

# Co-creating solutions for mitigating food loss and waste in Brazil

A look at the value chain  
of essential crops and  
consumer behavior

White paper based on expert discussions  
at the BASF Creator Space™ São Paulo

 **BASF**  
We create chemistry

## Challenges



**1**

How to improve sustainability of potato production in Brazil?

page 8



**2**

How to reduce waste and losses throughout the Brazilian Wheat Production Chain?

page 14



**3**

How to Reduce FWL in the tomato supply chain in Brazil?

page 20



**4**

EduCreator: A Broad Awareness Campaign to promote better consumer behavior

page 24

Final Remarks [page 30](#)

References [page 31](#)

## Acknowledgments

We would like to express our deepest appreciation to all those who cooperated with this project realization.

Agnes Hanashiro, PREFEITURA DE SÃO PAULO

Alan Bonjanic, FAO

Allan Kardec Braga Ramos, EMBRAPA

Andrea Koga Vicente, UNICAMP

Andrea Wang Catalani, PREFEITURA DE SÃO PAULO

Augusto Boccia, SÃO RAFAEL

Dag Mendonça Lima, UNICAMP

Daniel Taichi Watanabe, LABRUNIER

Eduardo Sekita de Oliveira, SEKITA

Érico Trebeschi, TREBESCHI

Gustavo Porpino de Araujo, EMBRAPA

Helio Mattar, INSTITUTO AKATU

Luiz Alberto de Paula Bueno, LAVOURA E PECUÁRIA IGARASHI LTDA

Luiz Cornacchioni, ABAG

Marcelo Mikio Hanashiro, EMBRAPA

Murillo Freire, EMBRAPA

Prof. Franco Lajolo, USP

Prof. Helio Vanucchi, USP

Prof. Jorge Mancini, USP

Prof. Paulo César Tavares de Melo, ESALQ / USP

Prof. Rui Curi, USP

Prof. Walter Belik, UNICAMP

Renata Anaruma, MAPA-SP

Renata Welinski da Silva Seabra, ONU/PACTO GLOBAL

Ricardo Magnani, ANPEI

Ricardo Nardon, BUNGE

Ricardo Young, CÂMARA MUNICIPAL DE VEREADORES DE SÃO PAULO

Rita de Fátima Alves Luengo, EMBRAPA HORTALIÇAS

Roberto Carlos Painelli, COOPAVEL

Roger Mizushima, BUNGE

Tatiana Lorocca, NESTLÉ

## Purpose

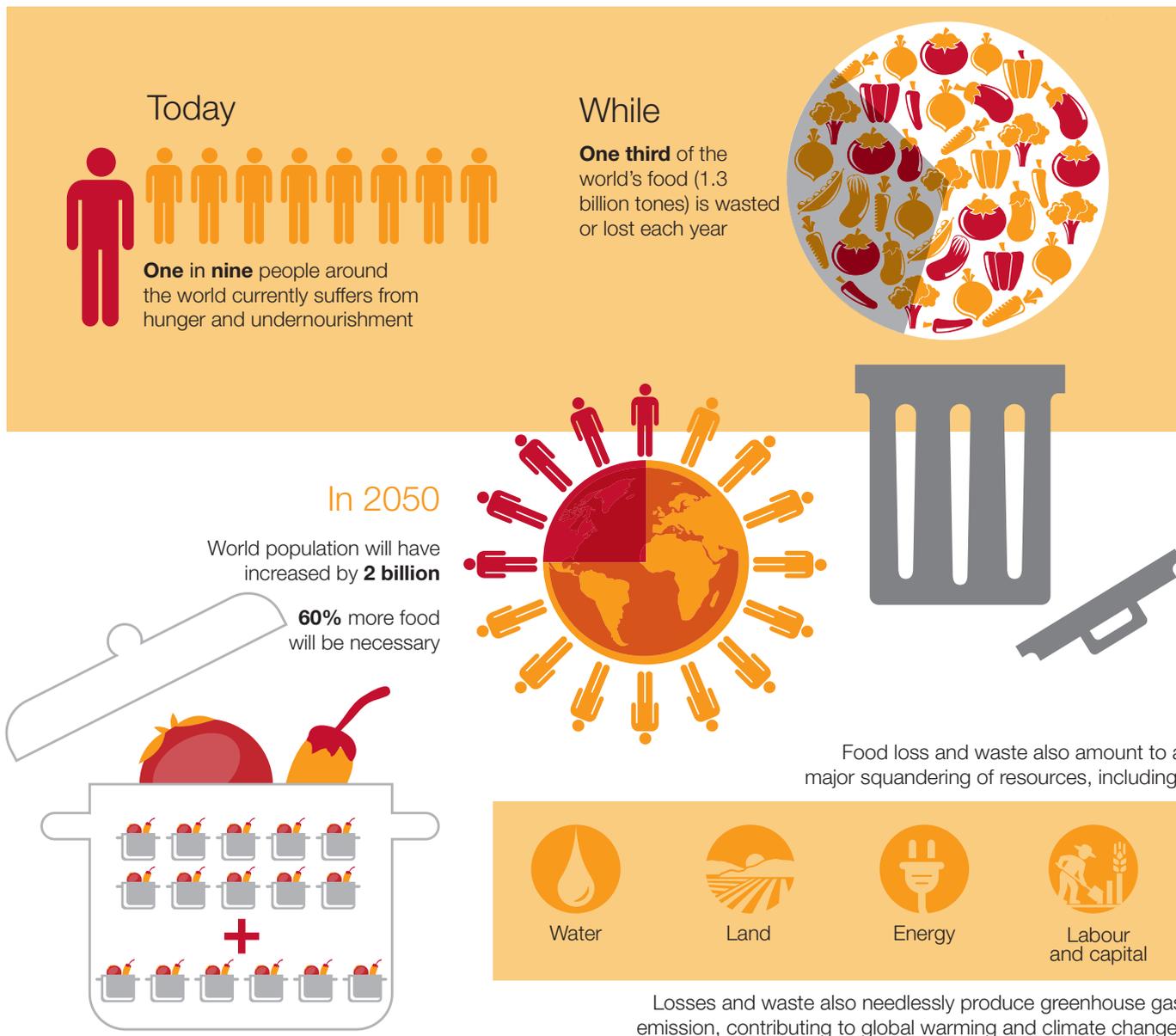
One in every nine of the world's people currently suffers from hunger and malnourishment (FAO, IFAD and WFP 2015). In 2050, the world population will have increased by a further 2 billion, and increasingly rich, urban populations will demand 60% more food than they did in 2005 and 2007 (Alexandratos and Bruinsma 2012). Furthermore, other factors,

including climate change, will create additional complications for long-term food security. In short, if action is not taken now to address this critical situation, world food imbalances will soon affect even greater numbers of people.

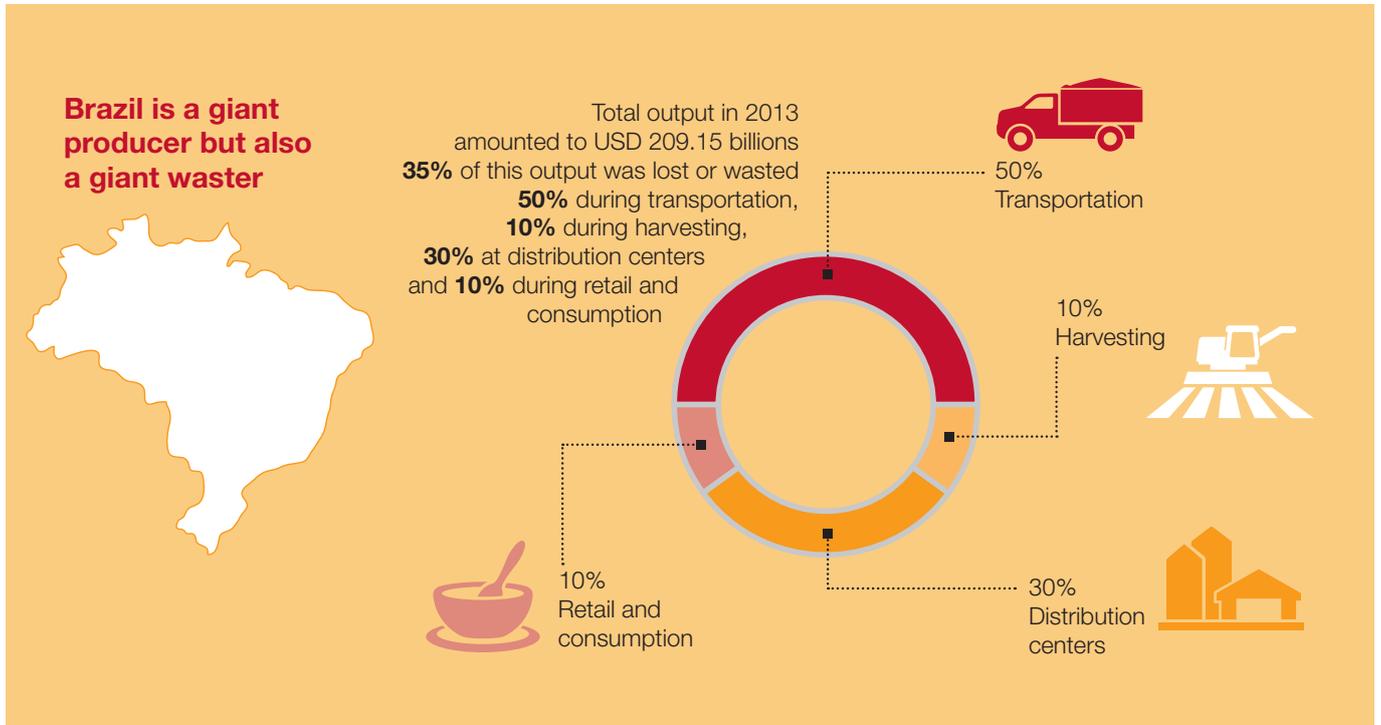
According to a study by the United Nations (UN), one third of the world's food is wasted or lost each

