# PDPE Market Analysis Tool: Shock scenarios

## What insights can this tool provide?

Scenarios can help anticipate the effect of a market shock on the food security of different livelihood groups. Depending on their livelihood and food access profiles, households will face different levels of vulnerability to production falls or drastic changes in prices. This tool helps to disentangle the effects on different livelihood groups and to identify those groups that are likely to suffer the most. It is important to note that the scenarios will only provide an insight into the first-round income and substitution effects of a shock on the food consumption of households and does not incorporate households' coping mechanisms used in response to the shock (except substitution for a less preferred crop), which may also affect food consumption.

The tool helps to anticipate the magnitude of changes in food consumption as a result of a shock. When an actual shock occurs, an EFSA can use these scenarios to identify which livelihood groups should be assessed as a matter of priority, and check the actual effects of the shock on food consumption. Better evaluation of the severity of the shock should help with targeting and recommendations on response options, including the amount of food aid if a food aid response is appropriate.

## How to analyse, interpret and use the data

Scenarios give a rough idea of the potential effects of a shock on the food consumption of different livelihood groups. The data needed are provided by Comprehensive Food Security and Vulnerability Analyses (CFSVA), in-depth Emergency Food Security Assessments (EFSAs) and secondary sources (on elasticities for example). Shocks that can be analysed include a fall in food production as a result of drought, pests or other calamity, a price increase of the major food staple and a price decline of the main cash crop.

CFSVAs and in-depth EFSAs characterize livelihood groups according to their level of food insecurity and risks based on food consumption patterns and food access profiles. The data they collect can be used to analyse the vulnerability to shocks propagated through markets. The shock scenario tool provides insights about the vulnerability to price shocks. Vulnerability to market shocks cannot be captured through one single food security indicator, as the same household can be positively or negatively affected by different market shocks. E.g. an increase in food prices will hurt many households, but an increase in cash crops prices might benefit some of the same households. Cross-tabulations are an important way to describe vulnerability to markets-related shocks for different food security profiles.

Assuming limited opportunities and capacities to adapt livelihood strategies, households who are dependent on own production for food consumption are very vulnerable to production losses. Similarly, a price increase in the major staple will particularly affect those households that are very dependent on purchasing this food crop for consumption. Finally, households dependent on income from the sales of a major cash crop to buy food, are vulnerable to a shock that affects the cash crop prices.

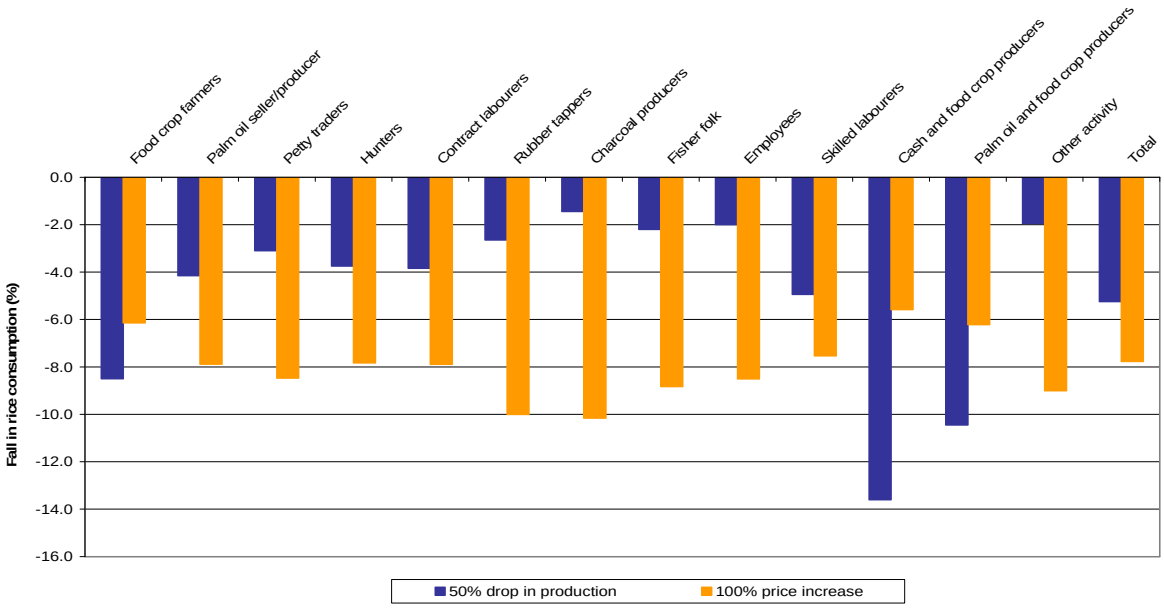
## Example: Simulation of shocks on rice consumption of different livelihood groups in Liberia

