

## Increasing maize production in high priority countries to counteract negative impacts of rising food prices and civil unrest

### 1. Background

The accelerated demand for food, feed and bio-fuel has outpaced agricultural productivity growth now for several years and, together with increasing fuel prices (which affect transport and fertilizer prices), is at the core of rising maize food prices. In addition, the unprecedented rise in fertilizer prices (200% in 2007; 9 times more than US maize grain price increases in 2007) is creating a fertilizer crisis for resource-poor farmers in developing countries and results in reduced application rates on maize in more developed economies. With grain reserves at an all time low and unless corrective measures are taken, this could have catastrophic impacts on global maize supply and prices starting 2009.

Global maize production of the past five years (2001 – 2006) averaged 676 million tons Table 1). 77 million tons were net-traded between countries with 93% originating from the USA (60%), Argentina (15%), France (9%), China (5%) and Brazil (4.0%), and Japan (22%), Korea (11%), Mexico (7%) and Egypt (6%) as the most significant maize importers. Hence, farm-level decisions by the main maize exporters, influenced by increasing fuel and fertilizer prices (negative), increasing grain prices (positive) and national policies will have a pronounced impact on next year's global maize prices.

*Table 1. Maize demand in 1997 and 2020 (Rosegrant et al., 2001)*

	Demand (million MT)			Area (million ha)			Food		Feed		Other		Net trade million MT
	1997	2020	Change	1997	2020	Change	Perc	million MT	Perc	million MT	Perc	million MT	
Global	586	852	45%	138	158	14%	15%	128	69%		16%		
Industrial	291	344	18%	42	50	19%	5%	17	76%		19%		67
Developing	295	508	72%	96	108	13%	22%	112	64%		14%		-67
East Asia	136	252	85%	24	30	25%	4%	10	82%	207	14%	35	-43
Latin America	75	118	57%	28	32	14%	25%	30	60%	71	15%	18	5
Sub-Saharan Africa	29	52	79%	25	26	4%	76%	40	10%	5	14%	7	-6
South East Asia	23	39	70%	8	9	13%	32%	12	58%	23	10%	4	-8
WANA	18	28	56%	2	2	0%	28%	8	63%	18	9%	3	-14
South Asia	14	19	36%	8	9	13%	70%	13	13%	2	17%	3	-1

Even though the greatest current and future maize demand increases are taking place in East Asia, the Americas and other countries where maize is used for feed and biofuel and economic growth/activities stimulate an accelerated demand for meat and fuel (Table 1), the greatest concerns for maize food insecurity and civil unrest arise among poor countries and poor people that consume maize as food.

These include countries within Sub-Saharan Africa, Latin America and South and South East Asia with a predicted food consumption of 40, 30 and 25 million metric tons, respectively, in 2020. Even though they may be mostly “onlookers” to the big supply and demand changes taking place on the world market, most of these countries are net importers for maize (Table 2) and their purchasing power (as a country or of significant poor population groups) restricts their ability to respond to increasing food, fuel and fertilizer prices.

In addition, growth estimates of the past five years indicate that maize productivity increases fall behind projected maize demand increases in particular in Africa and

Latin America, or may be disproportionately based on area increases and hence limited in East Asia (Table 2). Higher productivity growth in Asia is likely directly related to recent investments in agricultural R&D (see World Development Report 2008).

Table 2. Annual maize productivity and production increases between 2002 and 2006 and net trade. Shaded cells indicate where maize productivity and production increases fall behind predicted increases in maize demand.