year as a result of production and consumption practices (FAO 2011). It is worth noting that besides the ethical factors involved, food waste and losses (FWL) have noteworthy environmental and socioeconomic impacts as well (FAO 2013). The discarding of organic material, for example, generates disproportionately high levels of CO<sub>2</sub> – up to 3.3 billion

## Waste and losses facts



## Facts about waste and loss



tons per year – thus worsening greenhouse effects. Moreover, FWL represent the inefficient use of limited production factors and inputs which could otherwise be employed to produce goods and services. The FAO estimates that FWL consume approximately 250 cubic kilometers of water and 1.4 billion hectares of land every year (FAO 2013).

BASF, its partners and others civil society representatives agree that one way to contribute toward filling this growing gap between human needs and global food output is to think about the sustainability of food production and consumption around the world.

**Brazil, as a large food producer and consumer, will undoubtedly play a very important role in facing these challenges in the near future.**

According to FAO, Brazil is the world's second largest food supplier after the United States. It will become the world's largest food supplier by 2050, through the combined growth and efficiency gains of both agribusiness and smallholder farming. Already, family farmers produce 70% of food in Brazil, the Agrarian Development Ministry estimates. Without a doubt, efforts to maintain smallholder and family farming will have knock-on effects in decreasing pressures on rural-urban migrations, strengthening food security for urban populations, and improving living conditions for the farmers themselves.

During the past decade, Brazil has advanced considerably in terms of hunger mitigation, and was finally removed from the Hunger Map in 2014. Brazil achieved this with public social-spending policies and other government incentives for food production. Nevertheless, despite the implementation of several successful projects focused on increasing the sustainability of farming and consumption practices, the current levels of FWL are still a matter of concern. It is worth noting that the poor condition of roads and the lack of other modes of transportation are an important reason for food loss and can cancel out gains in sustainability made by farmers. This is a situation found throughout much of the developing world.

As a result, Brazil is not only recognized as one of the world's largest food producers, it is also regarded as one of the world's top

ten food wasters, with nearly 35% of total output going straight to the trash every year. In 2013, total food output was worth \$209.15 billion (FAOSTAT, 2016). If 35% of this food production was not wasted, but instead contributed to total output, Brazil would produce food worth roughly \$73.2 billion more each year. That is nearly 3.3% of Brazil's \$2.24 trillion GDP in 2013.

In Brazil, experts believe that food losses due to the transportation and handling of food account for 50% of all FWL. The other 50% of losses come from harvesting (10%), at distribution centers (30%) and during the retail and consumption stages (10%) (Val 2012).

## With this in mind, BASF organized the Creator Space™ Tour São Paulo in 2015 as part of its 150<sup>th</sup> anniversary celebration.

The Creator Space™ Tour focused on finding solutions to improve the sustainable production and consumption of food. The event brought together a wide variety of stakeholders with extraordinary interest and expertise for this cause – consumers, local businesses, students, scientists, technicians, policy-makers, and more – and engaged them in a multi-day co-creation exercise. In addition, the Creator Space™ Tour São Paulo

had the opportunity to gain from merging with the 10th edition of Top Ciência, an initiative developed in Brazil and other Latin American countries in which experts from a variety of areas come together to co-create agricultural technologies.

As a diversified chemical company, with more than 100 years of experience providing solutions to improve agricultural production all over the world, BASF believes



that it can contribute considerably toward mitigating the negative impacts of food waste and losses, thus helping to feed the world in a more efficient and dignified way.

Innovative agricultural solutions are actually written into BASF's DNA, as demonstrated by actions such as the groundbreaking innovation of the Haber-Bosch process for the synthesis of ammonia at the beginning of 20th century, which enabled the large-scale production of fertilizers. Today, as an industry leader with a broad portfolio of chemical and biological products, BASF helps farmers to sustainably increase the yield and quality of their crops. By nurturing a culture of innovation in alignment with customers' needs, BASF technologies aim to ensure that crops grow healthier, stronger, and

more resistant to stress factors such as heat and drought besides help to avoid pests diseases and invasive plants in important crops.

Given the multidimensional nature and complexity of FWL issues, the co-creation efforts were focused on a few specific crops that are commonly grown in Brazil. Crops selected were chosen for a variety of reasons: because of higher volumes of waste and losses, economic and social importance, and the potential impact of wasting less of a particular crop. At this point, it is important to state that we define waste as the voluntary act of discarding viable food, which commonly happens during the final stages of distribution and happens most often in developed countries. Losses, in contrast, refer to the decrease in edible food mass that



Solutions to loss and waste require an integrated approach including increased efficiency, sustainability and awareness in:

- Consumption
- Retail
- Logistic
- Farming





### Tubers and roots

The tubers and roots food group, besides accounting for a significant fraction of FWL, also has a significant socioeconomic importance in Brazil. Gross production value was approximately \$1.9 billion in 2013, while waste and losses

totaled \$202.9 million, or 10.38% of total output, according to FAO estimates. Potatoes are the most important crop in this group: Actions to reduce FWL in this crop have great potential to improve living conditions of smallholders and family farmers.



### Grain

The failure of logistic infrastructure, as well as poor coordination between grain producers, handlers, and processors, increases the level of FWL along the grain production chains in Brazil. Despite low domestic production, Brazil is a large consumer of wheat. Brazil needs new economic and social

policies for wheat that will lead to an increased domestic supply of wheat, which will improve national food security. In the case of grain, waste in production and resources – including water, labor, and land, among others – is higher than losses in the final production of grain.



### Tomatoes

FWL are high in the fruit and vegetables production chains, mainly due to the high perishability of these crops. In the ten largest capital cities in Brazil, average annual consumption of vegetables is 35 kilos per capita, while per capita vegetable

wastage equals 37 kilos each year. Tomatoes are significant in terms of both wasted and lost volume and the economic impact of the loss. According to some estimates, FWL for this particular crop can reach 54% of output (see FAO 2011).

takes place during production, post-harvest or during processing. This happens most often in developing countries. With this in mind, we chose to co-create ways to reduce FWL in the potato, wheat and tomato production chains.

Waste on the supply side is clearly a big problem, but BASF, its partners, and experts know that to mitigate loss, consumer behavior must also be addressed. Wasteful cooking and eating habits, such as the reluctance to eat misshapen

fruits and vegetables, are significant sources of food waste. With this in mind, the Creator Space™ Tour São Paulo focused on reducing FWL in specific crops and also pursued the co-creation of solutions to improve consumer education. Participants did not address the quality of roads and infrastructure, though this is a major issue, as stated above. These problems need to be addressed by government bodies.

This white paper is an interim report that summarizes some of

the proposals emerging from the Creator Space™ Tour São Paulo and parallel events. This report is organized around the discussion of various “challenges,” or themes brought to the table at the Summit. All of the challenges focus on high levels of FWL in Brazil. Challenge 1 is about potatoes, Challenge 2 focuses on wheat, and Challenge 3 deals with tomato supply chain problems. Finally, Challenge 4 relates to consumers’ behavior and its impact on FWL.

# CHALLENGE : 1

## How to improve sustainability of potato production in Brazil?



In terms of human consumption, potatoes are the third most important food crop in the world after rice and wheat.

(International Potato Center, 2016)

In Brazil, potatoes are grown in the states of Minas Gerais, São Paulo, Paraná, Rio Grande do Sul, Bahia, Goiás and Santa Catarina. Since this crop is very sensitive to weather conditions and farm management, growers' profiles and levels of yield are quite different across these areas.

