## KEY MESSAGES

- Several foods commonly available to households in Rwanda are rich in nutrients lacking in young children's diets. The most affordable foods to meet several nutrient needs individually and/or jointly are also the three most commonly consumed nutrient-dense foods by Rwandan households: dark green leafy vegetables, small dried fish, and pulses.
- Vitamin A and vitamin B<sub>12</sub> are the most affordable nutrients with evidence of gaps in Rwanda, and households have multiple options for filling likely gaps in consumption: beef liver (both nutrients), small dried fish (vitamin B<sub>12</sub>), dark green leafy vegetables (vitamin A), carrots (vitamin A), mango (vitamin A), and milk (both). Milk was also an affordable food in the joint nutrient analysis.
- Animal-source protein and calcium are less affordable, and only small dried fish could meet requirements at less than 10% of adjusted household food expenditure. Iron and zinc are the least affordable nutrients; the lowest-cost food options for these nutrients (dark green leafy vegetables and pulses for iron; small dried fish and pulses for zinc) are still unaffordable to many households.
- Interventions to increase household production of dark green leafy vegetables and pulses, which many households already produce, and market-based interventions to reduce the prices of these two foods and of small dried fish, could increase affordability and should be the focus of future research. Other options include iron supplementation and iron or zinc fortification or biofortification, as well as safety net programmes for the lowest-spending 10–25% of households, which will likely continue to face barriers to accessing the least-affordable nutrients, even with price reductions.

## WHY DOES AFFORDABILITY OF COMPLEMENTARY FOODS MATTER IN RWANDA?

Rwanda, a low-income country in Eastern Africa, had a per capita gross national income (GNI) of \$820 and a population of 13 million in 2019.<sup>1–3</sup> The country is landlocked, although its territory encompasses and borders numerous lakes. It is among the smallest (by area) and most densely populated countries in Africa.<sup>4</sup> Eighty-three per cent of Rwanda's population is rural, and agriculture accounts for 75% of the labour force and 31% of GDP.<sup>2,4</sup> Annual GNI per capita growth ranged from 1% to 7% between 2010 and 2019, and 39% of the population lives below the national poverty line.<sup>2,4</sup> Although the prevalence of stunting among children under age five has declined since 2005, in 2015 it was estimated at 38%, and in almost half of districts it exceeded 40%.<sup>5</sup> Anaemia prevalence among children was 37% in 2015, and wasting prevalence was 2%.<sup>5</sup>

Many children in the complementary feeding period—the period when infants and young children are 6–23 months old and breast milk is no longer sufficient to meet their nutritional needs—do not consume enough iron, vitamin A, calcium, zinc, folate, vitamin B<sub>12</sub>, and animal-source protein, and these shortfalls hinder their growth and development.<sup>6,7</sup> Unaffordability is an important barrier, among others, to the consumption of foods rich in these important nutrients. However, the extent to which unaffordability is a barrier for specific nutrients and which foods are the most affordable sources of

these nutrients are unclear. This brief summarizes the affordability of nutritious foods that could fill important nutrient gaps during the complementary feeding period and discusses implications for policy and programmes.

## METHODS

Using price and household expenditure data from the 2016–17 Rwanda Integrated Household Living Conditions Survey,<sup>8</sup> we benchmarked the cost of foods that could meet nutrient requirements against current household food expenditures to assess affordability, using a previously developed method.<sup>9</sup> Because nutrients are generally obtained from a combination of foods, we analysed whether households could afford to meet half of the daily requirements for protein, iron, vitamin A, calcium, zinc, folate, and vitamin B<sub>12</sub> for their children aged 6–23 months through specific foods. These foods were chosen because of their nutrient content and availability in Rwanda. For protein, only animal-source foods were used since plant-based sources of protein are generally not complete in essential amino acids critical for child growth and development.<sup>10</sup> We calculated the cost of realistic portion sizes required to meet 50% of nutrient needs from complementary foods (since nutrient requirements are met through a combination of foods), adjusting for refuse, cooking yield, and bioavailability where applicable. To assess the relative affordability of nutrients and foods, these costs were compared with current food spending per adult equivalent (a method of adjusting for household size and composition) for each