	Increases		Net regional import	Net exporters (quantity, 1000 tons)
	Productivity	Production	1000, tons	
Eastern Africa	4.2%	4.5%	1,392	Tanzania (15)
Central Africa	-1.8%	1.5%	176	
Northern Africa	0.9%	1.9%	8,381	
Southern Africa	5.9%	-4.4%	-405	South Africa (511)
Western Africa	2.4%	5.2%	191	Burkina Faso (12)
Latin America & Caribbean	0.9%	1.5%	-641	Argentina, Brazil, Paraguay (15037)
Central Asia	7.0%	6.1%	-14	Kazakhstan, Uzbekistan (18)
Eastern Asia	2.7%	5.5%	21,707	China (3894)
Southern Asia	4.9%	8.3%	2,033	India (396)
South-Eastern Asia	3.8%	5.4%	3,511	Cambodia, Laos, Myanmar, Thailand (441)
Western Asia	6.5%	11.4%	5,414	

## 2. Targeting international interventions for maize to high risk countries

Table 3 assesses the risk of raising maize food prices on national economies and prioritizes countries which likely will need international support for increasing maize productivity. Risk is considered high (shaded) if per capita maize consumption is high (> 20 kg per capita and year), maize food demand is close to or greater than national maize grain production (> 85% national maize grain production), large quantities of maize are imported (> 5% of national production), and the country has a low national ability to respond (per capita GNI < USD 1,000 categorized as high priority; per capita GNI 1,000-2,500 categorized as medium priority). Based on this assessment, highest priority countries for international support include

	Very high	High	Medium
AFRICA	Angola Kenya Malawi Mozambique Zimbabwe	Burundi Congo, Dem Republic of Côte d'Ivoire Ethiopia Lesotho Mali Tanzania, United Rep of Zambia	
CWANA			Egypt Morocco
LATIN-AMERICA		Honduras	Colombia  El Salvador Guatemala
ASIA		Indonesia	

Together these countries currently have a combined production of 38 million tons of maize and a combined population of 760 million people.

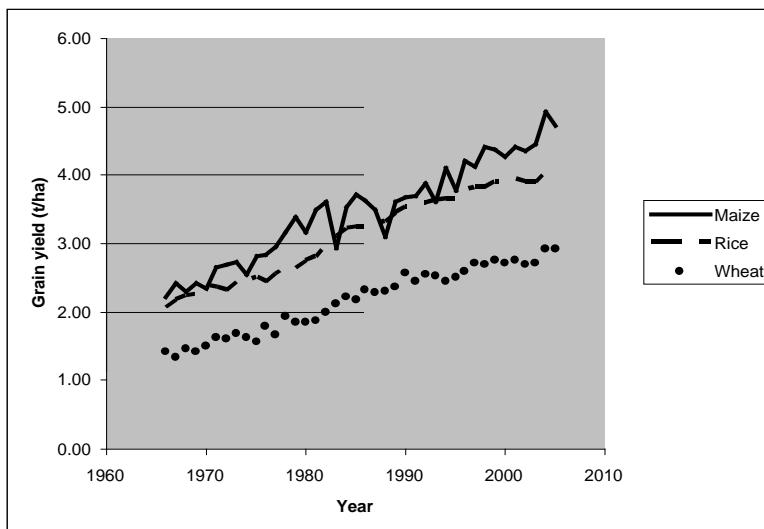
There are other countries where increasing international maize prices will lead to very significant problems among the poorer proportion of the population (eg in Mexico). At this stage these countries have not been prioritized because their GDP enables them to mobilize national resources and capacities to increase maize production or take alternative measures (per capita GNI > 2500).

### 3. Relevant interventions for stabilizing and increasing maize production and the role of international agricultural research

Increasing global maize production, stabilizing maize prices and removing undesirable impacts on malnutrition and civil unrest require a concerted investment at the level of policies, deployment of modern/new technologies and capacity building. Also short-term interventions need to be matched with longer-term research investments which ensure sustained productivity gains that equate demand increases and respond to global challenges such as climate change.