Rice is the main staple food in Liberia. It is the largest item among households' expenditures for food, accounting for 25 per cent of household total expenditures on average. It also is the most important food crop cultivated throughout the country. It is also imported in significant quantities. One recurrent shock that affects household food security in Liberia is the loss of harvest due to pests. Households cope with the consequence of this shock by reducing the number of meals and substituting rice consumption with less-preferred foods.

The effect of this shock on the rice consumption of different livelihood groups can be simulated. The size of effect depends on the size of the production fall (in this example, the fall is assumed to be 50 per cent), and the share of rice consumption that is sourced from own production, for which data comes from the CFSVA.[1] The effects are shown in the chart below.

The impact of a pest is relatively small, largely because the bulk of households' rice consumption is purchased. Not surprisingly, those livelihood groups that have the highest share of rice consumption sourced from own production (food crop farmers, cash and food crop producers and palm oil and food crop producers) are the groups hardest hit by the shock. Their food consumption falls by over 8 percent. One might have expected that food crop farmers would be affected most, but the simulation shows that the households that produce both cash and food crops would actually be the worst affected.

*Expected impact of a 50 percent fall in domestic rice production or a 100 percent rice price increase on rice consumption of different livelihood groups in Liberia*




Another shock that can be simulated is an increase in the price of rice. This can be caused by a fall in production or by an increase in the price of imported rice (e.g. by an exchange rate devaluation). For a rice price increase of 100 percent, charcoal

[1] Government of Liberia and WFP, *Comprehensive Food Security and Nutrition Survey*, October 2006.

producers and rubber tappers are the most vulnerable. Their food consumption declines by 10 percent (see chart above).

## Limitations of the tool

- As the precision and reliability of the underlying data (from the CFSVA and the elasticities) is limited, the simulation gives an insight into the approximate impact of a shock on food consumption, and not a precise estimate. In this context, a particular problem relates to the seasonality of underlying information, which may not be captured by the CFSVA/EFSA. This may bias the estimation of the indicators.
- Elasticities vary by income level, but different elasticities for each livelihood group are usually not available. Even for the country, elasticities might not be available. Yet, because of their strong correlation with income, price and income elasticities from countries with similar levels of per capita income could be used. (See PDPE MARKIT data on elasticities.)
- The simulation only provides an insight into the first-round impact of a shock on the food consumption of households and does not incorporate livelihood strategy changes made by households in response to the shock, with the exception of substitution for a less-preferred staple. In particular the tool does not address other coping strategies which may also affect food consumption.
- The spreadsheet currently does not take into account the persistence of the shock and only gives a point estimate of the anticipated effect.