household with children aged 6–23 months surveyed. To assess absolute affordability, we established a threshold of 10% of household food spending per adult equivalent, based on previous analysis.<sup>9</sup> We also assessed foods in terms of their affordability for meeting needs for several micronutrients in combination. In this joint micronutrient analysis of six key micronutrient commonly lacking in the diets of infants and young children, we calculated which foods are most affordable at providing an average of one-third of a young child’s daily nutrient requirements from complementary foods. Finally, we compared the relative costs of energy among those foods that provide at least 100 kilocalories of energy in a 100-gram (g) portion (a threshold of 50 g was used for milk). It is important to note that the methods used in this research contain several limitations, which are described in Ryckman et al. (2021).<sup>9</sup>

### HOUSEHOLD EXPENDITURE AND CONSUMPTION PATTERNS

On average, 55% of total expenditures among Rwandan households with 6–23-month-old children went towards food (including food consumed from purchases, home production, and in-kind sources). Most resources for food went towards roots and tubers (23% of total food expenditure) and cereal products (22%), followed by pulses (12%), vegetables (9%), and fruits (7%). These food groups were also consumed by the largest share of households: 95% of households had consumed vegetables in the previous week, 92% had consumed cereal products, 90% had consumed roots and tubers, 85% had consumed pulses, and 72% had consumed fruits. Meat, fish, and eggs; dairy products; and nuts and seeds accounted for less than 5% of food expenditure for the average household. Although 56–58% of households consumed meat, fish, and eggs and nuts and seeds, only 28% of households consumed dairy products. The lowest-spending 20% of households consumed fewer food groups and allocated more resources to roots and tubers (28%) and less to animal-source foods (2% to meat, fish, and eggs; less than 1% to dairy). Of those lowest-spending 20% of households, only 69–77% consumed roots and tubers, cereal products, and/or pulses; only 31–45% consumed fruits, nuts and seeds, and meat, fish, and eggs; and less than 8% consumed dairy products.

Figure 1 displays the nutritious foods chosen for the analysis as possibilities to meet one or more nutrient gaps. All nutritious foods were consumed less frequently than cereal products. More than 70% of households consumed pulses (mostly dried beans) and dark green leafy vegetables (including cassava leaves, amaranth greens, and spinach), 40–42% of households consumed small dried fish and avocado (from all sources), and

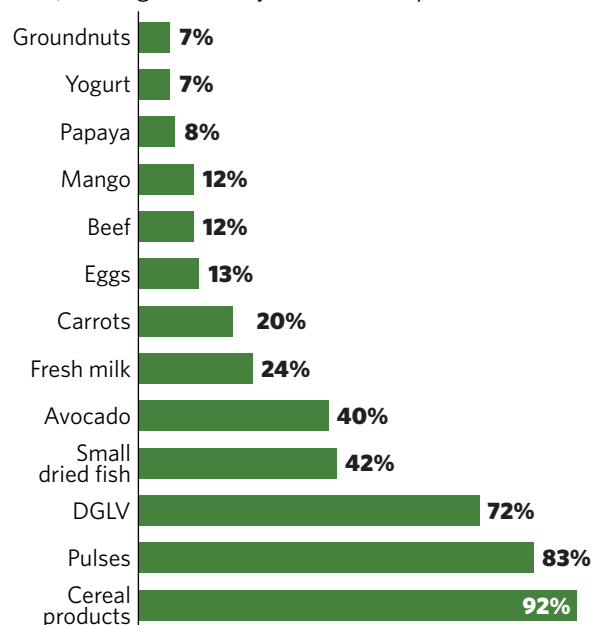
less than 25% of households consumed the remaining foods. Pulses and dark green leafy vegetables were also frequently consumed from home production—by 35% and 50% of households, respectively. Less than 6% of households consumed the other nutritious foods from home production.