#### 3.1 Investment in authoritative prediction models as a basis for national, regional and global food policy decisions

With the significant role of maize trade, the multiple use of maize for food, feed and fuel, rising fuel and fertilizer costs and increasing demands for feed and biofuel, factors that influence world maize supply and demand have become much more complex. We need to acquire an improved understanding and quantification of their implications on the competitiveness of maize production, global and national maize availability, and maize prices. Market forces linked to economic growth, food, feed and fuel and country-specific macro- and micro-economic realities will influence future global supply and global market prices, and dissociated national policies can have highly undesirable consequences on global maize supplies and food prices. These factors also need to be looked at in view of unpredicted production short falls due to natural disasters such as droughts or floods, in particular since maize as a rainfed crop is highly prone to such environmental stresses and they are expected to increase as climate change progresses (Fig 1).



*Fig 1. World maize, rice and wheat grain yields between 1966 and 2005 (FAOSTAT, 2006). Annual fluctuations in global maize yields are due to droughts and floods.*

### **3.2 Increasing national maize production in low income countries with high national maize food consumption**

Table 4 lists potential short-, medium and long-term strategic/high impact interventions that countries could take to address national food shortages and reduce food prices. They apply similarly to countries proposed for international support in Table 3 as for other countries that can mobilize national resources and capacities.

Important to note is that interventions 1 and 2 provide the lowest value for money, are expensive and highly unsustainable. Also they do not address the core of the problem (insufficient production and low productivity) and are contra-productive to stimulating increased production.

Principles for interventions that lead to increased national maize production (Interventions 3, 4 and 5 in Table 3) include:

- Exchange short-term interventions which combat symptoms (eg food relief, grain subsidies) with medium and long-term interventions which address the causes of low productivity and poor market and R&D performance
- Address knowledge gaps and improve market access by farmers and enable them to move from subsistence to income generation (farm = agro-business)
- Reorient public R&D and policy investments to be demand- and development-driven and in support of emerging agro-businesses
- Align public interventions with the ability of local service providers to deliver recommended inputs
- Develop sustainable national safety nets and R&D support

Farmers in countries with low maize productivity typically lack information about appropriate market-responsive production practices, and have limited access to effective input/output markets. Appropriate technologies and know-how may be available on the regional or international market, they are however not being implemented at the local level ("low adoption") due to lack of farm-level know-how (eg "what is the advantage of new varieties and where can I get the seed? What fertilizer application rates are cost effective under the current price scenario?") and market insecurities which affect both suppliers (eg seed sector investment in the scale up of new varieties, agro-dealer investment in stocking inputs) and producers (eg "what security do I have that I make a profit from monies invested in seed and fertilizer?").

Emerging agro-industries which are at the core of improved market performance, on the other hand, struggle with know-how, high risks, difficulties to access credits, and over-regulated markets.

Table 3. Risk factor for negative impacts of raising maize food prices on national economies. Risk is considered high if per capita maize consumption is high, food demand is greater than national maize grain production and large quantities of maize are imported.

Region	Subregion	Country	Priority for international support	National ability to respond (GNI)	Food demand/ National production	Net trade/ National production	Population (million)	Per capita maize consumption (kg)
AFRICA	CENTRAL	Cameroon		Low	76%	-1%	17.4	45
AFRICA	CENTRAL	Central African Republic		Low	85%	-1%	4.3	26
AFRICA	CENTRAL	Chad		Low	76%	0%	10.0	10
AFRICA	CENTRAL	Congo, Dem Republic of	High	Low	96%	-1%	66.1	22
AFRICA	CENTRAL	Congo, Republic of		Low	306%	-19%	3.8	8
AFRICA	CENTRAL	Gabon		High	82%	-4%	1.5	18
AFRICA	EAST	Burundi	High	Low	118%	-46%	8.0	24
AFRICA	EAST	Djibouti		Low	10852%	9540%	0.7	2
AFRICA	EAST	Eritrea		Low	395%	-293%	4.6	4
AFRICA	EAST	Ethiopia	High	Low	101%	-2%	76.1	45
AFRICA	EAST	Kenya	Very high	Low	107%	-7%	35.4	89
AFRICA	EAST	Madagascar		Low	90%	-3%	19.8	14
AFRICA	EAST	Rwanda		Low	93%	-25%	9.0	10
AFRICA	EAST	Somalia		Low		-5%	8.8	16
AFRICA	EAST	Sudan		Low	96%	-119%	36.7	2
AFRICA	EAST	Tanzania, United Rep of	High	Low	91%	0%	42.1	75
AFRICA	EAST	Uganda		Low	63%	-1%	30.4	34
AFRICA	NORTH	Algeria		Medium	43115%	-194031%	34.1	13
AFRICA	NORTH	Egypt	Medium	Medium	65%	-66%	76.5	62
AFRICA	NORTH	Libyan Arab Jamahiriya		Medium	338%	-11771%	6.1	1
AFRICA	NORTH	Morocco	Medium	Medium	602%	-835%	33.7	34

