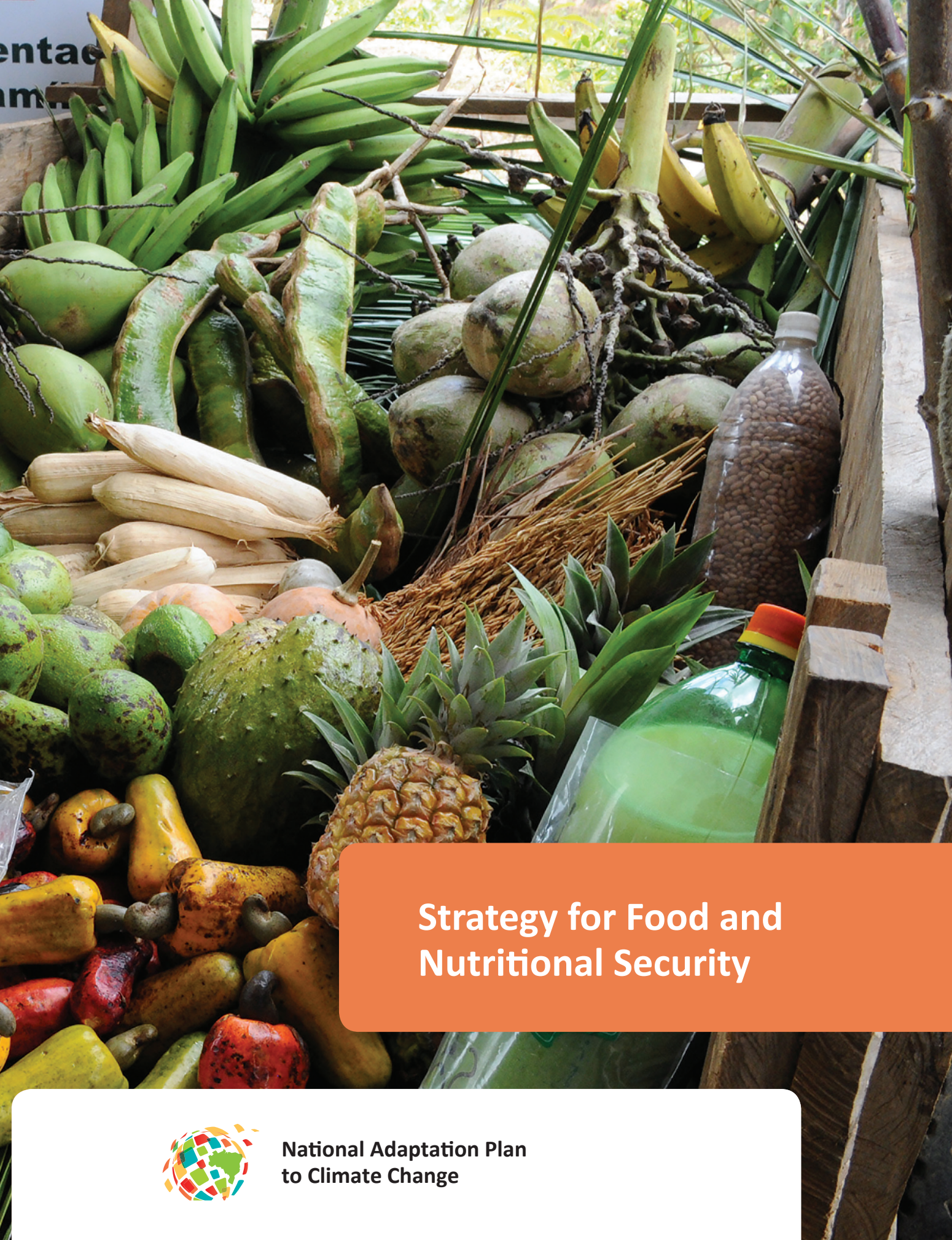

Strategy for Food and Nutritional Security

National Adaptation Plan
to Climate Change

10 Strategy for Food and Nutritional Security

10.1 Introduction

The aim of this strategy is to assess vulnerabilities, impacts and risks posed by climate change to Brazilian food supply and nutritional security and to propose guidelines and practices that contribute toward reducing such vulnerabilities.

To this end, a deeper examination of the six groups of actions presented in the National Food and Nutritional Security Policy will be presented, with a view to establishing guidelines to increase the adaptive capacity of this sector.

The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5) was emphatic in concluding that the world faces unprecedented global warming, and that greenhouse gas emissions (GGEs) are its main cause. Chapter 2.1 (Volume I) of this National Plan for Adaptation (NAP) reports that, by the end of the 21st century, average global surface temperatures my rise by more than 1.5°C in relation to the 1850-1900 period, and that warming is likely to continue beyond 2100 under all the scenarios, except RCP 2.6. In such a context, the consequences for the Planet could be enormous, with grave impacts upon food supply and nutritional security in Brazil. Agriculture is one of Brazil's most vibrant economic sectors and one of its most sensitive to climate change, since it depends directly upon weather conditions. If adaptive measures are not taken, food production could be jeopardised and so could innumerable jobs and farm-sector incomes, with dire consequences for food and nutritional security. In Brazil, 17% of the population is employed in agricultural activities, but in the Northeast and North regions, this proportion rises to 29.6% and 20.2%, respectively (NEAD/MDA, 2011).

To block climate change, greenhouse gas emissions must be reduced at the global level. The impacts of climate change, however, can already be felt throughout the world and in all parts of Brazil and require adaptation measures to reduce risks and ensure national food and nutritional security.

The Inter-ministerial Chamber for Food and Nutritional Security (CAISAN) for purposes of preparation of this NAP, has undertaken coordination of this sectorial strategy and will be responsible for its implementation. To this end, a Technical Committee for Food and Nutritional Security and Climate Change was established in partnership with the Ministry of Social Development and Combating Hunger (MDS); the Ministry of Environment (MMA); the Ministry of Agrarian Development (MDA); the National Indian Foundation (FUNAI); the Secretariat-General of the Presidency of

the Republic; the National Council for Food and Nutritional Security (CONSEA); and the National Supply Company (CONAB). This Chapter of the NAP is thus a collective and collaborative effort on the part of these institutions.