### AFFORDABILITY BY NUTRIENT

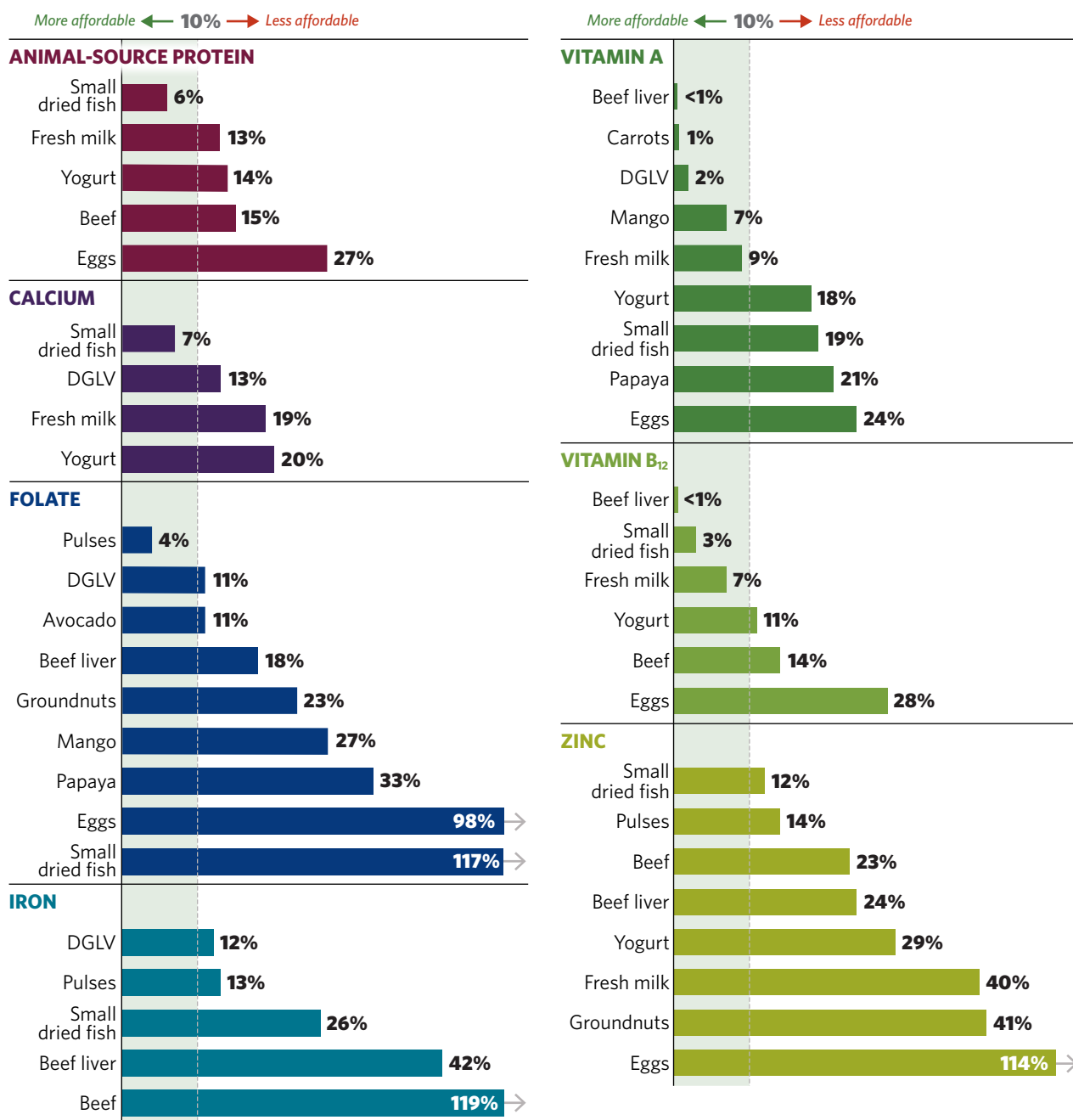
**Animal-source protein:** Small dried fish were the only animal-source food that could meet 50% of daily protein requirements for less than 10% of food expenditure per adult equivalent for the average household (Figure 2) and would be affordable to more than 90% of households at a 10% threshold (Figure 3). Fresh milk, yogurt, and beef were slightly above the 10% threshold and could be affordable for 59–70% of households, while eggs were the least affordable option and exceeded 10% of adjusted household food expenditure for 70% of households.

