CCSL Learning Brief No.4 ••
March 2014

RESEARCH PROGRAM ON
Climate Change, Agriculture and Food Security

CGIAR

CCAFS

Envisaging change in maize farming: the push and pull factors

Key messages

- Changing weather patterns and climate may cause smallholder maize farmers to change their practices, but should be considered in the context of market challenges and opportunities, and new technologies.
- Institutional failures have forced farmers to internalise risks and led to a distrust of external interventions and information, including weather forecast and climate model projections
- Therefore, farmers seek precautionary — low investment and reversible — changes, based on experience
- There is a need for more transparency in information provision and inclusive interventions to build trust — otherwise there will be resistance to interventions.

Participatory and deliberative approaches were used in order to draw out and evaluate pathways of adaptation in maize farming in the Kenyan districts of Makueni (in Central Province) and Nandi/Nyando (in Western Province), whilst allowing participants[1] to reflect on and share their own perceptions, experiences, and expectations of future change.

Research method

In Makueni and Nandi/Nyando a combination of primary and secondary data was collected in order to identify the relative merits and challenges of three main pathways of change — changing land management; preparation and inputs adopting varieties and technologies (e.g. adopting genetically modified maize); replacing maize with alternatives for market and home consumption — as well as a status quo scenario (no change pathway).

In describing merits and challenges, participants were encouraged to think about both 'push' and 'pull' factors that might instigate the changes, identify the 'actors' (inclusive of individuals, officials, organisations, and non-human actors) responsible for these factors, and estimate the likelihood and timescales over which such factors might materialise.

Push: A challenge that makes current practice unviable/less desirable

Pull: An opportunity that makes an alternative practice more desirable

Maize production in Makueni and Nandi/Nyando

Maize farming is almost entirely rainfed in both districts and, as a result, rainfall patterns represent an important determinant of yields. Nandi/Nyando is found with Kenya's agricultural belt and courtesy of its relative high and reliable rainfall and productive soils; it produces high average maize yields (approximately 15–20 bags (1,350–1,800kg) per acre). Low rainfall in the Makueni district means that water availability represents a major constraint on cereal crop growth, with average maize yields of around five bags (450kg) of dried maize per acre.

[1] Mixed groups of male and female smallholder maize farmers (with holdings of approximately two acres or below) aged from approximately 18 to 70 years old, and identified and invited with the help of key informants and village councillors participated in the workshops

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About Us ••

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) brings together the world's best researchers in agricultural science, development research, climate science and Earth System science, to identify and address the most important interactions, synergies and tradeoffs between climate change, agriculture and food security. CCAFS is a strategic parternship of CGIAR and Future Earth, led by the International Center for Tropical Agriculture (CIAT). www.ccafs.cgiar.org

Table 1.

	Makueni	Nandi/Nyando
Primary data	• Observation of farming practices, agricultural extension work, agricultural shows and non-agricultural activities (Wote, Makindu and Machakos) • Interviews with 16 farmers (Wote) about maize varieties and biotechnology during village baseline survey workshops • Two participatory scenarios workshops (14 and 18 participants) conducted as part of CCAFS village baseline survey • Rainfall projections for 2030 and 2050 using the CCAFS MarkSim tool with A1B emissions scenario input using ECHam5 (Makindu)	• Observation of farming practices, agricultural extension work, agricultural shows and non-agricultural activities (Kipkaren, Turbo) • Interviews with 30 farmers (Kipkaren, Turbo) • Four participatory scenarios workshops (6 to 30 participants) (Turbo, Kipkaren, Ndalat, Mutwot) • Rainfall projections for 2030 and 2050 using the CCAFS MarkSim tool with A1B emissions scenario input using ECHam5 (Lower Nyando)
Secondary data	• CCAFS household (140 questionnaires) and village baseline survey data (Wote) • KMD monthly rainfall data 2000–2011 (Makindu weather station)	• CCAFS household (140 questionnaires) and village baseline survey data (Lower Nyando Basin) • KMD monthly rainfall data 2000–2011 (Kakamega weather station (just outside of district)