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AFRICA	NORTH	Tunisia						0
AFRICA	SOUTHERN	Angola	Very high	Low	87%	-26%	16.8	39
AFRICA	SOUTHERN	Botswana		High	795%	-331%	1.6	47
AFRICA	SOUTHERN	Lesotho	High	Low	316%	-7%	2.1	152
AFRICA	SOUTHERN	Malawi	Very high	Low	88%	-8%	13.5	138
AFRICA	SOUTHERN	Mozambique	Very high	Low	96%	-14%	20.9	63
AFRICA	SOUTHERN	Namibia		High	341%	-121%	2.0	55
AFRICA	SOUTHERN	South Africa		High	51%	5%	44.0	117
AFRICA	SOUTHERN	Swaziland		Medium	96%	-48%	1.0	71
AFRICA	SOUTHERN	Zambia	High	Low	172%	-2%	12.5	136
AFRICA	SOUTHERN	Zimbabwe	Very high	Low	170%	-71%	14.4	96
AFRICA	WEST	Benin		Low	51%	0%	7.8	58
AFRICA	WEST	Burkina Faso		Low	81%	2%	14.8	46
AFRICA	WEST	Cape Verde		Medium	436%	-258%	0.5	88
AFRICA	WEST	Côte d'Ivoire	High	Low	100%	0%	18.8	37
AFRICA	WEST	Gambia		Low	41%	-1%	1.5	8
AFRICA	WEST	Ghana		Low	64%	-3%	22.8	44
AFRICA	WEST	Guinea		Low	21%	0%	9.7	10
AFRICA	WEST	Guinea-Bissau		Low	106%	-4%	1.4	19
AFRICA	WEST	Liberia					2.9	7
AFRICA	WEST	Mali	High	Low	94%	0%	14.3	34
AFRICA	WEST	Mauritania		Low	100%	-25%	3.3	2
AFRICA	WEST	Niger		Low	999%	-1005%	14.4	4
AFRICA	WEST	Nigeria		Low	50%	0%	138.7	22
AFRICA	WEST	Senegal		Low	52%	-29%	11.4	13
AFRICA	WEST	Sierra Leone		Low	122%	-9%	5.7	4
AFRICA	WEST	Togo		Low	65%	0%	5.5	75
AMERICA	CENTRAL	Belize		High	14%	1%	0.3	21
AMERICA	CENTRAL	Costa Rica		High	121%	-3433%	4.6	4
AMERICA	CENTRAL	El Salvador	Medium	Medium	87%	-67%	7.1	88
AMERICA	CENTRAL	Guatemala	Medium	Medium	106%	-53%	13.8	98
AMERICA	CENTRAL	Honduras	High	Low	106%	-54%	7.5	84
AMERICA	CENTRAL	Mexico		High	65%	-28%	108.8	132