**Calcium:** Small dried fish were the most affordable source of calcium and could be purchased for less than 10% of adjusted food expenditure by all but 13% of households. Dark green leafy vegetables were the next lowest cost option but exceeded 10% of adjusted food expenditure for about one-third of households. Dairy was a less affordable option to fill calcium gaps in Rwanda.

**Folate:** Pulses were the only clearly affordable source of folate, costing 4% of adjusted food expenditure for the



**FIGURE 1. Percentage of surveyed households that had consumed selected foods in the past week.** Data are from 2,771 households with children aged 6–23 months in the 2016–17 Household Integrated Living Conditions Survey.<sup>8</sup> DGLV = dark green leafy vegetables.

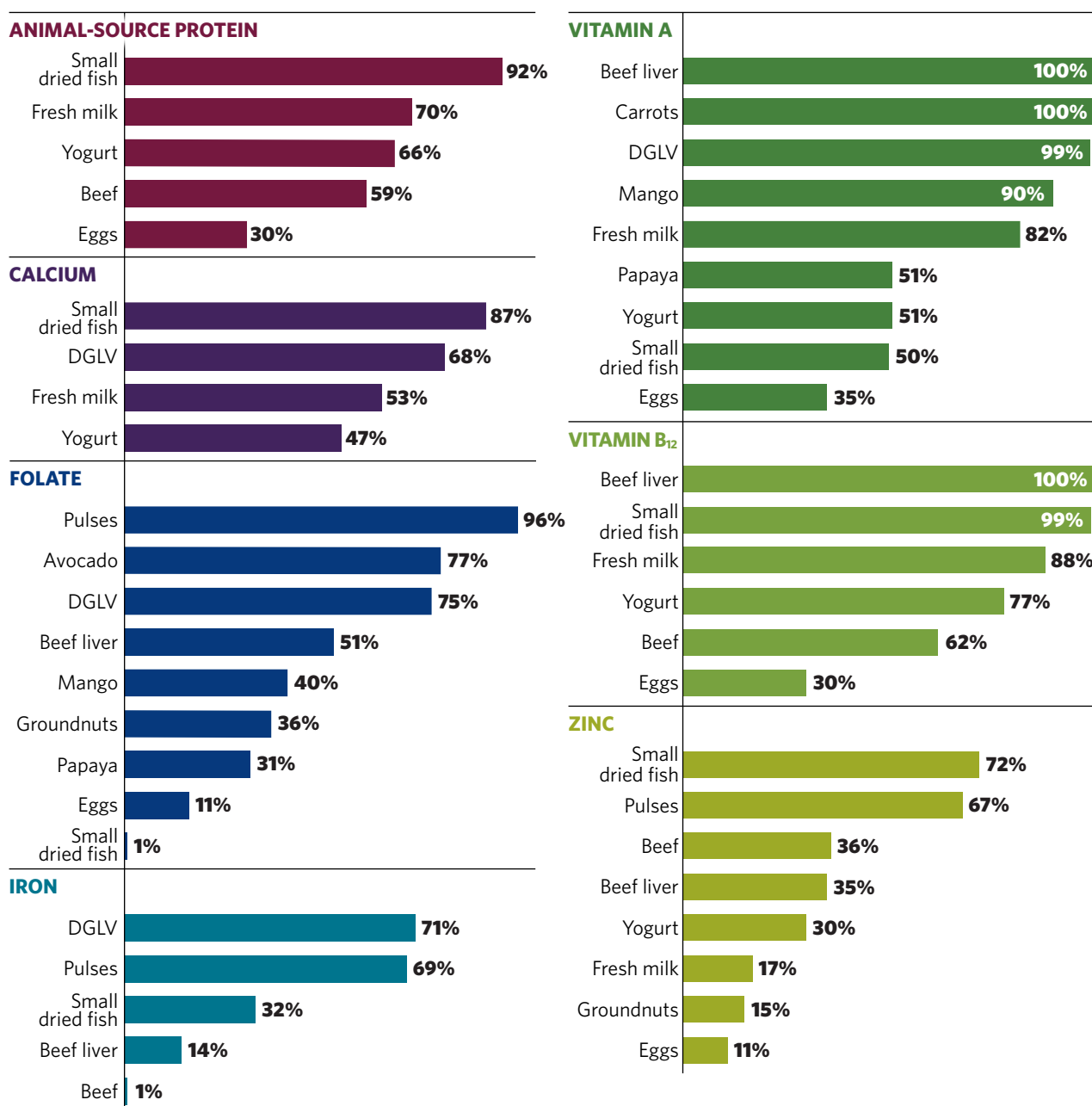


**FIGURE 2. Share of food expenditures per adult equivalent needed to meet half of nutrient requirements from complementary foods.** The dashed line represents the affordability threshold of 10%. Bars below the dashed line are considered affordable. Household expenditure data are from 2,771 households with children aged 6-23 months in the 2016-17 Household Integrated Living Conditions Survey.<sup>8</sup> Nutrient densities are mostly from the United States Department of Agriculture food composition database as well as regional food composition tables and published literature.<sup>11-17</sup> Nutrient requirements from complementary foods are from Ryckman et al. (2021).<sup>9</sup> DGLV = dark green leafy vegetables.

average household and costing less than 10% of adjusted food expenditure for 96% of households. The next most affordable foods to meet folate requirements were dark green leafy vegetables and avocado; both cost 11% of adjusted food expenditure on average and were affordable to 75-77% of households. Beef liver may be affordable