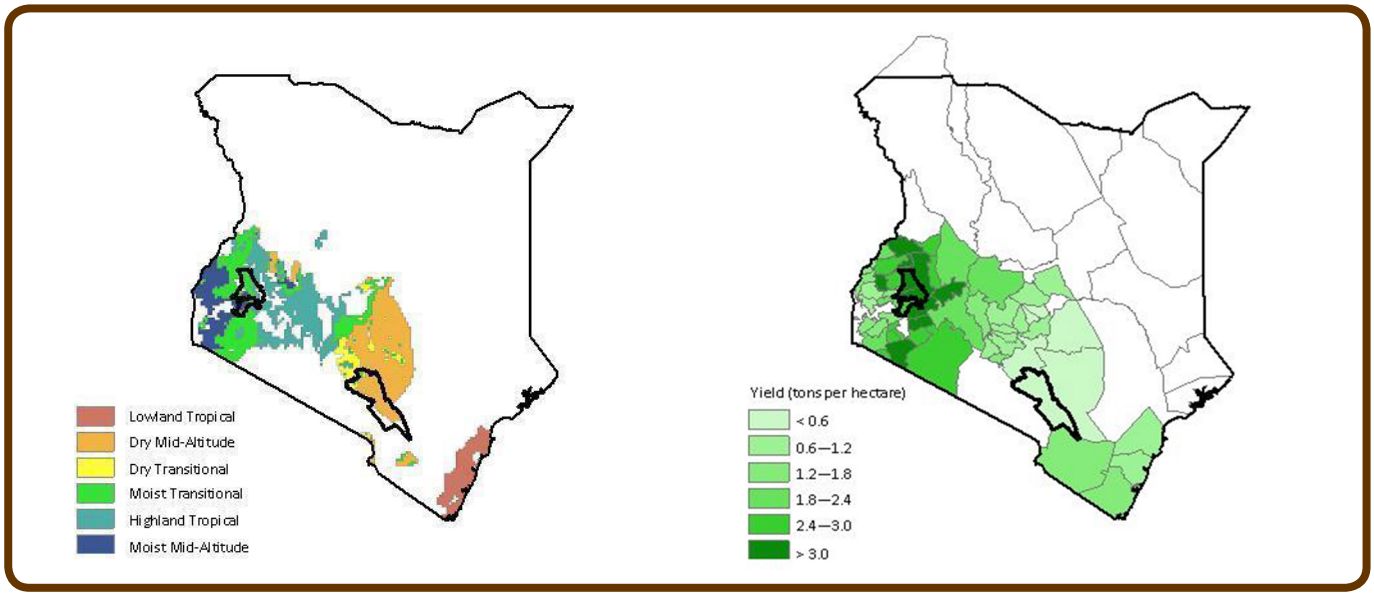

Figure 1. Agro ecological classification of Kenya's major maize growing regions. Coloured areas on the map are those in which maize farming represents at least 5% of land use. Nandi/Nyando and Makueni districts are outlined. Data provided by CIMMYT (2012).
Figure 2. Maize yields per district recorded as part of national maize survey 2001. Data provided by CIMMYT (2012)

Internalising risk and the cost of adaptation

Farmers in both regions have suffered as a result of the poor regulation of seed and agro-chemical suppliers, which permits the marketing and selling of 'fake' seeds and agro-chemicals and causes supply shortfalls in publically supported seed systems. In Nandi, investment in government-subsidised fertiliser is a risk to the farmer because of supply-side failures and administrative problems, for which there are apparently no mechanisms of responsibility and compensation. In Makueni, there are some farmers who feel they have been misinformed about upcoming challenges and market opportunities and they have made bad investments as a result. These experiences have resulted in distrust of agricultural extension institutions and information suppliers, which is reflected in attitudes towards investment in technologies or climate-based insurance (which none of the participants had bought) and even in attitudes towards weather forecasts and climate change projections.