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AMERICA	CENTRAL	Nicaragua	Low	51%	-5%	6.1	55
AMERICA	CENTRAL	Panama	High	74%	-343%	3.2	21
AMERICA	SOUTH	Argentina	High	3%		40.4	11
AMERICA	SOUTH	Bolivia	Low	40%	0%	9.8	33
AMERICA	SOUTH	Brazil	High	10%	7%	186.0	25
AMERICA	SOUTH	Chile	High	24%	-88%	16.6	17
AMERICA	SOUTH	Colombia	Medium	128%	-139%	47.4	41
AMERICA	SOUTH	Ecuador	Low	25%	-42%	14.2	13
AMERICA	SOUTH	Guyana	Low	63%	-423%	0.8	2
AMERICA	SOUTH	Paraguay	Medium	31%	46%	6.6	54
AMERICA	SOUTH	Peru	Medium	28%	-80%	28.7	14
AMERICA	SOUTH	Suriname	Medium	873%	-44096%	0.4	1
AMERICA	SOUTH	Uruguay	High	66%		3.5	34
AMERICA	SOUTH	Venezuela, Bolivar Rep of	High	75%	-26%	27.4	50
ASIA	CENTRAL	Armenia		0%			0
ASIA	CENTRAL	Azerbaijan, Republic of	Low	48%	-11%	8.4	8
ASIA	CENTRAL	Georgia	Low	47%	-1%	5.0	38
ASIA	CENTRAL	Kazakhstan	Medium	2%	3%	16.0	1
ASIA	CENTRAL	Kyrgyzstan	Low			5.4	
ASIA	CENTRAL	Tajikistan	Low			6.6	
ASIA	CENTRAL	Turkmenistan	Low	0%	-2%	5.4	0
ASIA	CENTRAL	Uzbekistan	Low	79%	8%	27.8	5
ASIA	EAST	China	Low	17%	3%	1,356.0	16
ASIA	EAST	Japan	High	923307%			12
ASIA	EAST	Korea, Dem People's Rep	Low	56%		22.3	42
ASIA	EAST	Korea, Republic of	High	1012%		48.6	16
ASIA	EAST	Mongolia	Low			2.8	0
ASIA	EAST	Singapore	High			4.4	
ASIA	SOUTH	Bangladesh	Low	219%	-112%	159.8	2
ASIA	SOUTH	Bhutan	Low			2.6	
ASIA	SOUTH	India	Low	40%	3%	1,118.8	4

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ASIA	SOUTH	Nepal		Low	72%	-1%	27.4	48
ASIA	SOUTH	Pakistan		Low	87%	0%	172.1	11
ASIA	SOUTH	Sri Lanka		Low	330%	-372%	20.2	5
ASIA	SOUTH-EAST	Cambodia		Low	69%	6%	15.7	12
ASIA	SOUTH-EAST	Indonesia	High	Low	72%	-8%	231.5	35
ASIA	SOUTH-EAST	Laos		Low	90%	8%	6.3	23
ASIA	SOUTH-EAST	Malaysia		High	213%	-3677%	25.0	7
ASIA	SOUTH-EAST	Myanmar		Low	13%	10%	51.7	2
ASIA	SOUTH-EAST	Papua New Guinea		Low		-10%	5.7	2
ASIA	SOUTH-EAST	Philippines		Medium	9%	-3%	85.9	5
ASIA	SOUTH-EAST	Thailand		High	9%	8%	68.0	6
ASIA	SOUTH-EAST	Timor-Leste		Low	96%		0.7	107
ASIA	SOUTH-EAST	Viet Nam		Low	24%	-6%	86.6	9
ASIA	WEST	Afghanistan		Low		0%		14
ASIA	WEST	Brunei Darussalam		High			0.4	8
ASIA	WEST	Iran, Islamic Rep of		Medium	7%	-124%	78.6	2
ASIA	WEST	Iraq		Medium		-9%	22.9	1
ASIA	WEST	Israel		High	167%		6.9	20
ASIA	WEST	Jordan		Medium	2668%	-2881%	6.0	67
ASIA	WEST	Kuwait		High	3171%		2.3	13
ASIA	WEST	Lebanon		High	4%	-9068%	3.9	0
ASIA	WEST	Saudi Arabia		High	1395%		25.8	22
ASIA	WEST	Syrian Arab Republic		Low	40%	-429%	19.6	6