for some households, while other foods averaged 20% or more of adjusted food expenditure.

**Iron:** Dark green leafy vegetables and pulses were the most affordable sources of iron, but both foods slightly exceed the 10% threshold on average and would be considered unaffordable to 29-31% of households at



**FIGURE 3. Percentage of households able to afford portion sizes meeting half of nutrient requirements from complementary foods.** Foods were considered affordable if their required share of food expenditures per person was below the affordability threshold of 10%. Household expenditure data are from 2,771 households with children aged 6–23 months in the 2016–17 Household Integrated Living Conditions Survey.<sup>8</sup> Nutrient densities are mostly from the United States Department of Agriculture food composition database as well as regional food composition tables and published literature.<sup>11–17</sup> Nutrient requirements from complementary foods are from Ryckman et al. (2021).<sup>9</sup> DGLV = dark green leafy vegetables.

this threshold. Small dried fish, beef liver, and beef were much less affordable, and their cost exceeded 20% of food expenditure per adult equivalent on average.

**Vitamin A:** Several foods could meet half of daily vitamin A requirements while costing less than 10% of food expenditure: beef liver, carrots, dark green leafy vegetables, mango, and fresh milk. Beef liver, carrots, and dark green leafy vegetables cost less than 2% of adjusted

household food expenditure on average and were affordable for over 99% of households at a 10% threshold.