Participation of CONSEA ensures a channel for dialogue with civil society and debate on issues relating to food and nutritional security within the context of climate change, both during the initial preparatory phase and during subsequent implementation of this strategy, with a view to integrating adaptation measures and actions into public policies for fostering Brazil's development.

In summary, the mechanism and institutional framework created for drafting of this chapter placed value on public participation, inter-sectoral approach, institutional, inter and intra-government coordination with society, in line with the guiding principles of Brazilian food and nutritional security policy.

10.2 The National Food and Nutritional Security System and Policy and adaptation to climate change

Preparation of this sectoral strategy for Food and Nutritional Security (FNS) has sought to establish: 1) a priority focus on discussion of policy for promotion of food and nutritional security within the context of climate change and on the impacts on food production and subsequent repercussions on food supply; 2) a social and territorial approach that requires special attention, in view of the expected negative effects of climate change on food and nutritional security, on family farmers and, above all, on the semi-arid region.

These choices were based upon a diagnostic study on the impacts and risks of climate change for food production, and on the current National Food and Nutrition Security Policy (PNSAN). A review of this policy examined the extent to which current approaches collaborate toward building adaptive capacity and more resilient farming systems, capable of ensuring maintenance of measures for ensuring food and nutritional security of families. It was concluded that such measures should be reinforced and the scope of their activities expanded.

It should be stressed that, in this analysis of food and nutritional security, aside from production, a number of other factors were considered, given the inter-sectoral and holistic characteristics of this approach. These include, for instance, the interface of nutrition and health; logistics of access to and availability of food in cities; and other specific features relating to the food and nutritional security of families living in urban environments. For purposes of this NAP, the focus has been to prioritize discussion on the impacts of global climate change on food production, on family agriculture and on rural environments, especially in the semi-arid region. In the course of future periodic reviews of this NAP, other FNS dimensions will gradually be taken up to reflect the status of the on-going debate on the impacts of climate change and

adaptation measures needed to face up to it.

The institutional framework of FNS policies is well aligned to the National Food and Nutritional Security System (SISAN) established by the Organic Law for Food and Nutritional Security (LOSAN - Law 11346, of 15th September 2006) for the purpose of promoting and protecting the Human Right to Appropriate Food (HRAF). It therefore fosters effective participation of various players by imbuing claims to this right with legitimacy and transparency.

One of the most innovative aspects of LOSAN is the way it establishes how the Brazilian State shall organise to ensure the HRAF. Two strategies are promoted under this institutional framework: inter-sectoral approaches; and participation of society.

Inter-sectoral aspects, though challenging, must be assessed, given that fulfilment of the HRAF involves not merely "having something to eat" but also, regular and permanent access to high-quality food in sufficient quantities, without compromising fulfilment of other needs, based upon food practices that promote health, respect cultural diversity, and are socially, economically and environmentally sustainable.

To ensure coordination and integration among the various actions of different sectors, the coordination of SISAN is conducted by two national-level bodies: CONSEA (Decree 6272/2007) that ensures participation of civil society; and the Inter-ministerial Chamber for Food and Nutritional Security (CAISAN) (Decree 6273/2007) presided by the Ministry of Social Development (MDS) with representatives of 20 ministries. CAISAN is responsible for networking, monitoring and coordinating the PNSAN and for coordination with state and municipal-level SISAN authorities.

In 2010, the right to food was enshrined as a social right in Article 6 of the Federal Constitution. At the same time, Decree 7272 instituted the National Food and Nutritional Policy and provided for its monitoring.

In 2011, the National Food and Nutritional Security Plan (PLANSAN-2012/2015) was launched. This Plan integrates dozens of actions and programmes that encompass the various dimensions of FNS, including access to food, food production and availability, and nutritional aspects.

Guidelines of the National Food and Nutritional Security Policy are listed below:

1. Promote universal access to appropriate and healthy food;

2. Promote sustainable and structured food supply systems, based upon agro-ecological production, extraction, processing and distribution;

3. Institute permanent food and nutritional education processes, research and training in the fields of food and nutritional security;

4. Promote, universalise and coordinate food and nutritional security actions targeted at quilombola and other peoples and communities;

5. Strengthen food and nutritional actions at healthcare facilities at all levels, in coordination with other food and nutritional security measures;

6. Promote universal access to sufficient quantities of high-quality drinking water;

7. Support initiatives to foster food sovereignty, food and nutritional security and the human right to adequate food at the international level.

8. Monitor fulfilment of the human right to adequate food.

10.3 Impacts of global climate change on food and nutritional security in Brazil

The risk of setbacks in recent FNS achievements in Brazil as a consequence of the negative effects of climate change is unacceptable. Such change poses a threat to the food and nutritional security of the population, by triggering extreme events, desertification and other impacts that may jeopardise the human right to appropriate food. This right implies regular and permanent access to food, in sufficient quantity and quality. Promotion of FNS policies becomes of even greater importance within the context of climate change, as they serve to promote adaptation capacity and resilience.

That climate change may further aggravate existing poverty is a major concern. Social vulnerability and vulnerability to climate change feedback on each other, since more vulnerable populations generally have lower capacity to adapt to adverse effects of climate change while, at the same time, such effects can exacerbate social vulnerabilities of Specific Traditional Population Groups, (e.g., extractivists, indigenous peoples, *quilombolas*, artisanal fishermen, riparian populations, family farmers and agrarian-reform settlers[62]) whose economic survival, customs, culture and lifestyles are strongly influenced by weather conditions.

[62] Notwithstanding their great diversity, such groups share some common features expressed in the legal concept adopted for "traditional peoples and communities" in Art. 3, item I of Decree 7040/2007 which establishes the National Policy for Traditional Peoples and Communities (PNPCT) quote: "culturally differentiated groups and that are recognized as such, that possess their own forms of social organization, that occupy and use territories and natural resources as a condition for their cultural, social, religious, ancestral and economic reproduction, using knowledge, innovations and practices generated and transmitted by tradition".