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ASIA	WEST	Turkey	High	53%	-31%	72.8	19
ASIA	WEST	United Arab Emirates	High			2.9	0
ASIA	WEST	Yemen	Low	730%	-553%	24.9	15
CARIBBEAN		Antigua and Barbuda	High	733%		0.1	6
CARIBBEAN		Bahamas	High	422%		0.3	4
CARIBBEAN		Barbados	High	1566%		0.3	14
CARIBBEAN		Cuba	Medium	83%		11.5	25
CARIBBEAN		Dominica	High	129%	-9%		3
CARIBBEAN		Dominican Republic	Medium	154%	-2612%	9.3	7
CARIBBEAN		Grenada	High	129%	-955%	0.1	4
CARIBBEAN		Haiti	Low	93%	-1%	9.2	22
CARIBBEAN		Jamaica	High	1142%	-14007%	2.8	6
CARIBBEAN		Netherlands Antilles				0.2	12
CARIBBEAN		Saint Kitts and Nevis	High			0.0	2
CARIBBEAN		Saint Lucia	High			0.1	3
CARIBBEAN		Saint Vincent/Grenadines	High	161%	-502%	0.1	8
CARIBBEAN		Trinidad and Tobago	High	280%	-1773%	1.3	7
CARIBBEAN		Sao Tome and Principe		101%			
CARIBBEAN		Norfolk Island					
CARIBBEAN		Saint Helena					
CARIBBEAN		Saint Pierre & Miquelon					

Table 4. Potential short-, medium and long-term strategic/high impact interventions to address national maize food shortages and high maize food prices

Objective	#	Intervention	Impact	Comment
Encouraging lower grain prices (< 1 year)	1.1	Vouchers valid for purchasing grain at lower prices	Very expensive; only works if grain is available on local market ie does not address supply shortage	If implemented, vouchers to be targeted at poorest only
	1.2	Taxation of non-food uses of maize grain (feed, biofuel)	Short-term measure to increase in-country allocation of grain use over feed and biofuel	Needs to be removed over medium-term as it is a disincentive for expanding production
Encouraging increased domestic maize food supply (< 1 year)	2.1	Export restrictions	Regional and international political implications	Needs to be removed over medium-term as it is a disincentive for expanding production
	2.2	Import subsidies, food aid	Contra-productive for increasing domestic production; less impact than input subsidies or guaranteed minimum prices	Needs to be removed over medium-term as it is a disincentive for expanding production
Encouraging increased domestic production – short term (1 year)	3.1	Guaranteed minimum grain prices	Increase incentives for farmers and SMEs to engage in market-oriented production; currently farmers insufficiently invest due to extreme price volatility	Minimum grain price is targeted at macro- and micro-economically viable production => recovery of investment through defined mechanisms
	3.2	Input subsidies (seed, fertilizer, postharvest chemicals) – use of vouchers	Stimulate local production; expose farmers to new technologies; input subsidies are less expensive than food aid but will need to be phased out in the longer-term as information about socio-economically viable practices is being improved (interventions 3.3 and 4.3 )	Input subsidy is targeted at macro- and micro-economically viable production => recovery of investment through defined mechanisms