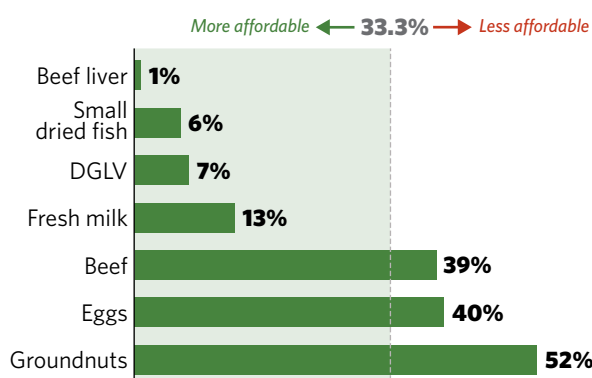
**Vitamin B<sub>12</sub>:** Several foods could meet vitamin B<sub>12</sub> requirements from complementary feeding for less than 10% of adjusted food expenditure: beef liver, small dried fish, and milk. Beef liver and small dried fish fell below the 10% threshold for 99–100% of households in Rwanda. Yogurt and beef were also close to the affordability threshold

for half or more of households, while eggs were the least affordable source of vitamin B<sub>12</sub>.

**Zinc:** While no foods fell below the affordability threshold on average, small dried fish and pulses are the most affordable sources of zinc, at 12–14% of adjusted food expenditure. However, over 25% of households would likely face affordability barriers to purchasing enough small dried fish or pulses to meet zinc needs from complementary feeding. All other foods would cost more than 20% of food expenditure.

### AFFORDABILITY ACROSS MULTIPLE MICRONUTRIENTS

Five animal-source foods (beef liver, small dried fish, milk, beef, and eggs) and two plant-source foods (dark green leafy vegetables and groundnuts) that are commonly consumed in Rwanda could meet an average of one-third of young children’s requirements for the six micronutrients combined through a daily portion size of 100 g or less (Figure 4). Of these seven foods, only four could do so while costing less than one-third of adjusted food expenditure for the average household. These four foods—beef liver, small dried fish, dark leafy greens, and milk—fell far below the one-third threshold, all costing less than 15% of adjusted food expenditure for the average



**FIGURE 4. Share of food expenditures per person needed to provide an average of one-third of a young child’s requirements for iron, vitamin A, zinc, folate, vitamin B<sub>12</sub>, and calcium.** The affordability threshold (dashed line) was set at one-third (33.3%) of food expenditures because this analysis is based on meeting an average of one-third of requirements for six micronutrients from complementary foods. The share of daily requirements of each nutrient provided by the specified quantity of food was capped at 100%. Household expenditure data are from 2,771 households with children aged 6–23 months in the 2016–17 Household Integrated Living Conditions Survey.<sup>8</sup> Nutrient densities are mostly from the United States Department of Agriculture food composition database as well as regional food composition tables and published literature.<sup>11–17</sup> Nutrient requirements from complementary foods are from Ryckman et al. (2021).<sup>9</sup> DGLV = dark green leafy vegetables.

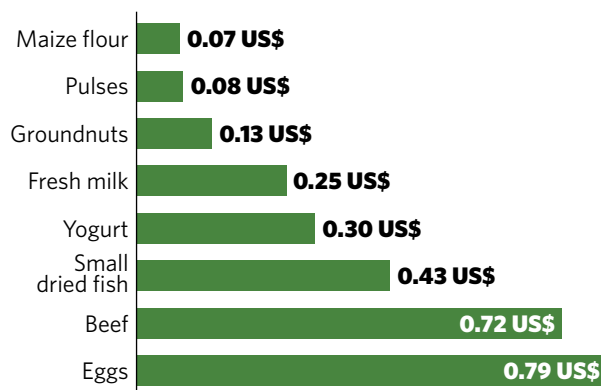
household. In addition to being affordable when joint micronutrient contributions are considered, these four foods were also among the more affordable sources of several single micronutrients. Beef, eggs, and groundnuts, on the other hand, were relatively unaffordable sources of both single and joint micronutrients.