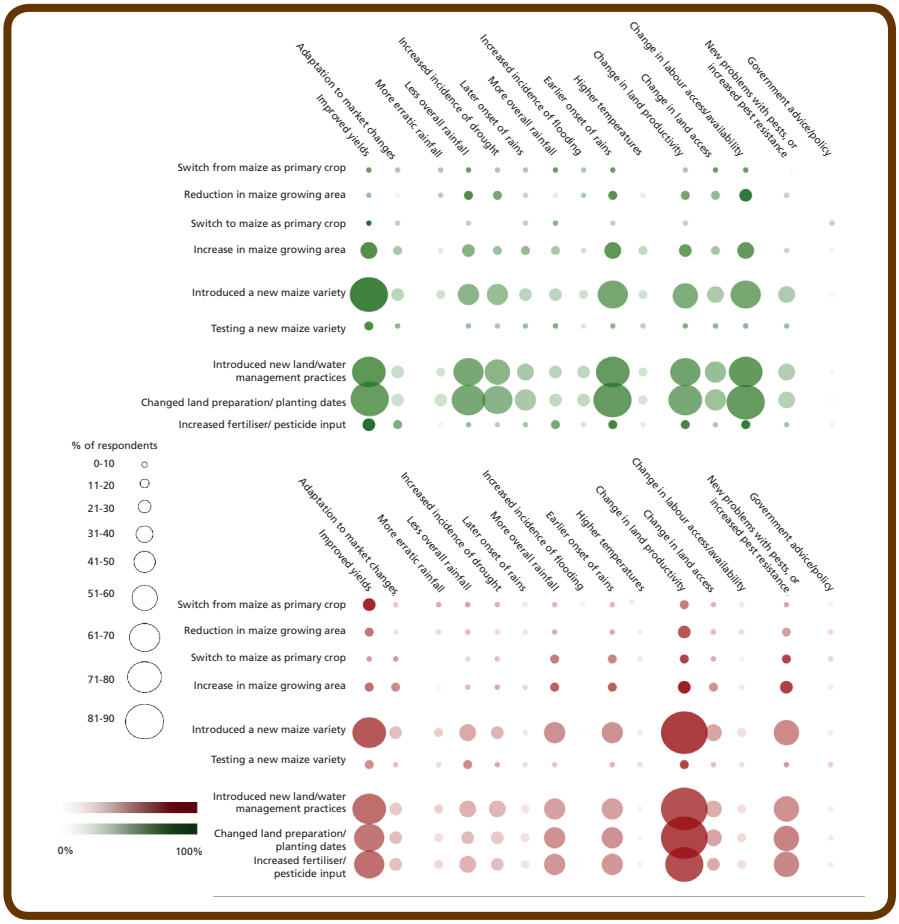

Figure 3. Adoption and Change in Maize Systems. These charts illustrate data collected as part of the CCAFS survey on the relative frequency of changes reported in maize farming over the last 10 years and reasons given for making those changes by participants in Lower Nyando (green chart) and Wote (red chart). The size of the circle represents the percentage of respondents citing that combination of change and reason. The darkness of the shading represents the percentage of respondents citing a particular change that also cited the corresponding reason.

Responding to changes is widely understood as a risky endeavour, because information about changes is interpreted as being incomplete and often incorrect. Crop changes, new land management practices, technology adoption, even switching to new varieties were all understood as requiring investments that may not pay off. Climate forecasts and descriptions of new GM maize varieties provided by seed companies, for example, were not sufficient to envisage future change in most cases.

Trust and information provision

Pull factors relating to information provision include information about new technologies and market opportunities. This information is likely to be received by farmers through a combination of attending farm shows and field days, interacting with extension workers, through the media, or via word of mouth. Long- and short-term weather forecasts (push information) are provided through the Kenya Meteorological Department and communicated over the radio.

The workshop findings suggest that many farmers are unlikely to make changes based on information provided from external sources, and would only adopt a new technology, for example, once they had seen it for themselves. A lack of trust in seed suppliers and lack of trust in the systems through which they are held accountable, was implied as a reason for a need to observe and experience the success of new varieties (and technologies), rather than just adopt on the basis of information/ advice from the suppliers.

Weather forecasts are seen by many farmers as often being inaccurate, unreliable, or not relevant due to the very local nature of their weather systems. In terms of planting dates and land management practices, most farmers were disinclined to make changes on the basis of weather forecasts, and preferred instead to either rely on their own observations of local weather indicators, or simply depend on traditional dates.

Narratives of conspiracy and distrust certainly play a role in attitudes towards GMOs. Beliefs that Kenyans are unknowingly consuming GMOs, which were mentioned by a number of participants, stem from a distrust of, or a sense of ineffectuality of, regulating institutions and scepticism about the motivations behind international investment and aid.

Precaution and change

Brooks *et al.* (2009) argue that a lack of confidence in the ability of the national food system to supply affordable maize, coupled with heavy nutritional reliance on it, means that small-scale farmers, even in the driest and least suitable agro-ecological conditions, continue to favour maize over alternative crops. Those living in acute poverty may find themselves in the impossible position that all pathways (even a no change pathway) carry too many risks. Resource and capacity limitations go a long way to explaining:

- why pathways of change were largely envisaged as reactionary or forced adaptations (caused by pull factors), as opposed to proactive or opportunistic changes (caused by push factors); and
- preferences for, and greater perceived proximity of, low investment or least regrets changes.

Changing land management, preparation and inputs, for example, was seen as the most realisable of the pathways of change in part because of its perceived low investment costs and reversibility. This is a pathway that participants could envisage themselves being 'pushed' into by rising input costs and climate-related

Table 2.