## How to calculate the indicators

a) Impact of a fall in production of the main staple food on household food consumption

$$\Delta C_{LG} = \Delta q \times \gamma_{LG}$$

$\Delta C_{LG}$ : change in main staple food consumption for livelihood group LG (in %)
$\Delta q$ : change in main staple crop production (in %) *(shock)*
$\gamma_{LG}$ : share of main staple consumption sourced from own production

In some cases, $\gamma_{LG}$ is not available, and is estimated using the proportion of households who only consume their own production. In that case, all households should be included in the denominator, not only the ones that consume or produce the staple.

b1) Impact of a price increase of the main staple food on consumption (without substitution effect)

$$\Delta C_{LG} = \varepsilon_{\text{Price}} \times \Delta p \times \alpha_{LG} \times \beta_{LG}$$

$\Delta C_{LG}$ : change in food consumption for livelihood group LG (in %)
$\varepsilon_{\text{Price}}$ : price elasticity of demand for the main staple food
$\Delta p$ : price change of the main staple food (in %) *(shock)*
$\alpha_{LG}$ : share of main staple food bought by livelihood group LG
$\beta_{LG}$ : share of staple consumption in total consumption

Note of explanation: The first two terms ($\varepsilon_{\text{Price}}$ x $\Delta p$) would calculate the change in consumption of the main food staple if all of the main food staple was bought. Usually, only part of the consumption of the main food staple is purchased. The third term ($\alpha_{LG}$ ) is, therefore, added. Furthermore, to move from the change in

consumption of the main staple to the change in total food consumption, the fourth term ($ß_{LG}$) is added.

This last term ($ß_{LG}$) can be estimated using various proxies, but it is suggested to use a proxy on the basis of the relative frequency of food consumption, data generally available in CFSVA. First, divide the number of days the staple is consumed by the total number of days of the week (7). Second, repeat this for all food groups and calculate the cumulative value of these relative food consumption frequencies. Finally, divide the relative staple food frequency by the total cumulative value to have a proxy of the importance of the staple food in total food consumption. .

In some cases, $\alpha_{LG}$ is not available, and is estimated using the proportion of households who purchase 100% of the staple consumed. In that case, all households should be included in the denominator, not only the ones that consume or produce the staple.

b2) Impact of a price increase of the main staple food on consumption (substitution effect)

$$\Delta C_{LG} = \varepsilon_{Cross} \times \Delta p \times \delta_{LG} \times \chi_{LG}$$

$\Delta C_{LG}$ : change in food consumption for livelihood group LG (in %)
$\varepsilon_{Cross}$ : cross price elasticity of demand for the less-preferred staple with respect to the price of the main staple food
$\Delta p$ : price change of the main staple food (in %) *(shock)*
$\delta_{LG}$ : share of less-preferred food bought by livelihood group LG
$x_{LG}$ : share of less-preferred food in total consumption

To calculate this last term ($x_{LG}$), please use the same approach as for calculating $ß_{LG}$.

In some cases, $x_{LG}$ is not available, and is estimated using the proportion of households who purchase 100% of the less-preferred staple consumed. In that case, all households should be included in the denominator, not only the ones that consume or produce the staple or less-preferred food.

c) Impact of a price decrease of the main cash crop on household food consumption

$$\Delta C_{LG} = \varepsilon_{Income} \times \Delta \pi \times \theta_{LG}$$

$\Delta C_{LG}$ : change in (main staple) food consumption for livelihood group LG (in %)
$\varepsilon_{Income}$: income elasticity for (main staple) food
$\Delta \pi$: price change of cash crop (in %) *(shock)*
$\theta_{LG}$ : share of household income derived from the cash crop (include all monetary and non-monetary revenues).

Example: Different impact of shocks on rice consumption in Liberia

To give a simple numerical example, the impact of various shocks on two different livelihood groups is calculated. The number of livelihood groups to be compared can be adapted according to the underlying data. (For an example with more groups see the spreadsheet). We assume the following values for the elasticities: $\varepsilon_{Price}$ : -0.4, $\varepsilon_{Income}$ : 0.8, $\varepsilon_{cross}$ : 1.0.