### DIETARY ENERGY AFFORDABILITY

Apart from pulses, obtaining daily energy needs from the nutritious foods analysed would cost substantially more than maize flour, a commonly consumed but nutrient-poor staple (Figure 5). Plant-source foods such as pulses and groundnuts were more affordable to meet energy requirements than dairy, which cost less than small dried fish, beef, and eggs. With the exception of small dried fish, which was an affordable source of several micronutrients, these findings largely mirror the nutrient analysis and demonstrate the difficulty many households likely face in purchasing foods that are more nutrient-dense but much less affordable sources of energy.

### CONCLUSIONS

Vitamin A and vitamin B<sub>12</sub> are the most affordable nutrients with evidence of complementary feeding gaps in Rwanda, and adequate quantities cost less than 10% of adjusted food expenditure for the vast majority of households via several foods: beef liver (both vitamins), small dried fish (vitamin B<sub>12</sub>), dark green leafy vegetables (vitamin A), carrots (vitamin A), and mango (vitamin A). Milk is also an affordable option to meet vitamin A and B<sub>12</sub>



**FIGURE 5. Cost of daily dietary energy requirements from complementary foods (450 kilocalories).** Price data were estimated from the 2016–17 Household Integrated Living Conditions Survey and the World Food Programme’s Food Security Vulnerability Analysis and Mapping (VAM) price data.<sup>8,18</sup> Dietary energy densities are mostly from the United States Department of Agriculture food composition database as well as regional food composition tables and published literature.<sup>11–17</sup> The cost of 450 kilocalories is shown because this is the average daily dietary energy requirement for a child aged 6–23 months.

requirements for many households, and it is the second lowest cost animal-source food to meet protein needs. Liver, small dried fish, dark green leafy vegetables, and milk were also considered affordable when contributions to all six micronutrient requirements were considered jointly. Only one food could affordably meet protein (small dried fish) and calcium (small dried fish) needs at a 10% threshold, and no foods fell below this threshold for iron and zinc, although dark leafy greens and pulses were the lowest-cost options for iron and small dried fish and pulses were the lowest-cost options for zinc.

The three foods that are already the most frequently consumed by Rwandan households are also among the most affordable foods to fill nutrient gaps: dark green leafy vegetables, pulses, and small dried fish. In addition to being an affordable source of vitamin A, dark green leafy vegetables are affordable when the six micronutrients are considered in combination, and they are the lowest-cost or second lowest-cost food to fill likely gaps in iron and calcium consumption. However, their cost exceeds the 10% threshold for these nutrients, and they would be unaffordable for about 25–30% of households. It is possible that some children could still consume adequate quantities of dark green leafy vegetables through household production; more than half of surveyed households consumed at least one type of dark leafy green from their own production. Future research could explore production-related interventions that could simultaneously increase the availability of dark green leafy vegetables and improve the livelihoods of households that already produce this food.

Pulses were also among the most affordable options to fill iron and zinc gaps, but like dark green leafy vegetables they are likely unaffordable for 25–30% of households. Pulses are another food that is already frequently consumed and produced by households, and similar interventions could be a focus of future research.

Small dried fish were the most affordable source of several nutrients—protein, calcium, and zinc—and the second most affordable source of vitamin B<sub>12</sub> (and all six micronutrients jointly). However, 5–15% of households may face affordability barriers to consumption (for zinc, closer to 30%). A recent market assessment of fish in Rwanda surveyed households on their fish preferences; 88% of respondents agreed that fish is nutritious for young children, but 88–89% of households identified prices and/or availability as barriers to increased consumption. However, the survey did not distinguish between small dried fish and other fish, which are generally consumed less frequently and are less nutrient dense.<sup>19</sup> Interventions to reduce prices could make small

dried fish more accessible to lower-resource households and should be another research priority.

Notably, although eggs and chicken tend to be unaffordable foods for meeting nutrient needs across the region,<sup>9</sup> eggs were relatively even more expensive in Rwanda, and both foods were less frequently consumed.