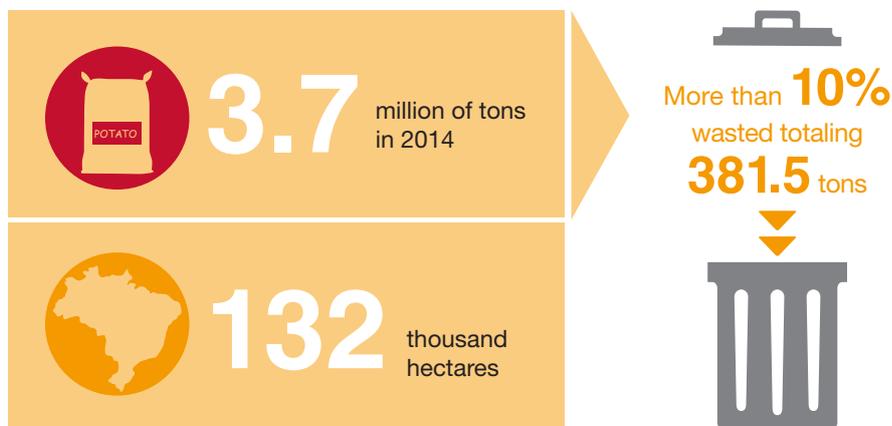
In general, "production and distribution" encompasses harvesting, cleaning, classifying, packaging, marketing, and consumption. Between one stage and another, one should also consider the transport and storage required to move potatoes to the next step in production.

In 2014, Brazilian farmers produced 3.7 million of tons of potatoes, using an area of 132 thousand hectares (FAOSTAT, 2015).

According to the Brazilian Potato Association (ABBA), industrial products include frozen potato foodstuff (9% of total output), and chips and straw potatoes (11% of total output). Fresh potatoes account for more than 62% of the market, whereas seeds accounted for around 8%. The "waste industry" consumes the remaining 10%. This waste is equivalent to approximately 381.5 thousand tons of potatoes going straight to the trash every year. One should note that this amount would be enough to meet the entire import demand of regions such as East Africa, Central Asia, South America, or East Asia in 2013.

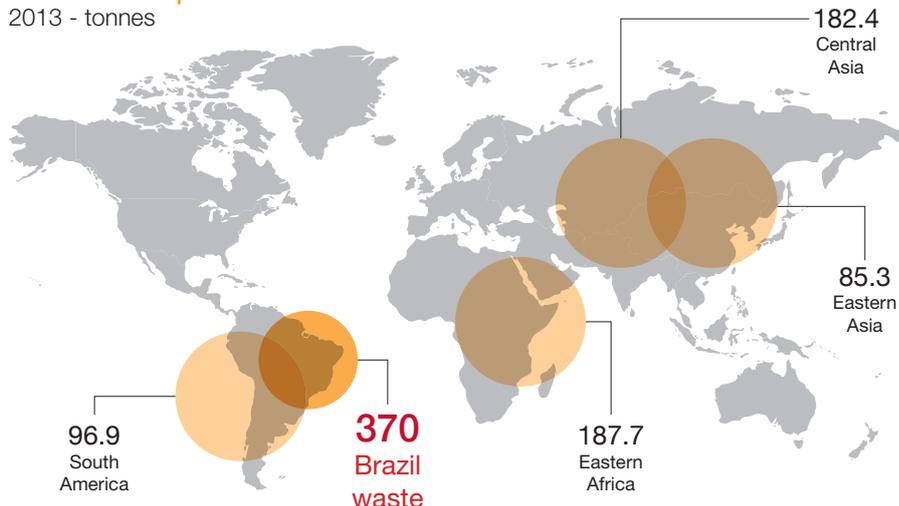
Farmers and experts usually point to bad farming practices such as planting at the wrong time, choosing bad varieties, poor fertilizing and phytosanitary treatment, harvesting at the wrong maturity, inadequate post-harvest processing (washing and drying), inadequate packaging, inadequate handling and transportation, long exposure in retailing centers, low producer prices, and lack of marketing information as major causes of waste and losses of potatoes (Henz and Sieglinde 2004). In other words, the high occurrence of disease and physiological problems, mechanical damage, and the long

### Potato production in Brazil



### Potato imports

2013 - tonnes



## Major drivers of waste and losses



### High proportion of out-spec

bad farming practices and mechanical damages



### Bad consumption habits

strong preference for yellowish skin and washed potatoes



### Lack of access

to alternative markets and delays between production and consumption

Growers include smallholders and larger farmers producing potato varieties for industry, as well as for smaller fruit and vegetables markets.

time elapsed between production and consumption constitute a perfect recipe for high levels of waste and losses in this crop.

Consumption and production are quite distinct depending on the end purpose. For a number of reasons, FWL volumes tend to be higher among smallholders growing table potatoes.

First, smallholders tend to have less access to technical and financial assistance and are thus more likely to suffer severely when things go wrong. This leads to a higher proportion of lower-grade potatoes in their final output. Second, buyers at fresh produce markets often have a cultural preference for “good-looking” potatoes with yellowish skins and pulp that are between 42-70 mm. But the varieties that have such characteristics tend to be inferior to others in terms of pest and disease tolerance, as well as yield.

Some smallholders also grow potatoes for industrial processing.

Tolerance for small defects not affecting nutrition and safety is higher among industrial consumers. But industrial output will nevertheless only find a market after processing to remove some defective parts.

Smallholders typically lack the capacity to do this processing, or they do not produce at volumes that would make them of interest for third party processors. This is also a problem in the fresh potato market, since misshapen potatoes

could be used as ingredients for mixed vegetable products after only minimal processing.

Thus, the major challenges to be confronted are the high proportion of off-spec potatoes resulting from deficient farming, processing, and marketing practices – including the reluctance of consumers to buy misshapen potatoes. This is what needs to be addressed to cut down waste levels in potato production chains.

After intense debates, participants commonly developed ideas to address each of these problems simultaneously through combined actions that will decrease the volume of off-spec potatoes and help find alternative market channels for misshapen ones.





## A project for improving farming and developing alternative marketing channels for potatoes in Brazil

Actions suggested address both angles of the problem simultaneously. On one hand, they will enable farmers to improve their farming techniques with better access to technology and best practices. On the other hand, with an understanding that it is virtually impossible to produce zero off-spec potatoes, actions will also support farmers in locating markets for these goods.

BASF has a central role in implementing this project, since it

is able to bring together farmers, industry and alternative market agents around a common objective, which will improve returns. However, strong commitment to this cause by other agents is paramount for the success of the project.

In the field, BASF already supports farmers in pursuing increased sustainability through better technical assistance, stewardship training, and sustainability measures to boost yields without neglecting the matter of crop “appearance.” Farmers, on the other hand, need to commit themselves to better practices and understand that a more comprehensive view should be preferred over short-term, cost-based decisions. In particular, tools such as AgBalance™, developed by BASF, will play a central role. AgBalance™ is a holistic method

for assessing sustainability in agriculture and identifying key drivers for improvement. It involves gathering key data, analyzing it with algorithms, and interpreting results that compare the relative sustainability of alternative production methods, processes or systems being analyzed.

During processing and classification, BASF can work through partnerships to ensure the correct classification of potatoes into special and off-spec categories. However, when losses are related to bad practices in processing – such as washing and drying the wrong way – representatives of the processing industry need to be involved in correcting those practices.

In the marketplace, BASF can promote enhanced coordination and communication between

The participation of NGOs and supermarkets committed to the cause of promoting increased consumption of misshapen fruits and vegetables will be essential.

farms and industry and farms and alternative markets, since the current low level of coordination between smallholders makes these connections difficult.

Moreover, alternative channels for marketing off-spec potatoes will also need partners who operate on new logistic routes, since traditional distribution centers won't take these products. Logistic improvements, especially for the fresh segment, will also reduce losses caused by the long times spent in the distribution stage.

Of course, these efforts would be of limited value without corresponding

improvements in consumer education. Many campaigns around the world have advocated with consumers for the cause of “ugly fruits” and food waste reduction. In line with this trend, the Creator Space™ Tour São Paulo came up with another proposal, the Edu-Creator project, which is discussed later in this document (Challenge 4).