In Brazil, owing to deeply and spatially dispersed social disparities, global climate change may have diverse impacts on traditional population groups. Furthermore, in view of the vast size of the country, various different weather patterns may prevail, which may have either beneficial or adverse impacts upon such groups, depending upon location and distribution throughout Brazilian territory.

As discussed in Volume I of this NAP, exposure to such climate variations as temperature, rainfall, humidity, wind speed, rising sea levels, etc., stemming from global climate change, does not, in itself, determine the impacts on ecosystems, production systems and local communities. Social vulnerability and adaptive capacity account for the magnitude of the effect, whether it will be negative or beneficial. For example, building of cisterns for catchment of rainwater, better soil conservation, and protection of water sources are effective measures for facing up to temperature, rainfall and evapotranspiration variations, and for conservation of water resources.

Analysis of the risks of climate change for promotion of Brazilian food and nutritional security must take into account three dimensions that explain the vulnerability: sensitivity; exposure; and adaptive capacity. For exposure, given the vast size of Brazil and considering the diversity of current climate scenarios, it is strategically desirable that analyses be based on geo-referenced findings at the lowest possible level of geographical disaggregation. For sensitivity and adaptation capacity, findings should, whenever possible, stem from disaggregation of social factors entailing investigation of disparate socioeconomic conditions, capacity to respond and resilience, to guide the targeting of public policies for FNS.

10.4 Water availability

Promotion of universal access to sufficient quantities of high-quality water is a component of the National Food and Nutritional Security Policy. This policy is based on the human right to appropriate nutrition, which includes ensuring the right of access to drinking water. Water, in turn, is also an essential input for food and livestock production.

Water availability in Brazil is closely linked to climate and especially to rainfall during summer months. Late onset of rainy seasons can affect farming and electricity generation. Large scale flooding and droughts have had strong impacts on the Brazilian economy and on national food and nutritional security. Studies suggest that future changes in rainfall patterns and regimes may strongly affect flow levels of Brazilian rivers.

Conservation of agro-biodiversity, soil recovery in degraded areas, restoration of water sources and promotion of integrated crop-livestock-forestry systems are all factors that could contribute to greater stability of the water balance and availability of water for agricultural use. Such practices should thus be encouraged, as they contribute

indirectly to the maintenance of food and nutritional security, given that water is an essential input for food production.

10.5 Food production of family farming and food sovereignty

Studies have indicated that, as a consequence of climate change, Brazil may face: 1) a reduction of up to 10.6 million hectares of agricultural land by 2030; 2) reduction of forests and woodland areas on farms, with increases of pastureland; 3) reduction of low climate-risk areas for planting the main staple and export crops (rice, beans, corn, soybeans and cassava); 4) regional redistribution of certain crops in search of more suitable climatic conditions; 5) more accentuated focus on livestock in rural regions of the Northeast, in detriment to crops; and 6) increased frequency and intensity of extreme climate events, with a tendency to generate adverse impacts on agricultural production and yields (MONZONI, 2013; PBMC, 2014; MARGULIS *et al.*, 2011; FERES *et al.*, 2011; EMBRAPA, 2008). In the short term, climatic extremes may cause crop failure, leading to shortages of staple foods and price volatility. These are, in short, the main effects that may impact the Brazilian food supply system, food prices, the basic family "food basket", and family expenditures on food.

The impacts of climate change can be expected to affect crop yields, but this will tend to vary by category: family farming; and agribusiness. This is because geographical location and soil characteristics of farms, and their agricultural potential and adaptive capacity, determine the degree of impact and potential food-production losses.

A pioneering study carried out by the MMA in partnership with OXFAM, and with collaboration of CAISAN, estimated potential losses stemming from global climate change for cassava, rice, beans, corn and coffee produced by family farmers.

These crops were selected in view of their importance for the food and nutritional security of families, for the Brazilian food supply, and for the proportion of national production from family farms. According to the latest Agricultural Census (IBGE, 2006) 84% of Brazilian farms are family owned and account for 74% of all rural labour. There are 4.3 million family farms that, as a group, account for 38% of farm Gross Production Value (GPV) and produce 70% of all food consumed in Brazil (UNSCN, 2014; IBGE, 2006). Family farmers account for 83% of the cassava, 70% of the beans, 46% of the corn (maize), 38% of the coffee and 33% of the rice produced in Brazil (KEPPLE, 2014).

The MMA/Oxfam research was based on agricultural production data for family farming from the 2006 Agricultural Census. It also relied upon future weather projections produced by the National Institute for Space Research (INPE) considering temperature and rainfall parameters for Brazil. It estimated expected yield losses for selected crops, stemming from temperature and rainfall variations. Factors such as

soil characteristics and the agricultural aptitude of farm properties (fertility, erosion, topography, etc.) explain differences in productivity among farmers and were, therefore, used as control variables for the impact model.

Crop yields of family farms were calculated for the selected crops and, subsequently, future agricultural productivity was assessed, within projected climate-change scenarios. The difference between the first value observed and the projected value corresponds to the expected variation in agricultural productivity as a consequence of global climate change. The findings of this research are grouped by biome, based on projected impacts for municipalities and are summarized below.

Coffee yields may be affected either by water shortages or by excessive heat in traditional production regions. Thus, with higher temperatures, coffee grown in the Mata-Atlântica biome (Minas Gerais, Espírito Santo and São Paulo) is likely to migrate from areas of Mata-Atlântica in the Southeast to those in the South, in search of more favourable production conditions and profitability. In municipalities such as Lajedo do Tabocal (BA), São José do Mantimento (MG) and Santa Cruz do Rio Pardo (SP) productivity losses for coffee are expected to reach 100% by 2100, thus making local coffee production unfeasible.

There may be productivity gains for cassava, especially in the Pampa biome, with fewer areas subject to colder weather and frost. In the Amazon, cassava production may also benefit from less rainfall. The greatest productivity losses and declines in area under cultivation are expected to occur in the Caatinga biome (semi-arid and arid areas of the Northeast) where cassava is of great importance for the food and nutritional security of families. For more than half of the municipalities in the Caatinga, projections indicate severe losses in cassava yields, with dire consequences for subsistence farmers and incomes of labourers engaged in cassava production. In the Northeast, according to data from National Household Sample Surveys (PNAD) in 2012, cassava production accounted for 6.1% of farm jobs, a proportion second only to corn (maize) that employed 8.9% of the agricultural labour force.