*Table: Data from the CFSVA of Liberia*

| Livelihood group | Rice consumption from own production ($\gamma_{LG}$) % | Rice consumption from purchases ($\alpha_{LG}$) % | Bulgur consumption from purchases ($\delta_{LG}$) % | Share of rice in total consumption ($\beta_{LG}$) % | Share of bulgur in total consumption ($x_{LG}$) % | Income derived from palm oil production ($\theta_{LG}$) % |
|---|---|---|---|---|---|---|
| Food crop farmers (FC) | 17.0 | 64.1 | 96.9 | 16,4 | 7,6 | 3.0 |
| Palm oil producers (PO) | 8.3 | 81.7 | 92.7 | 14,0 | 12,1 | 76.0 |

a) Impact of a 50% fall in rice production on consumption

$$\Delta C_{FC} = -50 \times 0.17 = -8.5\%$$

$$\Delta C_{PO} = -50 \times 0.083 = -4.2\%$$

b1) Impact of a 100% increase in the price of rice on consumption (without substitution effect)

$$\Delta C_{FC} = -0.4 \times 100 \times 0.641 \times 0.164 = -4.2\%$$

$$\Delta C_{PO} = -0.4 \times 100 \times 0.817 \times 0.140 = -4.6\%$$

b2) Impact of a 100% increase in the price of rice on consumption of bulgur (substitution effect)

$$\Delta C_{FC} = 1 \times 100 \times 0.969 \times 0.076 = 7.4\%$$

$$\Delta C_{PO} = 1 \times 100 \times 0.927 \times 0.121 = 11.2\%$$

c) Impact of a 25% price decrease in the price of palm oil on rice consumption

$$\Delta C_{FC} = 0.8 \times -25 \times 0.03 = -0.6\%$$

$$\Delta C_{PO} = 0.8 \times -25 \times 0.76 = -15.2\%$$

One could think of the first three simulations as a chain of events. First, pests destroy part of the crop and rice consumption of food crop farmers declines by 8.5 percent. Then, rice prices increase and food crop farmers reduce food consumption by 4.2 percent because they are also buying rice and a given income now buys less rice. But as a coping strategy, they substitute bulgur (the less preferred food crop) for rice, increasing consumption by 7.4 percent.

There are only two livelihood groups that depend heavily enough on palm oil for their income to be significantly affected by a decrease in palm oil prices.

Palm oil producers are most vulnerable. For them, a 25 percent drop in palm oil prices reduces food consumption by 15 percent.

Possible refinements:

i) Break down livelihood groups into food secure and food insecure households (see spreadsheet/advanced).
ii) A sensitivity analysis on the values for the elasticities and the magnitude of the shock (see spreadsheet). For example, a price elasticity of -0.5 and a rice price increase of 150 percent leads to food consumption decrease by 19 percent for rubber tappers and charcoal producers.
iii) Account for consumption substitution effects between rice and alternative staples (see spreadsheet/basic/E24-E37)).
iv) Simulate the shocks for geographical areas or livelihood zones, rather than livelihood groups, which could be helpful to determine which areas should be targeted.

## Data needs, data sources

| Data needs | Data source |
|---|---|
| Food sources: Household sources of the main staple food by livelihood group (bought ($\alpha_{LG}$)/own production ($\gamma_{LG}$)) and less-preferred foods (bought ($\delta_{LG}$)). | CFSVA, in-depth EFSA |
| Consumption patterns: Share of main staple in total consumption (e.g. rice ($\beta_{LG}$)) and of alternative staple food (e.g. bulgur or cassava) by livelihood group (e.g. bulgur ($x_{LG}$)). | CFSVA, in-depth EFSA |
| Income sources: Share household income derived from main cash crop by livelihood group ($\theta_{LG}$) | CFSVA, in-depth EFSA |

| Parameter needs | Data source |
|---|---|
| Typical shocks that may occur | CFSVA |
| Typical coping strategy applied after shock | CFSVA, in-depth EFSA |
| Price elasticity of demand for major staple food | MARKIT/elasticities database; literature review |
| Income elasticity for major staple food | MARKIT/elasticities database; literature review |
| Cross price elasticity of demand for the less-preferred staple with respect to the price of the main staple food | MARKIT/elasticities database; literature review |

[PDPE, 19vi2007]