Implementing the action plan will benefit a variety of agents throughout the supply chain. In particular, growers and smallholders will gain from positive brand impacts (in the case of IP), enhanced training, higher revenues, and better

## Reducing waste and losses of tubers in Brazil

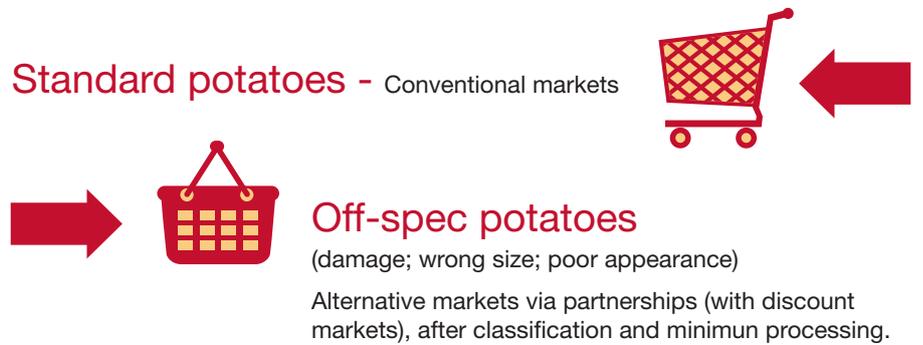
Technical Assistance

Sustainability measures

Stewardship training

---

Reduce off-spec, increase yield and find alternative markets



Positive outcomes for:

- Input industry**: Standard potatoes requires better inputs
- Retailers**: Standardized and expanded supply of potatoes
- Consumers**: Better prices and increased satisfaction
- Environment**: Reduced waste of natural resources
- Farmers**: reduced proportions of off-spec and higher value-added



identification of their particular needs. Processors and retailers will gain improved access to highly nutritious products and new technologies, and they will be able to improve their reputation through their support of small farmers and environmentally friendly practices. Finally, the input industry will enjoy a unique opportunity to familiarize itself with the needs of small farmers, an increasingly important agricultural sector.

Small and middle-sized farmers in Brazil represent an important share of agricultural production, and policies involving this sector usually have a significant social impact. These farmers often play an important role in supplying local

supermarkets and school meals. Thus, the proposed action plan will increase the availability of local fresh foods and broadly improve access to food.

FWL and its accompanying negative environmental impact will certainly drop consistently as the number of participants in the program increases. In addition, sizeable new business opportunities will be created, especially in niche markets.

This business model is primarily based on the case of potato production, but can easily be adapted and expanded to other vegetables or fruits. Notably, the project could also be implemented

in other countries and regions around the globe that face similar challenges in reducing FWL.

BASF has been successful in implementing similar projects in countries such as Peru, Colombia and Brazil. These projects have given producers more productivity and better access to markets.

**The benefits of the projects obviously end up reaching other agents on the production and distribution chain.**

# CHALLENGE : 2

**How to reduce waste and losses throughout the Brazilian wheat production chain?**



## Per capita consumption of wheat has been increasing globally, largely as a result of higher income levels worldwide.

At the same time, factors such as climate change, and export restrictions have been playing havoc with wheat supply levels worldwide. As a result, prices have risen persistently during the past decades, increasing from \$2.61 per bushel in 1990 to \$7.75 in 2012 (USDA, 2016). The low level of stocks – in the face of strong demand – have also caused significant volatility in prices.

Wheat is a typical crop for temperate climates, but a number of technological developments – especially in the seed industry – have enabled production in other parts of the globe. Research

centers in Brazil have achieved considerable advances in this field, such as the development of varieties well-adapted for cultivation in the Brazilian Cerrado, thus boosting national output and yield levels.

Nevertheless, despite being one of the largest consumers of wheat by-products (given its large domestic processing industry), Brazil has performed very poorly in its attempts to grow high quality wheat efficiently and in sufficient quantity. Production suffered a significant slowdown after the implementation of trade liberalization policies and deep cuts to subsidies in the early-1990s. While annual wheat-product consumption is around 12 million tons (MT), only 5 MT are produced internally, forcing the country to import more than 7 MT of wheat per year (FAOSTAT, 2016 – based on data for 2013).

Wheat is a risky crop – highly sensitive to climate and soil conditions – and it is consumed continuously by industry. Since quality and availability are subject to risk, producing wheat requires

more parties to coordinate their actions compared to other crops. Agents within the wheat supply chain often complain about inefficiencies caused by the lack of coordination between actors, which certainly increases the overall level of waste and losses in the sector.

For most growers, yield parameters are a major factor in the decision about which variety to produce. One reason is that millers pay growers by volume. At the same time, they struggle to achieve the quality standards demanded by the food industry. In response, millers often blend locally produced wheat with higher quality imported wheat, thus creating a high level of variability in wheat flour characteristics. The food industry, further ahead in the value chain, incurs higher costs by having to adjust processing machinery to cope with such high variability. Another common complaint regards public policies in the sector, such as the establishment of classification standards and floor prices. Industry says these policies are inefficient and fail to fulfill its needs.

## Wheat production in Brazil

Lack of coordination and isolated, risky decision-making.



**Farmer**  
Producers for maximum yield per hectare

**Mill**  
Pays by volume and struggle to achieve quality standards required by industry (blend)

**Processing industry**  
Faces higher costs by having to adjust processing machinery to cope with high variability in wheat flour features

Major squandering of resources



Water

Energy

Land

Labour and capital

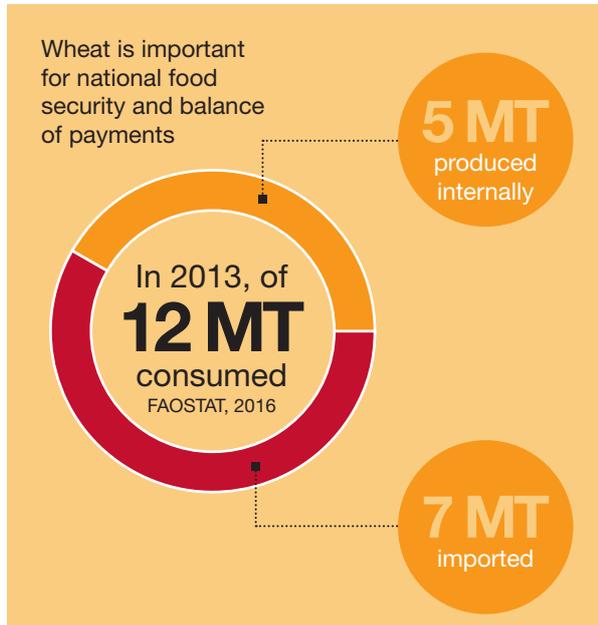
In other words, under the current governance structure, transactions are made almost on a spot-market basis, with price mechanisms guiding production decisions, low levels of hierarchical control among agents, and contracts that are difficult to enforce. Many agricultural transactions involve these common attributes, and it is not by chance that there is a growing global effort to more effectively integrate agro-food chains to avoid these problems.

Interestingly, strong government intervention led Brazil to be almost self-sufficient in wheat by the 1980s, but several specialists argue that this excessive intervention was also the cause for the sector's breakdown during the 1990s. In fact, years of price floors and guaranteed commercialization policies, without accompanying incentive mechanisms for improving quality, turned out to be a recipe for an increasing mismatch between product quality and industry requirements.

Without a doubt, this lack of coordination throughout the domestic wheat supply chain is harmful for Brazil as a whole, and it impacts the wheat industry in a variety of ways.

Millers incur extra costs to “fix” low-quality wheat and are threatened by the recent trend of flour imports by actors in the national food industry. The food industry's cost structure is also

Growers cannot reap the benefits of selling improved varieties.