As in several other Eastern and Southern African countries, iron and zinc were found to be the least affordable nutrients.<sup>9</sup> Although reductions in prices of small dried fish, pulses, and dark leafy greens and increased household production of the latter two foods could improve affordability, alternatives such as supplementation, fortification, and biofortification could also be explored. Finally, even if prices are reduced, some lowest-resource households may require alternative interventions such as cash transfers, food subsidies, or other social safety net interventions.

## REFERENCES

1. United Nations. *World Population Prospects 2019*. Accessed December 8, 2020.
2. World Bank. *DataBank*. Accessed February 9, 2020.
3. World Bank. *Data: World Bank country and lending groups*. Accessed February 22, 2019.
4. Central Intelligence Agency. *The World Factbook: Rwanda*. Accessed December 8, 2020.
5. National Institute of Statistics of Rwanda, Ministry of Finance and Economic Planning/Rwanda, Ministry of Health/Rwanda, ICF International. *Rwanda Demographic and Health Survey 2014–15*. Kigali, Rwanda: National Institute of Statistics of Rwanda, Ministry of Finance and Economic Planning/Rwanda, Ministry of Health/Rwanda, and ICF International; 2015.
6. Beal T, White JM, Arsenault JE, Okronipa H, Hinnouho G-M, Morris SS. Comprehensive Nutrient Gap Assessment (CONGA): A method for identifying the public health significance of nutrient gaps. *Nutr Rev*. 2021;79(4, Suppl 1):4–15.
7. Global Alliance for Improved Nutrition (GAIN), United Nations Children's Fund (UNICEF). *Comprehensive Nutrient Gap Assessment (CONGA): Micronutrient gaps during the complementary feeding period in Kenya*. Geneva: GAIN; 2021.
8. National Institute of Statistics of Rwanda. *Integrated Household Living Conditions Survey 5*. Accessed December 8, 2020.
9. Ryckman T, Beal T, Nordhagen S, Chimanya K, Matji J. Affordability of nutritious foods for complementary feeding in Eastern and Southern Africa. *Nutr Rev*. 2021;79(4, Suppl 1):35–51.
10. Semba RD, Shardell M, Sakr Ashour FA, et al. Child stunting is associated with low circulating essential amino acids. *EBioMedicine*. 2016;6:246–252.
11. U.S. Department of Agriculture, Agricultural Research Service. *FoodData Central*. Accessed January 26, 2020.
12. Food and Agriculture Organization of the United Nations (FAO)/Government of Kenya. *Kenya Food Composition Tables*. Nairobi: FAO/Government of Kenya; 2018.
13. Stadlymayr B, Charrondiere UR, Enujiugha VN, et al. *West African Food Composition Table/ Table de Composition des Aliments d'Afrique de l'Ouest*. Rome: FAO; 2012.
14. Korkalo L, Hauta-alus H, Mutanen M. *Food Composition Tables for Mozambique: Version 2*. Helsinki: Department of Food and Environmental Sciences, University of Helsinki; 2011. Accessed January 26, 2020.
15. Nyirenda DB, Musukwa M, Mugode RH, Shindano J. *Zambia Food Composition Tables*. 4th ed. Lusaka, Zambia: National Food and Nutrition Commission; 2009.



16. Steiner-Asiedu M, Lied E, Lie Ø, Nilsen R, Julshamn K. The nutritive value of sun-dried pelagic fish from the rift valley in Africa. *J Sci Food Agric*. 1993;63(4):439-443.
17. Kabahenda MK, Amega R, Okalany E, Husken SMC, Heck S. Protein and micronutrient composition of low-value fish products commonly marketed in the Lake Victoria region. *World J Agric Sci*. 2011;7(5):521-526.
18. World Food Programme. Food Security Vulnerability Analysis and Mapping (VAM): Economic: Prices. Accessed December 8, 2020.
19. Ipsos Limited. *East Africa Fish Market Assessment*. Nairobi: Msingi East Africa; 2018. Accessed December 8, 2020.