Rice yields are likely to suffer smaller losses in irrigated production areas with abundant rainfall in the State of Goiás, the northern part of Mato Grosso and in Pará. According to data from MAPA, irrigated paddies in the South of Brazil account for roughly 54% of national rice production, and Rio Grande do Sul is the largest Brazilian rice-producing state.

Corn is already under threat and, with climate change and predicted higher temperatures and water shortages, the risk is expected to rise significantly. This is because projected future temperature rises throughout Brazil may affect the water balance and evapotranspiration in corn. Production restrictions cover almost all of Brazilian territory, with the exception of the Pampa, where productivity improvements are expected to result from fewer frosts. In the Northeast,

where nearly 9% of the agricultural labour is employed in corn cultivation, the most affected municipalities are likely to be Porto Fraco, São João do Caru, Centro Novo do Maranhão, Feira Nova do Maranhão and Brejo, all in the State of Maranhão.

Yields of beans are expected to drop in several localities, owing to higher temperatures and water stress. In search of better production and profitability conditions, bean cultivation will tend to locate in the Pampa biome and in the southern part of Minas Gerais. In the Northeast, where beans account for 3.4% of agricultural jobs, the most affected municipalities are likely to be Pedra Lavrada (PB), Ceará-Mirim (RN/), Trindade (PE) in the Caatinga; and Humberto de Campos (Maranhão) in the Cerrado biome[63].

These expected climate-change induced productivity losses will have two types of impacts on food security: firstly, through reduced food supplies, including for subsistence consumption of family farmers; and through reduced capacity to generate income on the part of such farmers. Family farmers are generally both sellers and buyers, i.e., they specialize in the production of certain crops and, with income from their sale, purchase other foods, goods and services. Projected losses of agricultural productivity thus affect farm incomes which, in turn, influence the quality and diversification of the diets of families and their access to the basic goods and services needed for maintenance of their quality of life and food security.

An adaptive strategy for strengthening food security in Brazil is expansion of warehousing capacity, which entails a greater role for governmental regulatory stocks. Silos and warehouses are important for stockpiling harvests during periods in which climate conditions are favourable and enable longer planting and harvesting periods. Furthermore, in some situations, markets signal a need for intervention, e.g., in cases of crop failure caused by an extreme climatic event that my lead to higher price volatility in commodity markets.

To foster building of public and private stockpiles, warehousing capacity will have to be expanded. Data from the 2006 Agriculture Census revealed that only 1.6% of the Brazilian farms have silos or warehouses for grain and forage. Moreover, most of Brazil's silos and warehouses are located in the Central-West region where production of most of the grain for export is concentrated (Figure 17). Nonetheless, according to data from the National Supply Company (CONAB), Brazil's static storage capacity amounts to 152 million tonnes, whereas grain production in the 2014/2015 growing season was estimated at 200 million tonnes. The map in Figure 18 shows micro-regions where there is a gap between storage capacity and grain production.

Also according to CONAB, private companies own most (75%, equivalent

[63] An expanded discussion of these results can be found in a study produced by Speranza et al., 2015 for MMA/Oxfam available at: <http://www.mma.gov.br/clima/adaptacao/projetos>.

to 152 million tonnes) of Brazil's static storage capacity. Cooperatives own 21% and, finally, governmental bodies account for the remaining 4%. There are some 5.600 storage companies in Brazil, but 50% of this storage capacity is concentrated in the hands of 156 companies. From a regional perspective, 42%, of Brazil's static storage capacity is concentrated in the South, followed by 35% in the Central-West, and 15% in the Southeast. The North and Northeast regions, together, account for only 8% of storage capacity.

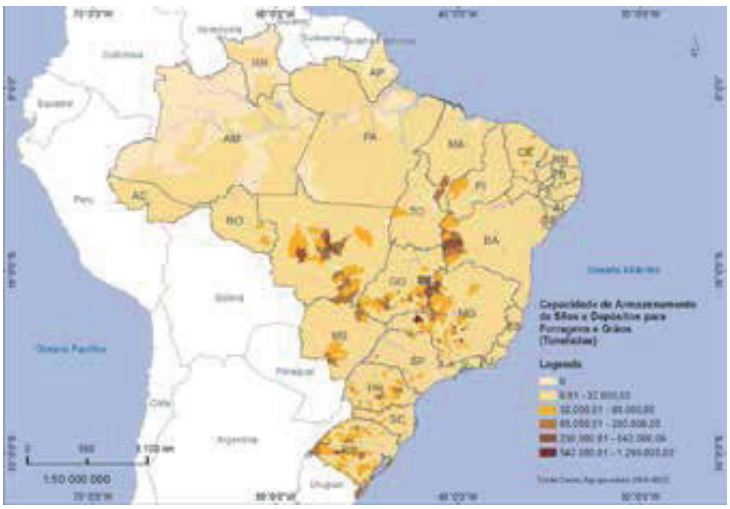

Figure 17- Distribution of silos and warehouses in Brazil

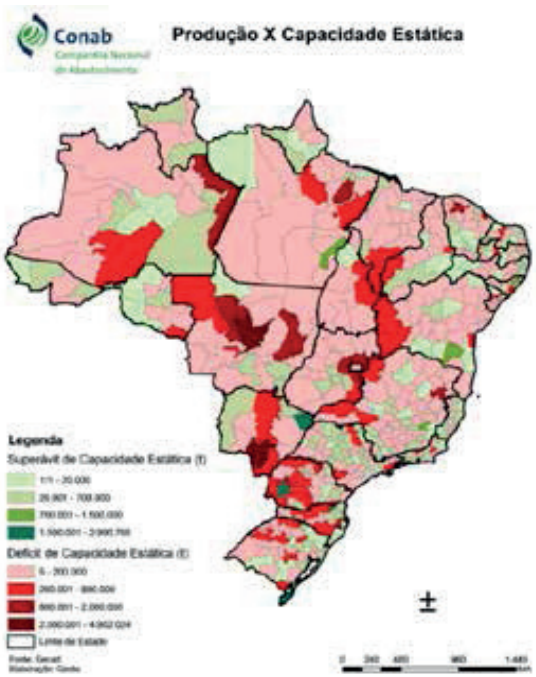

Figure 18- Comparison of grain production vs. static storage capacity in Brazil

In short, climate change will require a higher degree of planning and greater precision on the part of Brazilian farmers. More silos and warehouses would contribute to this, by enabling exploitation of the most favourable climate conditions and extending planting and harvesting periods. Without storage capacity, good harvests may be lost, thereby wasting the potential that stockpiles allow for regulating food supply, stabilising market prices and promoting FNS.