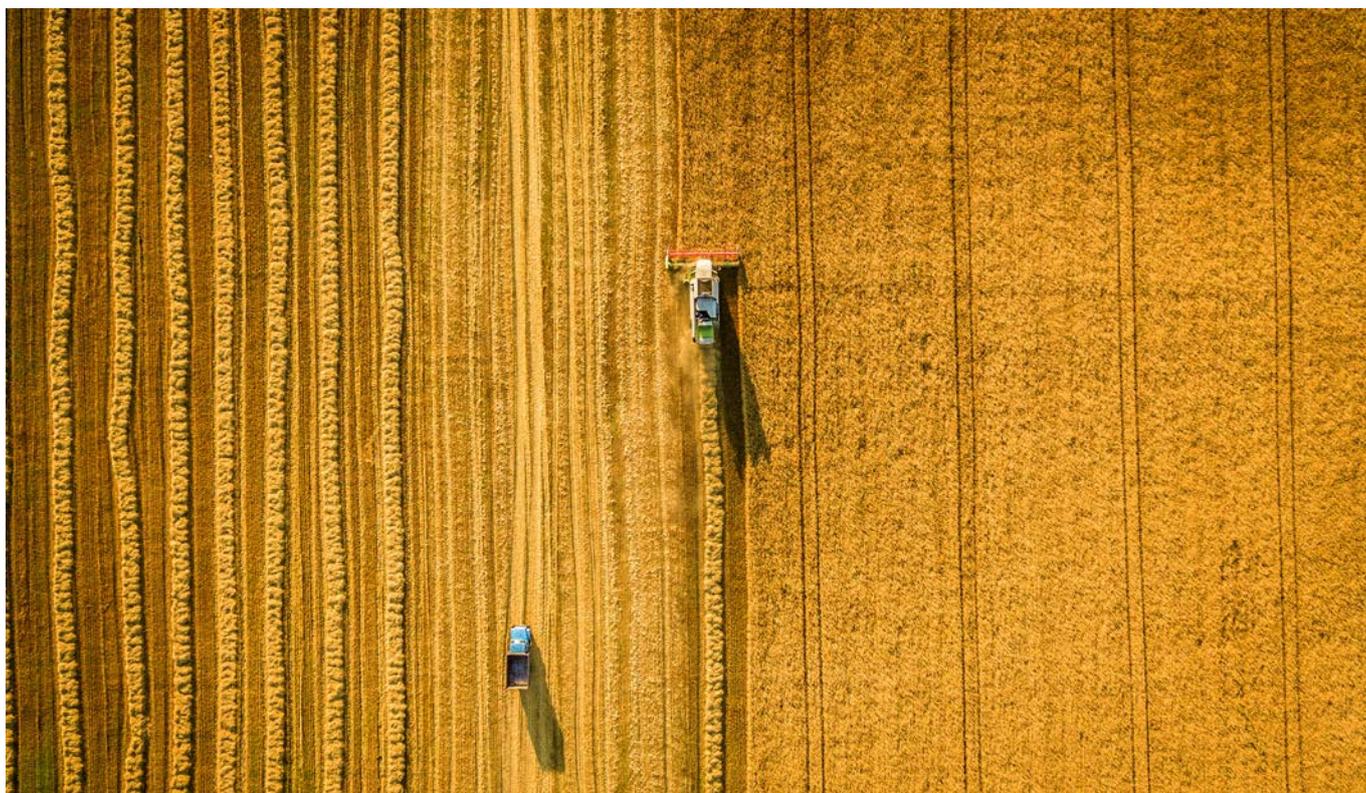


- Overall waste and losses almost **12%** of which:
- ★ **50.8%** at farm level
  - ★ **42.4%** at storage in cooperatives
  - ★ **42.2%** during transport (farm to cooperative)
  - ★ **2.6%** during transport (cooperative to mill)

### Major Challenges

- Increased imports of flour (threatening internal milling activities)
- Trade balance (wheat is one of primary products imported by Brazil)
- Inefficiency leads to higher prices and environmental risks





adversely impacted when facilities are brought to a standstill or producers experience other delays in manufacturing. Ultimately, consumers pay more for wheat products, a key component in the Brazilian diets.

These inefficiencies lead to the waste of land, capital, labor, and other resources that, if employed more effectively, could improve social welfare for society as a whole. An industry slowdown and the replacement of national production by imports result in domestic job losses, mostly in the areas of growing and milling. Dependence on imports also puts Brazil's food security at risk, with potential direct impacts on welfare. Finally, processors relying on imports suffer from spiking costs during periods of devaluation of the Brazilian Real – as they currently are due to Brazil's ongoing political and economic crisis.

The University of São Paulo (USP/ESALQ) and the University of Illinois (UIUC) estimate waste and losses of 11.8% of total wheat output in Rio Grande do Sul state – which produces around 50% of total national output. From that amount, 50.8% is lost at the farm level, 42.4% at cooperatives during storage, 4.2% during transport from farm to the cooperatives, and 2.6% during transport from cooperatives to mills. This amount represents on average 200,000 tons per year, enough to feed 3,000 people for a year (Bartholomeu et al. 2015).

Inputs such as seeds, fertilizers, herbicides, insecticides and fungicides represent \$11.3 million. Operations – including planting and harvesting – are valued at \$11 million, including the costs of permanent labor.

This is not only a question of reaping the potential benefits of

**The current scenario calls for urgent action, which should be undertaken jointly by agents in the industry.**

a better-coordinated value chain, but also a question of maintaining the operation of some domestic production stages.

With this in mind, BASF, its private and public partners, customers, and civil society aim to bring to the public attention a series of actions that could mitigate the challenges faced by the wheat industry and generate various business opportunities for stakeholders. The Pre-Competitive consortium will act to improve governance of the supply chain, optimizing decisions to generate overall gains that will be shared by all stakeholders.



## The Pre-Competitive Consortium in the wheat supply chain

The Pre-Competitive Consortium will work to accommodate incentives, increase joint control of value chains, and improve contracts by establishing clear standards for quality and prices.

Short to mid-term solutions will be implemented by common agreement between the main actors in the supply chain: growers, millers and food processors. By setting clear rules for quality and prices, the processing industry can transform the current way of doing business. A system of premiums paid for high quality flour – defined by the food industry at a point between cost savings and import prices – tends to be a

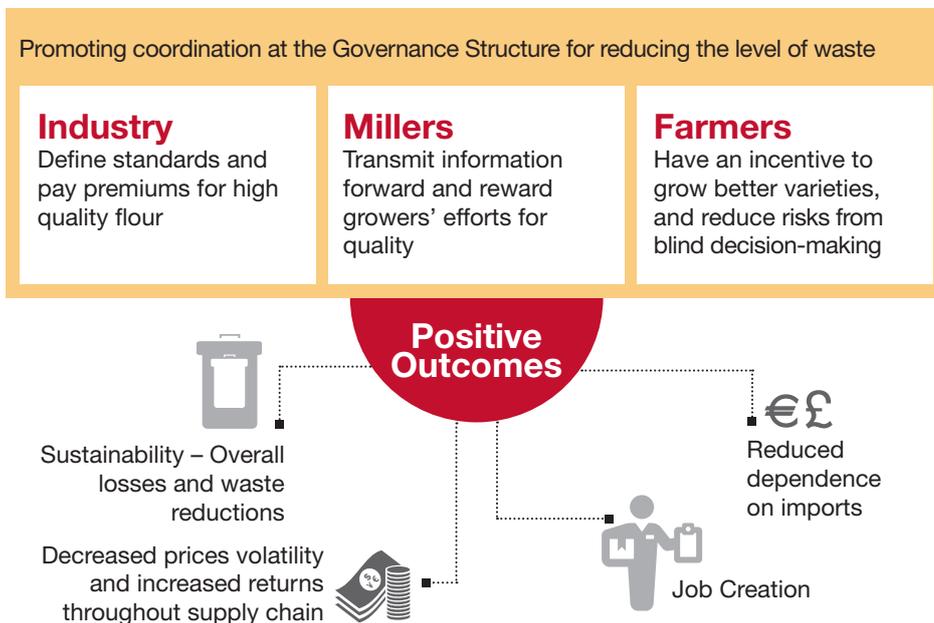
better incentive than current floor prices and classification policies. Millers should be in charge of transmitting information and rewarding growers’ efforts to deliver high-quality wheat. Growers, when able to access more symmetric information, are able to decrease the risks of acting individually, and thus have more incentives to adopt better crop varieties and farming practices. Industry concentration, in this particular case, could make it easier to achieve compromise between different agents.

Long-term solutions must be adopted in parallel with short and mid-term ones. Since wheat productivity in Brazil is below the world average, research and

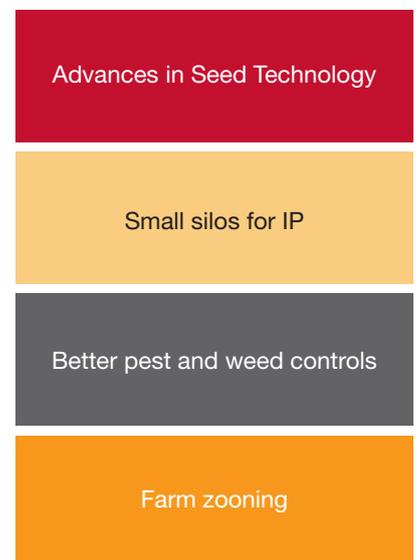
development in seed technologies must advance in order to boost yields. Furthermore, the development of better pest-control practices and farm zoning will have a positive impact on yield levels. Logistic improvements are clearly necessary to decrease overall costs and motivate segregation by quality. They will depend heavily on public sector intervention, even if through public-private partnerships. Employing smaller silos within the constraint of preserving scale economies is a promising and feasible practice for efficient IP (Identity Preservation), as different varieties can be more easily segregated even if produced in smaller quantities.

The proposed consortium must be seen as the starting point of a process that will elevate governance onto a better and more effective level.

## Wheat Pre-Competitive Consortium



## Long-term Actions





Once agents can clearly perceive the economic benefits of favoring quality over quantity, the formal consortium will no longer be necessary, although the clear information it provides for all agents will always be crucial.