	Likely to cause change	Unlikely to cause change
Push	**Successive crop failures** Examples of successive crop failure driven changes include: (1) the earlier preparation of land in parts of Nandi where changes in rainfall patterns (and more specifically the earlier onset and cessation of rains) were thought to be responsible for low maize yields recorded in both 2008 and 2009; (2) an increase in the use of fertilisers (and storage pesticides) by farmers in Nandi who were experiencing successive sub-optimal yields (attributed to decreasing soil fertility) and increasing losses during storage (attributed to weevil damage) between 2007 and 2010; and (3) a switch away from maize as the primary crop by some farmers in Makueni because of successive low yields in the early 2000s. **Unaffordability and inaccessibility of inputs** The most commonly cited single cause for a change in land management practices, and in some cases a reduction in maize farming and even a switch away from maize as the primary crop, were trends in the rising costs of inputs, as well as their availability. While those participants from Nandi/Nyando were primarily concerned with the affordability and accessibility of DAP (di-ammonia phosphate) fertiliser (which is government subsidised), for participants from Makueni (many of whom did not use chemical fertilisers anyway, because of the cost) the primary concern was the affordability and accessibility of certified seeds. Approximately 80 per cent of participants from Nandi/Nyando attempted to obtain government subsidised DAP, and often paid for it and waited months for it to arrive, causing them to miss the beginning of the long rains season.	One off climatic events (i.e. those not repeated in the following season/year) Weather/climate forecasts Fluctuating markets and prices
Pull	**Observation of successful new technologies and techniques** The observation of new maize varieties being successful in neighbouring farms, or being demonstrated at field days and agricultural shows, commonly results in the adoption or trial of new varieties in both Nandi and Makueni. There is reluctance to invest in new seeds, particularly more expensive varieties, by farmers until their neighbours have tried and been successful, but with a small amount of evidence/proof there is a willingness to invest in new varieties. In Makueni, farmers have introduced new crops such as sisal and fruit crops as a result of Ministry of Agriculture extension activities and demonstrations, and similarly, in Nandi, extension work through a local agricultural training centre had led to some of the participants adopting a conservation agriculture approach to maize farming. For most participants, the adoption of new technologies and techniques is a slow process, with adoption being done on a small fraction of the farm in the first place, and broader adoption being dependent on the observation of successful trials over two or three years. **Market opportunities** There was some evidence of changes being made to maize farming in direct response to market opportunities. For the most part, such changes were the introduction of new crops and switches away from maize as the primary crop, in Nandi this was evident among farmers that had switched to sugar cane and in Makueni to fruit trees. In both cases, the crops were seen as more profitable and capable of achieving higher prices on the market than maize. However, very few farmers respond quickly to perceived market opportunities, the volatility of markets and the risk of investment cause many farmers to be cautious about taking advantage of market opportunities, and, as with new technologies and techniques, the observation of success on neighbouring farms and small scale on farm trialling is likely to precede larger scale (or more risky) market response changes for most farmers.	Unobserved technologies (those with little outreach and observable trials — few willing to be the first to invest in an area)

Table 3. Summary of findings from scenarios workshops

Change pathways	Nyando/Nandi		Makueni	
	Timescales	**Critical change response factors**	**Timescales**	**Critical change response factors**
Changing land management, preparation and inputs	3-10 years	• Rising input costs • Climate-related crop failures • Evidence/experience of success	2-3 years	• Rising input costs • Climate-related crop failures
Adopting varieties and technologies	3-10 years	• Climate-related crop failures • Evidence/experience of success	5-10 years	• Availability and accessibility • Evidence/experience of success • Financial resources
Adopting GM maize	10+ years	• Evidence/experience of success • Information	10+ years	• Information • Availability and accessibility • Evidence/experience of success
Alternatives to maize for market and home consumption	5-10 years	• Financial resources • Information • Evidence/experience of success	5-10 years	• Financial resources • Evidence/experience of success

crop failure. By comparison, adopting new technologies or growing alternatives to maize were, on the whole, perceived as much more risky and less viable and were associated primarily with pull factors, such as evidence of success.

Building trust through transparency and participation

A lack of transparency about the assumptions and uncertainties inherent within information inevitably increases the perception of risk associated with acting on it, and it is clear that farmers commonly felt that they did not have enough of an understanding of the completeness of knowledge in order to critically analyse the piecemeal information that they received. This was evident in the asking of questions about the absolute nature of information, such as "when will climate forecasts be 'good enough' to act on?" and "are GMOs safe to consume?", by participants who did not feel that they could make a judgement of their own.

This research points to the importance of institutions building credibility and trust through their communication (Cash, Clark *et al.* 2003) if adaptation interventions are to be successful. Interventions are likely to be unsuccessful unless they are based on trusted information because otherwise farmers will tend towards precaution.

Transparent information, which can be achieved for example by allowing farmers to participate in evaluation (observe and experience success for themselves) is one way in which the viability of a pathway of change can be advanced. The effective communication of trustworthy information — that is, information that is transparent about the completeness of knowledge (and motivations) on which it is based — will be essential to successful adaptation to change.

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Acknowledgements
We aim to practice what we preach. This briefing series is the product of an on-going social learning process — the Climate Change and Social Learning initiative (CCSL) — between the CCAFS team and its partners, in which knowledge has been co-constructed through many different channels, including workshops, the CCSL 'Sandbox', and social media. Many thanks to everyone who has participated in this process so far and to those who continue to do so.

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The CARIAA program is jointly funded by the International Development Research Centre, Canada and the UK Department for International Development