10.6 Living conditions in the semi-arid area

From a territorial and social perspective, the semi-arid region epitomises exposure, sensitivity and (low) adaptive capacity, making it the geographical priority area for implementation of measures for addressing negative effects of climate change.

Efforts have focused, for example, on ensuring access to water for human consumption and production systems. In recent years, the Brazilian Federal Government has brought about a paradigm change for public policies targeted at this region, by acknowledging the viability of survival under sustainable living conditions in this land as a right of the local (*Sertanejo*) population. Moreover, through an extensive network and partnerships with civil society, it has also promoted access to water by means of a programme for construction of rain-water catchment cisterns.

On the other hand, since 2012, Brazil's Northeast region has suffered the worst cycle of drought in 50 years, with more than 1,400 municipalities affected. The Ministry of National Integration estimates agricultural losses of the order of US$ 6 billion (MCTI, 2014). It is in this the region that the semi-arid area is located; where 1,340,172.60 km^2 are susceptible to desertification, an area equivalent to almost 16% of Brazilian territory, with a population of 34.8 million (17% of Brazil's total) distributed in 1,488 municipalities (PAUPITZ, 2013). These numbers provide a notion of scale of this area, the most highly populated dry region in the world.

The Harvest Guarantee Programme[64], an agriculture insurance scheme for family farmers of the semi-arid area, has had to expand the number of beneficiaries and the number of instalments granted, as a consequence of worsening drought in this region in recent years (2011/2012 and 2013/2014 growing seasons). Climate projections point to even more extreme weather for the Brazilian semi-arid region. Adaptation guidelines for this region will be discussed in greater detail in the section on strategies. The

[64] Harvest Guarantee (*Garantia-Safra* – GS) is an action under the National Programme for Strengthening Family Farming (PRONAF), under responsibility of the Ministry of Agrarian Development, initially directed toward farmers and their families located in the Northeast region, in the north of the State of Minas Gerais, Vale do Mucuri, Vale do Jequitinhonha and northern Espírito Santo. This is the area covered by the Superintendency for Development of the Northeast (SUDENE) and is mostly semi-arid, and suffers crop failures owing to drought or excessive rainfall. Farmers who sign up to Garantia Safra in the municipalities that suffered losses of no less than 50% of production of beans, corn, rice, cassava, cotton, or of other crops, as defined by the management of the Garantia Safra Fund, owing to drought or excessive rain, receive financial compensation directly from the Federal Government, in five monthly instalments, by means of smart cards provided by *Caixa Economica Federal*. Owing to intensification of the drought in the latest harvest seasons, the government has extended the number of instalments to eight.

challenge is to strengthen adaptation measures so that climate change does not jeopardise advances promoted by the Federal Government for improving living conditions of families in the semi-arid.

10.7 Conclusions and guidelines

10.7.1. The importance of a resilient agrarian system

Building of a more resilient food system requires adjustments to ecosystems, to social-welfare systems and to economic systems. Such changes will be difficult to effect in most regions and will fall most heavily upon more vulnerable populations in practically all regions. Climate change models suggest that the direst effects, such as more intense drought, are likely to be felt in tropical areas, including Brazil's semi-arid Northeast region.

Poor food-production sustainability poses a threat to resilience and must be addressed through changes in food production models and better governance of national and global food systems. Food production and distribution practices that are more efficient in allocation and use of natural and biophysical resources must be identified and supported, with a view to reducing negative environmental externalities, such as GGEs. In Brazil, between 2005 and 2012, agricultural-sector emissions jumped from 415,724 to 446,445 Gg CO_2eq, which corresponds to a relative change from 20% to 37% of total Brazilian emissions (MCTI, 2015). Currently, alongside those of the Energy sector (37%) agricultural emissions are the largest component of Brazil's total GGE footprint. Thus, a resilient food system, based on agro-ecological practices is a solution and counterpoint to the predominant food production system in Brazil which is responsible for most of national GGEs and has collaborated toward loss of productive diversity and depreciation of the value of agro-biodiversity products, thereby jeopardising national food sovereignty.

Brazil must take up the challenge of implementing mutually self-reinforcing mitigation and adaptation actions to reduce agricultural GGEs, through creation of more resilient agrarian systems that are better adapted to withstanding negative effects of climate change. The National Food and Nutritional Security Policy (PNSAN) encompasses implementation of sustainable food production and distribution systems, with a focus on promotion of agro-ecology systems, preservation and valorisation of agro-biodiversity, implementation of native seed banks, diversification of production, recovery and preservation of soil and of water sources, and lower pesticide and chemical-fertiliser use[65].

According to Olivier de Schutter (2012:23-24) an agro-ecological production approach provides a variety of advantages for the building of a sustainable food

[65] Between 1992 and 2010, ratio of fertilizer sold to area under cultivation more than doubled in Brazil (IBGE 2012). Brazil is world leader in consumption of pesticides. Nitrogen fertilizers accounted for 6.5% of GEEs produced by Brazilian agriculture in 2012 (MCTI, 2015). This could be reduced by avoiding waste when applying fertilizer and by cultivating nitrogen-fixing plants. Researchers from the universities of Harvard and Minnesota have estimated that 50% of the nitrogen applied for production of cereals in the world is unnecessary.

system, including better prospects for adaptation to climate change. As a former Special United Nations Rapporteur for the Right to Food (2008-2014) Schutter affirms that agro-ecology has contributed to fulfilment of the right to food by: 1) increasing yields at the field level; 2) reducing rural poverty[66]; 3) fostering better nutrition; 4) stimulating collaboration toward dissemination of best practices among farmers; and 5) (as already mentioned) improving resilience of agrarian systems to climate change.