A better-integrated value chain will certainly bring about various positive outcomes. First, we can expect a significant reduction in the levels of waste and losses – currently 10% of output – and the improved use of factors and resources employed in wheat production. Second, it will contribute to decreased volatility in prices and improved quality for the food industry, enhanced efficiency in milling, and better returns for farmers. By increasing overall returns throughout the value chain, the Consortium will also create a

range of business opportunities for other agents.

The crop protection industry, for instance, will benefit from increased demand for inputs, since higher-value varieties of wheat demand more crop protection services. Logistics operators would enjoy a range of new opportunities, as a more profitable value chain would increase capacity to invest in transportation and storage facilities. The seed technology industry, both private and public, will have a field of possibilities in the development of new specialty varieties.

Reduced dependence on external suppliers, enhanced job creation, higher levels of food security, and price reductions, among other factors, will benefit the

Brazilian economy as a whole. In particular, the reduction in external dependence can be quite beneficial for the balance of payments, since wheat constitutes one of Brazil's largest commodity import categories (Júnior, Sidonio, and Moraes 2011). Additionally, job creation and price reductions would bring benefits to Brazil's lower-income population, since wheat by-products are a large part of the Brazilian diet.

Last but not least, increasing production of wheat in Brazil can reduce global shortages.

BASF is interested in bringing together principal stakeholders and offering agriculture solutions for the common objective of a better and more sustainable wheat production chain.

# CHALLENGE : 3

**How to reduce FWL  
in the tomato supply  
chain in Brazil?**



Brazil is the 8th largest producer of tomatoes in the world, with an output of 4.19 million tons in 2013. Major tomato-producing states include Goiás, Minas Gerais, São Paulo and Bahia. Approximately two thirds of the output goes to fresh-produce markets, while one third goes to industrial processing. Interestingly, tomatoes grown for the processing industry in open-field settings can be marketed in fresh tomato markets during shortages. Industrial tomatoes are produced mainly in Goiás, where 80% of production is destined for processing. In contrast, in São Paulo, only 12% of production is processed.

Tomatoes are very fragile fruits, consisting of 93-97% water. Thus, intrinsic characteristics make the amount of losses for this crop very high. In Latin America, losses and waste of fruits and vegetables are estimated at 20% on the farm, 10% during post-harvest (handling and storage), 20% during processing and packaging, 12% during distribution and 10% during consumption (FAO 2011). These estimates fall within the range of percentage losses estimated by Lana et al. (1999) for the particular case of tomato production and distribution in Brazil.



According to these estimated percentages, more than 2.27 million tons of tomatoes were wasted in Brazil in 2013 alone – some 54% of the output for that year.

## More tomato volume is wasted than effectively consumed.

This amount of waste is higher than the quantity of tomatoes produced by Indonesia, the Philippines, Thailand, or Paraguay in 2013.

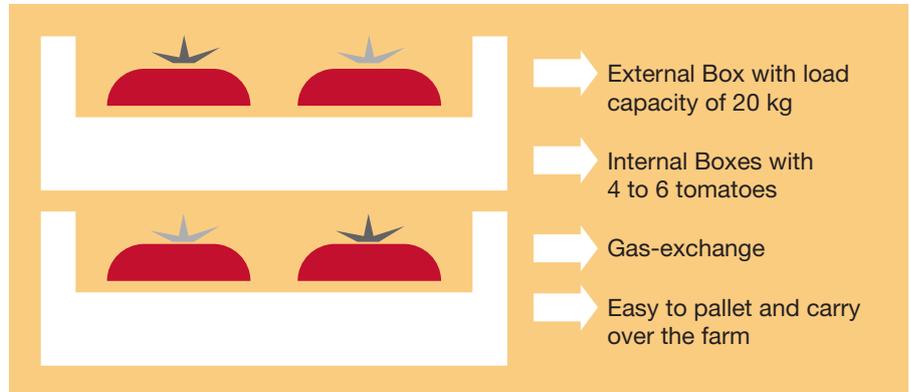
Experts say the major challenges for the tomato value chain include low-quality tomatoes, the long time-lapse between farm and table, mechanical damages (accidental cuts and crushing), diseases faced in the field, poor transportation conditions, inadequate packaging, and inappropriate display in supermarkets. Together, these difficulties drive losses and waste to alarming levels. Moreover, consumers' behavior, such as over-handling fruits at the grocery store before placing them into carts, buying more than needed for family consumption, and avoiding the purchase of misshapen fruits makes the situation even worse.

## Tomato Production in Brazil



Farming inefficiencies aside, after intense debate, experts came to the conclusion that properly packaging tomatoes plays a paramount role in reducing waste and losses, since over-handling tomatoes is considered one of the major causes of waste and losses. With this in mind, BASF would like to engage the public in a dialogue about a multi-packaging system for tomatoes, combined with other actions that would reduce FWL for this crop.

## Multi-Box System to Avoid Over-handling Tomatoes



## Multi-packaging system for tomatoes in Brazil

BASF believes that the development of a multi-box system with external and internal boxes, compatible with pallets, with an external box load capacity of 20 kg, can drastically reduce handling requirements during transportation. Undoubtedly, waste reduction will be even greater when the multi-box system is used in conjunction with both standard farm carts (to improve farm-level harvesting and packaging of tomatoes) and refrigerated trucks for longer-distance transportation.

The project will require that logistic operators manage reusable and recyclable packages, thus ensuring hygiene, cleanliness, reusability, and correct treatment of residuals. Retailers near distribution centers

### Nearby Consuming Markets



### Distant Consuming Markets



will employ a returnable packaging system, while those farther away (650 km, for example) should use recyclable boxes to avoid the high costs of returning containers.

Internal boxes will be adapted to different consumption profiles according to willingness to pay and proximity to distribution centers, among other factors. For consumers with a higher willingness to pay, the size of containers will be customized for small-scale consumption (approximately 500g or 4 to 6 tomatoes for individual consumers), and packaging will allow gas exchange with the external environment. This will avoid losses and waste by allowing consumers

to buy more specifically according to their needs and by extending the product life cycle.

When combined with an enhanced traceability system, the multi-box system will work as an incentive for adopting best practices by exposing those growers who deliver low-quality tomatoes or use less-sustainable techniques. Efforts to negotiate freight by weight instead of volume – a problem also identified in the current distribution system of other fruits and vegetables – are also necessary to avoid losses during transportation.

Given the shocking rates of losses and waste for this crop, much progress can be made with this project. It would reduce tomato damage and create additional incentives for quality improvement through a more direct connection between growers and consumers.

Increased costs from the multi-box system can be offset with the increased supply of tomatoes.



Consequently, the overall impact of the project should be price-neutral, with a possibility of a decrease in prices to consumer.

The project creates a wide array of business opportunities, with a particularly big one for on the company that designs and manages the circulation of the boxes throughout the distribution network. Operators using refrigerated trucks and those able to see the potential of this transformative project could also benefit.

The best farmers will be rewarded for their efforts to maintain quality and sustainability once tomatoes become traceable. With this, new opportunities will emerge for certification companies.

Consumers and society as a whole will benefit from better use of resources, output increases, lower prices and a reduction of the adverse ethical and environment effects of FWL. A broader range of packaging size options for individual consumers will be a benefit to those committed with the cause of FWL.

Notably, parts of the project are highly dependent on regulatory authorities who must enforce better practices and standards for tomato packaging. In addition, consumers must also be willing to buy tomatoes and other fruits and vegetables in a new way.

BASF can contribute significantly by providing its expertise and product portfolio, as well as engaging stakeholders around a common objective of having more sustainable production and distribution chain for tomatoes.

## Major Outcomes

- 

Overall losses and waste reductions
- 

Better returns for efficient farmers
- 

Business Opportunities – mainly for input industry and logistic operators



# CHALLENGE : 4

## How to promote consumer awareness to reduce FWL?



As we have shown earlier in this document, improved consumer awareness about the social, economic, and environmental impact of food waste is necessary to mitigate high levels of FWL. According to the FAO, 10% of cereals, 4% of roots and tubers, 2% of oilseeds and pulses, 10% of fruits and vegetables, 6% of meat, 4% of fish and seafood, and 4% of milk are wasted at the household-level in Latin America each year (FAO 2013).