	3.3	Country-wide information on best-best maize production and farm-level investment packages (radio, demonstrations, posters)	Increase incentives for farmers and SMEs to engage in market-oriented production	Large-scale demonstrations which are simultaneously used for collection of farm-level data/feed-back and synchronized with input providers
	3.3.1	Micro-economics of on-farm maize production and mix with other crops		Recommendations should be targeted based on expected (realistic) yields and input costs
	3.3.2	Recently released maize varieties and their characteristics		Demonstrations and information to be synchronized with seed availability
	3.3.3	Best-bet, price-responsive fertilizer, crop and farm management recommendations		Targeted at micro-economically viable production; synchronized with fertilizer availability
	3.3.4	Post harvest pest management		Synchronized with pesticide availability
Encouraging increased domestic production – medium term (2-3 years)	4.1	Guaranteed minimum grain prices	Increase incentives for farmers and SMEs to engage in market-oriented production; currently farmers insufficiently invest due to extreme price volatility	Targeted at macro- and micro-economically viable production
	4.2.1	Impact- / farmer- /business-oriented in-service training of NARES and regulatory staff (public servants)	Increase capacity for public servants to respond to needs of farmers and agro-businesses	
	4.2.2	Output-oriented remuneration of NARES and regulatory staff (performance contracts)	Increase incentive for public servants to respond to needs of farmers and agro-businesses	
	4.3	Location-specific and price-responsive information on best-best maize production and farm-level investment packages	Increase incentives for farmers and SMEs to engage in market-oriented production	Large-scale demonstrations which are simultaneously used for collection of farm-level data/feed-back

	(radio, demonstrations, posters)		
4.3.1	Micro-economics of on-farm maize production and mix with other crops		Based on socio-economic analysis of large-scale demonstrations
4.3.2	Recently released maize varieties and their characteristics		Synchronized with seed availability
4.3.3	Best-bet, price-responsive fertilizer, crop and farm management recommendations		Targeted at micro-economically viable production; synchronized with fertilizer availability
4.3.4	Post harvest pest management		Synchronized with pesticide availability
4.4.1	Accelerated release and scale-up of more productive maize varieties	Availability of improved technologies	Use of regional synergies; technology shopping from IARCs and recent varieties released in neighboring/similar countries
4.4.2	Accelerated identification of micro-economically attractive crop and farm management practices	Availability of improved technologies	Use of regional synergies; technology shopping from IARCs and neighboring countries
4.5.1	Credit, training opportunities and risk management strategies for seed producers, fertilizer importer and agro-dealers	Increase incentives for SMEs to engage in market-oriented agro-businesses	
4.5.2	Deregulation and regionalization of policies in support of agro-enterprises	Increase incentives for SMEs to engage in market-oriented agro-businesses	
4.5.3	Support to grain marketing boards for the development of sustainable and competitive market mechanisms	Increase incentives for SMEs to engage in market-oriented agro-businesses	

Encouraging increased domestic production – long term (> 3 years)	5.1.1	Impact- / farmer- /business-oriented formal training of NARES and regulatory staff (public servants)	Increase capacity for public servants to respond to needs of farmers and agro-businesses	
	5.1.2	Output-oriented remuneration of NARES and regulatory staff (performance contracts)	Increase incentive for public servants to respond to needs of farmers and agro-businesses	
	5.2.1	Development of more productive maize varieties	Availability of productivity-enhancing technologies	Demand-driven public investment driven by issues identified by farmers and SMEs (eg through large-scale demonstrations)
	5.2.2	Development of improved price-responsive fertilizer, crop, farm and produce management recommendations	Availability of productivity-enhancing technologies	Demand-driven public investment driven by issues identified by farmers and SMEs (eg through large-scale demonstrations)
	5.3.1	Credit, training opportunities and risk management strategies for seed producers, fertilizer importer and agro-dealers	Increase incentives for SMEs to engage in market-oriented agro-businesses	
	5.3.2	Deregulation and regionalization of policies in support of agro-enterprises	Increase incentives for SMEs to engage in market-oriented agro-businesses	
	5.3.3	Support to grain marketing boards: sustainable and competitive market mechanisms; inbuilt mechanisms to support to sustain highest priority R&D needs	Increase incentives for market-oriented and demand-driven agro-business development and R&D	