The use of agro-ecological techniques can significantly attenuate negative impacts of climate change, and especially of extreme events, as resilience is strengthened by use and promotion of agricultural biodiversity within ecosystems. Agro-ecology production systems are much better equipped to withstand drought and flooding. Moreover, the diversity of species and agricultural activities that the agro-ecological methods stimulate serve to mitigate risks of the impacts of extreme meteorological phenomena, and to ward off invasive new pests, weeds and diseases. Agro-ecological practices consisting of growing consortia of cultivars rely on genetic diversity in fields to improve disease resistance in crops.

Agro-ecology also places agriculture on the path to sustainability by liberating food production from dependence on fossil energy (oil, gas and chemical fertilizers). It contributes to mitigation of climate change, both by increasing carbon sinks through build-up of organic matter in the soil and by increasing quantities of biomass in surface soils. Moreover, it curtails emissions of carbon dioxide and of other greenhouse gases on farms, by directly and indirectly reducing energy use.

Another significant advantage of agro-ecology is that, by valuing traditional knowledge of family farmers and traditional communities (indigenous peoples, quilombolas, riparian communities, etc.) through constant networking between farmers and rural-extension and training networks, it fosters resilience. Agro-ecology is thus an alternative in counterpoint to new models that propose solutions to challenges posed by the negative effects of climate change under such labels as “intelligent agriculture”, “new double green revolution”, etc. These models are normally highly dependent upon agricultural inputs, machinery and equipment, and are generally based upon commercialisation of nature and entrepreneurial agricultural practices.

10.7.2. Guidelines for promoting adaptation

The need to strengthen food and nutritional security within a context of

[66] The cost of creating jobs in agriculture is significantly lower than in other sectors. In Brazil, INCRA data reveals that each job generated in a settlement costs the Government US$ 3,640, while the cost would be 128% higher in industry, 190% higher in trade and 240% higher in the services sector. Comparisons among countries demonstrate that GDP growth stemming from agriculture is at least twice as effective in reducing poverty as non-agricultural GDP growth. Some types of investments are more effective than others in achieving this goal. The multiplier effects are significantly greater when growth is triggered by higher income of smallholders, stimulating demand for goods and services from local tradespeople and service providers. When large landholders increase revenues, most is invested in inputs and imported machinery and only a much smaller portion goes to local commerce (SCHUTTER (2012), based on WORLD BANK (2008) and MIGUEL CARTER (2010)).

global climate change makes it imperative that current Brazilian public policies in this field be maintained. Institutional arrangements entailing coordination and integration among different agencies, ministries and representatives of civil society and the system for monitoring the FNS status of families account for much of the progress achieved.

Brazil's FNS system is based upon an inter-sectoral and holistic approach. These characteristics will facilitate attainment of the subsequent steps to be taken following publication of this National Adaptation Plan; i.e., establishing adaptation to climate change as a crosscutting theme permeating all aspects of governance at the federal, state and municipal levels. CAISAN and CONSEA are the appropriate loci for deliberations and debate on progress in this direction.

For creation of resilient agrarian systems, adaptation strategies need to be based on strengthening both communities and ecosystems. Such strategies include actions targeted at: 1) improving water-resources management through construction of water-abstraction and storage systems for human water supply and for food production (First and Second water[67]); 2) cultivation of short-cycle varieties; 3) establishment of community-based seed and cereal banks; 4) adaptation of farm practices to conserve soil humidity, organic material and nutrients; and 5) conservation and restoration of agro-biodiversity.

[67] First water: water for drinking and cooking. Second water: water destined for agricultural production.

There follows a list of current guidelines of the National Food and Nutritional Security Policy that are of relevance for fostering of a more resilient environment in the context of this NAP:

Guideline 1: Strengthening of programmes for access to drinking-water and water for food production in the semiarid region

One of the most commonly used techniques for withstanding long dry periods and sporadic rainfall in the Brazilian semiarid region is rainfall-catchment and storage in cisterns. The Ministry of Social Development and Combating Hunger (MDS) has a Cisterns Programme that aims to ensure supplies of drinking water (First water) and water for crops and livestock (Second water) for homes and public schools in rural areas.

The right to water is encompassed within the human right to adequate food, and it is the responsibility of the State to ensure this right to all citizens, especially those in situations of socio-environmental vulnerability. Effective guarantee of this right requires coordination among a variety of inter-sectoral actions, in view of its interfaces with water-resources, basic-sanitation and,recently, with FNS policies. Lack of regular access, or precarious access to drinking water sources are part of day-to-day reality for hundreds of families, especially those in situations of extreme poverty, living in rural areas of Brazil. Climatic variations that curtail water availability, pollution of water sources, and poor access to water resources mar the quality of life of

families. The very survival of many families is jeopardised because they cannot afford access to safe drinking water or to water for food production.

To face up to this situation, new socially and economically feasible approaches for promoting universal access to water supply have been gaining strength, based on extensive social mobilization and participation.

Issues relating to water supply for underprivileged segments of the population were the focus of the National Programme for Universalization of Access to and Use of Water (Water for All - Decree 7535, of 26th July 2011) under which the Federal Government assumed a commitment to universalise access to water for rural populations, especially those in situations of extreme poverty. For indigenous families and schools in the semiarid region, universalization of access to water is foreseen within the next four years (2016-2019).

The persistent problem of water vulnerability of rural families in the semiarid region has prompted mobilization of numerous civil-society organisations in Brazil's Northeast region, dedicated to defence of the rights of this population, including the right to water as an essential element for survival and for nutritional security. Prospects of more severe climatic conditions make the strengthening of such initiatives all the more important, with a view to increasing the resilience of populations in the semi-arid region and their capacity to withstand drought, by capturing sporadic rainfall in cisterns and better managing scarce water resources.