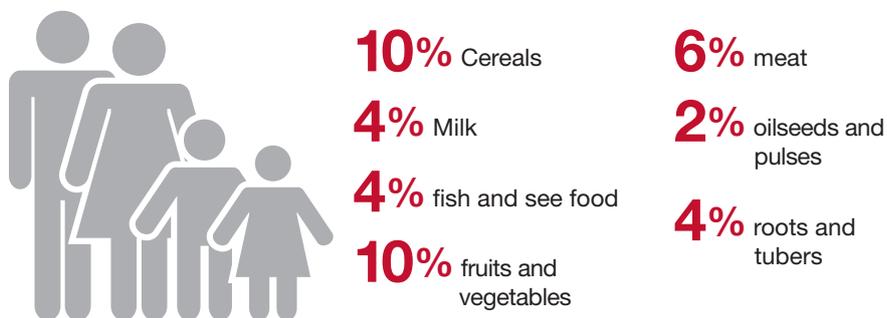
On the one hand, increased per capita incomes have led to higher levels of fresh food consumption, and the rush of modern life has increased the preference for processed fruits and vegetables all over the world. On the other hand, our society has advanced very little in terms of food consumption education, to the extent that the average consumer knows very little about the impact of FWL and how to avoid it. This was one of the facts that came up frequently in discussions about consumer behavior at the Creator Space™ Tour São Paulo. The voluntary act of discarding viable food is something that happens frequently during the end-consumption stage. Food waste (FW) happens most often in medium and high-income countries.

However, it is important to consider that consumption-based FWL can go beyond the direct effects of food waste.



### Consumers Behavior in Brazil

Food Waste and Loss in Latin-American Annual household level:



### Major cause



### Drivers in Brazil

- Cultural Habits (such as avoiding ugly fruits and vegetables)
- Regulation discouraging food donation
- Lack of awareness about impacts of waste



### Outcomes

- Socioeconomic**  
reduced wellbeing, increases hunger, and worsens family budget
- Environmental**  
organic waste constitutes 52% of overall waste in Brazil
- Health**  
obesity cause more deaths than hunger today – 56% of adults are obese in Latin America

## The consumption of potatoes is illustrative of how consumer preferences may contribute to overall FWL.

Producers know that the current varieties of fresh potato are not the best in terms of agricultural or nutritional traits. They also know that washing potatoes before displaying them on supermarket shelves diminishes their life cycle. Nevertheless, consumers have strong preferences for washed and yellowish potatoes, and producers respond accordingly.

In Brazil, it is possible to observe that some cultural habits,

regulations, and a general lack of awareness about the harmful effects of FWL contribute to the current situation. Consuming the edible but less attractive parts of some fruits and vegetables, for example, is sometimes looked down upon. Furthermore, cooking with and eating misshapen fruits and vegetables, or buying leftover produce at a discount, is considered shameful by many people. Regulations about the safety of food donated by restaurants and supermarkets discourage donation of prepared food, since donors are held liable for food safety, even if the donated food was edible at the time of donation. Lawmakers have been discussing making changes to the regulations since 1988.

Wasteful consumer practices impact society and the

environment. For instance, low levels of composting mean Brazilian waste has a high organic component – currently 52% of total waste. In the United States, in comparison, this value totals only 12% (IPEA 2012).

According to the national household income survey conducted by the Brazil Geography and Statistics Institute (POF-IBGE), an average family in Brazil with a monthly family income between R\$ 1,245 and 2,490 (approximately \$336 to \$672), spends R\$ 379 (approximately \$102) on fruits and vegetables per month. That means average waste of 10% costs R\$ 37.90 per month. If this waste value was invested with a return rate of 8% per year, it would result in a total savings of R\$ 1.2 million after 70 years – an average life expectancy.





Another point is the problem of obesity. Experts say reasons for obesity are increasing income levels combined with full schedules. This leads people to eat more processed food. Even when incomes increase only slightly, the lower middle class tends to consume these products excessively. The World Economic Forum states that obesity-related

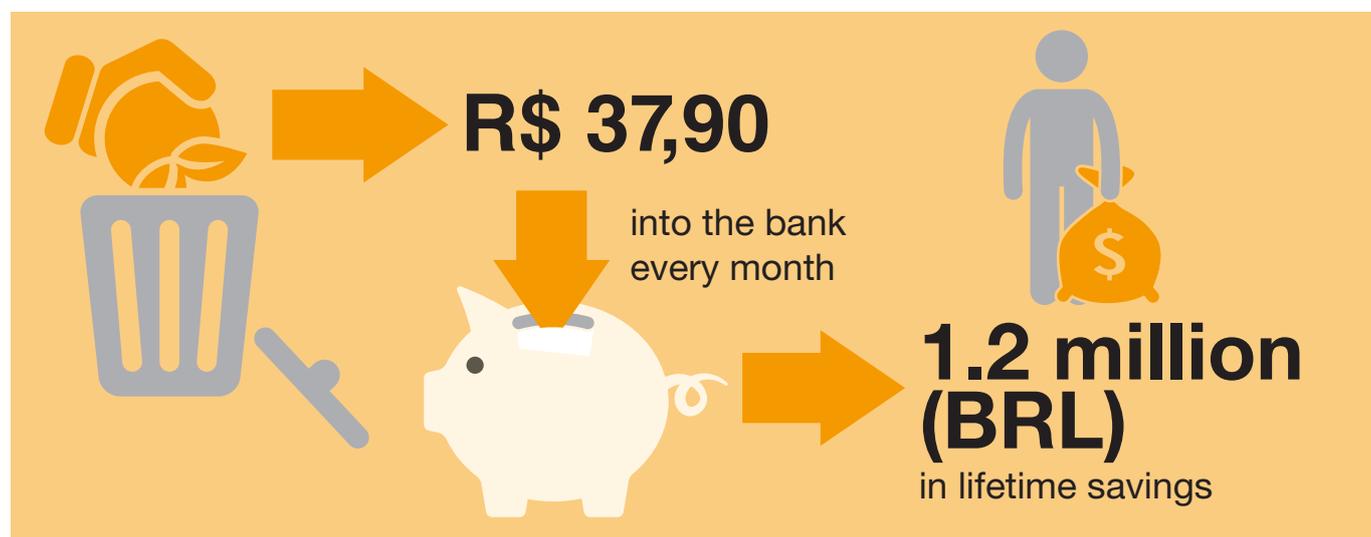
diseases such as diabetes and heart disease cause more deaths than malnutrition itself. More than 56% of adults in Latin America are considered obese, while the world average is 34%.

It is clear that consumer education has great potential to positively impact FWL, with positive knock-on effects for family budgets

and health. BASF believes that much of consumer behavior that leads to waste comes from a lack of awareness about the social-economic and environmental impacts of FWL.

With this in mind, BASF aims to introduce to the public a series of ideas cocreated to fight against wasteful consumer behavior.

## The Economics of Food Waste





## A broad awareness campaign to promote better consumer behavior

A project for an awareness campaign focusing on avoiding food waste and promoting nutrition education. The project is divided

into three stages: developing partnerships with stakeholders, developing a portfolio of tools for education and training, and developing key performance indicators to evaluate results.

Partnerships between organizations such as BASF and NGOs, academia, civil society, and government will provide the requisite know-how to carry out the project. The project will need

basically two types of partnerships – one focused on financing, and the other on the development of educational content.

Apps will be developed, for example, to support people in cooking with the less attractive parts of fruits or vegetables, or with any ingredient that was about to be wasted. A portion calculation app will make consumers' lives easier and more sustainable by

## Awareness Campaign



Stage 1 **Partnerships**  
BASF, NGOs, Academia, Civil Society and Government



Stage 2 **Tools**  
Apps, games, videos, booklets, e-books, seminars



Stage 3 **Control**  
Analysis of performance and level consumers education

## Major outcomes



Higher levels of Awareness



Business Opportunities



Food Production Sustainability



Improved health outcomes



Increased wealth

Educational content will include a set of actions to promote the culture of “use and re-use.”

calculating the effective food quantity needed for each recipe.

Additionally, videos, booklets, and e-books will pull together information to improve consumer awareness in themes related to Brazil’s high levels of malnutrition, levels of FWL, and social-economic and environmental impacts – including family budget issues.

Understanding the need to reach adults and children for more effective results, seminars at companies and activities at schools will be carried out. Seminars at companies will, for instance, discuss themes related to

functional diets and family budgets. At schools, the program seeks to create awareness through practical and dynamic activities such as visiting farms, cultural contests, learning to cook healthily and cheaply, and with lectures about FWL themes.