With respect to water for food production, EMBRAPA has been engaged in development of strategies for promoting drought resistance. In view of onsets of desertification, much of the semiarid region is likely to become unsuitable for cultivation of many of habitual crops, particularly cassava and corn. To contain the advance of desertification and, at the same time, provide dietary alternatives for the population and forrage for livestock, several researchers have advocated solutions based on endemic species. They propose to use knowledge of drought-resistant plants and to encourage their extensive cultivation. Several characteristic species of the semiarid region are much more efficient at maintaining a water balance, including certain native drought-resistant forage grasses that have greater resilience than exotic grasses.

Guideline 2: Reduction of poverty and vulnerability of rural social groups, by strengthening inclusive rural production policies

There are three public-policy focuses for attainment of this guideline: establishment of seed banks in the semiarid region; the Development Programme (*Programa Formento*), and the Green Stipend Programme (*Programa Bolsa Verde*).

To stimulate productive inclusion of family farmers of the semiarid region, the MDS has sponsored the building of 640

community seed banks. This initiative, carried out in partnership with the Ministry of Agrarian Development (MDA) and the Brazilian Development Bank (BNDES) will benefit at least 12,800 rural families listed on the Single Registry for Social Programmes of the Brazilian federal government (*Cadastro Único*).

The aim is to increase food production and ensure food and nutritional security for families that already have access to drinking water and water for food production under the Water for All (*Água para Todos*) Programme. These seed banks store landrace (unmodified) seeds that are well adapted to the region and regular components of local diets.

Furthermore, access to such seeds will empower family farmers and grant them greater autonomy with respect to decisions on when and what to plant. Seed banks are also expected to induce farmers and their families to pass on knowledge and share seeds, with a view to preserving regional genetic heritage of food varieties and stimulating other families to participate in the project.

A major attraction of the initiative is that it is based upon the experience of local farmers with native landrace seeds and provides an opportunity to foster and enhance knowledge on the genetic heritage of the Semiarid region.

Landrace seeds play an important role in renewing diversity of food-crop varieties and broadening the adaptive capacity of production systems. Thus, seed banks constitute an adaptive strategy that should be strengthened in the context of climate change.

The Development Programme (*Programa Formento*) is a part of the strategy for productive inclusion of family farmers, traditional peoples and communities, and indigenous peoples living in situations of extreme poverty. Under joint coordination of the MDS and MDA, the programme consists of two actions: provision of technical assistance and of rural extension services contracted by public tender[68]; and direct income-transfer stipends distributed to families under the *Bolsa Familia* programme. Both these actions aim to foster the productive capacities of poor rural families, preferably through agro-ecological approaches that reinforce and diversify their ability to produce food for their subsistence and/or for generating income.

The Environmental Conservation Support Programme (Green Stipend - *Bolsa Verde*) launched in September 2011, grants quarterly benefits of R$300 to families in situations of extreme poverty living in priority areas for environmental conservation. This benefit is granted for two years and may be renewed. Since 47% of the 16.2 million people in situations of extreme poverty live in rural areas, this programme serves the twin goals of raising incomes of this population segment, and stimulating conservation of ecosystems and sustainable use of natural resources.

[68] The initial goal in the 2012/2015 PPA was to attend to an estimated 9,000 indigenous families. This goal was exceeded and, by the end of 2015, is expected to extend to roughly 17,500 indigenous families.

Bolsa Verde is targeted at populations that conduct activities involving sustainable use of natural resources in Extractivist Reserves, National Forests, Federal Sustainable Development Reserves, and Environmentally Differentiated Agrarian Reform Settlements.

Traditional populations, including riparian, extractivist, indigenous, quilombolas and other rural communities are also eligible for benefits under the Programme, which seeks to acknowledge and compensate such communities and family farmers for environmental services provided. The *Bolsa Verde* Programme, by strengthening conservation of agro-biodiversity and contributing toward construction of a resilient agrarian system, is closely aligned to the Ecosystem-based Adaptation approach advocated in this National Adaptation Plan.

Guideline 3: Enhancement of Family-farming into agro-ecological, organic and socio-biodiversity based production systems

Launching of the National Agro-ecology and Organic Production Policy (PLANAPO) marks a commitment toward expanded implementation of guidance for sustainable rural-development approaches, in the light of rising awareness on the part of grass-roots rural and forest-dwelling organizations, and of the general public of the need for healthier food production and conservation of natural resources.

Among the advantages promoted by Brazilian organic agro-ecological farming are the biological diversity of production systems, diversification of farming activities and development of niche markets that attend to socioeconomic, environmental and cultural needs, and their ability to ensure large-scale food and nutritional security for the population. The knowledge of conservation and of sustainable-use practices of indigenous peoples and traditional populations is an important contribution to agro-biodiversity approaches.

The Inter-ministerial Chamber of Agroecology and Organic Production (CIAPO) in compliance with item I of Art. 9 of the National Policy for Agroecology and Organic Production (PLANAPO) and with ample public participation through the National Agro-ecology and Organic Production Committee (CNAPO) launched the National Agro-ecology and Organic Production Policy (PLANAPO 2013-2015) targeted at implementation of programmes and actions for fostering transition to a new form of agriculture based on organic and agro-ecological production methods. This policy aims to improve the quality of life of the population, both by ensuring supplies of healthy foods and fostering sustainable use of natural resources.

The aim of the National Plan for Promotion of Sociobiodiversity Products (PNBSB) is to promote and strengthen production chains for the products of socio-biodiversity, by adding value and

consolidating sustainable markets[69]. This initiative is part of the federal government's strategy for promoting sustainable development while, at the same time, fostering income-generation activities and social justice, through conservation, management, and sustainable use of the products of socio-biodiversity and strengthening the social and productive capacities of indigenous peoples, *quilombolas,* traditional communities and family farmers.

Guideline 4: Strengthening of the implementation of the National Policy for Territorial and Environmental Management of Indigenous Lands

Decree 7747 of 5th June 2012, established the National Policy for Territorial and Environmental Management of Indigenous Lands (PNGATI). The purpose of this policy is to guarantee and promote the protection, recovery, conservation and sustainable-use of the natural resources of indigenous lands and territories, while ensuring the integrity of indigenous heritage, improving the quality of life and fully ensuring conditions for the physical and cultural reproduction of indigenous peoples, and respect for their sociocultural autonomy. A great number of strategic lines of actions for strengthening the food and nutritional security of indigenous people is provided for in the seven specific goals/axes[70] of the PNGATI, among them: 1) strengthening and promotion of indigenous productive initiatives, with support for use and development of new sustainable technologies; 2) continuous high-quality technical assistance, adapted to the particular needs of indigenous peoples; 3) certification of indigenous products and their marketing; 4) fostering of actions for environmental recovery and restoration of indigenous lands; and 5) recovery and conservation of agro-biodiversity and of other natural resources essential for the food and nutritional security of indigenous peoples, with a view to restoring and enhancing the value of traditional seeds and cultivars.

Indigenous peoples are among the groups potentially vulnerable to such impacts of climate change as droughts, prolonged dry seasons, flooding and forest fires that threaten their territories. Strengthening of environmental conservation measures and sustainable management of indigenous territories, as proposed in the PNGATI, will increase the capacity of indigenous peoples to face up to the adverse effects of climate change.

Guideline 5: Mainstreaming of the climate change theme in the National System for Food and Nutritional Security - SISAN

[69] Placing socio-biodiversity products on institutional markets (e.g.: PAA, PNAE, PGPM-Bio) is an important FNS promotion mechanism. It ensures fair prices for products, enabling shorter marketing cycles and stimulates revival of traditional foods at indigenous schools, thereby strengthening cultural identity.

[70] Namely: axis I: territorial protection and of natural resources; axis II: indigenous governance and participation; axis III: protected areas, conservation units and Indigenous lands; axis IV: prevention and recovery of environmental damage; axis V: sustainable use of natural resources and indigenous productive initiatives; axis VI: genetic property and intellectual heritage; axis VII: qualification, training, exchanges and environmental education.

Implementation of SISAN at the state and municipal levels is voluntary. State and municipal authorities assume responsibility for instituting CAISANs and CONSEAs and a commitment to drawing up FNS Plans. All of the states have subscribed to the SISAN and, so far, 12 have published their FNS Plans. Some such plans contain provisions for actions and programmes for addressing adaptation to climate change; however, the mainstreaming of a climate perspective needs to be strengthened at the sub-national levels, and risk management assimilated into periodic-review procedures.

Guideline 6: Expansion public food stockpiles and warehousing capacity

The number of grain silos and warehouses for food and forage needs to be increased, in order to expand Brazil's storage capacity. Expansion of such facilities is the focus of the National Plan for Storage 2013/2014 over the next five years. CONAB is to receive an allocation of R$500 million to build 10 new warehouses, thereby increasing its static storage capacity by 756,000 tonnes. Each year, R$ 5 billion is to be allocated for investments in storage, amounting to a total of R$ 25 billion by the end of the Plan. These measures are designed to increase Brazil's static storage capacity by 65 million tonnes over the next six years. Silos and warehouses enable more efficient use of favourable climatic conditions, by shortening planting and harvesting periods and providing storage for good harvests. The National Food and Nutritional Security Plan (PLANSAN) that came into effect in 2016, contains guidelines for monitoring with specific markers relating to adaptation to climate change.

10.7.3. Information gaps and research recommendations

Building of adaptive capacity in Brazil requires production of scientific knowledge on the vulnerabilities, risks and resilience of key sectors, including food and nutritional security.

For an assessment of FNS risks and vulnerabilities posed by climate change, this strategy used as a basis a study carried out in partnership by the MMA and Oxfam. Though merely a preliminary contribution, this study nonetheless provided a profile of potential impacts of climate change on the rural environment and, more specifically, on family farmers. For a broader and more integrated analysis of the impacts of global climate change and assessment of the progress of food and nutritional security measures, a series of scientific knowledge gaps need to be overcome. There follows a listing of such knowledge gaps, accompanied by research recommendations:

- Expand the number of studies and research that include the analyses of vulnerabilities, risks and impacts of climate change on FNS in Brazil. Most of the current studies focus only on climate change effects on agriculture, which are not the same as its effects on promotion of FNS.

- Expand the number of studies and research that include analyses of vulnerabilities, risks and impacts of

climate change on the FNS of specific population segments, especially: extractivists, indigenous peoples, *quilombolas*, riparian communities and family farmers, taking territorial aspects into account.

- Expand knowledge on observed and future impacts of climate change on the survival strategies of Brazilian artisanal fishermen, riparian and costal populations. The MDS has already provided food assistance to a group of fishermen in Lagoa dos Patos (RS) in response to declining fish and shrimp yields, attributed to climatic effects. Fishing is of vital importance for the diet of various vulnerable populations, traditional communities and indigenous peoples.

- Promote and publicise debate and exchanges of information relating to adaptation initiatives focused on the semiarid region recommended by EMBRAPA and other institutions.

- Promote studies on the impacts of climate change on food supply in Brazil, with a focus on short-cycle systems, production close to consumption centres, and urban agriculture.

- Promote studies on the technological feasibility and expansion and/or refocusing of the Water For All (*Água para Todos*) programme, in the light of future climate scenarios produced by INPE.

- Promote studies on the farming systems of indigenous peoples and traditional communities and on their knowledge and practices, with a view to recovery, conservation and sustainable use of agro-biodiversity and stimulating intercultural and inter-science dialogue.

Filling of such knowledge gaps and promotion of actions for fostering adaptive capacity and resilience of the Brazilian food system will not only contribute toward enabling Brazil to cope with the adverse effects of climate change without compromising the FNS of families, but also foster: (1) reduction of agricultural GGEs; (2) expansion and strengthening of productive diversification and rural incomes of families; (3) recovery and conservation of agro-biodiversity; (4) reduced wastage of food; and (5) and, more generally, promote social well-being.