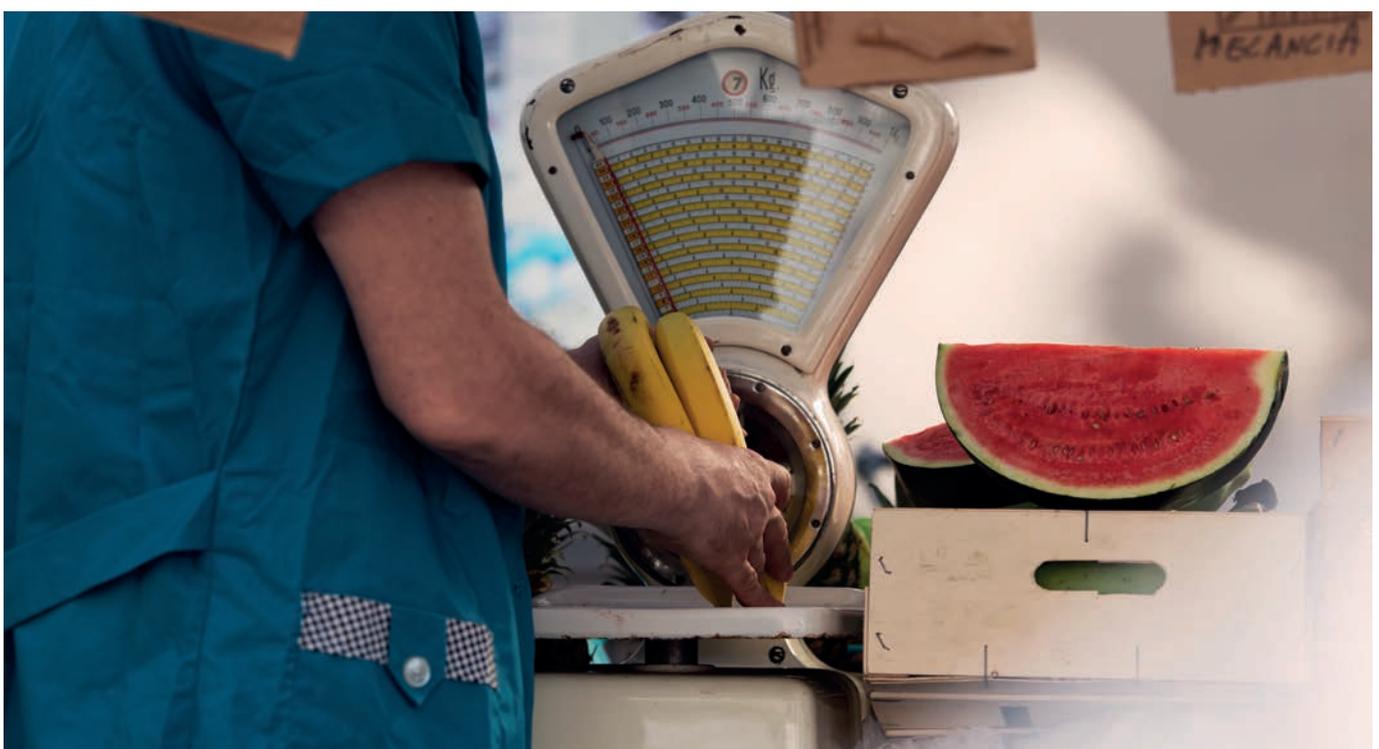
Finally, indicators will be formulated and published to measure how well the program has done in teaching and FWL reduction, keeping in mind that the main intended outcome is to significantly reduce food waste by making consumers more aware of the broader impact of their decisions. Other effects, however, would emerge naturally from actions taken within the scope of the project.

The project has potential for a broad range of organizations and stakeholders. Private enterprise will gain from better-educated consumers who want a better balance between cultural habits

and sustainable production. There is room for new business growth in the areas of functional food, alternative markets, processing and packaging, and software and educational material development, among other areas. Finally, there is a unique opportunity for brands to associate themselves in a positive light with the project.

Government will gain mainly from a decrease in expenses for health and social programs related to bad eating habits and malnutrition – especially diseases related to obesity. Last but not least, a more informed society can push for laws that will provide the proper incentives for food donation.

Broadly, society will gain from increased food availability and a more efficient use of resources.



# Final Remarks

Global food imbalances and alarming levels of Food Waste and Losses (FWL) are a reality. The task for society as a whole is to think of ways to mitigate the negative impacts of food imbalances while promoting more sustainability in production chains, to allow the world's people to live dignified and healthy lives. Solving the problems of hunger and malnutrition in the world, as well as addressing other negative effects of FWL, may sound overly ambitious, but it can be accomplished one step at a time by creating processes that move the project forward and allow adjustments along the way.

Public and private agents have an ethical duty to support this cause, and must strive to attain better levels of sustainability in both food production and consumption. Actors from different sectors and industries need to come together and co-create solutions for more efficient production and more conscious consumption.

The Creator Space™ Tour São Paulo was one exercise in listening to stakeholders' concerns and tapping into their best insights, but many should follow. Specific projects will always require a

solid base of support. Partners with strong scientific and design qualifications must also be recruited to plan projects and make sure investments are spent wisely. Through media, community gatherings, and other venues, these credible voices can provide ongoing progress reports to the public and help to maintain coalitions of support. Additionally, BASF believes that business agents will also have a key role in making progress toward mitigating FWL and its socio-economic and environmental impacts.

Every effort should be made to dovetail these projects' plans with the solutions outlined in this paper. For further funding, participatory opportunities can be presented to private development partners; every effort should be made to reach out to smaller "mom and pop" local interests as enthusiastically as to larger corporations. To aid in the navigation of regulatory issues, government advocates will also be needed at the neighborhood, city, state, and federal levels.

As one of many partners in the ongoing proposals, BASF stands ready to support the initiation of

project implementation according to its internal set of criteria. Nevertheless, beyond direct financial support, BASF has a unique capacity to contribute to the development of holistic solutions. It could make available a wide range of products to improve the performance of farming practices and could find partners to support problem-solving related to marketing channels and consumer behavior. It can also offer broad-based and in-depth expertise drawn from its global experience and workforce.

The challenge of food production sustainability and consumption is one that should speak to all of us. The planet is a home for all of us, and has limited resources and regeneration capacity. Yet, globally, one in nine people are struggling to feed themselves and their families. Besides the devastating effects of hunger today, nutrition is a primary prerequisite for equality of opportunity and for the educational and physical development of children. How are you contributing to keep the planet alive? How will you contribute to hunger mitigation and to the future of our children? When it comes to improving the quality of life, all of us share these responsibilities.



## References

- Alexandratos, N. and J. Bruinsma. 2012. *World Agriculture towards 2030/2050: The 2012 Revision*.
- Bartholomeu, Daniela Bacchi et al. 2015. "Measuring Postharvest Losses in Wheat Logistics Chain: A Brazilian Case Study." Pp. 6–9 in *The First International Congress on Postharvest Loss Prevention*. Rome.
- FAO. 2011. *Global Food Losses and Food Waste: Extent, Causes and Prevention*. Rome. Retrieved ([http://www.fao.org/fileadmin/user\\_upload/ags/publications/GFL\\_web.pdf](http://www.fao.org/fileadmin/user_upload/ags/publications/GFL_web.pdf)).
- FAO. 2013. *Food Wastage Footprint: Impacts on Natural Resources*.
- FAO. 2015. "FAOSTAT - FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS." Retrieved (<http://faostat.fao.org/site/537/default.aspx>).
- FAO, IFAD, and WFP. 2015. *The State of Food Insecurity in the World: Meeting the 2015 International Hunger Targets: Taking Stock of Uneven Progress*. Rome. Retrieved (<http://www.fao.org/3/a4ef2d16-70a7-460a-a9ac-2a65a533269a/i4646e.pdf>).
- Henz, Gilmar Paulo and Brune Sieglinde. 2004. *Redução de Perdas Pós-Colheita Em Batata Para Consumo*. Brasília, DF.
- IPEA. 2012. "Plano Nacional de Resíduos Sólidos: Diagnóstico Dos Resíduos Urbanos, Agrosilvopastoris E a Questão Dos Catadores." *Comunicados do IPEA* 145:1–15.
- Júnior, Celso de Jesus, Luiza Sidonio, and Victor Emanuel Gomes de Moraes. 2011. *Panorama Das Importações de Trigo No Brasil*.
- Lana, M. ..., A. W. Moita, E. ... Nascimento, G. S. Souza, and M. F. Melo. 1999. "Quantificação E Caracterização Das Perdas Pós-Colheita de Tomate No Varejo." *Horticultura Brasileira* 17(3):295.
- Val, Adalberto Luis. 2012. "Desperdício de Alimentos Amplia O 'Custo Brasil.'" *Ecodebate* 3–5.
- Vigitel Brasil. 2014. *Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico*.
- World Economic Forum: Annual Meeting (2015).



**BASF SE**

Communications & Government Relations  
67056 Ludwigshafen, Germany

Editorial Office Germany: Elise Kissling  
and Katharina Barta

Editorial Office Brazil: Cristiana Brito,  
Rafael Conejo, Luiziana Ribeiro and  
Daniela Santucci

Content Management: Paulo Ricardo Silva  
Oliveira

Copyrights: BASF, all rights reserved.

**BASF BRAZIL**

[basf.brasil@basf.com](mailto:basf.brasil@basf.com)

Creator Space™ program:  
[creator-space@basf.com](mailto:creator-space@basf.com)